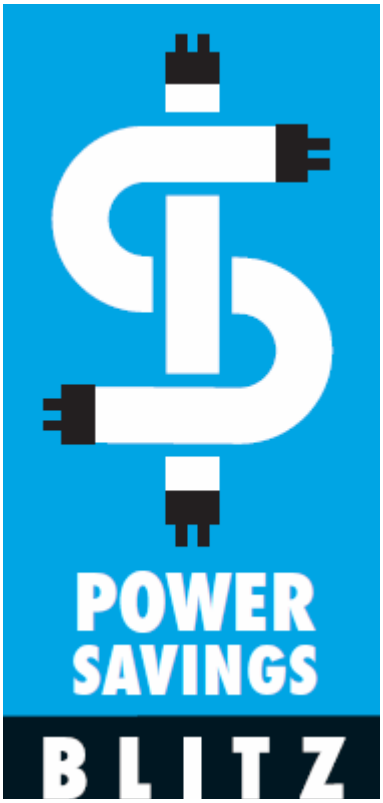
Ontario Power Authority

2008 Small Commercial Direct Install Program



Impact and Process Evaluation of 2008 Program Year (April 2008 – March 2009)

Final Report

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1. Executive Summary

This document represents the final report on KEMA's process and impact evaluation of Ontario Power Authority's 2008 Small Commercial Direct Install Program (SCDIP), also known as the Power Savings Blitz program. The program was officially launched in April 2008 to provide energy efficiency incentives to non-food service and non-food retailers within the small commercial sector (defined as < 50 kW demand). The 2008 program year ran from April 2008 through March 2009.

The primary purpose of this program evaluation is to ensure the reliability of demand reduction and energy savings achieved. As the first year of the program, it is especially important to assess program design performance, and provide information for continuous improvement through future program years and ensure proper validation of input assumptions made for specific end-use measures.

The key research objectives of the 2008 SCDI program evaluation, as outlined in the program evaluation plan and informed by the OPA's evaluation protocols, are the following:

1. Review, and update as appropriate, the prescriptive per-unit input assumptions of the measures included in the program
2. Determine the free rider or other net-to-gross adjustment factors as appropriate
3. Estimate the gross and net energy savings and peak demand reductions achieved through the initiative
4. Determine the relative impacts of the delivery strategy used to gain program participation
5. Determine the relative impacts of OPA and LDC communication, marketing and incentive structures on gaining program participation
6. Determine the suitability of the current set of measures included in the program and identify additional measures that could be beneficial to include in future years
7. Create the baseline data required to assess the performance of the market transformation efforts

These evaluation objectives are organized in this report, with Objective #1-3 and 7 categorized as impact evaluation objectives, and #4-6 as process evaluation objectives.

1.1 Impact Evaluation

The Small Commercial Direct Install (SCDI) Program is designed to be a resource acquisition program involving the assessment and turn-key retrofit of primarily lighting and water heater measures for independent small businesses of the participating local distribution companies (LDCs). At the close of the 2008 SCDI program year, LDCs in aggregate achieved 96 percent of their goals and collectively saved 28,275,628 net kWh annually and 3,837 net kW (summer peak). Fifty-nine LDCs had signed up to deliver the SCDIP in their service territories.

KEMA estimated gross savings based on the work orders included in the final tracking database for 2008. Table 1 shows that the vast majority of energy savings (98.9%) are related to lighting measures. The overall program net-to-gross ratio (NTGR) was calculated to be 93% for energy, summer demand and winter demand savings, and applied to the gross savings to determine the program net savings.

Table 1: Summary of 2008 SCDI Program Impacts

Measure Type	Gross kWh	Gross kW (Summer)	Gross kW (Winter)	Net kWh	Net kW (Summer)	Net kW (Winter)
T8 Fixture	22,376,494	3,043.5	3,676.1	20,810,140	2,830.5	3,418.8
CFL	6,617,357	900.1	1,087.1	6,154,142	837.1	1,011.0
Halogen	139,563	19.0	22.9	129,794	17.7	21.3
LED Exit Sign	926,685	126.0	152.2	861,817	117.2	141.6
Lighting Total	**30,060,099**	**4,088.6**	**4,938.4**	**27,955,892**	**3,802.4**	**4,592.8**
Water Heater Tank Insulation	219,450	23.5	37.2	204,089	21.9	34.6
Pipe Insulation	97,402	10.4	16.5	90,584	9.7	15.4
Low Flow Faucet Aerator	26,949	2.9	4.6	25,063	2.7	4.3
Water Heating Total	**343,802**	**36.9**	**58.3**	**319,735**	**34.3**	**54.2**
Program Total	**30,403,901**	**4,125.5**	**4,996.8**	**28,275,628**	**3,836.7**	**4,647.0**

KEMA also estimated the lifetime savings associated with the program impacts. Table 2 presents the lifetime impacts and the program weighted effective useful life (EUL) for each measure type. The lighting measure EULs varied depending on the specific business type.

Table 2: Summary of 2008 SCDI Program Lifetime Impacts

Measure Type	Weighted EUL	Gross Lifetime kWh	Net Lifetime kWh
T8 Fixture	14.7	328,656,536	305,650,579
CFL	2.3	15,152,246	14,091,589
Halogen	0.6	77,174	71,772
LED Exit Sign	16.0	14,826,966	13,789,078
Lighting Total	**11.9**	**358,712,922**	**333,603,018**
Water Heater Tank Insulation	7.0	1,536,150	1,428,620
Pipe Insulation	15.0	1,461,033	1,358,761
Low Flow Faucet Aerator	5.0	134,747	125,315
Water Heating Total	**9.1**	**3,131,930**	**2,912,695**
Program Total		**361,844,852**	**336,515,713**

No adjustments were made to the program reported quantity installed. KEMA reviewed the prescriptive assumptions (PIAs) per measure, and applied the PIA values to the work orders included in the 2008 program tracking database to estimate gross program savings. KEMA also reviewed the EUL values to develop lifetime savings.

Although a targeted on-site inspection was conducted, this was based on a non-random sample selected by program staff. KEMA was able to verify that 87 percent of measure quantities reported on the selected work orders were actually installed. This may be considered a worst case scenario, as the work orders were specifically selected due to concerns about the potential for inaccuracies. Since the on-site verification was based on a non-random sample of program participation, the verification rate was not utilized to adjust the measure quantities in the program database.

The net energy savings approach is to subtract the energy savings related to free-riders and add in energy savings related to spillover. Free-riders are program participants who would have implemented the same energy efficiency measures absent the program. Conversely, spillover customers went beyond the scope of the program to install additional energy efficiency measures as a result of one or more elements of the program. The computer aided telephone interview (CATI) survey of program participants indicate that the spillover rate is estimated to be zero, and the free-ridership rate at 7 percent, resulting in a net-to-gross ratio of 93 percent.

The survey instrument and the method for determining free-ridership from the responses were based on the instrument developed for small customers with simple measures as part of the 2006-08 program evaluations currently being conducted for the California Public Utilities Commission.

1.1.1 Market Transformation Baseline

The SCDI Program Logic Model includes a two-fold market transformation goal. As part of this first year evaluation effort, we document the baseline to lay the foundation for assessing the performance of the market transformation efforts in the 2009 and 2010 iteration of the SCDI program.

1.1.1.1 Baseline: Percentage of Participants Investing Above $1000

To the extent that participating customers choose to install measures beyond the maximum incentive levels, this increases the cost-effectiveness of the program. For the 2008 program year, 28 percent of completed projects included some out-of-pocket investment from the participant. The average additional investment was $358.12, with the largest project size recorded at $7,397.

Interviews with LDCs and service providers indicate that there is some inherent tension between an LDC's target number of completed retrofits and the program goals to increase the number of retrofits going over $1000. This is because completing the additional retrofits above $1000 takes time, and keeps a contractor from moving on to other customers who have agreed to the participate in the program.

1.1.1.2 Baseline: Increase the SCDIP Participation in Other OPA CDM Programs

The only other OPA CDM program that SCDIP businesses are eligible for is the PeakSaver program. Results of the computer aided telephone interview (CATI) surveys indicate that approximately 15 percent of participating businesses and 8 percent of non-participating businesses said they were aware of other OPA sponsored CDM programs. Furthermore, 15 percent of businesses said they had participated in another OPA program, but participant recall of actual program name was poor. This market transformation goal may need to be refined, since it may be difficult for businesses to know if they are participating in other OPA programs, making self-reported participation inaccurate. The goal may also be revised to be based on customer awareness of multiple OPA programs.

1.2 Process Evaluation Results

KEMA examined the relative impact of delivery strategy by focusing on OPA's interactions with LDCs and other program administration issues. We then assessed the effectiveness of communication and marketing strategies related to LDC outreach to the target market. We also examine the incentive structure of the program, and suitability of the current set of measures.

1.2.1 Relative Impact of Delivery Strategy

As 2008 was the first year that the SCDI program was implemented, many of the barriers and challenges faced by participating LDCs to deliver the program were simply to get internal processes up and running to reach their small business segments. For example, the principal reason for LDCs not meeting their targets for the 2008 program year were due to problems engaging electrical contractors (or qualified service provider) to deliver the program and to conduct the installations.

Since LDC service territories vary significantly in size, customer type, geography and location, the results of the process evaluation did not show a single best approach to delivering the program. While larger LDCs generally need a service provider to assist with the logistics of several hundred retrofits, some smaller LDCs have been successful by engaging a single contractor to complete all retrofits. As the program matures however, and LDCs need to meet increased installation targets, a single electrical contractor with only a few staff may not be able to keep up. Some larger contractor operations are available in the province, but these are not as common as the small time contractors. Many small LDCs have teamed up to cooperatively implement the program and this appears to be a good strategy.

Some key issues that were identified by the evaluation effort include:

- **OPA reporting and payment** – Feedback from LDCs and service providers indicates that the Portal is an extremely useful system where they can find the information they need. The Portal and Tracking Database have also been recognized as tedious and difficult to use when entering a substantial number of work orders. In response to these concerns, the OPA program staff are developing an improved portal that would allow bulk uploads, based on electronic Excel file work orders.

- **Defining customer eligibility** – During the 2008 program, customer eligibility wording in program documentation suggested that businesses were eligible for $1000 in free retrofit per LDC account number. This meant that businesses with multiple electric account

numbers (<50 kW) were eligible for multiple projects resulting in thousands of dollars in free retrofits. For the 2009 program year, eligibility requirements have been revised to only pay one retrofit incentive of $1000 per business address that is separately metered. This will hopefully exclude larger businesses with multiple account numbers from receiving multiple $1000 retrofits.

- **Proper disposal of baseline equipment** – In-depth interviews indicated that LDCs, contractors and program participants all have concerns about the proper disposal of old materials. This is another first year challenge for launching the program; to develop processes to properly dispose of old ballasts that potentially contain polychlorinated biphenyls (PCBs).

- **Ongoing communications between OPA and LDCs** – During the first year of the program, LDCs and market actors frequently had questions and issues that arose. For instance, there are technical questions from time to time, such as whether a product was meeting the intent of the program. One LDC mentioned that they were not informed when the program staff changed and it was very confusing to be receiving emails from an unknown person.

1.2.2 Relative Impact of Communication and Marketing

It is clear that the majority of the participants were motivated to be a part of the program due to the financial benefits. Most qualified businesses approached by service providers and their contractors appeared to end up having their equipment retrofitted as part of the program. Only a small percent of businesses did not participate because they did not understand the program or because they did not believe it was true. Concerns that businesses would think the program was a scam did not turn out to be a significant reason for non-participation. Instead, the main reason for non-participation was related to lack of awareness of the program.

Reaching the decision-maker can be the most significant challenge to successfully engaging small business facilities that are eligible for the program measures. Businesses often have "gate keepers" who are people that conclude that the program is not of interest because they assume it is another attempt to sell something to them. As a result, the information is never presented to the decision-maker (e.g. owner or manager). People are frequently put off by a sales approach and will dismiss the program offer before reviewing the material.

Therefore, consistent and varied marketing is found to be an important tactic for marketing the program and engaging small businesses. Although customers most easily recall door-to-door

solicitation, the importance of the other channels for marketing should not be underestimated. It is important to build credibility before the assessor or contractor arrives on-site. The brochures, letters of endorsement and phone calls all serve to improve the sense of legitimacy associated with door-to-door SCDIP representatives.

Since 2008 was the first year of the program, just "getting the word out" was the most significant challenge and this is expected to become easier as the program matures. Review of the non-participant contact information provided to KEMA indicated that some LDCs did a better job of tracking the calls and contact attempts to non-participants than others. Information such as name and or date of contact would be useful fields to track. Effective program marketing requires that LDCs and their service providers track non-participant information to ensure that contact attempts are well-coordinated, that participating businesses are not approached again, and to enable follow-up with customers who have not yet responded.

1.2.3 Suitability of Current Set of Measures

Through interviews with LDCs, service providers, installation contractors, and program participants, KEMA collected feedback on the retrofit measures previously offered as part of the 2008 SCDI program price list. Recognizing that the 2009 SCDI program is well underway, KEMA has focused its assessment on the current price list in effect. The results of our research show that OPA has already been responsive to feedback from market actors in the field. One example is that 8 foot T8 fluorescent fixtures were added to the 2009 price list.

1.3 Evaluation Measurement & Verification (EM&V) Approach

KEMA is following the EM&V requirements as outlined in the EM&V Framework for Ontario Power Authority Conservation Programs document, to undertake rigorous independent evaluations of OPA-funded programs, in accordance with internationally credible standards. Key methods utilized include:

- In-depth interviews with program staff, LDCs, market actors, program participants and non-participants.
- Computer aided telephone interviews (CATI) were conducted with program participants and non-participants.

- Review of the prescriptive per-unit input assumptions (PIAs) for program measures, including the resource savings assumptions, effective useful life (EUL) and measure costs.

- Review of program tracking database statistics and information included in the work orders.

Program energy and demand savings were based on the work orders including in the program tracking database. Although a targeted on-site verification was conducted, the results were not utilized to adjust measure quantities installed since the sample was not representative of the participant population.[1] Work orders were presumed to accurately represent installed measures.

1.4 Conclusions and Recommendations

The results of this impact and process evaluation have shown that the OPA SCDIP is acting proactively to address the challenges and issues raised in the first year of the program. The key issues that have been, or are being, addressed include previously confusing eligibility requirements and difficulties using the work order tracking database. Overall, the program is working well, with many LDCs successfully meeting their target number of completed projects. As shown in the report, satisfaction among LDCs, service providers, contractors and program participants is also quite high.

1.4.1 Impact Evaluation Findings

The results of the program impact evaluation show the prescriptive per unit input assumptions (PIAs) appear to be generally in good shape, and the program net-to-gross ratio was quite high. The impact evaluation findings are focused on issues that affect program savings and market transformation goals.

Actual installations may not match information provided in work orders. For the purposes of this evaluation, the program impact savings assumed that all projects were correctly and accurately entered into the program tracking database. The targeted on-site verification found a non-installation rate of 13 percent, although this is considered a "worst-case scenario" because work orders were specifically selected due to concerns about the potential for inaccuracies. The CATI participant survey found that 33 percent of participants who received water heating related

[1] Specific sites were selected due to concerns about potential inaccuracies of the work orders.

measures, reported having a natural gas water heater and not an electric one, as required by the program. As part of day-to-day program procedures, OPA is strongly recommended to conduct post-installation inspections prior to approving work orders for payment. This will help to improve the accuracy and quality of the work orders submitted. This may be conducted across all projects (100 percent inspection), or a random sample.

Additional information should be collected on work orders to improve impact savings calculations. The 2009 Commercial and Institutional Measures and Assumptions document provides a solid foundation for gross savings calculations. Additional parameters can be collected on work orders that could improve the accuracy of savings estimates. For lighting measures, additional information include typical operating hours, area descriptions, rated ballast factor. Water heater measures should include water heater capacity, manufacturer, brand, and exact length of pipe insulation installed.

PIAs are generally well developed, and should continue to be updated from time to time. KEMA reviewed the prescriptive per-unit input assumptions (PIAs) related to the program measures, including electricity and demand savings assumptions, effective useful life (EUL) and measure costs. Some of the resource savings assumptions and calculation methodologies provided in the M&A document were found to be incomplete or inconsistent. Revised values were provided to estimate gross savings for the program.

LDCs and service providers do not have incentives to promote market transformation goals. While LDCs appear sufficiently motivated to meet their targets for the program, very little incentive exists for contractors to sell projects that are above the $1000 incentive limit. Since contractors and service providers work directly with LDCs to deliver the program (and not with OPA), the OPA should develop funding for LDCs tied directly to the number of work orders exceeding $1000. Additionally, processes do not appear to exist to measure participation in other OPA programs. Businesses are not always aware that they are participating in an OPA funded program. Therefore, this market transformation goal may need to be refined, or processes developed to track participation in multiple OPA programs.

1.4.2 Process Evaluation Findings

The purpose of the process evaluation was to give feedback to program design and implementation as well all parties involved with administering and implementing the programs to foster continuous program improvement. With this in mind, KEMA recognizes that unique challenges exist for new programs to be launched in utility service territories. The process evaluation findings are intended to focus on future growth issues for the SCDIP.

The tracking database and work order forms are being revised to improve program processes and impact estimates. Managing data flow and project specific information is a common challenge for all energy efficiency programs. As OPA develops a revised work order form, it will be important to balance simplicity and user-friendliness with the need for quality control. KEMA recommends that the new electronic work order include data validation features for quality control, drop-down boxes for business type, automated payback and cost information, separate field for mailing address and facility address. The database should also be easy to download work orders into an Excel file.

Successfully reaching the target market requires utilizing multiple channels and strategies. To promote a sense of legitimacy with the program, it is important that businesses be provided information in writing, especially when the energy assessor or installation contractor arrives on site. Businesses mention that they would prefer information in writing explaining the program. The brochure should prominently display program contact information on the front cover. Since contractors are such an important aspect of program success, consider developing a brochure for recruiting contractors to the program. Also consider increasing the visibility of the official OPA SCDIP website and utilizing email as a form of communication with interested businesses.

Tracking outreach to non-participating businesses is important to effectively market the program. Review of the non-participant contact information provided to KEMA indicated that some LDCs did a better job of tracking the calls and contact attempts to non-participants than others. Effective program marketing requires that LDCs and their service providers track non-participant information to ensure that contact attempts are well-coordinated, that participating businesses are not approached again, and to enable follow-up with customers who have not yet responded. Consider developing a standard set of codes for reasons for non-participation.

The measure and price list are continually updated to improve program effectiveness. KEMA recommends that OPA provide additional guidance to ensure that high quality equipment is being installed. For example, consider providing ENERGY STAR qualifying lamp lists to contractors and LDCs, if this is not already being done. Consider new lighting measures including T5 fixtures, pulse start metal halides and occupancy sensors. Also consider adding a number of refrigeration measures and discontinuing standard halogen and water heating insulation measures.

Proper disposal of lighting equipment has been problematic. The OPA can potentially provide significant assistance and work with province-wide entities to develop consistent protocols for proper disposal. The program may consider requiring contractors to submit

environmental certificates as proof that ballasts were disposed of properly. Also informational handouts and CFL recycle days could be sponsored by OPA to promote proper disposal of CFLs.

LDCs and market actors indicate that communications from the SCDI program could be improved. During the first year of the program, LDCs and market actors frequently had questions and issues that arose. Given the large number of LDCs delivering the program, KEMA recommends developing regular communications such as a newsletter or email bulletin. The SCDIP LDC Forum was also extremely successful and should be repeated for future program years.

1.4.3 Future Evaluation Measurement & Verification (EM&V) Activities

Given the difficulty of assessing accuracy of the tracking database through phone interviews, future impact evaluation efforts should include a field verification component to audit the accuracy of the program tracking database. Specific areas of focus would include verifying baseline conditions (e.g. rate of fixture burn-out), measure retention rate, actual installation rate, and water heater fuel type, to name a few.

Future evaluation efforts may also include a "measurement" component to assess actual operating hours and savings values. This research could inform future PIA revisions, by utilizing actual data from Ontario Province small businesses.

2. Introduction

This document represents the final report on KEMA's process and impact evaluation of Ontario Power Authority's 2008 Small Commercial Direct Install Program, also known as the Power Savings Blitz program. The Small Commercial Direct Install Program (SCDIP) is a resource acquisition program, involving the assessment and turn-key retrofit of lighting and water heater measures for independent small businesses of the participating local distribution companies (LDCs). This report outlines our research approach, results and recommendations for improving the effectiveness of the program in future program years.

2.1 Program Description and Overview

The 2008 Small Commercial Direct Install Program was officially launched in April 2008 to provide energy efficiency incentives to non-food service and non-food retailers within the small commercial sector (defined as < 50 kW demand). The first year of the program was primarily focused on introducing LDCs to the program and coordinating efforts to get the program up and running to complete energy saving retrofits in the service territories of participating LDCs. The 2008 program year ended with 59 local distribution companies (LDCs) having signed up to deliver the program to their small business customer populations.

OPA provides support and oversight to LDCs by requiring quarterly reports on marketing efforts and installations completed. To be reimbursed for installations completed, LDCs must submit completed Work Orders to the Small Commercial Direct Install (SCDI) Work Order Tracking Database. OPA has assigned a target number of completed projects to each LDC, which is approximately 4% of each LDC's small commercial customer population.[2]

The OPA SCDIP was designed to address the underserved and hard to reach small commercial segment. The target market for 2008 was independent non-food retail/service and office sub-sectors located in the downtown business improvement areas of the participating LDCs. These sub-sectors include a wide range of businesses from professional dry cleaners to medical offices to beauty salons to other small retailers.

The 2008 program year ran from April 1, 2008 through March 31, 2009, and is defined as including all completed work orders which had an energy assessment developed prior to the end of the program year, and installed by mid-June 2009.

[2] For LDCs that signed up after Dec. 1, 2008, these companies have a prorated target for completed projects.

2.1.1 Program Objectives

Small Commercial Direct Install is designed to be a resource acquisition program. It involves the assessment and turn-key retrofit of primarily lighting and water heater measures for independent small businesses of the participating LDCs. The 2008 program was originally developed to focus on the supply constraint areas of the province which have the most immediate need. Most LDCs who have these concerns have already signed up for the program. Additional LDCs across the province have also been participating.

The Small Commercial Direct Install Program program theory (see Appendix A for the program logic model) is based on the following elements:

- Significant incentives and a turnkey installation of the measures are required to overcome the market barriers.
- Concentrated marketing and implementation is required to maximize the efficiency and savings associated with the program.
- A greater level of savings is to be achieved by addressing a limited number of high value measures (lighting) with a large number of customers than by conducting a more comprehensive approach with more measures for a limited number of customers.
- The greatest savings opportunity exists with small commercial customers in the downtown business improvement areas.
- The free rider rate for this program is expected to be significantly lower than 30%.

According to the "Business Plan CSD for Small Commercial Direct Install (January 2008)," the original program objectives were as follows:

- Resource acquisition - to achieve a demand savings of 4.8 MW by retrofitting the targeted program measures in over 4,500 small retail businesses in the supply constraint areas of the province in 2008.
- Market transformation - to increase awareness of the importance of conservation with the small businesses in this hard to reach market.
- To cross promote other OPA conservation programs such as Peaksaver and ERIP.

The final commitment to the Ontario Energy Board was to complete 15,000 retrofits for program year 2008. For the next program year 2009, the targets have been increased to 22,000 retrofits.

2.1.2 Program Services

The measures supported by the program include converting T12 to T8 fluorescent lighting, replacing incandescent lights with compact fluorescent lights and halogen lamps, replacing incandescent exit signs with LEDs, and installing insulation blankets and pipe-wrap on electric water heaters.

Participating customers receive a free energy assessment of their lighting and water heating equipment. A work order summarizes the potential lighting and water heating retrofit measures that are applicable for that location and the associated cost and savings. Through the program, small business customers are eligible to receive up to $1,000 to cover the cost of the product and installation costs. The program offers the free supply and installation of the measures because: 1) this is a difficult to serve segment with high transaction costs; 2) there is a lack of awareness of energy costs and opportunities; and 3) limited access to capital and time to deal with energy opportunities. If the cost of the measures identified exceeds the $1,000 incentive limit, the customer is responsible for paying the incremental amount, if they choose to install the additional measures.

2.1.3 Program Changes

Although the original 2008 SCDIP was envisioned to target the 21 LDCs in supply constrained areas of the province, the program engaged a total of 59 LDCs to implement the program. The 2008 program ended on March 31, 2009. The 2009 program will run from April 1, 2009 through December 31, 2009.

Several revisions and improvements to the program have already been made in response to LDC and market actor feedback, as well as the preliminary KEMA evaluation findings from February 2009. Key program changes include:

- **Modified measure price list** – Several measures and new equipment specifications have been added to the program price list. The prices were also clarified to include all applicable taxes.
- **Re-defined eligibility for $1000 incentive** – In 2008, customers were eligible to receive $1000 of free retrofit per account number, but the requirements have been modified to only allow one retrofit per business address that is separately metered.

- **Broaden scope of business types** – Food service and restaurant small business customers were not previously eligible to participate in the program in 2008, but will be allowed for 2009.
- **Begin developing improved work order tracking system** – In response to significant negative feedback on the 2008 work order form and Portal Tracking Database system, OPA will be developing an electronic work order form that can be uploaded automatically to the OPA system.

2.1.4 Short term and Long-term Program Goals

The short term goals for the program include:

- Expanding the program to LDCs beyond the supply constraint areas
- Targeting specific sub-sectors such as Food Service/Retail with a unique offer of incentives, measures and marketing approach.
- Leveraging retail associations to build support for a broader based program.
- Encouraging the manufacturers and distributors of refrigeration equipment for retailers to replace the equipment earlier and improve the levels of efficiency.
- Increase the percentage of SCDIP participants who are willing to invest additional dollars above the retrofit incentive limit
- Increase number of SCDIP participants who also participate in other OPA sponsored conservation programs.

The long term goal is to make the retrofits sustainable in the market without OPA incentives, and involve:

- Building the market awareness with electrical contractors of the opportunities available to target the small commercial customers
- Building awareness of the savings opportunities with customers so that they seek out the retrofits
- Increasing demand for T8 lighting to reduce the cost and increase the availability among retailers.

2.2 Evaluation Objectives and Approach

EM&V refers to the evaluation, measurement and verification of OPA conservation program activities and the associated effects anticipated by program planners and designers. KEMA is following the EM&V requirements as outlined in the EM&V Framework for Ontario Power Authority Conservation Programs document, to undertake rigorous independent evaluations of OPA-funded programs, in accordance with internationally credible standards.

The primary purpose of this program evaluation is to ensure the reliability of demand reduction and energy savings achieved. This is important since it helps determine the amount of generation that must be built to meet provincial energy needs. As the first year of the program, it is especially important to assess program design performance, and provide information for continuous improvement through future program years and ensure proper validation of input assumptions made for specific end-use measures.

The key research objectives of the 2008 SCDI program evaluation, as outlined in the program evaluation plan and informed by the OPA's evaluation protocols, are the following:

1. Review, and update as appropriate, the prescriptive per-unit input assumptions of the measures included in the program
2. Determine the free rider or other net-to-gross adjustment factors as appropriate
3. Estimate the gross and net energy savings and peak demand reductions achieved through the initiative
4. Determine the relative impacts of the delivery strategy used to gain program participation
5. Determine the relative impacts of OPA and LDC communication, marketing and incentive structures on gaining program participation
6. Determine the suitability of the current set of measures included in the program and identify additional measures that could be beneficial to include in future years
7. Create the baseline data required to assess the performance of the market transformation efforts

These evaluation objectives are organized in this report, with Objective #1-3 and 7 categorized as impact evaluation objectives, and #4-6 as process evaluation objectives.

Key methods utilized to address the objectives listed include:

- In-depth interviews with program staff, LDCs, market actors, program participants and non-participants.
- Computer aided telephone interviews (CATI) were conducted with program participants and non-participants.
- Review of the prescriptive per-unit input assumptions (PIAs) for program measures, including the resource savings assumptions, effective useful life (EUL) and measure costs.
- Review of program tracking database statistics and information included in the work orders.

Program energy and demand savings were based on the work orders including in the program tracking database. Although a targeted on-site verification was conducted, the results were not utilized to adjust measure quantities installed since the sample was not representative of the participant population.[3] Work orders were presumed to accurately represent installed measures.

2.3 Organization of Report

The following chapters of the report are organized as follows:

Chapter 3 summarizes the impact evaluation, including gross and net savings

Chapter 4 reviews the process evaluation findings

Chapter 5 provides an overview of the evaluation, measurement and verification (EM&V) approach and data collection strategies.

Chapter 6 provides a summary of findings and recommendations

[3] Specific sites were selected due to concerns about potential inaccuracies of the work orders.

3. Impact Evaluation Results

Impact evaluation activities focused on developing gross and net savings resulting from the program, and baselines for program market transformation goals. At the close of the 2008 SCDI program year, LDCs in aggregate achieved 96 percent of their goals, encompassing 11,442 completed retrofits out of a target of 11,936. (See Appendix B for specific achievements by LDC). In this chapter we present the energy and demand savings for the 2008 program year, review the calculation methodology for estimating program savings and baselines for assessing future progress against program market transformation goals.

3.1 Gross and Net Savings from Program

Since no kWh or kW savings had previously been calculated for the SCDI program as a whole, KEMA estimated gross savings based on the work orders included in the final tracking database for 2008. Table 3 shows that the vast majority of energy savings (98.9%) are related to lighting measures. The overall program net-to-gross ratio (NTGR) was calculated to be 93% for energy, summer demand and winter demand savings, and applied to the gross savings to determine the program net savings.

Table 3: Summary of 2008 SCDI Program Impacts

Measure Type	Gross kWh	Gross kW (Summer)	Gross kW (Winter)	Net kWh	Net kW (Summer)	Net kW (Winter)
T8 Fixture	22,376,494	3,043.5	3,676.1	20,810,140	2,830.5	3,418.8
CFL	6,617,357	900.1	1,087.1	6,154,142	837.1	1,011.0
Halogen	139,563	19.0	22.9	129,794	17.7	21.3
LED Exit Sign	926,685	126.0	152.2	861,817	117.2	141.6
Lighting Total	**30,060,099**	**4,088.6**	**4,938.4**	**27,955,892**	**3,802.4**	**4,592.8**
Water Heater Tank Insulation	219,450	23.5	37.2	204,089	21.9	34.6
Pipe Insulation	97,402	10.4	16.5	90,584	9.7	15.4
Low Flow Faucet Aerator	26,949	2.9	4.6	25,063	2.7	4.3
Water Heating Total	**343,802**	**36.9**	**58.3**	**319,735**	**34.3**	**54.2**
Program Total	**30,403,901**	**4,125.5**	**4,996.8**	**28,275,628**	**3,836.7**	**4,647.0**

KEMA also estimated the lifetime savings associated with the program impacts. Table 4 presents the lifetime impacts and the program weighted effective useful life (EUL) for each measure type. The lighting measure EULs varied depending on the specific business type.

Table 4: Summary of 2008 SCDI Program Lifetime Impacts

Measure Type	Weighted EUL	Gross Lifetime kWh	Net Lifetime kWh
T8 Fixture	14.7	328,656,536	305,650,579
CFL	2.3	15,152,246	14,091,589
Halogen	0.6	77,174	71,772
LED Exit Sign	16.0	14,826,966	13,789,078
Lighting Total	**11.9**	**358,712,922**	**333,603,018**
Water Heater Tank Insulation	7.0	1,536,150	1,428,620
Pipe Insulation	15.0	1,461,033	1,358,761
Low Flow Faucet Aerator	5.0	134,747	125,315
Water Heating Total	**9.1**	**3,131,930**	**2,912,695**
Program Total		**361,844,852**	**336,515,713**

No adjustments were made to the program reported quantity installed. KEMA reviewed the prescriptive assumptions (PIAs) per measure, and applied the PIA values to the work orders included in the 2008 program tracking database to estimate gross program savings. KEMA also reviewed the EUL values to develop lifetime savings (see Appendix C for full documentation of PIA review).

Although a targeted on-site inspection was conducted, this was based on a non-random sample selected by program staff. KEMA was able to verify that 87 percent of measure quantities reported on the selected work orders were actually installed. This may be considered a worst case scenario, as the work orders were specifically selected due to concerns about the potential for inaccuracies. Since the on-site verification was based on a non-random sample of program participation, the verification rate was not utilized to adjust the measure quantities in the program database.

The net energy savings approach was to subtract the energy savings related to free-riders and add in energy savings related to spillover. We detail in the sections below our approach for estimating program impacts shown above.

3.2 Review and Update of Prescriptive Per-Unit Input Assumptions

KEMA reviewed the prescriptive per-unit input assumptions (PIAs) related to the program measures, including electricity and demand savings assumptions, effective useful life (EUL) and

measure costs. For the EUL and measure cost review, KEMA reviewed the references included in the OPA M&A documents to verify data sources. We also conducted a literature search and review of energy efficiency documentation sources (such as utility program workpapers and California DEER database) and provided updated values where appropriate. In some cases, the values in the PIA document could not be substantiated, so values were provided that could be documented. Where OPA values appeared reasonable, no change was recommended. A full review of the PIAs is included in Appendix C.

Gross savings are calculated for measures included in each work order, based on revised per-unit input assumptions (PIAs) as briefly described in this section. Gross savings are based on all "submitted" work orders included in the tracking database for 2008 program cycle.[4] For a full description of review and revised PIAs, see Appendix C. Estimated savings values include annual energy savings (kWh) and coincident peak demand savings (kW) for both summer and winter.

For the purposes of estimating gross savings, the measure descriptions from the OPA Small Commercial Direct Install program Portal Tracking Database are used as the basis for all assumptions, where possible. Both the existing equipment and retrofit measure descriptions are used. The gross impact savings values do not account for any deviations from these measure descriptions that may occur in practice for both pre and post retrofit.

The OPA PIAs and measure substantiation documents, primarily related to the 2009 Commercial and Institutional Measures and Assumptions[5] document (M&A Document), are the foundation for gross savings calculations. Some of the PIAs provided in the M&A document were found to be incomplete or inconsistent. Several calculations were incorrect, or could not be completed with the given information. Therefore, revisions and modifications were made to PIAs to determine gross savings impacts. Some of the equations and assumptions were also revised to reflect more current or applicable values.

Coincident peak demand savings are calculated using the methodology described in the M&A document. The period definitions end-use coincident factors, and end use load profiles in the M&A document are also used.

[4] Tracking Database includes "New" and "Submitted" entries. Submitted entries are the finalized work orders uploaded to OPA for payment.
[5] 2009 Commercial and Institutional Measures and Assumptions, The Ontario Power Authority, http://www.powerauthority.on.ca/Storage/97/9279_2009_M__A_List_-_CI_Apr14.pdf

3.2.1 Lighting Measures

This program provides direct install services for four distinct lighting measure types. The measure types include linear fluorescent fixture retrofit (T12 with magnetic ballast to T8 with electronic ballast), replacement of inefficient lamps with ENERGY STAR® compact fluorescent lamps (CFLs), replacement of inefficient lamps with Halogen General Service Lamps, and exit sign retrofit/replacement with LED lamps/fixtures.

Savings for all lighting measures are based on the reduced wattage resulting from the retrofit, and the hours that lights are used. Wattage reductions for fluorescent fixture retrofits and exit sign measures include the entire fixture wattage. CFL and halogen wattage reductions are based on individual lamp wattages. The hours lights are used is estimated based on business type.

The M&A document provides values for both hours of use and wattages. Some measures do not have wattages included. In these instances, alternative sources were used. Hours of use provided in the M&A document do not correspond to business types in the OPA Small Commercial Direct Install program Portal Tracking Database. The 2008 DEER database hours of use were used instead, as they are more current and applicable. The M&A document savings methodology is used to calculate gross savings.

3.2.2 Hot Water Tank Insulation

This measure involves the installation of a water heater insulation jacket on a water heater with no insulation jacket. It is specified that this is only applicable for electric storage water heaters. The insulation jacket is described as 5/32" barrier bubble film laminated between two layers of foil. Measure 37 specifies that the insulation jacket be installed on tanks between 50 to 119 gallon capacity. Measure 38 specifies installation on tanks between 12 and 40 gallons.

Gross impact savings for tank insulation are based on several parameters associated with water heaters characteristics, amount of insulation added, operating conditions, and domestic hot water usage. The M&A document provides a methodology for determining energy savings, however, several parameters are not provided or are applied incorrectly. Therefore, KEMA estimated gross savings based on this methodology, but made some assumptions for the parameters. The evaluation team worked with the OPA to determine appropriate assumptions.

3.2.3 Pipe Insulation

This measure involves the installation of insulation on hot water pipes with no existing insulation present. Pipe insulation is only eligible for program incentives if water is heated with an electric storage water heater. Measure 39 specifies the installation of 10ft flexible polyethylene insulation on outlet pipe for 0.75 inch and 1.2 inch pipe diameters. However this pipe diameter is not consistent with the description outlined in the M&A Document, where pipe diameters are either less than 40 mm or greater than 40 mm. The pipe insulation savings estimates are based on an equal distribution of 0.75 and 1.2 inch pipe diameters across program participants who received this measure.

Gross impact savings for pipe insulation is based on the pipe characteristics, insulation properties, ambient temperature, hot water temperature, and hot water usage. Impact savings utilize a similar savings calculation as the M&A document , however several corrections were needed. Additionally, the M&A document did not provide assumptions necessary for determining heat loss through the existing pipe with no insulation present. The evaluation team worked closely with the OPA to determine appropriate modified saving calculations and assumptions.

3.2.4 Low Flow Faucet Aerators

This measure involves the installation of low flow aerators (Measure 40). Low flow aerators are only eligible for program incentives if applied to faucets connected to electric water heaters. The measure is described as an aerator with an average flow of 1.5 gallons per minute (gpm) replacing a faucet with an average flow of 2.75 gpm.

Gross impact savings for low flow faucet aerators are based on the reduced hot water usage. Unfortunately, gross impact savings for this measure were difficult to determine with the data collected in work orders. The estimated reduction in hot water use is based on business type specific parameters, such as the number of employees or meals served per day. The approach outlined in the M&A document needed to be supplemented with data from secondary sources and CATI results, such as floor area by business type.

3.2.5 Future Improvements to PIAs

A more exhaustive in-depth review of all measures' PIAs could be conducted. Market and technology research could inform baseline assumptions and other savings parameters. Conducting in-depth measure reviews could improve impact savings estimates, reduce

confusion during future evaluations, and ease updatingPIA in the future. The OPA may also consider developing a prescriptive savings manual based on revised methodologies and inputs.

Some revisions could include:

- Clearly define lighting fixture and lamp wattages and provide assumptions and sources
- Review the document for incomplete calculations, missing inputs and outdated/missing references
- Develop water heater insulation savings method that incorporates the built in insulation value, or identify a secondary source with estimated savings

3.3 Determination of Net-to-Gross Adjustment Factors

The net energy savings approach is to subtract the energy savings related to free-riders and add in energy savings related to spillover. Free-riders are program participants who would have implemented the same energy efficiency measures absent the program. Free-riders take advantage of program incentives, but their behavior is not influenced by the program. While free-riders are program participants by definition, their associated energy savings are not part of net energy savings.

Conversely, spillover customers went beyond the scope of the program to install additional energy efficiency measures as a result of one or more elements of the program. Spillover is calculated by determining the proportion of additional energy savings that can be attributed to the program from installations that take place with no support from – and as a result of participation in – the program. The spillover rate is the ratio of the total spillover savings to the total savings installed by the program.

KEMA utilized the 401 completed computer aided telephone interview (CATI) surveys with program participants to determine the spillover and free-ridership rate. We then combined the spillover rate and the free-ridership rate to give the overall Net-to-Gross Ratio (NTGR), according to the following equation:

$$NTGR = 1 + (SpilloverRate) - (FreeRidershipRate)$$

3.3.1 Spillover Fraction

Although anecdotal evidence suggests that some customers have installed additional measures following their participation in the program, the results of the CATI survey indicate that the spillover rate is estimated to be zero. Low spillover is expected in a program with low free rider rates; if customer would typically not inclined to adopt program measures on their own the rate of adopting additional measures outside the program is similarly likely to be low. In order to be counted as spillover, customers must both purchase and install measures after receiving assistance from the program, and indicate a high degree of program influence on their decision to purchase and install. Additionally, customers who are free-riders generally can not be included as contributing to spillover.

OPA evaluation procedures typically include spillover rate in the calculation of net-to-gross ratio. The identification of spillover related to SCDIP is complicated by the fact that work orders often include installations of measures not strictly funded by the program, but that are included in program savings since they are program measures installed as part of the program delivery process. It is unclear whether customers see these as part of the program, or not. Future evaluation efforts should ensure rigorous approaches to estimating and including spillover.

3.3.2 Free-ridership Fraction and Net-to-Gross Adjustment Factor

Since free-riders, by definition, would have installed the measures in absence of the program, only a proportion of the savings associated with free-rider installations can be attributed to the program. Free-ridership is calculated by determining what proportion of the surveyed respondents' energy savings (measure installation) would have taken place in absence of the program and then extrapolating to the population.

For this study, since spillover was estimated at zero, net savings were determined by applying estimates of free-ridership rate to gross savings.[6] The free-ridership rate is converted to the Net-to-Gross Ratio (NTGR) and then multiplied by the gross savings estimates in order to calculate net program savings, shown below:

$$NTGR = 1 - \left(FreeRidershipRate\right)$$

$$Savings_{NET} = \left(Savings_{GROSS}\right) \times \left(NTGR\right)$$

[6] Free-ridership fraction is the proportion of participants who would have implemented the same energy efficiency measures absent the program. By definition net-to-gross ratio (NTG) = 1 – (free-ridership fraction).

Sometimes an individual program participant can be a partial free-rider, meaning they would have installed a portion of the measures, but not all. The free-ridership methodology also accounts for acceleration, meaning the program enabled a participant to install a measure sooner than they otherwise would have. An example of this would be a participant who reports they were planning to replace their T12 fixtures with T8 fixtures at some point in the future (over a year or more), but the program influenced them to replace them during the program year.

Free-ridership is difficult to estimate since it seeks to measure hypothetical behavior. For this study free-ridership was estimated through self reporting, i.e. participants were asked what they would have done absent the program. If they would have installed similar equipment absent the program, participants were also asked if the program influenced them to install/purchase more efficient equipment, and whether the program influenced them to install/purchase sooner than later. The survey instrument used for this purpose and the method for determining free ridership from the responses were based on the instrument developed for small customer with simple measures as part of the 2006-08 program evaluations currently being conducted for the California Public Utilities Commission.

3.3.3 Methodology

Program participant CATI telephone surveys are the basis for free-ridership estimation. The surveys contained many key free-ridership questions[7]. The questions covered the timing of the installation (when they would have installed/purchased the equipment without the program); the efficiency of the equipment (what level of efficiency would they have purchased without the program); and the quantity of equipment (what amount of the equipment they would have purchased without the program). The responses to a number of questions relating to these three main topics allow quantification of free-ridership rates for surveyed program participants.

The portion of energy and demand savings deemed to be the result of free-ridership for survey respondents is divided by the gross energy or demand savings for these respondents in order to calculate the free-ridership fraction.

[7] Please see Appendix D for a more detailed description of the net-to-gross survey methodology.

3.3.4 Weighting Participant Free-ridership for Program Level Results

For the OPA SCDI Program, results were weighted by strata[8] in order to accurately represent all groups, including groups with relatively low sample sizes. Once weighted, the mean free-ridership rate was determined. The weighted portion of energy and demand savings deemed to be the result of free-ridership for survey respondents is divided by the weighted gross energy or demand savings for respondents in order to calculate the free-ridership fraction.

Based on survey responses, there is a weighted free-ridership rate of 7 percent. A 7 percent free-ridership rate is the equivalent of a 93 percent net-to-gross ratio, shown below in Table 5.

Table 5: OPA SCDI Free-ridership and Net-to-Gross Estimates

Free-Ridership Rate	Net-to-Gross Ratio
7.0%	93.0%

3.3.5 Extrapolation to All Program Participants

The free-ridership rates derived from the above methodology were applied to all program participants' energy and demand savings.

3.4 Potential issues with accuracy of tracking database

The scope of this evaluation did not include on-site verification of a representative sample of completed work orders. Therefore, the calculations used to determine project- and program-level savings assume that all work order installations follow the exact protocols outlined by the program. In this section, we utilize the results of the CATI survey of program participants to assess potential issues with the accuracy of the database which may affect actual program impact savings.

Program impact calculations assume that all fixtures were operational at time of retrofit and replaced the baseline technology specified in the measure list. Results from the CATI survey of program participants indicate that sometimes lamps were burnt out or not working prior to the retrofit. While this reduces first year savings of a program, in the longer run, this is not expected to significantly impact lifetime savings.

[8] Please see Appendix E for a more detailed description of the stratification process.

Table 6 shows that 14 percent of T12 to T8 retrofit projects had between one and three T12 fixtures that were not working when they were replaced. More than one in five projects (21%) had at least one T12 fixture that was out of service at the time it was replaced. Results for CFL retrofits were similar to the T8 results. To better estimate energy savings, it is necessary to understand whether the fixture was temporarily out of service or not needed, what the natural replacement product was going to be, and when the replacement would have taken place. Respondent intentions – whether the respondents were going to replace the T12 fixtures in absence of the program – have been determined, but not at an individual lamp basis. This level of detail with respect to the replacement of burnt out equipment is suggested during upcoming evaluations.

Table 6: Percent of Participants with Burn-Out Fixtures

Quantity of replaced T12s that were not working when replaced by T8s	Overall
Zero	71%
1 to 3	14%
4 to 6	4%
7 or more	3%
Don't know	6%
Refused	2%
Total	100%

Responses to the CATI survey also indicate that there are instances when retrofit measures may have been used to supplement existing equipment, rather than replace. As shown below in Table 7, one or more T8 fixtures in approximately 5 percent of T8 projects were not replacements. T8 fixtures were installed to provide additional lighting to supplement existing lighting in approximately 4 percent of T8 projects, while another 1 percent installed at least one T8 fixture in an addition. These fixtures may actually increase the baseline energy consumption and demand of the location, if nothing was previously installed.

Table 7: Percent of Participants using T8 Fixtures for Additional Lighting

How T8 Fixtures were Used	Overall
To replace previously existing equipment	98%
To provide additional lighting to supplement existing lighting	4%
To install in an addition	1%
Don't know	1%

Note: Multiple responses accepted, total may exceed 100%

Program participant surveys show that that every exit sign installed or retrofitted as part of the program replaced an existing and working exit sign, as shown in Table 8 and Table 9. This may be the result of the following two main factors:

1. Building code typically requires a functioning exit signs at specified locations.
2. Exit signs typically remain on at all times, reducing the chance of failure due to excessive on / off switching.

Therefore, it is unexpected to encounter many burnt-out exit signs due to building code laws as well as the nature of the product being replaced. Similarly, since commercial buildings require exit signs in specified locations, it is unnecessary to install additional exit signs. Any building addition would have had exit signs installed during construction in order to comply with code.

Table 8: CATI Survey of How LED Exit Signs were Used

How Exit Signs were Used	Overall
To replace previously existing equipment	100%

Table 9: CATI Survey of LED Exit Sign Burn-out

Quantity of Exit Signs that were not working when replaced / retrofitted	Overall
Zero	52%
Refused[9]	48%
Total	100%

Energy and demand savings for water heater insulation measures and low flow faucet aerators assume that the water heating fuel type is electricity. In the case of water heater insulation measures, contractors should be able to assess the fuel type of the water heater during the installation. For faucet aerators, it is likely that the water heater is not inspected by contractors since it is unnecessary for the installation. Table 10 shows that the CATI survey of participants receiving incentives for water heating-related measures indicates that approximately one-third of the water heaters are fueled by natural gas, and therefore do not achieve electric energy savings or demand reduction. This would be an area to investigate during field verification of program work orders.

[9] Despite the fact that 48% of participants are unaccounted for (refused), KEMA assumes that all exit signs were working when they were replaced or retrofitted.

Table 10: CATI Self-Reported Water Heater Fuel Type

Water Heater Fuel Type	Overall
Electricity	62%
Natural Gas	33%
Don't Know	5%
Total	100%

It is extremely difficult to assess the accuracy of work order through phone interviews, much less through computer aided telephone interview (CATI) surveys. Future impact evaluation efforts should include a field verification component to audit the rate at which measures are installed (and remain installed) according to program rules.

3.5 Market Transformation Baseline

The SCDI Program Logic Model (Appendix A) includes a two-fold market transformation goal. As part of this first year evaluation effort, we document the baseline to lay the foundation for assessing the performance of the market transformation efforts in the 2009 and 2010 iteration of the SCDI program.

3.5.1 Baseline: Percentage of Participants Investing Above $1000

To the extent that participating customers choose to install measures beyond the maximum incentive levels, this increases the cost-effectiveness of the program. For the 2008 program year, 28 percent of completed projects included some out-of-pocket investment from the participant. As shown below in Table 11, the average additional investment was $358.12, with the largest project size recorded at $7,397.

Table 11: Summary of Participants Investing More than the $1000 Incentive

Total Number of Projects	Number of Projects Above $1,000	Percent of Projects Above $1,000	Average Amount Above $1,000	Largest project size recorded
11,444	3,150	28%	$358.12	$7,397.18

LDCs varied significantly in the percentage of participants who chose to invest their own dollars to extend the scope of the retrofits. Table 12 shows the relative number of projects completed by each LDC which exceeded the $1000 incentive limit.

Table 12: Participants Investing More than $1000 Incentive, by LDC

LDC	Projects > $1,000	Total Projects	% Above $1,000	Average Above $1,000
West Nipissing Energy Services Ltd.	14	17	82%	$606.50
St. Thomas Energy Inc.	59	75	79%	$295.61
Goderich Hydro	2	3	67%	$1,500.59
Halton Hills Hydro Inc.	34	57	60%	$137.75
Parry Sound Power Corporation	10	18	56%	$655.18
Milton Hydro Distribution Inc.	50	92	54%	$196.29
West Perth Power Inc.	30	59	51%	$659.69
Burlington Hydro Inc.	157	309	51%	$365.26
Wellington North Power Inc.	24	50	48%	$587.69
Lakefront Utilities Inc.	29	61	48%	$329.35
North Bay Hydro Distribution Limited	48	110	44%	$443.07
Innisfil Hydro Distribution Systems Limited	13	30	43%	$266.08
Oakville Hydro Electricity Distribution Inc.	100	241	41%	$432.58
Hydro Ottawa Limited	124	300	41%	$313.30
Orillia Power Distribution Corporation	67	163	41%	$537.15
Canadian Niagara Power Inc.	53	130	41%	$322.90
Brant County Power Inc.	32	80	40%	$386.67
Guelph Hydro Electric Systems Inc.	82	210	39%	$337.41
Erie Thames Powerlines Corporation	35	90	39%	$662.58
Greater Sudbury Hydro Inc.	63	166	38%	$667.82
Chatham-Kent Hydro Inc.	111	307	36%	$226.38
Waterloo North Hydro Inc.	84	235	36%	$512.20
Clinton Power Corporaton	15	43	35%	$618.81
Barrie Hydro Distribution Inc.	14	44	32%	$299.19
Essex Powerlines Corporation	70	220	32%	$186.49
Peterborough Distribution Incorporated	38	123	31%	$491.73
Woodstock Hydro Services Inc.	23	75	31%	$496.62
Festival Hydro Inc.	32	106	30%	$412.54
Newmarket - Tay Power Distribution Ltd.	57	201	28%	$402.84
Norfolk Power Distribution Inc.	30	106	28%	$575.58
Hydro One Networks Inc.	363	1318	28%	$488.19
E.L.K. Energy Inc.	26	95	27%	$276.16
Kitchener-Wilmot Hydro Inc.	93	353	26%	$368.94
Haldimand County Hydro Inc.	34	134	25%	$213.11
Centre Wellington Hydro Ltd.	3	12	25%	$502.83
Brantford Power Inc.	44	186	24%	$351.15
Oshawa PUC Networks Inc.	59	251	24%	$280.23
Whitby Hydro Electric Corporation	38	162	23%	$302.67
Veridian Connections Inc.	79	349	23%	$309.85
Midland Power Utility Corporation	4	18	22%	$795.28
Cambridge and North Dumfries Hydro Inc.	49	227	22%	$448.21
Horizon Utilities Corporation	279	1335	21%	$292.17
EnWin Utilities Ltd.	185	892	21%	$239.62
Wasaga Distribution Inc.	6	32	19%	$232.72
PowerStream Inc.	96	516	19%	$204.95

Toronto Hydro-Electric System Limited	291	1794	16%	$227.81
London Hydro Inc.	1	8	13%	$60.75
Orangeville Hydro Limited	0	39	0%	$0.00
Grand Total	3,150	11,442	28%	$358.12

In the next chapter, we will examine the program delivery strategy to assess reasons that customers choose, or do not choose to exceed the $1000 incentive maximum and how the SCDIP can improve the rate in future program years.

3.5.2 Baseline: Increase the SCDIP Participation in Other OPA CDM Programs

The only other OPA CDM program that SCDIP businesses are eligible for is the PeakSaver program. Future OPA program, however, may be available for small commercial customers.

The following other OPA CDM programs have been identified:

- Electricity Retrofit Incentive Program (ERIP) – This program has two tracks encompassing a prescriptive track and custom track.
- High Performance New Construction – This program supports strategies and technologies for reducing energy consumption in new construction.
- Load Management – This program offers incentives for load curtailment for industrial, commercial and institutional facilities.
- Other OPA CDM programs target the residential sector.

In general, program participants and non-participants were not very aware of other OPA conservation programs. Table 13 shows, however, that program participation does have an influence on business awareness of other OPA CDM programs. Program participants are almost twice as likely as program non-participants to be aware of other CDM programs.

Table 13: Comparison of Awareness of Other CDM Programs

Aware of Other Programs?	Participant	Non-Participant
Yes	15%	8%
No	84%	90%
Don't know	1%	2%
Total	100%	100%

Interestingly, as shown in Table 14, approximately 14 percent of program participants mentioned that they have participated in other energy efficiency programs offered by their LDC.

Table 14: Participation on Other CDM Programs

Has your business participated in other programs?	Overall
Yes	14%
No	83%
Don't know	4%
Total	100%

Through the in-depth interviews with twenty participants, one participant was aware of the Peaksaver program, one participant was aware of a program being offered for CFL replacements for residential usage, and another participant was aware of a residential hot water tank replacement program.

This market transformation goal may need to be refined, since it may be difficult for businesses to know if they are participating in other OPA programs, making self-reported participation inaccurate. Future progress against this baseline should be measured based on OPA program tracking databases, and not based on participant self-report. A unique customer ID may be necessary to compare between programs, especially since businesses may have multiple LDC account numbers and 2009 eligibility rules now restrict participation to unique business addresses that are separately metered. The goal may also be revised to simply be based on customer awareness of multiple OPA programs.

3.6 Summary of Impact Evaluation Findings

The results of the program impact evaluation show that the 2008 SCDI program has achieved significant electricity savings. The prescriptive per unit input assumptions (PIAs) appear to be generally in good shape, and the program net-to-gross ratio was quite high. The results of the review of PIAs should be incorporated into program documents to calculate impact results for future program years.

For the purposes of this evaluation, the program impact savings assumed that all projects were correctly and accurately entered into the program tracking database. As shown through the

CATI participant survey, and a separate targeted verification of select 2008 work orders,[10] however, this is not an accurate assumption. The key issue for future program impact evaluations will be to focus on field verification to assess actual installation behavior and measure retention. Tracking database accuracy is an issue to be explored during field verifications in future EM&V efforts. As part of day-to-day program procedures, OPA is also recommended to implement post-installation inspections to improve the accuracy of the work orders submitted.

Another key to success is to focus on increasing the number of program participants and improve program procedures to enable LDCs to meet their increased targets for 2009 and 2010. In the next chapter, we examine these issues, and assess the efficiency and effectiveness of the SCDIP's design and delivery mechanisms to market.

[10] During summer 2009, KEMA conducted a non-random verification of specific work orders for the SCDI program.

4. Process Evaluation Results

According to the OPA EM&V protocols, “conservation program process evaluations identify and make recommendations for improvement to increase the program’s efficiency and/or effectiveness in achieving its objectives (energy and peak demand savings, education and awareness, etc.) while maintaining high levels of participant satisfaction.” KEMA conducted most of the data collection activities associated with the process evaluation from February through June 2009, which encompassed a portion of the 2008 program year and continued into the 2009 year.

The purpose of the process evaluation is to give feedback (in-program and post-program) to program design and implementation as well all parties involved with administering and implementing the programs to foster continuous program improvement. With this in mind, KEMA recognizes that unique challenges exist for new programs to be launched in utility service territories, and that process evaluation findings need to focus on future growth issues for the SCDIP.

In this chapter, we first examine the relative impact of delivery strategy by focusing on OPA’s interactions with LDCs and other program administration issues. Secondly, we assess the effectiveness of communication and marketing strategies related to LDC outreach to the target market. We also examine the incentive structure of the program, and suitability of the current set of measures. Throughout the process evaluation chapter, we review the market feedback and assess market satisfaction with program elements.

4.1 Relative Impact of Delivery Strategy

In this section we focus on how OPA works with LDCs to get the program in the field, and strategies to assist LDCs to more effectively engage and oversee contractor work.

4.1.1 LDC challenges and barriers to launching the program

As 2008 was the first year that the SCDI program was implemented, many of the barriers and challenges faced by participating LDCs to deliver the program were simply to get internal processes up and running to reach their small business segments. For example, the principal reason for LDCs not meeting their targets for the 2008 program year were due to problems engaging electrical contractors (or qualified service provider) to deliver the program and to conduct the installations.

To be successful, LDCs must identify qualified electrical contractors to perform the actual installations of the retrofit measure, since LDCs do not typically have such staff already available on their payroll. As of early July 2009, a few LDCs that had signed up during the 2008 program year have not yet identified local contractors to deliver the program in their areas. The primary strategy for engaging service providers and contractors has been to release an RFP for services.

In some LDC territories, no electrical contractors responded to their RFP, thus hampering their abilities to deliver the program. Some LDCs utilized an RFP document developed by the Electricity Distributors Association (EDA) and found that contractors were overwhelmed by the 35 page document, and did not understand it. These LDCs then followed up directly with the larger contractors in their areas through phone calls and even direct visits to their offices. Some LDCs were successful in these follow-up efforts, but a few were not.

LDCs in the more remote areas of the province faced special challenges in implementing the program. They tend to have smaller populations of contractors to recruit to deliver the program, and the distance from other population centers makes it difficult for other contractors to travel and complete the installations.

Most LDCs, however, were able to engage qualified service providers and contractors to deliver the program, although it turned out to be a lengthy process for some. Interviews with LDCs indicate the following successful strategies for engaging contractors:

- Host an informational session for contractors to learn more about the program. Several LDCs have had success engaging local contractors this way. One LDC mentioned that 20 contractors attended their information session, with 7 being sufficiently interested enough to sign up.
- Ideally, approach contractors during the winter, when they are less busy. Anecdotal evidence indicates that summer tends to be the busiest time of the year for contractors, making it difficult for them to take on additional commitments. This implies that LDCs would need to decide to participate in the program by the end of the summer, and begin searching for contractors in the fall.
- Develop simple, easy-to-understand documents and contracts for service providers and/or contractors.
- Emphasize the benefits of the program to contractors, including ease of securing retrofit projects, that projects sell themselves, and program allows contractor to minimize marketing efforts and focus on working directly with customers.

One LDC that was still having difficulty engaging a local contractor to complete program retrofits suggested that they would like some marketing collateral, such as a brochure or handout, targeted at electrical contractors to explain how the program works, benefits of participation and their level of responsibility. OPA may wish to consider developing a standard document that LDCs could use.

Another LDC did not meet their targets because they deliberately chose to pilot the program for the first year in a small geographic area before expanding the program to its entire service territory. The LDC representative mentioned that they would have liked to have seen more of the challenges and potential negative aspects of the program highlighted in the pilot program final report. Specifically, they wanted to hear more about what went wrong during the pilot and what was done to fix these problems.

4.1.2 Approaches to delivering the OPA SCDI program

To launch the SCDI program in their territory, LDCs must first determine how it will engage contractors to install the retrofit measures at customer sites – whether to contract with one or two contractors, or hire a "service provider" to manage a group of contractors. For the purposes of this evaluation, we define "service providers" as an intermediary company who engages and organizes the activities of multiple electrical contractors from different companies.

Table 15: Summary of Delivery Strategy

Delivery Strategy	Number of LDCs	Percent of LDCs
Service provider	45	77%
Contractor	6	10%
No contractor identified yet[11]	2	3%
Unknown	6	10%
Total	59	100%

As shown above in Table 15, most LDCs have chosen to hire service providers to assist with the delivery of the program. Some LDCs mentioned that they launched the program by engaging a single contractor, but as the program became more successful, the contractor could not keep up with the demand. Since then, one LDC has hired a service provider to help deliver the program and organize contractor work.

[11] As of July 8, 2009

Most service providers are for-profit companies, although two were non-profit organizations. Table 16 summarizes the nature of service provider core business operations.

Table 16: Service Provider Core Business

Core Business	Number
Consulting	4
Electrical Distributor	2
Non-profit	2
Total	8

In addition to service providers, a few contractor businesses are quite large, and have a significant number of licensed electricians in-house who are capable of completing installation work across multiple LDC territories. The service providers and larger contractor operations are found to mostly provide turn-key services for LDCs, from marketing and outreach to conducting assessments and installations to entering work order and quarterly reports into the Portal.

Since LDC service territories vary significantly in size, customer type, geography and location, the results of the process evaluation did not show a single best approach to delivering the program. While larger LDCs generally need a service provider to assist with the logistics of several hundred retrofits, some smaller LDCs have been successful by engaging a single contractor to complete all retrofits. As the program matures however, and LDCs need to meet increased installation targets, a single electrical contractor with only a few staff may not be able to keep up. Some larger contractor operations are available in the province, but these are not as common as the small time contractors. Many small LDCs have teamed up to cooperatively implement the program and this appears to be a good strategy.

One issue arose during the first year of the program involving select contractors being eligible to deliver the program. In some instances, local contractors were upset either because an outside contractor was operating in their area, or because other contractors were now working with some of “their” customers. There are complicated issues associated with whether to open the program to all local contractors. Logistically, an LDC (or their service provider) has to oversee the quality of the contractor work, and it is far easier to do so with a few known contractors.

Table 17 summarizes some of the pro's and con's of opening the program to all contractors compared with a select few.

Table 17: Comparison of Pro's and Con's to Allowing All Contractors to Participate

	Open the program to all contractors	Focus on a small group of contractors
Pro's	◦ Instills sense of fairness ◦ Allows customers to use "their" contractor ◦ Can leverage existing relationships with customers	◦ Easier to coordinate work and outreach to customers ◦ Reduces competition between participating contractors
Con's	◦ More difficult to overview and coordinate contractor work ◦ Time consuming to orient new contractors participating in program	◦ Exclusionary approach ◦ Increases competition with non-participating customers ◦ May irritate contractors who want to participate

For LDCs and service providers who choose to open the program to all contractors, it is worth noting that anecdotal evidence suggests that usually about 2-3 of the contractors ultimately end up completing the majority of retrofits. Other contractors who sign up to participate may only complete a few retrofits for the program. Yet, the identification of these few dedicated contractors is key to successfully meeting LDC targets.

As LDCs ramp up their operations to meet increased targets, more contractor manpower will be necessary to complete retrofits. For LDCs with more contractors wishing to join than they feel they can manage, they should consider having specific open periods (deadlines) for applying and communicate this to interested contractors. This means that LDCs can train multiple contractors at once, rather than on a rolling basis. Sometimes it becomes complicated when customers have a preference for their own contractor, and it may delay the measure installation for them to take the time to enroll. Whatever approach is adopted, it should be applied consistently to other contractors.

4.1.3 Organization of installation contractors in the field

This section examines issues related to energy assessor and installation contractor experiences implementing the program. KEMA conducted a number of interviews with installation

contractors whose primary responsibility is to complete the retrofits at customer sites. These contractors mention the following positive reasons for participating:

- Provides much needed work during a recession
- Exposes their firm to potential new customers
- Program improves the contractors' revenue stream

Most service providers handled the marketing and assessments in-house and subcontracted the installations to contractors. In some instances, contractors would perform the assessments as well, but this does not occur as often due concerns about the potential for fraud. A few LDCs with this model have their service provider conduct audits of contractor work.

In situations where a dedicated assessor conducts the energy audits, some contractors complained that the assessments were done poorly. One installation contractor said "We have to go over everything the (service provider) has given us because their assessments were poorly done." Sometimes, contractors discover on-site that the customer is not actually qualified because the job does not actually meet the $300 minimum or the site is not under 50 kW. One contractor expressed frustration that the service provider sends leads, of which about 15-20 percent are not actually eligible. They would like service providers to hire more qualified program recruiters that are more knowledgeable about lighting.

On the other hand, installation contractors also say that scheduling assessments is an onerous process, as the audits require extensive time and sometimes multiple visits before the customer would agree to have the retrofits completed. One contractor mentioned that they were only paid $30 for each energy assessment. Another mentioned "Doing the coordination to arrange an assessment with business owners is a time consuming and expensive endeavor." A third remarked that it "takes about 3 visits per business" to get to a confirmed retrofit.

A few contractors said they had performed the assessments in the beginning of the program, but no longer do this because compensation is poor, especially when customers choose not to participate. The majority of contractors that performed assessments, did so for businesses after receiving a referral from the service provider. Given the option, it appears that installation contractors prefer that service providers develop the leads, even though sometimes a customer turns out to be only mildly interested and does not end up agreeing to the retrofit.

Contractors mentioned that during the beginning of the program, they may have conducted some cold calls or referred existing customers to the program. After the program "got rolling,"

contractors found that it was easier to get leads from the service provider and not conduct the marketing themselves.

Anecdotal evidence from LDCs indicates that contractors often talk to customers with whom they have existing relationships and convince them to participate. Table 18 shows that program participants in smaller LDCs tend to be more likely to have worked with their SCDIP contractors previously.

Table 18: LDC size and contractor relationships[12]

Worked with Installer Previously?	Small LDCs	Medium LDCs	Large LDCs	Overall
Yes	15%*	10%	6%	10%
No	85%	90%	92%*	90%
Don't know	0%	0%	1%	0%
Refused	0%	0%	1%	0%
Total	100%	100%	100%	100%

* Difference between Large and Small LDCs is statistically significant

Overall, program participant satisfaction with the installation contractor is quite high, as shown below Table 19. Customers of small LDCs are more likely to be satisfied with their installation contractor than businesses in other LDCs. This may be partly due to the fact that businesses in smaller LDCs are more likely to have had an existing relationship with their installer.

Table 19: Participant Level of Satisfaction with Installer

Level of Satisfaction with Installer	Small LDCs	Medium LDCs	Large LDCs	Overall
5 - Very satisfied	89%*	82%	82%	84%
4 - Somewhat satisfied	10%	9%	13%	12%
3 - Neither dissatisfied nor satisfied	0%	2%	3%	2%
2 - Somewhat dissatisfied	1%	2%	1%	1%
1 - Very dissatisfied	0%	2%	1%	1%
Don't know	0%	1%	0%	0%
Total	100%	100%	100%	100%

* Difference between Small and Large LDCs is statistically significant

[12] Small LDCs are designated as less than 2500 <50kW customers, medium LDCs have between 2500 and 8000 <50 kW customers.and large LDCs have more than 8000 <50 kW customers. There were 33 small LDCs, 17 medium and 8 large LDCs.

One common reason given for dissatisfaction with the installer included messy operations where equipment was left sitting around. In another instance, there was a broken light bulb, and the business had concerns that this posed a safety hazard for patients who were in the office. Two participants mentioned that they were unhappy with the length of time required to have the retrofits completed.

Issues related to timing, however, appear to be relatively minor and affected only a small percentage of program participants. Table 20 shows that 41 percent of program participants had the installations completed within 1 week of the assessment, with 89 percent being completed within the month. No significant differences in timing were found between different LDC sizes.

Table 20: Typical Time-Lag between Assessment and Retrofit

Time Between Assessment and Installation Completion	Overall
One week	41%
Two weeks	26%
Three weeks	13%
Four weeks	9%
Eight weeks	4%
More than eight weeks	1%
Other	0%
Don't know	6%
Total	100%

For instances where the participant said the installation took more than a week, 79 percent of them still expressed a high degree of satisfaction with the installation time. Table 21 shows that only 2 percent said they were somewhat dissatisfied.

Table 21: Participant Level of Satisfaction with Installation Timing

Level of Satisfaction with Time – to – Installation	Overall
5 - Very satisfied	79%
4 - Somewhat satisfied	18%
3 - Neither dissatisfied nor satisfied	1%
2 - Somewhat dissatisfied	2%
1 - Very dissatisfied	0%
Don't know	0%
Total	100%

The main reasons for participant dissatisfaction (1 or 2) were related to lack of communication from contractors on when they would be completing the retrofits. One participant said the contractor estimated the project would take 2 days, but after they showed up one afternoon, they did not return for a week and there was no explanation provided. Another participant said the contractor asked them to sign off on the project when it had not yet been completed.

In the in-depth interviews, the majority of the participants spoke very highly of the assessors and the contractors/ installers. The only negative feedback given was of an assessor that was noticeably irritated when they were being directed back and forth between middle management and shop workers, unable to find someone who could make the final decision on the work order, but the participant acknowledged that it was a unique situation. Similarly, the only negative feedback given of an installation contractor was that they showed up an hour and half late for an appointment and interrupted the flow of work for that particular business. Otherwise, many people said that the installers were "quick, easy to deal with, and clean." During in-depth interviews with participants, there was no mention of being upset about the timing between assessment and installation.

4.1.4 Issues related to OPA reporting and payment

Feedback from LDCs and service providers indicates that the Portal is an extremely useful system where they can find the information they need. For example, one LDC mentioned that they could get information such as when there are updated materials. Another LDC appreciated that the revision date is included within the body of SCDIP documents that are circulated. The Portal and Tracking Database have also been recognized as tedious and difficult to use when entering a substantial number of work orders. In response to these concerns, the OPA program staff are developing an improved portal that would allow bulk uploads, based on electronic Excel file work orders.

As the OPA develops the revised work order, KEMA suggest that the following features be included:

- Drop-down boxes for appropriate business type
- Automated payback and cost information
- Formatted to print in an attractive manner
- Data validation features to improve quality control (e.g. quantity can only be entered as a number, phone numbers as 7 digits)

LDCs are paid their fixed funding on a quarterly basis, which is intended to pay for administrative and marketing expenses related to implementing the program. The variable funding paid out is based on the number of work orders submitted through the Portal.

The variable funding portion is meant to be paid to LDCs each month, but one LDC mentioned that it could take more than two months to be paid. This makes it challenging because LDCs must pay their service providers and electrical contractors on a timely basis, and waiting even one additional month for the funding is sometimes problematic, especially as it trickles down to contractors.

For example, one LDC said they had underestimated how popular this program would be, and they ended up having 50 customers choose to participate within a single month. If the contractors completed the installations for half of that amount within one month, the LDC would have to pay the contractor about $25,000. This is far more than the $6-7,000 fixed funding that LDCs receive a month. Since installation contractors are also "cash-flow sensitive" operations and need to procure supplies and pay employees from their own cash reserves, timely payments can be critical to their participation in the program. The cash-flow issue, however, is mostly a problem for smaller LDCs, and larger LDCs interviewed did not appear to have these concerns.

Another issue that was raised is related to payments done through direct deposit to LDC bank accounts. When LDCs participate in multiple OPA programs, the full amount being paid to them is a summation of quarterly payments, monthly payments and other bonuses. When the sum is deposited, some LDCs need more information on how OPA calculates the total so they could appropriate the funds correctly. It was suggested that an accompanying explanatory document be provided with each payment.

4.1.5 Defining customer eligibility for the SCDIP

During the 2008 program, customer eligibility wording in program documentation suggested that businesses were eligible for $1000 in free retrofit per LDC account number. However, this meant that businesses with multiple electricity account numbers (<50 kW) were eligible for multiple projects resulting in thousands of dollars in free retrofits. For the 2009 program year, eligibility requirements have been revised to only pay one retrofit incentive of $1000 per business address that is separately metered. Hopefully this will prevent abuse of the program, and restrict the number of retrofit payments for a single business located at a site with multiple account numbers. Eligibility requirements should continue to be a research issue in future evaluations of the SCDI program.

Part of the difficulty in specifying customer eligibility is the complicated nature by which an entity may have numerous account numbers within a single facility or across multiple facilities. For leased facilities, the number of accounts and meters may not often align with the number and location of tenants in the building.

When eligibility is confusing, this is especially problematic for those trying to recruit customers to the program. Even in the list of non-participating business that KEMA received from service providers and LDCs, there were a number of businesses who indicated that they had already participated in the program. Some of this could be attributed to customers who have multiple electrical accounts, as at least two of the six non-participants interviewed had more than one meter. The non-participant tracking database did not indicate that the customer had multiple account numbers. Maintaining centralized customer contact records for each LDC territory with clear codes for multiple accounts is also essential for ensuring that multiple contractors do not try to sell the program to the same customer.

4.1.6 Proper disposal of baseline equipment

In-depth interviews indicated that LDCs, contractors and program participants all have concerns about the proper disposal of old materials. This is another first year challenge for launching the program; to develop processes to properly dispose of old ballasts that potentially contain polychlorinated biphenyls (PCBs). PCBs have long been used in the manufacturing of fluorescent lamp ballasts and are now being phased out according to the Canadian Environmental Protection Act of 1999[13]. Exposure to PCBs, which range in consistency from heavy oil liquids to waxy solids, can cause skin illness, nausea, dizziness, eye irritation and bronchitis.

One service provider mentioned that they realized during the first program year that a "huge amount" of old ballasts with PCBs were simply being thrown away. Due to regulations regarding the transport of PCBs, some larger contractors can sometimes find appropriate storage locations for the ballasts, but smaller contractors may need a designated central location to drop off the equipment.

Due to the popularity of the program, some LDCs have found it challenging to find qualified professional organizations to dispose of the lamps. One LDC mentioned that they utilized some of the OPA funding to assist contractors with the proper disposal of the lamps. They indicated

[13] Environment Canada. CEPA Environmental Registry website. http://www.ec.gc.ca/ceparegistry/regulations/detailReg.cfm?intReg=105

that they considered this to be a goodwill gesture to thank contractors and maintain a positive relationship.

OPA and LDCs should emphasize the importance of proper disposal to contractors participating in the program. Old equipment must not be left at customer sites. The SCDI program may consider requiring environmental certificates from contractors to ensure that ballasts and lamps are properly disposed. OPA should also consider working with LDCs and contractors to develop solutions that are cost effective for the program. Guidelines could be developed to ensure that all PCB ballasts are sent to a recycling center that knows how to properly dispose of them.

Customers who receive CFLs should also be advised on how and where to dispose of them when they burn out, since CFLs contain a small amount of mercury. In addition to giving customers information on where they recycle their lamps, the OPA could potentially work with disposal companies and big box retailers to promote CFL recycle days, along with its other conservation awareness initiatives.

4.1.7 Ongoing communications between OPA and LDCs

Overall, LDCs and market actors express a high level of satisfaction with the SCDI program. Understandably, there was some frustration with how long it took to get the program off the ground in many jurisdictions, but once processes were in place, most LDCs and market actors appeared quite happy. Table 22 summarizes some of the feedback on the program, from KEMA's interviews.

Table 22: Summary of Positive Comments from LDCs and Market Actors

LDCs	▪ "It's a great program." ▪ "Most LDCs think the OPA is the best thing since sliced bread." ▪ "Relative to the other OPA programs, this is the best program that OPA offers. Customers love the program."
Service providers	▪ "Leveraging this program to create good will with LDC has been great." ▪ "This has been the richest program from the customer's point of view. It's great that it's targeted at small businesses, which is traditionally underserved." ▪ "Overall, [program is] well designed."
Installation contractors	▪ "Best program the government has put on." ▪ "It's a beautiful gesture by the LDCs and overall, people are really happy with it." ▪ "It's a great way to educate people on the energy savings options available to them. Encourages them to 'go green' and provides them the opportunity to do so."

During the first year of the program, LDCs and market actors frequently had questions and issues that arose. For instance, there are technical questions from time to time, such as whether a product was meeting the intent of the program. One LDC mentioned that they were not informed when the program staff changed and it was very confusing to be receiving emails from an unknown person. KEMA recommends that a regular OPA SCDIP newsletter or bulletin be distributed to LDCs to share information and answers to frequently asked questions. This would help to raise the knowledge level of all participating LDCs and can be used to inform LDCs of any staffing changes for the program.

Feedback from LDCs indicates that the SCDIP Forum meeting held in February 2009 was extremely successful. The OPA hosted a half day workshop and LDCs found it to be invaluable for program managers to connect and bond. It was an excellent opportunity to share experiences to date, lessons learned, and to simply know that others are encountering the same challenges. The LDCs and service providers who attended felt it fostered a sense of working together to improve the program. The OPA should continue to periodically host these meetings, perhaps on an annual basis.

4.2 Relative Impact of Communication and Marketing

In this section, we focus on how LDCs are reaching customers and businesses in the field. We study effective marketing messages and how outreach to the targeted population can be improved. Table 23 provides a summary of the business types as self-identified in the CATI survey of program participants. While large LDCs are more likely to engage warehouses, overall the majority of program participants are comprised of retail and service operations.

Table 23: 2008 SCDIP Participant Business Type

Business Type (from CATI)	Small LDCs	Medium LDCs	Large LDCs	Overall
Retail store or Service business (i.e. Hair Salon, Laundromat)	60%	63%	44%	53%
Offices	21%	19%	26%	23%
Warehouse	2%	3%	10%*	6%
Manufacturing/Industry	3%	3%	6%	5%
Hospital or Nursing Home	2%	5%	2%	3%
Multi Unit Residential Building (Apartments, Condos, etc.)	1%	0%	3%	2%
School	1%	1%	3%	2%
Grocery or Convenience Store	2%	1%	1%	2%
Restaurant	0%	0%	1%	0%
Hotel or Motel	0%	0%	0%	0%
Don't Know	0%	0%	1%	1%
Other	6%	3%	2%	3%
Total	100%	100%	100%	100%

4.2.1 What motivates customers to participate

It is clear that the majority of the participants were motivated to be a part of the program due to the financial benefits. Of the 20 in-depth interviews with program participants, sixteen stated that they chose to be a part of the program because the new equipment would decrease their energy usage and utility costs. Thirteen stated specifically that they decided to take a part of the program because they did not have to spend any money.

Table 24 shows the results of the CATI survey, which support the findings of the in-depth interviews. A significant portion was also motivated by the fact that a rebate was being offered by their utility. One business mentioned they were motivated to participate in the program because it was supported by the Ontario Power Authority.

Table 24: What Motivated Your Business to Participate in the PSB program?

Motivation for Participation	Overall
Saving money on energy bills	69%
To use less energy	41%
Obtaining a rebate	17%
Helping protect the environment	9%
Free, no cost	7%
Replacing old or broken equipment	7%
Acquiring the latest technology	6%
Higher quality of lighting	4%
Recommended by contractors	1%
Ease of participation	1%
Because the program was sponsored by a utility	1%
Recommended by utility	0%
Other	4%
Don't Know	2%
Refused	0%

Note: Multiple responses accepted, total may exceed 100%

Some program participants also mentioned that they were excited to receive the newer lighting technology that promised longer life, more pleasing color temperature, and brighter light compared to their existing equipment. Most of the participants who said that they were excited about the newer lighting technology also mentioned that they were interested in becoming more "green" by consuming less energy. One of the contacts was a building manager and they stated that they were most excited about the prospect of not having to change the light bulbs in the exit signs on the apartment complex that they managed, which was one of their most time intensive bi-annual tasks.

Table 25 below shows that despite the common barrier that renters who may not pay their utility bills have less of an incentive to improve energy efficiency in their facility, well over half of program participants lease their space. This shows that the program is effectively reaching many small businesses that lease their space and can benefit from energy efficiency upgrades. It is unclear, however, what portion of these renters also pay their own utility bill.

Table 25: Proportion of Participants Who Lease or Own their Facility

Own vs. Lease	Overall
Lease	61%
Own	36%
Other	1%
Don't know	1%
Refused	1%
Total	100%

Overall, however, program participants express a high level of satisfaction with the program, as shown below in Table 26.

Table 26: Participant Satisfaction with SCDI Program

Level of Satisfaction with overall PSB experience?	Overall
5 - Very satisfied	72%
4 - Somewhat satisfied	16%
3 - Neither dissatisfied nor satisfied	3%
2 - Somewhat dissatisfied	1%
1 - Very dissatisfied	0%
Don't Know	8%
Refused	1%
Total	100%

Of the participants who expressed dissatisfaction (1 or 2) with the program, most of the reasons were related to finding that there was no impact on their utility bill. One participant was told that the program would lead to a decrease in their energy bill, when in fact the company's electric bill has recently increased. While this is not likely a result of the program, it underscores the importance of not overselling program benefits.

4.2.2 Reasons for non-participation

In this section we explore reasons for non-participation. A database of contact information for non-participating businesses was provided to KEMA from several service providers. In identifying non-participants to survey, KEMA removed all that were labeled "not eligible" or "did not meet $300 minimum" in order to target those who voluntarily chose not to participate in the

program. When surveyed, approximately 60 percent of non-participating businesses said that they did not recall ever hearing about the program. This highlights the challenges of program marketing efforts to capture the attention of the target market.

Of the businesses who remembered being contacted about the program, approximately 30 percent had an energy assessment conducted at their business. Table 27 examines the reasons why businesses did not have an energy assessment completed. The most common reason given by respondents turned out to be "don't know," followed by businesses who did not believe it would be worth the effort.

Table 27: Reasons Why Energy Assessments Were Not Conducted

Why was an energy assessment not done?	Overall
Was not worth it/Business did not need it	24%
Opportunity was not provided	18%
Too difficult to schedule	6%
Determined not eligible	5%
Would be disruptive to business operations	4%
Did not believe the program was true	1%
Other	7%
Don't know	34%
Total	100%

For businesses that did not believe the energy assessment was needed, a commonly cited reason was that the facility was relatively new, or lighting and HVAC equipment was recently replaced. Some businesses also indicated that energy costs were a small part of overall operating costs, and did not think it was worth it. One said, "We're a very small business. We don't have lights on much, so I don't think I need it." Another non-participant said, "I'm only planning to lease this building for another year, so any improvements would benefit the next occupant. I'm not interested in getting involved with the process."

For non-participating businesses who had an assessment completed (approximately 12 percent of businesses in the non-participant population), we also examine reasons why retrofits were not installed. Table 28 below shows the responses from the CATI survey. The most commonly cited reason was that no opportunities were identified, and likely the project would not have met the program minimum requirement of $300 project cost. Thirteen percent of businesses were also determined to be ineligible for the program.

Table 28: Non-Participant Reasons for Not Having Retrofits Installed

Why were upgrades not installed?	Overall
No opportunities identified	22%
Too expensive, did not have money	14%
Was not eligible to participate	13%
Program representative did not follow up	8%
Too difficult to schedule	5%
Did not believe the program was true	4%
Did not understand the program	3%
Other	9%
Don't know	17%
Refused	5%
Total	100%

Interestingly, 14 percent of businesses who had an assessment done said they did not complete the upgrades because it would have been too expensive. This is of note, because the program offers $1000 of free incentives, so either the business did not understand the program, or there were other costs involved with the retrofit not covered by the program. One business said they did not have the retrofit completed because there would not be a consistent change in the store, with only a portion of lights being retrofitted, and they did not want to pay to have the entire store done. Anecdotal evidence from contractors also indicates that some businesses may have old wiring that is unsafe or inadequate, and participation in the program would require expenditures to bring the wiring to code before retrofits can be completed.

The vast majority of qualified businesses engaged by service providers and their contractors do appear to end up having their equipment retrofitted. Only a small percent of businesses did not participate because they did not understand the program or because they did not believe it was true. Concerns that businesses would think the program was a scam did not turn out to be a significant reason for non-participation. Most of the reasons for non-participation turned out to be location-specific barriers or businesses who simply did not want to be bothered. Businesses were asked what would have helped motivate them to have the energy efficiency measures installed. The following are some notable responses:

- "The fact that we wouldn't be able to hire our own contractor and use our own products killed the feasibility of participating. We could save more using our own contractor and products than going through the PSB program."
- "Just timing. If I would have been here, I would have done it."

- "We still have a lot of the old fluorescent lights and if they aren't going to [manufacture] them anymore, that would motivate us to change."

The comment highlights that some businesses do prefer their own contractors and the SCDIP should consider procedures to have an open process for allowing other local contractors to participate. Consistent and varied marketing is also an importance tactic for marketing the program and engaging small businesses. Regardless, some participants simply may not want to be bothered with the logistics of the program.

In the following sections we further explore effective approaches to marketing and engaging the attention of decision-makers within the target market to increase program participation.

4.2.3 Different marketing approaches, what works and what doesn't.

LDCs and their service providers are employing a wide range of channels for reaching the small business segment. A common approach is to initiate contact through direct mail, including bill inserts, brochures, and letters from the local reputable organizations (such as business improvement areas (BIAs), chambers of commerce and mayor's office). Other marketing efforts include newspaper advertisements and articles in monthly BIA and Chamber of Commerce newsletters. Several LDCs are also employing telemarketing approaches to engage customers.

Table 29 shows that the marketing approach with the greatest impact is face-to-face contact. The vast majority of participants mentioned that they recall first learning about the program through a door-to-door solicitation.

Table 29: How Participants Recall Hearing about the SCDIP

How business heard about program	Overall
Door-to-door solicitation by contractor or salesperson	43%
Received letter in the mail	23%
Word-of-mouth from friend or co-workers	16%
Phone call, directly contacted	8%
Bill insert	7%
Newspaper, radio, advertising	5%
Informed by contractor	4%
Respondent called their utility to complain about their electric bill	3%
[LDC] website	2%
Internet, email	2%
Attended event/presentation/meeting	2%
Community organization such as Chamber of Commerce	1%
Other	0%
Don't know/Refused	3%

Note: Multiple responses accepted, total may exceed 100%

Although customers most easily recall door-to-door solicitation, the importance of the other channels for marketing should not be underestimated. It is important to build credibility before the assessor or contractor arrives on-site. The brochures, letters of endorsement and phone calls all serve to improve the sense of legitimacy associated with door-to-door SCDIP representatives.

There is no consensus among LDCs as to the most effective approach for engaging customers. Some smaller LDCs mentioned that they were pleasantly surprised by the response to their direct mail efforts, and that no follow-up door-to-door solicitation was required. Another group of LDCs were said they did not get much response direct mail campaign, and found it to be extremely effective to put together a call center to recruit customers.

During the in-depth interviews, there was no negative feedback from program participants when discussing marketing approach. The participants who received the letter in the mail mentioned that they made the phone call to the utility and soon thereafter had an assessment completed to

identify appropriate measures. The participants who experienced walk-in salespeople found them to be non-intrusive and informative. One participant found out about the program through a local business seminar which they found to be particularly informative. One participant discovered the program through an ad in the local newspaper.

Reaching the decision-maker can be the most significant challenge to successfully engaging small business facilities that are eligible for the program measures. Businesses often have "gate keepers" who are people that conclude that the program is not of interest because they assume it is another attempt to sell something to them. As a result, the information is never presented to the decision-maker (e.g. owner or manager). People are frequently put off by a sales approach and will dismiss the program offer before reviewing the material.

To address this, service providers recommend targeting landlords and suggest that OPA engage some of the chain account companies with multiple locations across LDC territories. OPA could identify these head office contacts and proactively market retrofits for all stores in their real estate portfolio. One service provider mentioned that when they were able to get to the "head office," they completed 50 stores for one convenience store chain. Market actors also emphasize the importance of qualified salespeople who are persistent and effective to make a sale. One service provider instructs assessors to reach out to each business at least 3 times.

Non-participating businesses were asked what was the best way to provide them with energy efficiency information. Table 30 shows that the majority would prefer to be contacted through the mail, followed by email.

Table 30: Non-participant Feedback on Best Way to Receive Energy Efficiency Information

Best way to provide information on EE	Overall
Information from utility received through the mail	65%
An email from gas or electric utility	25%
A representative of the gas or electric utility	18%
Television or radio advertisements	11%
Advertisements in a newspaper or trade journal	8%
Electric utility website	5%
Phone Call	4%
An event, such as a business forum or trade meeting	4%
Personal face-to-face visit	2%
A contractor	1%
Fax	1%
A local government or non-profit agency in the community	0%
Other	2%
Don't know	3%
Total	151%

Note: Multiple responses accepted, total may exceed 100%

At the moment, little email communication is being utilized by LDCs and service providers to engage customers. This is a channel which LDCs may consider utilizing more in the future to communicate with customers. There are strategies to more effectively use email in a way that does not seem like "spam," such as restricting the frequency of contact and allowing customers to opt-out of email newsletters.

Since 2008 was the first year of the program, just "getting the word out" was the most significant challenge and this is expected to become easier as the program matures. Review of the non-participant contact information provided to KEMA indicated that some LDCs did a better job of tracking the calls and contact attempts to non-participants than others. Information such as name and or date of contact would be useful fields to track. Effective program marketing requires that LDCs and their service providers track non-participant information to ensure that contact attempts are well-coordinated, that participating businesses are not approached again,

and to enable follow-up with customers who have not yet responded. OPA may wish to consider developing a standard set of codes for reasons of non-participation to track this consistently across LDC territories.

As LDCs were successful in reaching the target market utilizing varied approaches to program delivery, we cannot conclude one specific method as being less effective than another. Similar direct install programs in North America have found that until the program is well known among the "hard to reach" small business sector, the "feet on the street" (i.e. door-to-door solicitation) can be an effective way to implement the program[14]. Service providers note, however, that "feet on the street" can be quite costly as a marketing approach, compared with call centers and direct mail. As the program matures, increased word-of-mouth and general customer awareness means that the "feet on the street" approach may not need to be such a large component to implementation.

4.2.4 Effectiveness of marketing collateral and messaging

The principal marketing collateral provided by the OPA to LDCs included a brochure, a letter and a call script for phone recruiting. LDCs and service providers have also developed additional marketing materials, including window clings, letters of endorsement, customer testimonials, newspaper ads[15] and sandwich boards (that advertise when a business is "going green" and being retrofitted).

[14] RLW Analytics, Inc. Small Business Energy Alliance Energy Savers Program Final Report 2002-2003

[15] One small LDC is planning to run a newspaper ad, with a photo of the contractor hired to recruit customers and perform installations.

Table 31 shows that most participants were very satisfied with the information. For businesses who were not satisfied (1 or 2), several mentioned that they did not receive any information in writing. Another mentioned that the verbal presentation was not clear regarding what the business needed to do, and would have preferred a letter from the LDC informing them that they would be contacted. One business mentioned that they were dissatisfied because the program promised savings and they did not see an impact on their utility bill.

Table 31: Participant Level of Satisfaction with Program Information

Level of Satisfaction with Program Information	Overall
5 - Very satisfied	77%
4 - Somewhat satisfied	18%
3 - Neither dissatisfied nor satisfied	2%
2 - Somewhat dissatisfied	1%
1 - Very dissatisfied	0%
Don't know	1%
Refused	0%
Total	100%

Contractors should be careful when explaining energy savings to customers and caveat that estimates may not be applicable to all situations. Actual savings may vary. Additionally, the savings estimates provided are annual estimates, which may not be readily apparent on a monthly bill (e.g. if their bill increases from September to October, it may be due to colder weather and shorter days and not related to the efficiency installation.) Furthermore, with any rate increases, this makes it difficult for customers to see the cost benefits of efficiency upgrades.

In terms of the marketing collateral provided by OPA, one service provider mentioned that they thought the existing brochure was too wordy. Another suggested that program contact information should be included on the front page of the brochure, with phone number and website information posted prominently. The marketing brochure should clearly emphasize the environmental benefits of the program.

One idea suggested by an LDC is to create an 11 x 17 inch document with a program description cover, including the work order with the payback calculation included in the work order. This hard-copy work order format should be consistent with the Excel-based work order. Alternatively, a promotional SCDIP cover sheet could be developed to be enclosed with the work order that includes information on the program benefits to the customer.

OPA has developed a website for the public that contains information related to the SCDI program. A search for "Power Savings Blitz" brings up a website hosted by a service provider, rather than the official OPA Power Savings Blitz website. OPA may wish to increase the visibility of its official website, as the website hosted by the service provider only gives information related to the LDCs it is serving.

4.3 Incentive Structures

Part of the OPA SCDIP objectives are to meet program targets (# of retrofits total) and encourage program participants to invest in energy efficiency upgrades beyond the $1000 incentive. LDCs suggest they do not have much incentive (only $50 per additional work order) to continue to market the program once they have achieved their program targets. Although LDCs are provided a fixed funding plus variable funding to support each work order completed, some LDCs indicate that the variable funding is not enough to support the continued marketing efforts.

LDCs state that they are motivated to meet targets simply because they want to feel successful in the program. Similarly, most service providers mentioned that they did not have any financial incentives to assist LDCs to exceed their targets, but they obviously want to do a good job so that their contracts are renewed. One service provider said they did get a bonus from some LDCs, where for any installation over the LDC target they get a percentage of the $50 bonus being paid by the OPA. In fact, one service provider mentioned that a few LDCs (particularly smaller LDCs) were quite reluctant to go beyond the target number of projects. It is unclear what the reasons are for this.

Interviews with LDCs and service providers indicate that there is some inherent tension between an LDC's target and the program goals to increase the number of retrofits going over $1000. For example, one LDC mentioned that they felt that customers who "go beyond the $1000" can tie up the crew that is supposed to be completing retrofits for the OPA program. This LDC said that they informed the contractor that the program funded retrofits should be completed immediately, and if the customer wishes to have additional fixtures installed, then the contractor should come back later to do so.

A number of businesses indicate that they are interested in projects above the incentive level. Table 32 below illustrates that about 40 percent of businesses were interested in the additional measures above the $1000 threshold.

Table 32: Small Business Interest in Projects above the Incentive Level

Interested in additional measures? (of those <$1000 projects)	Overall
Yes	40%
No	51%
Don't know	9%
Total	100%

Approximately half of the program participants mentioned that the energy assessment identified measures above the program incentive limit, as shown below in Table 33. For comparison purposes, approximately 30 percent of program participants ultimately invested their own money, as their project went beyond the $1,000 funding threshold.

Table 33: Whether Energy Assessment Identified Measures Above $1000

Did the Energy Assessment Identify Measures to Install that Went Above the $1,000 Threshold?	Overall
Yes	50%
No	46%
Don't know	4%
Refused	1%
Total	100%

Table 34 below examines the reasons given by customers who answered that they were interested in projects above the $1000 threshold, but who did not go on to complete the additional retrofits. Not surprisingly, the most common reason by far was simply lack of money to invest in the upgrades. Other reasons given include issues of leased space, lack of need for new lighting in storage areas and some who just wanted to try the free portion of the program first to ensure that it was legitimate.

Table 34: Reasons for Not Exceeding the $1,000 Threshold, Despite Additional Measures Being Identified

Why Didn't You Invest in These Measures Above $1,000?	Overall
Didn't have the money	57%
Non-primary, not necessary	12%
Wasn't sure if the measures would save money	11%
Didn't understand the technologies being recommended	7%
Wasn't sure if the program was for real (if contractor was legitimate)	4%
Timing	3%
Other	11%
Don't Know	2%
Total	100%

According to contractors, the margins for retrofits are low, especially for contractors who have to sell the program. Some contractors mention that they have reduced their prices in order to participate in this program, but this can also a selling point to customers who are contemplating additional fixtures beyond the incentive cap. Contractors can tell them "you won't see prices this low again."

For the most part, contractors are not being "enabled" to promote above $1000. One service provider, however, indicated that they are paying their contractors an amount proportional to the total project cost, rather than a fixed payment per project, to encourage projects above the threshold. This service provider was motivated to do so because they understood the market transformation goals of the program. OPA may consider restructuring the funding to LDCs with a portion based on LDCs submitting work orders above the $1000 threshold, to promote this program goal.

4.4 Suitability of Current Set of Measures

In this section KEMA reviews the current set of measures, focusing on the 2009 program year measures that are now offered as part of the SCDI program. Table 35 below provides a summary of the 2008 measure categories and the average price list cost per program weighted kWh and kW saved. Most of the prices on the measure list remain unchanged for 2009.

Table 35: Comparison of Price List Cost to Gross Program kWh and kW Savings

2008 Program Measures	Cost / Annual kWh	Cost / kW
T8 Fixtures	$ 0.47	$ 3,482.73
LED Exit Signs	$ 0.26	$ 1,883.88
CFLs	$ 0.10	$ 759.17
Halogens	$ 0.23	$ 1,718.17
Tank Wrap	$ 0.09	$ 860.72
Pipe Wrap	$ 0.05	$ 507.11
Low Flow Faucet Aerators	$ 0.08	$ 708.14

The water heater measures are the most cost-effective for the 2008 SCDI program from an OPA perspective, but they comprised a very small portion of the program savings. This is probably because the program is heavily weighted towards lighting contractors, and the cost analysis above does not factor in how cost-effective the measures are for the contractors to install. Commercial facilities are also likely to only have one (or very few) water heaters, and low numbers of faucets, compared to the number of available lighting fixtures.

4.4.1 Appropriateness of 2009 retrofit measures on the list

Through interviews with LDCs, service providers, installation contractors, and program participants, KEMA collected feedback on the retrofit measures previously offered as part of the 2008 SCDI program price list. Recognizing that the 2009 SCDI program is well underway, KEMA has focused its assessment on the current price list in effect. The results of our research show that OPA has already been responsive to feedback from market actors in the field. One example is that 8 foot T8 fluorescent fixtures were added to the 2009 price list.

4.4.1.1 Lighting Measures

Some customers had complaints about the installed equipment. One participant complained that the CFLs were too bright for the location, and they had replaced the CFLs with the older type of

incandescent bulbs that were installed before. Another site did not like the color of light coming from the newer T8 equipment and the contractor came by and installed different fluorescent tubes. It is unclear if the replacement tubes were from the old equipment (T12s), or if they were T8's with different color temperatures.

One LDC mentioned that they had concerns about the quality of CFLs, and that it is difficult to find CFLs with good color-rendering index, instant on-off, small footprint and adequate lumens. This LDC indicated that they were planning to provide specifications for lamps to ensure the quality of CFLs. The price list does require ENERGY STAR labeled CFLs, but it is unclear the degree to which contractors are following this specification. There are ENERGY STAR qualifying lamp lists which could be provided to contractors, if not already being done. Instituting post-installation inspections could help ensure that high quality CFLs are being installed.

Two of the metal halide measures involve the replacement of a metal halide lamp with a lower wattage metal halide lamp. The measure description specifies that this is for a direct lamp replacement. This replacement is typically not included in direct install programs because it is not an efficiency improvement measure, but a lighting reduction measure. While using a lower wattage metal halide lamp will reduce the fixture power, it may introduce unsatisfactory light levels over the lifetime of the lamp. Color temperature and lumens degrade over the lifetime of metal halide lamps. Replacing existing, degraded metal halide with a new, lower wattage lamp may maintain or improve light levels at the time of installation. However, as the new lamp degrades, lighting levels may fall below the initial lighting levels. As the reduced wattage lamps fail, they may be replaced by lamps that have the original, higher wattage.

The OPA may wish to consider including measures which replacing metal halide lamps with lower wattage, pulse start metal halide fixtures which can result in higher energy savings, and avoid problems with reduced light levels over the lamp lifetime. Pulse start metal halide lamps produce more mean lumens per watt compared to standard probe start metal halide lamps. They also have higher maintained light levels over the lifetime of the lamp. By retrofitting fixtures for pulse start lamps, failed lamps will be replaced with pulse start lamps.

Several measures involve the installation of standard halogen lamps and halogen infrared (IR) lamps. Installing lower standard wattage halogen lamps and lower wattage higher efficiency IR halogen lamps will save energy. However, typically halogen lamps are not included in direct install programs, as they are at risk of low measure retention. Also, the replacement of standard halogen to lower wattage, standard halogen lamps is a lighting reduction, and not an efficiency improvement. Replacement of standard incandescent or standard halogen lamps with IR

halogen lamps is only a marginal efficiency improvement. While halogen lamps have a longer life than standard incandescent, they still have a relatively short lamp life. Halogen lamps' published lamp life can be severely reduced if the supplied voltage is slightly higher than the designed voltage conditions. Due to the short lamp life, there is no guarantee that failed halogen lamps will be replaced with the same lamps. In many cases, replacements for the original lamps are in storage, and may be installed as the retrofitted lamps fail. Therefore, it is recommended that OPA discontinue all measures that include installation of halogen lamps.

4.4.1.2 Water Heater Insulation Jackets

Water heater insulation jacket savings are difficult to determine. The effectiveness of this measure is determined by baseline insulation levels. The M&A document suggests that water heaters will have no or minimal built-in insulation. This assumption is appropriate for older water heaters.[16] However, models available on the market have higher insulation levels. Water heaters manufactured after September 1, 2004 in Canada have strict insulation requirements[17]. There is little or no benefit of insulation jackets installed on water heater tanks with higher insulation levels.

Electricity and demand savings are only claimed for electric water heaters. According to CATI survey findings, 33% of water heaters that were involved with at least one water heating measure may have been fueled by natural gas. Contractors may not be properly accounting for water heater fuel type when identifying eligible measures. Based on limited savings for this measure as older models are removed, and a significant portion of water heaters being natural gas, it is recommended that this measure be discontinued.

4.4.2 Assessment of other potential measures for the SCDIP

Several measures were identified and recommended for consideration of future program cycles.

[16] 2004 Database for Energy Efficiency Resources (DEER) Update Study Final Report, Submitted by Itron, October 2004. According to this report, tank wraps are "only appropriate for older less insulated tanks and not the newer, more efficient models that have been mandated since the early 1990s. Most of the older tanks have been removed and therefore, this measure has been dropped from the DEER database.

[17] Canada Gazette Part II, electric storage water heater minimum efficiency requirements are defined by maximum standby losses. The maximum standby losses of a 40 gallon tank are 65 Watts. Assuming standby losses occur 8,760 hours per year, maximum standby losses are 572 kWh/yr. Therefore, minimal savings are achieved by adding insulation jackets to water heaters manufactured after September 1, 2004. An excerpt summarizing these regulations can be found at: http://oee.nrcan.gc.ca/regulations/water-heaters-sept-2004.cfm?attr=24.

4.4.2.1 Lighting Measures

High intensity discharger lighting (HID) such as metal halide, mercury vapor, or high pressure sodium fixtures can be replaced with high output T5 fixtures. Currently, two measures included in the program involve the replacement of metal halide fixtures to high output T8 fixtures. T5 fixtures would also make a good candidate for these fixture replacements, resulting in higher energy savings. A standard 250 watt metal halide could be replaced with a 3 lamp, high output T5 fixture. A standard 400 watt metal halide could be replaced with a 4 or 6 lamp, high output T5 fixture.

Occupancy sensor controls for lighting systems can reduce lighting usage when spaces are unoccupied. Small commercial businesses have significant opportunities for this measure.

4.4.2.2 Refrigeration

Several commercial refrigeration measures are available for coolers and freezers. Commercial refrigeration is generally found in grocery stores and warehouses. The OPA Measures & Assumptions documentation has savings methodologies developed for several of the measures listed below. It is unclear whether these measures are already being offered by another OPA program or not. These measures include:

- Strip curtains can be used to reduce infiltration in refrigeration storage areas. For convenience, doors are often left open while products are moved or for extended periods of time. Strip curtains reduce infiltration during these periods. Therefore, moisture and heat gain in the refrigerated space is minimized, reducing refrigeration loads.
- Night covers can be installed on open display cases to reduce refrigeration loads when businesses are closed.
- Damaged door gaskets allow air infiltration. By replacing damaged door gasket refrigeration loads can be reduced.
- Walk-in freezer doors may remain slightly open if not fully closed. By using automatic door closers, doors close firmly when they are nearly closed, ensuring that the door will not remain open slightly and allow air infiltration.
- Anti-sweat heater controls adjust anti-sweat heater usage based on needs. These controls are based on inputs from either humidity levels outside the case, or level of condensation inside the display case.

- If evaporation fans operate continuously at full speeds, evaporator fan controls can be installed to reduce the evaporate fan airflow when there is no refrigerant flow.
- Refrigerated vending machine controls turn off lighting and powers down the machine when the surrounding area is vacant. (The cooling system is often re-powered at one- to three-hour intervals.) Passive inferred occupancy sensors are used to determine occupancy.

4.4.2.3 Reviewed but Not Recommended

Several other measures were reviewed, but are not recommended at this time. There are several possible reasons measures are not recommended for consideration, such as:

- Level of technical expertise required by contractors and assessors
- High equipment costs, labor costs
- Questionable energy savings. Direct install programs may be reporting poor performance and low gross energy savings.

These measures include programmable thermostat, T12 lamps with magnetic ballasts to T5 lamps with electronic ballasts, air conditioning equipment retrofits, electronically commutated motor (ECM) for reach in refrigerated cases, and refrigeration evaporator fan motor retrofits.

5. Evaluation Measurement & Verification (EM&V) Approach

This section details the EM&V approach and data collection activities completed for this project. KEMA is following the EM&V requirements as outlined in the EM&V Framework for Ontario Power Authority Conservation Programs and OPA Evaluation Protocols documents, to undertake rigorous independent evaluations of OPA-funded programs, in accordance with internationally credible standards.

Table 36 presents a summary of the data collection activities, describing the number of computer aided telephone interview (CATI) surveys and in-depth interviews completed for each targeted population. Additionally, KEMA attended the February 2009 workshop organized for LDCs to provide feedback on the program.

Table 36: Overview of Data Collection Activities

	# of CATI	# of in-depth interviews	Identified population size
OPA program staff		2	3
LDCs		10	58
Market actors		10 service providers 11 installers	Unknown
Participants	401	20	9,918[18]
Non-participants	255	20	2,592[19]
SCDIP LDC workshop observation	n/a	n/a	1

5.1 Interviews with Program Staff and LDCs

The implementation structure for the OPA SCDI program consists of a program manager at OPA who oversees the 59 participating LDCs. KEMA conducted preliminary in-depth interviews with two OPA program staff, including the original 2008 SCDI Program Analyst,[20] as well as the

[18] When SCDIP participant data was downloaded from the Tracking Database on April 20, 2009.
[19] A total of 4721 non-participant entries were provided to KEMA, however, the list was cleaned of businesses who were deemed "ineligible" for the program and for duplicate phone numbers.
[20] In early February 2008, towards the end of the 2008 program year, internal OPA staff were allowed to rotate positions. Thus, the original program analyst transitioned to oversee a different program and a new OPA staff

Conservation and Sector Development Manager, to better understand the program and identify appropriate research issues associated with the evaluation objectives.

KEMA conducted interviews with 10 participating LDCs. A number of LDCs (mostly smaller ones) have chosen to partner together to deliver the SCDI program. These partnerships are sometimes formal organizations (such as the Cornerstone Hydro Electric Concepts Association, a.k.a. CHEC), with others working together as a consortium, and another set of LDCs using a single LDC to administer the program on a fee-for-service arrangement.

KEMA interviewed a range of LDCs encompassing the following attributes:

- Interview some LDCs who have projects listed in the Tracking Database, and some who have no projects entered in the Tracking Database
- Interview some LDCs who have contracted with a service provider, and some who have directly engaged electrical contractors themselves
- Interview some LDCs who only recently signed up in December, and some LDCs who signed up earlier in July or August 2008
- Interview some large LDCs, and some small LDCs

5.2 Interviews with Service Providers and Contractors

KEMA also conducted 21 in-depth interviews with two types of market actors: service providers and contractors. For the purposes of this report, "service providers" are defined as intermediary companies who engage and organize the activities of multiple electrical contractors from different companies. Service providers are also known as "delivery agents" and can be thought of as "implementation agencies" who have contracts with individual LDCs.

The term "contractor" is used to refer to individual contractor companies who conduct the actual installations. In some cases, LDCs are only hiring a single contractor (who may have multiple employees working for this company), to assist with the energy assessments and installations. This primarily occurs with smaller LDCs who have a lower program target. One contractor had sufficiently large operations and staff to work across multiple LDCs.

member assumed responsibility for day to day operations of the SCDIP. This all appeared to occur relatively smoothly, with a sufficient transition period for staff to "learn the ropes" of their new positions.

5.3 Telephone Survey of Participants

For the purposes of the process evaluation, KEMA conducted a number of interviews with SCDI program participants. The sample for the participant interview was pulled from the Tracking Database on April 20th, 2009. Although there were 10,162 work orders listed in the Tracking Database at this time, the database was cleaned of duplicate contact names and phone numbers for participants with multiple work orders. The final population identified was 9,918 unique participant contacts.

5.3.1 CATI Surveys

KEMA contracted with a survey house to complete 401 surveys with participating businesses. In order to get a representative sample, we stratified the population based on the following key criteria (see Appendix E for further description of sampling strategy):

- LDC – We divided the LDCs into categories based on their relative numbers of customers with demand >50kW.
- Measure Type – We divided the work orders into categories that included different combinations of measure types installed.

5.3.2 In-depth Interviews

KEMA conducted in-depth interviews with 20 SCDI program participants, out of approximately 60 unique businesses that were excluded from the CATI sample. This represented a random selection of participants from the overall SCDIP tracking database. The in-depth interviews explored topics such as perceptions of the SCDI program and experience with program processes, including ease of participation and satisfaction with the retrofit measures.

5.4 Telephone Surveys of Non-Participants

For the purposes of this evaluation, non-participants were defined as businesses that were contacted about the SCDIP and chose not to participate (i.e. either declined to schedule an assessment or declined to have the measures installed once the assessment was completed). Non-participant information was only provided for 23 of the 59 participating LDCs. Eleven LDCs were grouped together as part of the Niagara Erie Power Association (NEPA) and not distinguished by individual LDC. For the most part, the non-participant information was

provided directly by the service providers, since LDCs typically do not maintain this information themselves.

The non-participant data was provided in early June 2009, and originally comprised of 4,721 entries. KEMA subsequently cleaned the list of businesses who were deemed "ineligible" for the program according to any notes provided (this included businesses that did not meet the $300 project minimum); duplicate phone numbers were also removed from the database. The final population consisted of 2,506 unique business phone numbers. For the most part, no specific contact names were provided.

5.4.1 CATI surveys

KEMA contracted with the same survey house to complete 255 surveys with participating businesses. In order to get a representative sample, we stratified the population based on LDC or service provider.

The original target number of completes was 400, but the database of non-participant business information turned out to include wrong numbers, fax machines, some residential contacts and phone numbers that were out of service. A number of contacts in the database also indicated that they had participated in the SCDI program, and these were excluded from our interviews. After the CATI survey had been in the field for two weeks, it was apparent that the sample was becoming depleted and only a few additional interviews were being completed each day. Prior to closing the survey, the survey house called all remaining phone numbers one last time and the final number of completes was 255.

5.4.2 In-depth Interviews

KEMA researchers performed 20 in-depth interviews out of approximately 80 unique non-participant contacts that were excluded from the CATI sample. The purpose of these interviews was to further explore reasons for non-participation.

5.5 Analysis of Data in the Program Tracking Database

KEMA also performed a significant amount of analysis on the SCDIP tracking data. Final 2008 program tracking data was provided on June 18, 2009. The following program results are based on this dataset:

- Gross and net savings estimates
- Assessment of participants exceeding $1000 incentive limit
- Measure category price list cost per kWh and kW saved

5.6 Targeted On-site Verification of Work Orders

OPA selected specific work orders for KEMA to audit, focusing on work orders with a high potential for inaccuracies. Inspections were attempted for a total of 123 work orders across 25 unique business locations across 7 LDC territories and 10 contractor companies. The primary goal of the on-site audits was to determine the accuracy of the work orders submitted to the SCDIP tracking database.

6. Conclusion and Recommendations

At the close of the 2008 SCDI program year, LDCs in aggregate achieved 96 percent of their goals and collectively saved 28,275,628 net kWh annually and 3,837 net kW (summer). The results of this impact and process evaluation have shown that the OPA SCDIP is acting proactively to address the challenges and issues raised in the first year of the program. The key issues that have been, or are being, addressed include previously confusing eligibility requirements and difficulties using the work order tracking database. Overall, the program is working well, with many LDCs successfully meeting their target number of completed projects. As shown in the report, satisfaction among LDCs, service providers, contractors and program participants is also quite high.

In this chapter, KEMA summarizes our findings and provides recommendations and items for consideration for the remainder of the 2009 program year and 2010 program year.

6.1 Impact Evaluation Results

6.1.1 Finding: Actual installations may not match information provided in work orders

While this impact evaluation assumed that all work orders submitted by LDCs were 100 percent accurate, this is likely not the case. The results of the CATI survey of program participants and targeted verifications of specific work orders suggest that baseline equipment may not have matched the measure definitions and assumptions. For the CATI survey, 33 percent of water heater related measures were reported to be installed on natural gas water heaters. For the on-site verification, 13 percent of measure quantities could not be verified. Furthermore, retrofit equipment was found to be left behind at customer sites instead of being installed.

Direct install programs involve many diverse contractor businesses who need oversight and guidance on how to follow program procedures.

Recommendation:

- The SCDIP should conduct random post-installation inspections to ensure the quality of work is consistent with program protocols. If funds are available, OPA should consider 100% post-installation inspections, but this may not be feasible given limited resources. Inspections help to train contractors to the proper procedures by demonstrating when installations do not meet OPA standards and explaining how these discrepancies should

be resolved. Post-installation inspection sample size could decrease in size and/or rate as results show good performance.

- Consider employing dedicated staff (or third-party) to conduct post-installation inspections across all relevant OPA programs as part of program delivery process.
- Include third-party verification of program installations as part of future EM&V efforts, in order to assure proper use of rate-payer funded monies.

6.1.2 Finding: Additional information could be collected on work orders to improve impact savings calculations

The 2009 Commercial and Institutional Measures and Assumptions document provides a solid foundation for gross savings calculations. Additional parameters can be collected on work orders that could improve the accuracy of savings estimates.

Recommendation:

- For lighting measures, collect the following additional information:
    - Typical operating hours for lighting measures. Self reported lighting usage is regarded as relatively accurate. Typical operating hours could be collected by hours per week or usage type basis. For example, usage type categories could by assigned to fixtures such as high, medium, or low usage.
    - Area descriptions. A description of where fixtures or lamps are installed would help field verifications and inspections.
    - Rated ballast factor and ballast count for T8 fixtures.
- For water heater insulation measures, collect water heater capacity (gallons), manufacturer, brand, and model number. Currently, these measures are defined for a wide range of capacities. Knowing water heater capacity will improve savings estimates. Make and model information can possibly inform lookup values such as the energy factor, fuel type, and insulation value of a water heater.
- For pipe insulation, collect pipe diameter and length (feet) of insulation installed. Currently the quantity is reported in length of pipe that is insulated, by 10 foot intervals. While 10 feet is a common length that pipe insulation can be purchased, information

related to the specific length installed per work order is needed for program impact calculations.

- For low flow faucet aerators, collect the portion (percent) of faucets at site that are retrofitted to low flow aerators through the program. Also collect business type-specific parameters relevant to hot water usage.

6.1.3 Finding: PIAs are generally well developed, and should continue to be updated from time to time

KEMA reviewed the prescriptive per-unit input assumptions (PIAs) related to the program measures, including electricity and demand savings assumptions, effective useful life (EUL) and measure costs. The OPA PIAs and measure substantiation documents, primarily related to the 2009 Commercial and Institutional Measures and Assumptions[21] document (M&A Document), are the foundation for gross and lifetime savings estimates and cost-effectiveness calculations.

Some of the resource savings assumptions and calculation methodologies provided in the M&A document were found to be incomplete or inconsistent. Therefore, as part of KEMA's review of PIAs, some equations and assumptions were revised to reflect more current or applicable values. In some cases the values could not be substantiated, so values were provided that could be documented.

Recommendation:

- Consider additional market and technology research to inform PIA baseline assumptions and other savings parameters. For example, a lighting metering study could improve operating hour assumptions by business type or room type.

- Consider sponsoring a targeted measure cost study to assess validity of utilizing data sources and cost estimates from the United States.

6.1.4 Finding: LDCs and service providers do not have incentives to promote market transformation goals

While LDCs appear sufficiently motivated to meet their targets for the program, very little incentive exists for contractors to sell projects that are above the $1000 incentive limit. Since

[21] 2009 Commercial and Institutional Measures and Assumptions, The Ontario Power Authority, http://www.powerauthority.on.ca/Storage/97/9279_2009_M__A_List_-_CI_Apr14.pdf

contractors and service providers work directly with LDCs to deliver the program (and not with OPA), the OPA should develop funding for LDCs tied directly to the number of work orders exceeding $1000.

Additionally, processes do not appear to exist to measure participation in other OPA programs. Businesses are not always aware that they are participating in an OPA funded program. Therefore, this market transformation goal may need to be refined, or processes developed to track participation in multiple OPA programs.

Recommendation:

- Revise the fixed and variable funding structure to include reimbursements for LDCs based on the number of projects that exceed $1000. This may be designed in several ways, including:
    - Provide funding based on the average amount of all LDC work orders (e.g. average work order is $1300, so LDCs receive an incentive based on the $300).
    - Provide funding based on the number of LDC work orders that exceed $1000.
- Measure cross-participation in OPA programs based on tracking databases, and not based on participant self-report. A unique customer ID may be necessary to compare between programs, especially since businesses may have multiple LDC account numbers and 2009 eligibility rules now restrict participation to unique business addresses that are separately metered.
- Consider refining the market transformation goals, potentially based on customer self-reports of participation in other programs or on customer awareness of other OPA programs. Future progress could then be measured based on self-reported CATI survey results.

6.2 Process Evaluation Results

6.2.1 Finding: The tracking database and work order forms are being revised to improve program processes and impact estimates

The old 2008 Portal and Tracking Database have been recognized as tedious and difficult to use to enter a substantial number of work orders. In response to these concerns, the OPA program staff are developing an improved portal that will allow bulk uploads via an Excel-based electronic work order.

Managing data flow and project specific information is a common challenge for all energy efficiency programs. As OPA develops a revised work order form, it will be important to balance simplicity and user-friendliness with the need for quality control.

There is also an opportunity to improve the database to allow for greater transparency and monitoring of SCDI program achievements.

Recommendation:

- Incorporate the following features in the new electronic work order:
    - Data validation features to improve quality control (e.g. quantity can only be entered as a number, phone numbers as 7 digits) and ensure that all required fields are completed prior to submission
    - Drop-down boxes for appropriate business type
    - Automated payback and cost information
    - Formatted to print in an attractive manner
    - Collect mailing address and facility address, if different.
- Ensure that internal OPA procedures are in place to visually inspect all work orders before they are finalized and "submitted" for payment. This would include checking that the work order is filled out completely (e.g. both last name and first name of contact filled in). Also, check that contractor business name and individual contractor name associated with the work order are included.
- Include a field to designate which program year a work order is associated with (e.g. 2008, 2009 or 2010).

- Improve quarterly reporting inputs to allow for aggregate view of total responses and analysis of progress to date. Allow for quarterly reports to be downloadable.
- Consider incorporating estimated savings in the database to track SCDIP progress against program goals.

6.2.2 Finding: Successfully reaching the target market requires utilizing multiple channels and strategies

LDCs and their service providers are employing a wide range of channels to successfully reach the small business segment. A common approach is to initiate contact through direct mail, newspaper advertisements and articles in newsletters, as well as telemarketing approaches prior to a door to door engagement.

To promote a sense of legitimacy with the program, it is important that businesses be provided information in writing, especially when the energy assessor or installation contractor arrives on site. Businesses mention that they would prefer information in writing explaining the program. The below recommendations are provided to improve information flow both to customers and contractors.

Recommendation:

- Include program contact information prominently on the front page of brochures, including phone numbers and website information.
- Consider developing marketing materials (e.g. a SCDIP folder with program description cover) that include more information about the program along with a hard-copy of the energy assessment results and work order.
- Consider developing a brochure, or information sheet, directed at local contractors explaining how the program works, benefits of participation and their level of responsibility.
- Increase visibility of the official OPA website, and ensure that web searches for “Power Savings Blitz” bring up the OPA website first.
- Consider engaging chain account companies with multiple locations across LDC territories. OPA could identify head office contacts and proactively market retrofits for all stores and locations.

6.2.3 Finding: Tracking outreach to non-participating businesses is important to effectively market the program

Review of the non-participant contact information provided to KEMA indicated that some LDCs did a better job of tracking the calls and contact attempts to non-participants than others. Effective program marketing requires that LDCs and their service providers track non-participant information to ensure that contact attempts are well-coordinated, that participating businesses are not approached again, and to enable follow-up with customers who have not yet responded.

Recommendation:

- Consider developing a standard set of codes for reasons for non-participation to track this consistently across LDC territories.
- Require information such as date of contact(s) and name (if possible) to be tracked.
- Potentially develop a standard database format for LDCs to track non-participants

6.2.4 Finding: The measure and price list are continually updated to improve program effectiveness

Through interviews with LDCs, service providers, installation contractors, and program participants, KEMA collected feedback on the retrofit measures previously offered as part of the 2008 SCDI program price list. Recognizing that the 2009 SCDI program is well underway, KEMA focused its assessment on the current price list in effect. The results of our research show that OPA has already been responsive to feedback from market actors in the field.

Recommendation:

- Provide additional guidance to ensure that high quality equipment is being installed. For example, consider providing ENERGY STAR qualifying lamp lists to contractors and LDCs, if this is not already being done.
- Consider new lighting measures including pulse start metal halide fixtures to the measure list, as this can result in higher energy savings and avoid problems with reduced light levels over the lamp life. T5 fixture replacements may also be a good retrofit option. Also consider including occupancy sensors to the measure list. Small commercial businesses have significant opportunities for this measure.

- Consider new refrigeration measures as food and restaurant services are now eligible for the program. Measures may include strip curtains, night covers, door gaskets, automatic door closers, anti-sweat heater controls, evaporation fans and vending machine controls.

- Discontinue standard halogen and halogen IR lamp measures, due to risk of low measure retention and minimal energy efficiency improvements.

- Discontinue incentives for water heater insulation jackets. There are limited savings as older models are removed and a significant portion of water heaters are believed to be natural gas and not electric.

6.2.5 Finding: Proper disposal of lighting equipment can be problematic

Fluorescent fixtures contain hazardous materials that must be disposed of properly. Issues specifically related to fluorescent fixture ballasts were encountered during the first year of the program. Over time as the CFLs installed by the program burn out, their proper disposal will also become important. The responsibility and procedures for proper disposal of equipment was largely left to the LDCs. The OPA can potentially provide significant assistance and work with province-wide entities to develop consistent protocols for proper disposal.

Recommendation:

- Consider requiring contractors to submit environmental certificates as proof that ballasts were disposed of properly.

- Develop hand-outs or partner with organizations to distribute information related to proper disposal of CFLs. Consider promoting CFL recycle days along with other conservation awareness initiatives.

6.2.6 Finding: LDCs and market actors indicate that communications from the SCDI program could be improved

During the first year of the program, LDCs and market actors frequently had questions and issues that arose. Going forward, additional technical questions and issues related to eligibility are expected to arise from time to time. Given the number of LDCs delivering the program, consistent channels for communication should be developed to broadcast answers to commonly asked questions.

Recommendation:

- Develop regular communications, such as a newsletter or email bulletin, with LDCs about changes and answers to frequently asked questions. Alternatively, an online forum could be developed for posting issues and concerns, and allow stakeholders to comment on any new protocols or materials before they are finalized.
- Continue to host SCDIP LDC Forums at least once a program year, to allow LDC program managers and contractors to discuss best practices and challenges encountered, as well as provide feedback to the OPA.

6.3 Future Evaluation Measurement & Verification (EM&V) Activities

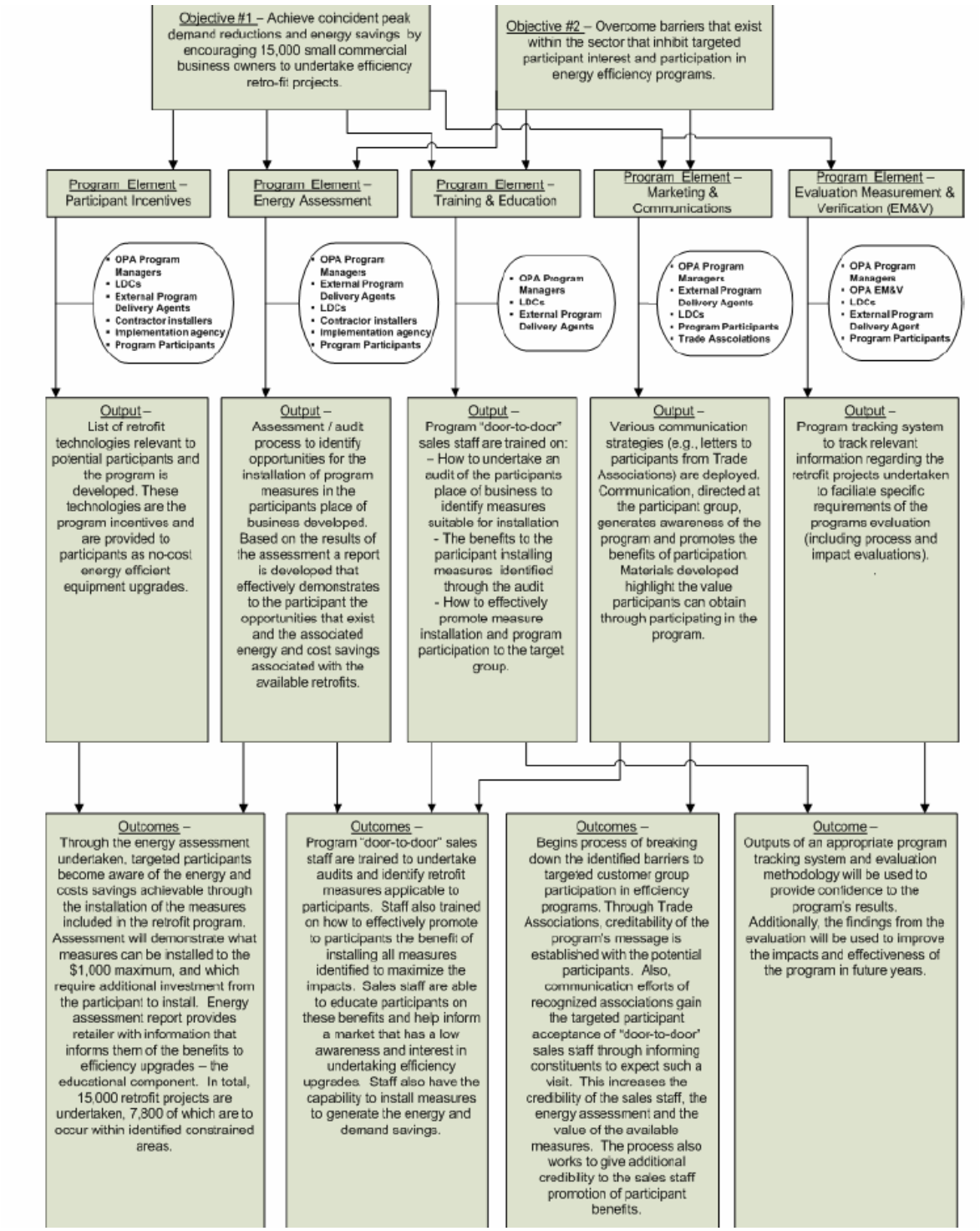
It is extremely difficult to assess the accuracy of work orders through phone interviews, much less through computer aided telephone interview (CATI) surveys. Future impact evaluation efforts should include a field verification component to audit the rate at which measures are installed (and remain installed) according to program rules.

The first year evaluation show that work orders may not be accurately capturing baseline equipment operating characteristics. Issues include rate of burn-out, whether new fixtures are replacing existing fixtures or providing additional lighting in a new space. For fixtures that were not previously functioning, to better estimate energy savings, it is necessary to understand whether the fixture was temporarily out of service or not needed, what the natural replacement product was going to be, and when the replacement would have taken place. This was out of scope for the 2008 SCDIP evaluation, but may be an area for further research.

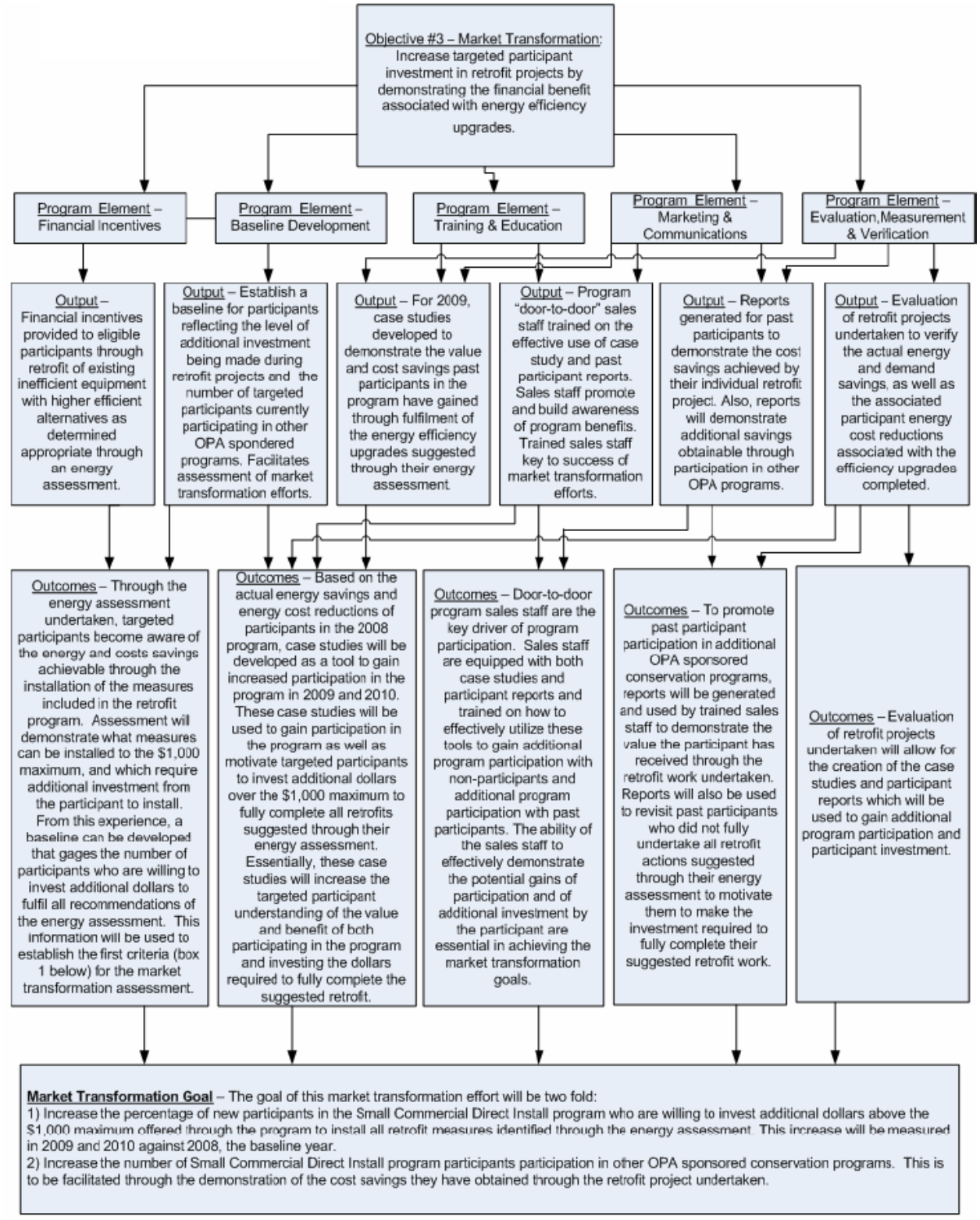
Furthermore, water heater fuel type is another area for field verification, as a significant portion of self-reports show that natural gas was the fuel type. The first year evaluation impact calculations assumed that all water heating measures were installed on electric water heaters. Additionally, measures included on the work order may not have been properly installed and in some cases, retrofit equipment may have been left at customer sites and not installed. Some equipment may have been subsequently removed. Field verification would provide a more accurate estimate of energy savings impacts associated with the program.

Future evaluation efforts should also ensure rigorous approaches to estimating and including spillover. Discussions with OPA can ensure that spillover estimates are consistent with those of other OPA sponsored programs.

Appendix A – SCDI Program Logic Model



Appendices


Objective #3 – Market Transformation: Increase targeted participant investment in retrofit projects by demonstrating the financial benefit associated with energy efficiency upgrades.
Program Element – Financial Incentives
Program Element – Baseline Development
Program Element – Training & Education
Program Element – Marketing & Communications
Program Element – Evaluation,Measurement & Verification
Output – Financial incentives provided to eligible participants through retrofit of existing inefficient equipment with higher efficient alternatives as determined appropriate through an energy assessment.
Output – Establish a baseline for participants reflecting the level of additional investment being made during retrofit projects and the number of targeted participants currently participating in other OPA spondered programs. Facilitates assessment of market transformation efforts.
Output – For 2009, case studies developed to demonstrate the value and cost savings past participants in the program have gained through fulfilment of the energy efficiency upgrades suggested through their energy assessment
Output – Program "door-to-door" sales staff trained on the effective use of case study and past participant reports. Sales staff promote and build awareness of program benefits. Trained sales staff key to success of market transformation efforts.
Output – Reports generated for past participants to demonstrate the cost savings achieved by their individual retrofit project. Also, reports will demonstrate additional savings obtainable through participation in other OPA programs.
Output – Evaluation of retrofit projects undertaken to verify the actual energy and demand savings, as well as the associated participant energy cost reductions associated with the efficiency upgrades completed.
Outcomes – Through the energy assessment undertaken, targeted participants become aware of the energy and costs savings achievable through the installation of the measures included in the retrofit program. Assessment will demonstrate what measures can be installed to the $1,000 maximum, and which require additional investment from the participant to install. From this experience, a baseline can be developed that gages the number of participants who are willing to invest additional dollars to fulfil all recommendations of the energy assessment. This information will be used to establish the first criteria (box 1 below) for the market transformation assessment.
Outcomes – Based on the actual energy savings and energy cost reductions of participants in the 2008 program, case studies will be developed as a tool to gain increased participation in the program in 2009 and 2010. These case studies will be used to gain participation in the program as well as motivate targeted participants to invest additional dollars over the $1,000 maximum to fully complete all retrofits suggested through their energy assessment. Essentially, these case studies will increase the targeted participant understanding of the value and benefit of both participating in the program and investing the dollars required to fully complete the suggested retrofit.
Outcomes – Door-to-door program sales staff are the key driver of program participation. Sales staff are equipped with both case studies and participant reports and trained on how to effectively utilize these tools to gain additional program participation with non-participants and additional program participation with past participants. The ability of the sales staff to effectively demonstrate the potential gains of participation and of additional investment by the participant are essential in achieving the market transformation goals.
Outcomes – To promote past participant participation in additional OPA sponsored conservation programs, reports will be generated and used by trained sales staff to demonstrate the value the participant has received through the retrofit work undertaken. Reports will also be used to revisit past participants who did not fully undertake all retrofit actions suggested through their energy assessment to motivate them to make the investment required to fully complete their suggested retrofit work.
Outcomes – Evaluation of retrofit projects undertaken will allow for the creation of the case studies and participant reports which will be used to gain additional program participation and participant investment.
Market Transformation Goal – The goal of this market transformation effort will be two fold:
1) Increase the percentage of new participants in the Small Commercial Direct Install program who are willing to invest additional dollars above the $1,000 maximum offered through the program to install all retrofit measures identified through the energy assessment. This increase will be measured in 2009 and 2010 against 2008, the baseline year.
2) Increase the number of Small Commercial Direct Install program participants participation in other OPA sponsored conservation programs. This is to be facilitated through the demonstration of the cost savings they have obtained through the retrofit project undertaken.

Appendix B – LDC Program Achievements

LDC	2008 Target	Projects Completed	Percent of Target
Atikokan Hydro Inc.	10	0	0%
Barrie Hydro Distribution Inc.	40	44	110%
Brant County Power Inc.	30	80	267%
Brantford Power Inc.	71	186	262%
Burlington Hydro Inc.	175	309	177%
Cambridge and North Dumfries Hydro Inc.	166	227	137%
Canadian Niagara Power Inc.	61	130	213%
Centre Wellington Hydro Ltd.	24	12	50%
Chatham-Kent Hydro Inc.	117	307	262%
Clinton Power Corporaton	9	43	478%
E.L.K. Energy Inc.	8	95	1188%
Enersource Hydro Mississauga Inc.	1314	0	0%
ENWIN Utilities Ltd.	259	892	344%
Erie Thames Powerlines Corporation	54	90	167%
Essex Powerlines Corporation	73	220	301%
Festival Hydro Inc.	81	106	131%
Fort Frances Power Corporation	15	0	0%
Goderich Hydro	12	3	25%
Greater Sudbury Hydro	137	166	121%
Grimsby Power Incorporated	15	0	0%
Guelph Hydro Electric Systems Inc.	129	210	163%
Haldimand County Hydro Inc.	55	134	244%
Halton Hills Hydro Inc.	48	57	119%
Horizon Utilities Corporation	662	1335	202%
Hydro One Networks Inc.	1400	1318	94%
Hydro Ottawa Limited	853	300	35%
Innisfil Hydro Distribution Systems Limited	19	30	158%
Kenora Hydro Electric Corporation Ltd.	30	0	0%
Kitchener-Wilmot Hydro Inc.	258	353	137%
Lakefront Utilities Inc.	42	61	145%
London Hydro Inc	435	8	2%
Midland Power Utility Corporation	17	18	106%
Milton Hydro Distribution Inc.	74	92	124%
Newmarket - Tay Power Distribution	106	201	190%
Niagara Peninsula Energy Inc.	93	0	0%
Niagara-on-the-Lake Hydro Inc.	29	0	0%
Norfolk Power Distribution Inc.	46	106	230%
North Bay Hydro Distribution Limited	108	110	102%
Oakville Hydro Electricity Distribution Inc.	194	241	124%
Orangeville Hydro Limited	37	39	105%
Orillia Power Distribution Corporation	51	163	320%
Oshawa PUC Networks Inc.	137	251	183%
Parry Sound Power Corporation	21	18	86%
Peterborough Distribution Incorporated	135	123	91%
PowerStream	880	516	59%
Rideau St. Lawrence Distribution Inc.	18	0	0%
Sioux Lookout Hydro Inc.	15	0	0%
St. Thomas Energy Inc.	59	75	127%
Grand Total	**11936**	**11,442**	**96%**

Appendix C – Review of Prescriptive Per-unit Input Assumptions (PIAs)

In this section we include KEMA's detailed review of the effective useful life (EULs), resource savings assumptions (kWh and kW savings) and measure costs. The review is based on OPA PIAs and measure substantiation documents, primarily related to the 2009 Commercial and Institutional Measures and Assumptions[22] document (M&A Document).

For the purposes of reviewing the PIAs, the measure descriptions from the OPA Small Commercial Direct Install program Portal Tracking Database are used as the basis for all assumptions (unless indicated otherwise).

1. Effective Useful Life (EUL) Review

KEMA's approach to calculate gross lifetime savings is to multiply the gross annual kWh savings by each measure's effective useful life (EUL), by business type. Total program lifetime savings were based on the revised EUL per-unit input assumptions (PIAs) as detailed in this document.

KEMA reviewed the data sources cited by OPA to develop EUL assumptions, and assessed the reasonableness of the original source and whether it is generally consistent with what is being used by other efficiency programs. Some of the EULs have been revised to reflect more current and accurate values when appropriate. These modifications are discussed in the following sections and will be utilized to calculate overall program gross lifetime impacts.

1.1 T8 Light Measures

The EUL of the electronic ballast (versus lamp life) is used to determine this measure's lifetime savings. The M&A document cites EUL values as follows:

[22] 2009 Commercial and Institutional Measures and Assumptions, The Ontario Power Authority, http://www.powerauthority.on.ca/Storage/97/9279_2009_M__A_List_-_CI_Apr14.pdf

Table 37: EUL for T8 lighting Measures, the M&A document

EUL Description	Reference
The useful life of standard T8 and T12 ballasts are 16 years and the lamps are rated for 16,000 hours	PG&E Workpapers, June 13, 2005
High performance T8 ballasts have a useful life of 24 years	Consortium for Energy Efficiency. http://www.cee1.org/com/com-lt/com-lt-main.php3

In the program tracking database and measure price list, there are no requirements specifying measures to have either standard or high performance ballasts. Therefore, it is assumed that standard electronic T8 ballasts are used for all linear fluorescent measures.

More current sources are available for assessing the EUL of T8 ballasts. Natural Resources Canada Lighting Reference Guide provides an estimated rated ballast life of 50,000 hours. California DEER practice is to determine EUL (years) by the lower value, as follows[23]:

$$EUL = \frac{\text{Rated Ballast Life}}{HOU}$$ or, 15 years, whichever is less

Where,

Rated Ballast Life = the rated hours the ballast operates, defined here as 50,000 hrs by Natural Resources Canada

HOU = annual hours of use (hrs/yr)

KEMA recommends utilizing the NRCAN value of 50,000 hrs with a cap of 15 years to determine lifetime savings for all T8 fluorescent lighting measures. HOU vary by business type. HOU, as described in the ”Resource Savings Assumptions (kWh and kW) Review” (page C-9) are used to determine the EUL.

Since the original OPA reference to 2005 PG&E workpapers are a little outdated, KEMA recommends utilizing the 2008 DEER approach to EULs as shown below in Table 46.

[23] DEER 06-07 update, section of website containing EUL discussion: http://www.deeresources.com/deer0911planning/downloads/EUL_Summary_10-1-08.xls

Table 38: EUL for T8 Lighting Measures, by Business Type

OPA SCDI Portal Business Type	HOU / Yr	EUL years	Basis
Convenience Stores	4,891	10.2	Rated ballast life and HOU
Grocery	4,891	10.2	Rated ballast life and HOU
Office	2,594	15.0	15 years lower than rated hours and HOU (19.3)
Bakery	3,253	15.0	15 years lower than rated hours and HOU (15.4 years)
Retail	3,253	15.0	15 years lower than rated hours and HOU (15.4 years)
Service	3,253	15.0	15 years lower than rated hours and HOU (15.4 years)
Restaurant	4,825	10.4	Rated ballast life and HOU (14.5 years)
Other	3,410	14.7	Rated ballast life and HOU

1.2 Compact Fluorescent Lamps (CFLs)

For compact fluorescent lamps (CFLs), the M&A document cites EUL values as follows:

Table 39: EUL for CFL Measures, the M&A document

EUL Description	Reference
The Useful life of CFL fixtures varies between 6,000 and 12,000 hours. The hardwired fluorescent lamps have a useful life of 8,000 hours and magnetic ballasts 32,000 hours	PG&E Workpapers, June 13, 2005
Incandescent bulbs have a useful life between 750 to 1,000 hours	No citation provided.

All SCDIP CFL measures involve CFLs replacing screw-in incandescent lamps. Fixture retrofit or hard-wired lamps are not involved with these measures. Additional sources were reviewed for EUL estimates, including the following:

- DEER 06-07 update, CFL lamps are separated by the rated lamp life categories as 6,000 hours, 8,000 hours, 10,000 hours, and 12,000 hours. The EUL (in years) is calculated by dividing the rated lamp life by the annual operating hours. [24]

- Evaluation of the SCE 2004-05 Small Business Energy Connection Program, This Report finds a CFL rated life of 8,321 hours, based on data collected during part of a logger study for the program. Make and model information was collected for a total of 692 lamps installed through the program. The EUL (in years) is calculated by dividing the rated lamp life by the annual operating hours.[25]

- EM&V Report for the Small Nonresidential Energy Fitness Program, This evaluation uses a 10,000 hour rated lamp life. The EUL (in years) is calculated by dividing the rated lamp life by the annual operating hours.[26]

The EUL depends on the specific rated lamp life for CFLs being installed through the program. This information is not available for direct review. Also, the M&A document cites rated lamp life for hardwire CFL lamps and fixtures, which is not applicable.

The OPA M&A Document provides a range of 6,000 to 12,000 hours for CFL useful life. Based on a review of secondary sources and KEMA's experience with other energy efficiency programs, a CFL rated lamp life of 8,000 hours is recommended. EUL is determined by:

$$EUL = \frac{\text{Rated Lamp Life}}{\text{HOU}}$$

Where,

Rated Lamp Life = the rated hours the ballast operates, defined as 8,000 hrs

HOU = annual hours of use (hrs/yr)

[24] DEER 06-07 update, section of website containing EUL discussion: http://www.deeresources.com/deer0911planning/downloads/EUL_Summary_10-1-08.xls. Ibid.

[25] Evaluation of the SCE 2004-05 Small Business Energy Connection Program, prepared by ECONorthwest, April 2, 2007. Report found at: http://www.calmac.org/publications/SCE_HTR_Eval_Report.pdf

[26] EM&V Report for the Small Nonresidential Energy Fitness Program #1409-04. prepared for the California Public Utilities Commission, bye Robert Mowris & Associates, April 20, 2007. Report found at: http://www.calmac.org/publications/RHA_EFP_1409-04_EM&V_FINAL_Report_RHA0002.01.pdf

Similar to T8 fixtures, HOU for CFLs vary by business type. HOU, as described in "Resource Savings Assumptions (kWh and kW) Review" (page C-9) are used to determine the EUL. KEMA recommends utilizing the EULs, by business type, as shown below in Table 40.

Table 40: EUL for CFL measures, by Business Type[27]

OPA SCDI Portal Business Type	HOU / Yr	EUL years
Convenience Stores	3,879	2.1
Grocery	3,879	2.1
Office	3,082	2.6
Bakery	3,721	2.1
Retail	3,721	2.1
Service	3,721	2.1
Restaurant	4,825	1.7
Other	3,174	2.5

For the incandescent bulbs, the Natural Resources Canada Lighting Reference Guide 2005 lists 1,000 hours as the estimated life. KEMA recommends that OPA utilize this value.

1.3 Halogen Lamps

The M&A document cites EUL values for halogen lamps, as follows:

Table 41: EUL for Halogen Measures, the M&A document

EUL	Reference
The useful life of halogen lamps is approximately 5,000 hours	No citation provided
Incandescent bulbs have a useful life between 750 to 1,000 hours	No citation provided

[27] The hours of use for CFLs are not the same as for T8 fixtures due to differences in usage patterns. Updated 2008 DEER hours of use values rely on data from the 2002-2003, and 2004-2005 California State-wide Express Efficiency lighting logger studies.

Halogen lamps have a longer rated life compared to standard incandescent lamps. Halogen lamps available on the market comprise a wide range of rated lamp life. Based on a review of the Natural Resources Canada Lighting Reference Guide 2005, we recommend that a value of 2,000 hours be used as the estimated useful life.

Thus, lifetime savings are calculated using a halogen rated lamp life of 2,000 hours (NRCAN value) for determining the EUL. EUL is determined as follows:

$$EUL = \frac{\text{Rated Lamp Life}}{HOU}$$

Where,

Rated Lamp Life = the rated hours the ballast operates, defined as 2,000 hrs

HOU = annual hours of use (hrs/yr)

Again, HOU vary by business type. HOU, as described in "Resource Savings Assumptions (kWh and kW) Review" (page C-9) are used to determine the EUL. The CFL HOU are used for halogen lamps since they are estimated to have similar usage patterns. KEMA recommends utilizing the EULs, by business type, as shown below in Table 42.

Table 42: EUL for Halogen measures, by Business Type

OPA SCDI Portal Business Type	HOU / Yr	EUL years
Convenience Stores	3,879	0.5
Grocery	3,879	0.5
Office	3,082	0.6
Bakery	3,721	0.5
Retail	3,721	0.5
Service	3,721	0.5
Restaurant	4,825	0.4
Other	3,174	0.6

For the incandescent bulbs, the Natural Resources Canada Lighting Reference Guide 2005 lists 1,000 hours as the estimated life. KEMA recommends that OPA utilize this value.

1.4 LED Exit Signs

The M&A document cites EUL values for LED Exit Signs as follows:

Table 43: EUL for LED Exit Sign Measures, the M&A document

EUL	Reference
Energy Star Requires that exit signs have a minimum life of 5 years, however most LED exit signs have an effective useful life of 10 years	http://energystar.gov/index.cfm?c=exit_signs.pr_exit_signs

The M&A document does not cite a source for determining 10 years as the LED exit sign EUL. Only the Energy Star minimum required life is cited. The DEER 06-07 update provides a recommended EUL of 16 years for this measure,[28] based on the review of several sources, of which 16 years is the predominate EUL.[29] Therefore, KEMA recommends following the DEER results and utilizing a EUL of 16 years for LED exit signs.

1.4.1 Water Heater Tank Insulation & Pipe Insulation

The M&A document cites EUL values as follows:

Table 44: EUL for Tank and Pipe Insulation, the M&A document

EUL	Reference
The effective useful life for pipe/tank insulation is 20 years	http://www.oldhouseweb.com/stories/Detailed/10383.shtml

The website cited appears to be an online resource for "old-house enthusiasts." The specific page with effective useful life information for pipe and tank insulation was not found by KEMA.

[28] DEER 06-07 update, section of website containing EUL discussion: http://www.deeresources.com/deer0911planning/downloads/EUL_Summary_10-1-08.xls. Ibid.

[29] 20 years - SDGE 1996 & 1997 Commercial Energy Efficiency Incentives Ninth Year Retention Evaluation
20 years- 1994 & 1995 Commercial Energy Efficiency Incentives - Ninth Year retention Evaluation
16 years - CALMAC 2000 Workshop
16 years - Energy Efficiency Policy Manual v2
15 years - GDS Measure Life Report Residential and Commercial/Industrial Lighting and HVAC Measures
16 years - EM&V Report for the Small Nonresidential Energy Fitness Program #1409-04

Therefore, we review EUL from other energy efficiency programs. Our research yielded the following results:

- The Connecticut Light and Power CL&P and UI program savings are based on 15 year life for pipe insulation and water heater tank wrap of life of 5 years[30]
- The Arkansas Statewide Quickstart Programs base lifetime savings on water heater pipe insulation life of 15 years and water heater insulation life of 10 years[31]
- DEER 2005 includes a EUL of 15 years for pipe insulation. (This measure was not included in any subsequent updates.) DEER 2006-07 uses a EUL of 7 years for hot water tank insulation, based on ENERGY STAR lifetime assumptions.

Since the M&A document's source for EUL of tank/pipe insulation could not be verified, KEMA recommends utilizing EULs that are consistent with other energy efficiency programs and DEER. To calculate these measures' lifetime savings, KEMA recommends that an EUL of 15 years be used for pipe insulation since all three sources agree on this value. KEMA recommends utilizing 7 years for tank insulation, since it is roughly the average of the values used in the other efficiency programs.

1.5 Low Flow Faucet Aerators

The M&A document cites EUL values as follows:

Table 45: EUL for Faucet Aerators, the M&A document

EUL Description	Reference
The useful life of a low-flow aerator has not been reported, but would be dependent on the concentration of the dissolved minerals in the water and the amount of build-up on the faucet. Faucets typically last 10 to 15 years, so it can be assumed low-flow aerators will have the same lifespan.	No citation provided.

The source for the M&A document's EUL for low flow faucet aerators is not provided, and therefore could not be reviewed. Therefore, KEMA reviewed the EUL from other energy efficiency programs. Our research yielded the following results:

[30] CL&P and UI Program Savings Documentation for 2008 Program Year, Prepared by The United Illuminating Company, 09/25/2007.
[31] Arkansas Statewide Quickstart Programs. Prepared by Frontier Associates LLC, April 2, 2007.

- The Connecticut Light and Power CL&P and UI program savings are based on a 5 year life for faucet aerators.[32]
- The Arkansas Statewide Quickstart Programs base lifetime savings on faucet aerators measure life of 5 years.[33]
- DEER 2005 includes a EUL of 9 years for faucet aerators. (This measure was not included in any subsequent updates.)

Again, since the OPA M&A document's source for EUL of faucet aerators could not be verified, KEMA recommends utilizing an EUL that is consistent with other energy efficiency programs. Since both the Connecticut and Arkansas programs are more recent documentation (2007) than the DEER value (2005), and agree on the same 5 year EUL for faucet aerators, KEMA recommends that OPA utilize the same (5 year EUL) to calculate this measure's lifetime savings.

2. Resource Savings Assumptions (kWh and kW) Review

Total program savings was be based on the revised per-unit input assumptions (PIAs) as detailed in this document. The PIAs are either a single fixed value or they are dependent on one or more variable inputs (for example, business type), depending on the technology. Estimated savings values include annual energy savings (kWh) and coincident peak demand savings (kW) for both summer and winter.

For the purposes of estimating gross savings, the measure descriptions from the OPA Small Commercial Direct Install program Portal Tracking Database are used as the basis for all assumptions (unless indicated otherwise). This means that impact savings use both the existing equipment and retrofit measure descriptions. The gross impact savings values do not account for any possible deviations from the measure descriptions that occur in practice for both pre and post retrofit.

Below we reviews the Resource Savings Assumptions of the OPA PIAs and measure substantiation documents. Some of the equations and assumed variables have been revised to

[32] CL&P and UI Program Savings Documentation for 2008 Program Year, Prepared by The United Illuminating Company, 09/25/2007.
[33] Arkansas Statewide Quickstart Programs. Prepared by Frontier Associates LLC, April 2, 2007.

reflect more current and accurate values when appropriate. These modifications are discussed in the following sections and were utilized to calculate overall program gross impacts.

2.1 Lighting Measures

2.1.1 Measure Description

The Ontario Power Authority provided direct install services for four distinct lighting measure types. The measure types include linear fluorescent fixture retrofit (T-12 with magnetic ballast to T-8 with electronic ballast), replacement of inefficient lamps with ENERGY STAR® compact fluorescent lamps (CFLs), replacement of inefficient lamps with Halogen General Service Lamps, and exit sign retrofit/replacement with LED lamps/fixtures. This section provides the equations used to calculate energy savings and demand savings for these measure types as well as outlining the assumed values used in the equations for each measure type.

The lighting hours of use (HOU) are based heavily on the 2008 DEER updated values. The OPA M&V Document had previously utilized 2005 DEER values, so the 2008 values are provided as updated numbers. The CATI results for business types with good data points (not all business types had good data) showed that HOU appear to be similar to the DEER 2008 HOU. Therefore, DEER is recommended to continued to be used, since the HOU estimations are based on significantly better data (i.e. rigorous on-site metering) than the CATI question series from this evaluation.

2.1.2 Algorithms and Variable Definitions

Impact savings calculations match the M&A Document. The M&A Document calculates energy savings per unit (lamp or fixture), using the equation below.

$$Annual\ Energy\ Savings\ (kWh) = (HOU)\left\{(kW_{base}) - (kW_{efficient})\right\}$$

Where,

HOU = hours of use per year (hr/yr).

kW_{base} = baseline connected demand per unit (kW).

$kW_{efficient}$ = efficient connected demand per unit (kW).

Impact savings calculations align with the M&A Document. Values for each of these variables are discussed below.

1.1.1 Hours of Use per Year

KEMA conducted a review of the prescribed hours of use (HOU) for lighting measures included in the program. The source cited in the M&A Document for the HOU assumptions is a Pacific Gas and Electric 2005 Workpaper, which corresponds to the 2005 DEER interior lighting HOU values. KEMA recommends utilizing the updated 2008 DEER interior HOU values.[34] Table 46 shows the assumed HOU from the M&A Document for all lighting measures. Table 47 on the next page shows the 2008 DEER Update values for CFL and fluorescent lighting HOU.

Table 46 – M&A Document Assumed Lighting HOU / Yr, by Business Type

OPA SCDI (M&A) Business Type	HOU / Yr
Grocery Store	5,800
Hotels/Motels	5,500
Large/Small retail (incl. restaurant)	4,450
Hospital/Nursing home	4,400
Large/Small office	4,000
University	3,900
Schools	2,150
Multi-unit residential bldg (MURB)	3,150
MURB Apartment	2,100
MURB Corridor/Lobby	5,100
MURB Parking Garage	8,760

[34] Regarding these values, 2008 DEER Update documentation states:

> "Lighting systems were simulated assuming only one fixture type operating under a single profile. The 2005 approach was adequate for simulating prototypical lighting power and operating conditions, it did not support the analysis of specific lighting measures such as replacement of incandescent with compact fluorescent lamps (CFL) or T-12 with T-8 lamps."

According to the 2008 DEER Update, the old 2005 DEER HOU values were based upon lighting usage profiles from studies conducted in 1994 and 2001. The updated 2008 DEER HOU values rely on data from the 2002-2003 and 2004-2005 California statewide express efficiency lighting logger studies, and are considered to be more accurate.

Table 47 – 2008 DEER Updated Lighting HOU / Yr, by Business Type

Business Type	HOU / Yr	
	CFL*	T-8
Assembly	2,286	2,440
Education - Primary School	2,399	2,167
Education - Secondary School	2,483	2,320
Education - Community College	2,622	2,593
Education - University	2,451	2,447
Health/Medical - Hospital	3,972	5,182
Health/Medical - Nursing Home	3,586	4,308
Lodging - Hotel	1,178	1,482
Lodging - Motel	1,041	1,184
Manufacturing - Bio/Tech	3,501	3,957
Manufacturing - Light Industrial	2,619	3,130
Office - Large	3,151	2,651
Office - Small	3,082	2,594
Restaurant - Sit-Down	4,815	4,815
Restaurant - Fast-Food	4,835	4,835
Retail - 3-Story Large	3,703	3,372
Retail - Single-Story Large	3,813	3,429
Retail - Small	3,721	3,253
Storage - Conditioned	2,780	3,441
Storage - Unconditioned	2,780	3,441
Grocery	3,879	4,891
Warehouse - Refrigerated	4,776	4,792
"Other" (avg. of non-gray)	3,174	3,410

* CFL HOU / Yr values are used for Halogen General Service Lamps as well, as they are estimated to have similar usage patterns.

Since updated 2008 DEER HOU values are available for program lighting measures, these values should be used to determine program savings, as they are the most up-to-date and most accurate HOU assumptions readily available. Although DEER values are based on California specific studies, they are utilized to estimate energy and demand savings for programs

throughout North America. The rows highlighted in gray have been deemed by KEMA to be irrelevant for the purposes of this evaluation because the associated businesses are typically not considered small commercial. To estimate program gross savings, business types listed as "Other" in the SCDI program tracking database will utilize an average of all non-gray business types' HOU, as shown above.

In addition, the business types outlined in the M&A Document (and above, in Table 46) do not correspond exactly to the business types from 2008 DEER, nor to the ones entered into the OPA SCDI Portal. As such, Table 48 shows the assumptions for DEER-to-Portal business type mapping. As shown, the HOU associated with the "Grocery" business type from 2008 DEER are applied to "Convenience Stores" and "Grocery" business types. The "Office – Small" HOU from 2008 DEER are applied to the "Office" business type. The "Retail – Small" HOU from 2008 DEER are applied to the "Bakery", "Retail" and "Service" business types. In order to map the "Restaurant" business type, KEMA applies average HOU of "Restaurant – Sit-Down" and "Restaurant – Fast-Food" from 2008 DEER. Since the DEER business types highlighted in gray in Table 47 are not considered small commercial, an average of all non-gray business type HOU are mapped to all "Other" business types.

Table 48 – OPA SCDI Portal to 2008 DEER Business Type and HOU / Yr Mapping

OPA SCDI Portal Business Type	2008 DEER Business Type	HOU / Yr	
		CFL*	T-8
Convenience Stores	Grocery	3,879	4,891
Grocery	Grocery	3,879	4,891
Office	Office - Small	3,082	2,594
Bakery	Retail - Small	3,721	3,253
Retail	Retail - Small	3,721	3,253
Service	Retail - Small	3,721	3,253
Restaurant	Avg of Sit-Down & Fast-Food	4,825	4,825
Other	"Other" (avg. of non-gray)	3,174	3,410

* CFL HOU / Yr values are used for Halogen General Service Lamps as well, as they are estimated to have similar usage patterns.

These HOU values will be applied to linear fluorescent (T8) fixtures, CFLs and halogen lamps. Exit Sign fixtures are assumed to operate 24 hours per day, 365 days per year (8,760 hrs/yr).

1.1.2 Wattage Reduction per Unit (Lamp or Fixture)

Table 49 shows the base case and retrofit wattages of lighting measures listed on the 2008 PSB Measure Price List. KEMA reviewed the available OPA program documentation for fixture wattage assumptions. For several measures, no wattages were provided by the OPA documentation. These are highlighted in grey in the table below. Where no values were available, KEMA utilized alternate sources. The sources for the fixture wattages are included in the tables, and are listed below:

(1) OPA Value from "No Catch to Conserve" document
(2) OPA Value from M&A Document
(3) KEMA Value from "2004 SPC Program Table of Standard Fixture Wattages v.2.3"[35]

Assumptions are also noted in the table, and are listed below:

(4) KEMA takes the average of the wattage range (or fixture wattage) listed in OPA program documentation because the exact wattages were not tracked
(5) Where different, we assume measure description wattage values listed in tracking database are more accurate than wattage values listed in M&A Document

[35] KEMA searched for standard wattage tables from the Northeast region of the United States, but no commonly utilized sources were found.

Table 49 – Base Case Wattages and Retrofit Wattages of Measures, as Available in OPA Program Documentation

Measure Technology	Measure Number	Measure Name (per tracking DB)	Base Case Wattage	Retrofit Wattage
High Performance T8 Fixtures	1	(1) from 8' 1 Lamp 75W to 4' 2 Lamps end to end 32W - with 80% BF	95 (1)	55 (2)
	2	(2) from 8' 1 Lamp 75W to 1 8' T8 32W with 80% BF	95 (1)	57 (3)
	3	(3) from 8' 1 Lamp 75W to 2 end to end 4' 25W T8 with 90% BF	95 (1)	48 (1)
	4	(4) from 8' 2 Lamps 75W to 4 - 4' end to end 32W Lamps with 80% BF	172 (2)	109 (2)
	5	(5) from 8' 2 Lamps 75W to 2 - 4' Lamps 32W + Reflector with 90% BF	172 (2)	55 (2)
	6	(6) from 8' 2 Lamps 60W to 4 - 4' Lamps 32W with 80% BF or use 25W lamp	142 (2)	109 (2)
	7	(7) from 8' 2 Lamps 60W to 2 - 4' Lamps 32W + Reflector with 90 % BF	142 (2)	55 (2)
	8	(8) from 4' 1 Lamp 40W to 4' 1 Lamp 32W with 80% BF or use 25W lamp	51 (2)	28 (2)
	9	(9) from 4' 2 Lamps 40W to 4' 1 Lamp 32W + Reflector with 90% BF	88 (2)	28 (2)
	10	(10) from 4' 2 Lamps 40W to 4' 2 Lamps 32W with 80% BF or use 25W lamps	88 (2)	55 (2)
	11	(11) from 4' 4 Lamps 40W to 4' 2 Lamps 32W + Reflector	175 (2)	55 (2)
	12	(12) from 4' 4 Lamps 40W to 4' 4 Lamps 32W with 80% BF or use 25W lamps	175 (2)	109 (2)
	13	(13) from 4' 1 Lamp 34W to 4' 1 Lamp 32W with 80% BF or use 25W lamp	47 (2)	28 (2)
	14	(14) from 4' 2 Lamps 34W to 4' 1 Lamp 32W + Reflector with 90% BF	81 (2)	28 (2)
	15	(15) from 4' 2 Lamps 34W to 4' 2 Lamps 32W with 80% BF or use 25 watt lamps	81 (2)	55 (2)
	16	(16) from 4' 4 Lamps 34W to 4' 2 Lamps 32W + Reflector	149 (2)	55 (2)
	17	(17) from 4' 4 Lamps 34W to 4' 4 Lamps 32W with 80% BF or use 25W lamps	149 (2)	109 (2)
	18	(18) from U-shaped 2 Lamps 34/40W to 2' 2 U-Tube Lamps 32W	87 (2) (4)	60 (3)
	19	(19) from U-shaped 2 Lamps 34/40W to 2 Linear 2' 32W + Reflector F17T8	87 (2) (4)	29 (3)
	46	(46) from 8' 4 Lamps 75W to 2 - 4' Lamps 32W + Reflector with 90% BF	256 (3)	55 (2)
ENERGY STAR® Compact Fluorescent Lamps	22	(22) from 40W (A line) to 11W CFL	40 (2)	11 (2)
	23	(23) from 60W (A line) to 13W CFL	60 (2)	13 (2)
	24	(24) from 100W (A line) to 23W CFL	100 (2)	23 (2)
	25	(25) from 150W (A line) to 28W CFL	150 (2)	28 (2)
	26	(26) from 60W PAR 38/30 recessed to 13W CFL PAR 38/30	60 (2)	13 (2)
	27	(27) from 75W PAR 38/30 recessed to 18W CFL PAR 38/30	75 (2)	18 (2)
	28	(28) from 100W PAR 38/30 recessed to 26W CFL PAR 38/30	100 (2)	26 (2)
	29	(29) from 40 - 60W standard incandescent track lighting to 13W CFL	50 (2) (4)	13 (2)
	31	(31) from 75W standard incandescent track lighting to 18W CFL	75 (2)	18 (2)
	33	(33) from 90 Watt Halogen track lighting to 23 to 28 watt CFL Par 38/30	90 (2)	25.5 (2) (4)
	35	(35) from 100W standard incandescent or greater track lighting to 26W CFL	100 (2)	26 (2)
Halogen General Service Lamps	30	(30) from 40 - 60W standard incandescent track lighting to 32 Watt halogen IR MR16 (screw base)	50 (2) (4)	32 (2)
	32	(32) from 75W standard incandescent track lighting to 50 Watt Halogen	75 (2)	50 (2)
	34	(34) from 90 Watt Halogen track lighting to 60 watt Halogen IR	90 (2)	60 (2)
	36	(36) from 100W standard incandescent or greater track lighting to 50-75 watt halogen	100 (2)	62.5 (2) (4)
LED Exit Signs	20	(20) from 2-15W Lamps exit sign to 3W LED exit sign	30 (5)	3 (5)
	21	(21) from 2-15W Lamps exit sign to Replace entire fixture with LED exit sign	30 (5)	3 (5)

2.1.3 Coincident Peak Demand Savings

Coincident peak demand savings will be determined using the procedure specified by the M&A Document. Coincident peak demand savings are calculated for peak periods during both summer and winter peak seasons, using the below equation. KEMA does not recommend any revisions at this time and will utilize the approach specified by the M&A Document.

$$Coincident\ Peak\ Demand\ Savings_{season}(kW) = (CF2_{\text{season}})\left\{\frac{(EULP_{season,period})(Annual\ Energy\ Savings)}{(TOUP\ Hours_{season,period})}\right\}$$

Where,

$CF2_{season}$ = Coincident Factor. This is the ratio of demand at top ten system peak hours to the average peak demand.

$EULP_{season,period}$ = end-use load profile (%). This is the estimated percent of energy savings that will fall into the defined season and period.

TOUP $Hours_{season,period}$ = time-of-use period hours (hrs). This is the number of hours in defined season and period.

The type of variable, assumed values, sources and assumptions for the variables used in the above equation are presented below in Table 50.

Table 50 – Assumed Values for Variables in Lighting Coincident Peak Demand Savings Equation

Variables	Type	Value	Source & Assumptions
$EULP_{season,period}$	Variable, by season	Summer, Peak = 7.1% Winter, Peak = 8.6%	M&A Document, pg 88, Table 2. End-Use is OPA Com Lighting
TOUP $Hours_{season,period}$	Variable, by season	Summer, Peak = 522 hrs Winter, Peak = 602 hrs	M&A Document, pg 88, Table 1. Summer peak is 1100 -1700 weekdays (June – September). Winter peak is 700 – 1100 and 1700 – 2200 weekdays, December – March)
$CF2_{season}$	Variable, by season	Summer = 1.00 Winter = 1.15	M&A Document, pg 90, Table 3. CF2 was selected as recommended by text.

2.2 Hot Water Tank Insulation

2.2.1 Measure Description

This measure involves the installation of a water heater insulation jacket on a water heater with no insulation jacket. It is specified that this is only applicable for electric storage water heaters. The insulation jacket is described as 5/32" barrier bubble film laminated between two layers of foil. Measure 37 specifies that the insulation jacket be installed on tanks between 50 to 119 gallon capacity. Measure 38 specifies installation on tanks between 12 and 40 gallons. This section provides the equations used to calculate energy savings and demand savings for these measures, as well as outlining the assumed values used in each equation.

2.2.2 Algorithms and Variable Definitions

Savings calculations in the M&A Document are incomplete; therefore the savings calculations have been modified. The M&A Document uses the same savings equations for tank insulation as for pipe insulation. This equation is applicable to both technologies; however there are several issues with the way it is applied to tank wrap, such as:

- Thermal conductivity, k, of the pipe insulation is used instead of the water heater insulation jacket, or the base water heater insulation.
- Thermal conductivity, k, values are not provided for the water heater or insulation jacket, nor are any assumptions to derive it.
- The base case outer radius, r_2, should be the outer water heater radius, not the insulation thickness.
- The base case inner radius, r_1 should be the inside radius of the water heater, this value is not provided.

In effect, the thickness of the water heater and the thermal conductivity is unknown. To account for this, instead of using the thickness and thermal conductivity equations, heat loss is described in terms of thermal resistance and surface area.

Savings are calculated per water heater insulated, using the equation series below.

$$\Delta T(°C) = (T_{water} - T_{ambient})$$

$$q_{base}(W) = \left(\frac{A_{base} \Delta T}{R_{heater}} \right)$$

$$q_{insulation}(W) = \left(\frac{A_{insulation} \Delta T}{R_{insulation} + R_{heater}} \right)$$

$$q_{savings}(W) = (q_{base} - q_{insulation})$$

$$Annual\ Energy\ Savings\ (kWh) = \frac{(q_{savings})(DHW\ hours)}{(1{,}000)(Boiler\ Eff)}$$

Where,

T_{water} = temperature of water in the pipe (°C).

$T_{ambient}$ = temperature of the surrounding space (°C).

$R_{insulation}$ = thermal resistance of insulation, R-value (K-m^2/W).

R_{base} = thermal resistance of the water heater, R-value (K-m^2/W).

$q_{insulation}$ = heat loss through insulation and water heater(W).

q_{base} = heat loss through water heater (W).

$A_{insulation}$ = surface area of the insulation (m^2).

A_{base} = surface area of the tank (m^2).

DHW hours = hours that hot water is operating (hr/yr).

2.2.3 Summary of Algorithm Inputs

Table 51 summarizes the values for variables used in the equations above.

Table 51 – Assumed Values for Variables from Equation Series in Section 2.1.2

Variables	Type	Value	Source & Assumptions
T_{water}	Fixed	55°C	M&A Document
$T_{ambient}$	Fixed	21.1°C	M&A Document
$A_{insulation}$	Variable, by tank volume	See Table 52	Calculated, 2π x r x h, where h is tank height, r is tank radius + insulation thickness. M&A Document assumption that tank height is 1.6 m, and insulation thickness is 0.0924m. Tank radius is square root((tank volume/(tank height x π))
A_{base}	Variable, by tank volume	See Table 52	Calculated, 2π x r x h, where h is tank height, r is tank radius. M&A Document assumption that tank height is 1.6 m. Tank radius is square root((tank volume/(tank height x π))
DHW hours	Fixed	8,760 hrs/yr	Assume no temperature setback, and heaters are on 24 hours/day and 365 days/year. M&A Document

			assumes hours that business type used hot water, however heat loss occurs during standby as well
R_{base}	Fixed	4 °F-ft^2-h/BTU (or 0.705 K-m^2/W)	Assumed. M&A Document did not provide R_{base} or k, only that no insulation jacket is present. However, there is some insulation built in to the water heater, this is usually accounted for in the Energy Factor, although estimating this value would require assumptions about vintage and further research. Therefore R_{base} is estimated
$R_{insulation}$	Fixed	12 °F-ft^2-h/BTU (or 2.11 K-m^2/W)	M&A Document
Boiler Eff.	Fixed	0.95	M&A Document

The SCDI program includes two separate water heater insulation jacket measures. These are differentiated by the tank capacity. Measure 37 is for tanks that are 50 to 119 gallons. Measure 38 is for tanks that are 12 to 40 gallons. As tank size is not tracked, the savings values are estimated for each measure as an average of the common tanks sizes in Table 52. This average is an estimate, and field research of retrofitted water heater sizes is needed to improve accuracy, as the savings vary significantly across tank sizes.[36] OPA may also consider requiring tank size to be specified on the work order.

Table 52 – Estimated Savings for Tank Wrap Measures

Measure Number	Capacity (gallons)	A_{base} (m^2)	$A_{insulation}$ (m^2)	Annual Energy Savings (kWh)	Average Annual Energy Savings (kWh)
37	119	3.0	3.9	898.4	700.0
	80	2.5	3.4	718.1	
	65	2.2	3.1	637.2	
	50	2.0	2.9	546.3	
38	40	1.7	2.7	477.8	350.2
	30	1.5	2.4	400.0	
	20	1.2	2.2	307.8	
	12	1.0	1.9	215.3	

2.2.4 Coincident Peak Demand Savings

Coincident peak demand savings will be determined using the procedure specified by the M&A Document. Coincident peak demand savings are calculated for peak periods during both

[36] This may be conducted as part of a future infield measurement and verification (M&V) study

summer and winter peak seasons, using the below equation. KEMA does not recommend any revisions at this time and will utilize the approach specified by the M&A Document.

$$Coincident\ Peak\ Demand\ Savings_{season}(kW) = (CF2_{season})\left\{\frac{(EULP_{season,period})(Annual\ Energy\ Savings)}{(TOUP\ Hours_{season,period})}\right\}$$

Where,

$CF2_{season}$ = Coincident Factor. This is the ratio of demand at top ten system peak hours to the average peak demand.

$EULP_{season,period}$ = end-use load profile (%). This is the estimated percent of energy savings that will fall into the defined season and period.

TOUP $Hours_{season,period}$ = time-of-use period hours (hrs). This is the number of hours in defined season and period.

The type of variable, assumed values, sources and assumptions for the variables used in the above equation are presented below in Table 53.

Table 53 – Assumed Values for Variables in Tank Wrap Coincident Peak Demand Savings Equation

Variables	Type	Value	Source & Assumptions
$EULP_{season,period}$	Variable, by season	Summer, Peak = 5.6% Winter, Peak = 9.2%	M&A Document, pg 88, Table 2. End-Use is OPA Com Water Heating
TOUP $Hours_{season,period}$	Variable, by season	Summer, Peak = 522 hrs Winter, Peak = 602 hrs	M&A Document, pg 88, Table 1. Summer peak is 1100 -1700 weekdays (June – September). Winter peak is 700 – 1100 and 1700 – 2200 weekdays, December – March)
$CF2_{season}$	Variable, by season	Summer = 1.00 Winter = 1.11	M&A Document, pg 90, Table 3. CF2 was selected as recommended by text.

2.3 Pipe Insulation

2.3.1 Measure Description

This measure involves the installation of pipe insulation on a hot water pipe with no insulation. Pipe insulation is only applicable if water is heated with an electric storage water heater. Measure 39 specifies the installation of 10ft flexible polyethylene insulation on outlet pipe for 0.75 inch and 1.2 inch pipe diameters. However this pipe diameter is not consistent with the description outlined in the M&A Document, where pipe diameters are either less than 40 mm or greater than 40 mm. The pipe insulation savings estimates are based on an equal distribution of 0.75 and 1.2 inch pipe diameters across program participants who received this measure. This section provides the equations used to calculate energy savings and demand savings for these measure types, outlining the assumed values for each.

2.3.2 Algorithms and Variable definitions

Savings calculations in the M&A Document are incomplete; however impact savings use a similar approach. The M&A Document uses a similar savings equation to calculate the heat loss for both the base case (pipe with no insulation) and the retrofit case (pipe with insulation). However, there are several problems with the way the equation is applied, as follows:

- Thermal conductivity, k, of the pipe material is not the same as the insulation, however, the same value is used for both
- Thermal conductivity, k, of the pipe material is not provided, nor are any assumptions to derive it
- The base case outer radius, r_2 should be the outer pipe radius, not the insulation thickness
- The base case inner radius, r_1, should be the inside radius of the pipe, not the outer pipe radius.

Savings are calculated per unit, using the equation series below. Program documentation defines one unit as 10 feet of insulation.[37]

$$\Delta T(^{\circ}C) = (T_{water} - T_{ambient})$$

[37] Note that this is an awkward unit definition, as accessible exposed pipes are typically much less than 10 feet in length.

$$q_{insulation}(W/m) = \left(\frac{2\pi k \Delta T}{\ln\left(\frac{r_2}{r_1}\right)} \right)$$

$$q_{savings}(W/m) = (q_{base} - q_{insulation})$$

$$Annual\ Energy\ Savings\ (kWh) = \frac{(3.05m)}{(unit)} \frac{(q_{savings})DHW\ hours}{(1{,}000)(Boiler\ Eff)}$$

Where,

$q_{insulation}$ = heat loss through insulation (W/m).

q_{base} = heat loss through bare pipe (W/m).

k = thermal conductivity of insulation (W/m-K)

T_{water} = The temperature of water in the pipe (°C).

$T_{ambient}$ = The temperature of the surrounding space (°C).

r_2 = outside radius of insulation (mm).

r_1 = inside radius of insulation (mm). This is the same value as the outer pipe diameter.

DHW hours = hours that hot water is in pipes (hr/yr). This value depends on the business type.

Boiler Eff. = the efficiency of the boiler.

2.3.3 Summary of Algorithm Inputs

Two scenarios are presented in the program tracking database. The program tracking database defines the pipe diameter as 0.75 inch or 1.2 inch diameter pipe; therefore the table below outlines different values for several of the variables, for each case. These inputs are summarized below in Table 54. A diameter of 1.2 inches is not a standard size, therefore 1.25 inches is used instead.

Table 54 – Assumed Values for Variables from Equation Series in Section 2.3.2

Variables	Type	Value		Source & Assumptions
q_{base}	Fixed	38.36 W/m (0.75 inch diameter) 57.0 W/m (1.25 inch diameter)		Values looked up from heat loss of a bare pipe (http://www.engineeringtoolbox.com/copper-pipe-heat-loss-d_19.html). The M&A Document did not provide information necessary to calculate this value. Therefore heat loss was looked up using a table.
k	Fixed	0.042 W/m-K		M&A Document
T_{water}	Fixed	55°C		M&A Document
$T_{ambient}$	Fixed	21.1°C		M&A Document
r_1	Fixed	10.7 mm (0.75 inch diameter) 17.5 mm (1.25 inch diameter)		Assumed copper pipe schedule M, Nominal Pipe size 0.75 inches, and 1.25 inches.
r_2	Fixed	$r_2 = r_1$ + insulation thickness r_2 = 23.1 mm (0.75 inch diameter) r_2 =29.5 mm (1.25 inch diameter)		M&A Document provided insulation thickness (12 mm)
Boiler Eff.	Fixed	0.95		M&A Document
DHW hours	Variable, by business type	Convenience Stores	2,077	M&A Document
		Grocery	2,077	
		Office	2,353	
		Bakery	2,077	
		Restaurant	2,077	
		Retail	2,077	
		Service	2,077	
		Other	3,749	

As described in Table 54 above, the base case heat loss (q_{base}) was determined from a look-up table, because the M&A Document provided insufficient guidance for estimating the heat loss of the bare pipe.

For the retrofitted heat loss, it is assumed that the insulating properties of the metal pipe itself are negligible. This is a good assumption as the thermal resistance and heat loss will be dominated by the installed insulation.

When Measure 39 is entered in the Program Tracking Database, no information is provided to differentiate between the two pipe diameter scenarios, so the average energy savings of 0.75

inch pipe insulation and 1.25 inch pipe insulation is assumed for measure energy savings.. A summary of savings per unit (1 unit = 10 ft of pipe insulation) are provided in Table 55 below.

Table 55 – Savings Estimates for Pipe Wrap Measures

Business Type	Annual Energy Savings 0.75 inch pipe (kWh)	Annual Energy Savings 1.25 inch pipe (kWh)	Average Annual Energy Savings (kWh)
Convenience Stores	178.16	265.9	222.0
Grocery	178.2	265.9	222.0
Office	201.8	301.2	251.5
Bakery	178.2	265.9	222.0
Restaurant	178.2	265.9	222.0
Retail	178.2	265.9	222.0
Service	178.2	265.9	222.0
Other	321.6	479.9	400.7

2.3.4 Coincident Peak Demand Savings

Coincident peak demand savings will be determined using the procedure specified by the M&A Document. Coincident peak demand savings are calculated for peak periods during both summer and winter peak seasons, using the below equation. KEMA does not recommend any revisions at this time and will utilize the approach specified by the M&A Document.

$$Coincident\ \ Peak\ \ Demand\ \ Savings_{season}(kW) = (CF2_{\text{season}})\left\{\frac{(EULP_{season,\,period})(Annual\ \ Energy\ \ Savings)}{(TOUP\ Hours_{season,\,period})}\right\}$$

Where,

$CF2_{season}$ = Coincident Factor. This is the ratio of demand at top ten system peak hours to the average peak demand.

$EULP_{season,period}$ = end-use load profile (%). This is the estimated percent of energy savings that will fall into the defined season and period.

TOUP $Hours_{season,period}$ = time-of-use period hours (hrs). This is the number of hours in defined season and period.

The type of variable, assumed values, sources and assumptions for the variables used in the above equation are presented below in Table 56.

Table 56 – Assumed Values for Variables in Pipe Wrap Coincident Peak Demand Savings Equation

Variables	Type	Value	Source & Assumptions
$EULP_{season,period}$	Variable, by season	Summer, Peak = 5.6% Winter, Peak = 9.2%	M&A Document, pg 88, Table 2. End-Use is OPA Com Water Heating
TOUP $Hours_{season,period}$	Variable, by season	Summer, Peak = 522 hrs Winter, Peak = 602 hrs	M&A Document, pg 88, Table 1. Summer peak is 1100 -1700 weekdays (June – September). Winter peak is 700 – 1100 and 1700 – 2200 weekdays, December – March)
$CF2_{season}$	Variable, by season	Summer = 1.00 Winter = 1.11	M&A Document, pg 90, Table 3. CF2 was selected as recommended by text.

2.4 Low Flow Faucet Aerators

2.4.1 Measure Description

This measure involves the installation of low flow aerators (Measure 40). Low flow aerators are only applicable if water is heated with an electric storage water heater. The measure is described as an aerator with an average flow of 1.5 gallons per minute (gpm) replacing a faucet with an average flow of 2.75 gpm. This section provides the equations used to calculate energy savings and demand savings for this measure as well as outlining the assumed values used in the equations.

2.4.2 Algorithms and Variable definitions

Impact savings calculations in the M&A Document are incomplete; however the approach is still similar. The M&A Document provides the domestic hot water usage per N, $DHW_{per\ N}$, where N is the means of determining the domestic hot water usage for a site or faucet. The units of N depends on business type (for example, for an convenience store, N = employee). However, no values are included in the M&A document. Therefore, it is not possible to determine the domestic hot water usage for a given faucet or site. N has been redefined as the count of unique units per 1,000 ft^2 of floor area (for example, convenience stores have 1 employee/1,000ft^2). The average area by a business type then becomes the basis for determining the number of Ns per business. Thus, savings are calculated on a per business basis, not a per faucet basis. A faucet adjustment factor was introduced to account for a proportion of faucets not retrofitted.

The following equations are used to determine energy savings:

$$\text{DHW}_{\text{reduction}}\ (\%) = \frac{(Flow\ Rate_{base} - Flow\ Rate_{aerator})}{(Flow\ Rate_{base})}$$

$$\text{DHW}\ Use_{\text{base}}(l/day) = (DHW_{per\ N})(N)\left[\frac{Ave\ Area}{1{,}000}\right]$$

$$\text{DHW}\ Use_{efficient}(l/day) = (\text{DHW}\ Use_{base})(1 - DHW_{reduction})$$

$$kWh_{base}\ (kWh/yr) = \frac{(DHW\ Use_{base})(Cp_{water})(\rho_{water})(\Delta T_{water})(Days)}{(Boiler\ Eff)}$$

$$kWh_{efficient}\ (kWh/yr) = \frac{(DHW\ Use_{efficient})(Cp_{water})(\rho_{water})(\Delta T_{water})(Days)}{(Boiler\ Eff)}$$

$$Annual\ Energy\ Savings\ (kWh) = (Faucet\ Adjustment)\left((kWh_{base}) - (kWh_{efficient})\right)$$

Where,

$DHW_{reduction}$ = domestic hot water reduction (%).

$Flow\ Rate_{base}$ = flow rate of base faucet (l/min).

$Flow\ Rate_{arator}$ = flow rate of base faucet (l/min).

$DHW\ Use_{base}$ = domestic hot water used for base case (l/day).

$DHW_{per\ N}$ = total domestic hot water used, for a given N (l/day).

N = The quantity of unique units per 1,000 ft^2. The unique unit definition depends on business type (for example, for offices N = number of employees per 1,000 ft^2)

Ave Area = average floor area for a given business type (ft^2)

$DHW\ Use_{efficient}$ = domestic hot water used with low flow faucet aerators (l/day).

kWh_{base} = base energy usage (kWh/yr).

Cp_{water} = Specific heat of water (kWh/kg-C). Constant, 4.18 (kJ/kg-C), or 0.00116 (kWh/kg-C)

ρ_{water} = density of water (kg/l). constant, 1,000 (kg/m^3) or 1 (kg/l).

ΔT_{water} = The average water temperature rise in the boiler (°C).

Days = the number of days that the faucets are used, depending on business type (days/yr).

Boiler Eff. = the efficiency of the boiler.

Faucet Adjustment Factor = This is to account for faucets that were not retrofitted.

2.4.3 Summary of Algorithm Inputs

A summary of the Inputs are provided below, in Table 57.

Table 57 -- Assumed Values for Variables from Equation Series in Section 2.4.2

Variables	Type	Value		Source & Assumptions
Flow Rate$_{base}$	Fixed	8.3 l/m		M&A Document
Flow Rate$_{arator}$	Fixed	5.7 l/m		M&A Document
$DHW_{per\ N}$	Variable, by business type	Convenience Stores	7.6 l/Employee-days	Values taken from M&A Document, where possible. Otherwise, values taken from Arkansas Deemed Savings Quick Start Program Draft Report Commercial Measures, 2007[38]
		Grocery	7.6 l/Employee-days	
		Office	3.8 l/Employee-days	
		Bakery	7.6 l/Employee-days	
		Restaurant	0.5 l/meals/day-days	
		Retail	7.6 l/Employee-days	
		Service	7.6 l/Employee-days	
		Other	3.8 l/Employee-days	
N	Variable, by business type	Convenience Stores	1 Employee/1,000 ft^2	Arkansas Deemed Savings Quick Start Program Draft Report Commercial Measures, 2007
		Grocery	1 Employee/1,000 ft^2	
		Office	2.3 Employees/1,000 ft^2	
		Bakery	1 Employee/1,000 ft^2	
		Restaurant	340 meals/day-1,000ft^2	
		Retail	1 Employee/1,000 ft^2	
		Service	1 Employee/1,000 ft^2	
		Other	0.7 Employees/1,000 ft^2	
Ave Area	Variable, by business type	Convenience Stores	4,375 ft^2	CATI Results, average by business type
		Grocery	4,375 ft^2	
		Office	7,005 ft^2	
		Bakery	9,944 ft^2	
		Restaurant	9,944 ft^2	
		Retail	9,944 ft^2	
		Service	10,237 ft^2	
		Other	9,276 ft^2	
Days	Variable, by business type	Convenience Stores	365 days/yr	Values not included in M&A Document. Values taken from Arkansas Deemed Savings Quick Start Program Draft Report Commercial Measures, 2007
		Grocery	365 days/yr	
		Office	250 days/yr	
		Bakery	365 days/yr	
		Restaurant	365 days/yr	
		Retail	365 days/yr	
		Service	365 days/yr	
		Other	250 days/yr	
ΔT_{water}	Fixed	44°C		M&A Document

[38] Arkansas Deemed Savings Quick Start Program Draft Report Commercial Measures, 2007, Tables 2-45 and 2-46, page 2-70. Contained in Docket available at http://www.apscservices.info/EFilings/Docket_Search_Documents.asp?Docket=06-004-R&DocNumVal=94

Boiler Eff.	Fixed	0.95	M&A Document
Faucet Adjustment	Fixed	0.75	Estimated

Based on the assumptions outlined above in Table 57, the annual energy savings are summarized below, in kWh per business, in Table 58:

Table 58 – Estimated Energy Savings for Low Flow Faucet Aerators

Business Type	Annual Energy Savings (kWh/business)
Convenience Stores	152.6
Grocery	152.6
Office	193.2
Bakery	346.8
Restaurant	7,788.4
Retail	346.8
Service	357.0
Other	77.9

2.4.4 Coincident Peak Demand Savings

Coincident peak demand savings will be determined using the procedure specified by the M&A Document. Coincident peak demand savings are calculated for peak periods during both summer and winter peak seasons, using the below equation. KEMA does not recommend any revisions at this time and will utilize the approach specified by the M&A Document.

$$Coincident\ Peak\ Demand\ Savings_{season}(kW) = (CF2_{\text{season}})\left\{\frac{(EULP_{season,\,period})(Annual\ Energy\ Savings)}{(TOUP\ Hours_{season,\,period})}\right\}$$

Where,

$CF2_{season}$ = Coincident Factor. This is the ratio of demand at top ten system peak hours to the average peak demand.

$EULP_{season,period}$ = end-use load profile (%). This is the estimated percent of energy savings that will fall into the defined season and period.

TOUP $Hours_{season,period}$ = time-of-use period hours (hrs). This is the number of hours in defined season and period.

The type of variable, assumed values, sources and assumptions for the variables used in the above equation are presented below in Table 59.

Table 59 – Assumed Values for Variables in Low Flow Faucet Aerator Coincident Peak Demand Savings Equation

Variables	Type	Value	Source & Assumptions
$EULP_{season,period}$	Variable, by season	Summer, Peak = 5.6% Winter, Peak = 9.2%	M&A Document, pg 88, Table 2. End-Use is OPA Com Water Heating
TOUP $Hours_{season,period}$	Variable, by season	Summer, Peak = 522 hrs Winter, Peak = 602 hrs	M&A Document, pg 88, table 1. Summer peak is 1100 -1700 weekdays (June – September). Winter peak is 700 – 1100 and 1700 – 2200 weekdays, December – March)
$CF2_{season}$	Variable, by season	Summer = 1.00 Winter = 1.11	M&A Document, pg 90, table 3. CF@ was selected as recommended by text.

3. Measure Cost Review

As a direct install program, actual cost of the retrofit measures is the basis for this review instead of incremental cost. This is because it is most likely with the direct install model that measures are early replacement, and thus the participant was not looking to install similar measures at the same time. Direct install promotes early replacement because the participant is typically approached regarding the installation, as opposed to the customer actively searching for the measures. For this program, the "incremental cost" is assumed to be equal to the actual cost.

For the purpose of this cost evaluation, only material costs are presented (no labor costs are associated). In the OPA M&A document, costs for these measures were found to be listed in US dollars, so this PIA review contains cost information in US dollars as well. Since measure cost numbers tend to be difficult to pinpoint anyways, it may not be necessary to correct for the difference in cost (~15%) resulting from the exchange rate.

KEMA's approach was to review the data sources cited by OPA to develop measure costs, and assessed the reasonableness of the original source. The Database for Energy Efficient Resources (DEER2008)[39] was found to have detailed measure cost for most SCDIP measures. We also reviewed the preliminary draft of KEMA's State of Wisconsin Focus on Energy

[39] http://www.deeresources.com/index.php?option=com_content&view=article&id=65&Itemid=57

Evaluation Incremental Cost Study (Wisconsin Study)[40] for overall reasonableness of OPA and DEER2008 measure costs.

3.1 T8 Light Measures

For T8 Measure Cost, the M&A Document cites a Consortium for Energy Efficiency (CEE) Commercial Lighting Systems Initiative document[41]. This document only provides estimated cost of $20 - $26 for 4-foot, 2-lamp fixtures (depending on premium or standard level T8s), and thus is not completely representative of the products installed in the OPA SCDIP.

Cost values for the range of SCDIP measures were obtained from two internet sources: www.1000bulbs.com and www.ballastwise.com, which carry lamps and ballast prices from different lighting manufacturers. Average costs were derived from these sources. Table 60 summarizes the measure costs values, as reviewed by KEMA.

Table 60: Measure Costs of T8 Retrofits

Description	OPA M&A Document[42]	KEMA Review	Source
2, 4ft T8 (80% BF)	$26	$27.70	Internet sources
1, 8ft T8 (80% BF)	Not Available	$33.96	DEER 2008
2, 4ft T8 (90% BF)	$20	$27.70	Internet sources
4, 4ft T8 (80% BF)	Not Available	$37.60	Internet sources
2, 4ft T8 w/Reflector (90% BF)	Not Available	$27.70	Internet sources
4, 4ft T8 (80% BF)	Not Available	$37.60	Internet sources
2, 4ft T8 w/Reflector (90% BF)	Not Available	$27.70	Internet sources
1, 4ft T8 (80% BF)	Not Available	$25.50	Internet sources
1, 4ft T8 w/Reflector (90% BF)	Not Available	$25.50	Internet sources
2, 4ft T8 (80% BF)	$26	$27.70	Internet sources
2, 4ft T8 w/Reflector (90% BF?)	Not Available	$27.70	Internet sources
4, 4ft T8 (80% BF)	Not Available	$33.96	Internet sources
1, 4ft T8 (80% BF)	Not Available	$27.70	Internet sources
1, 4ft T8 w/Reflector (90% BF)	Not Available	$37.60	Internet sources

[40] Focus on Energy Evaluation. Business Programs: Incremental Cost Study. To be completed for State of Wisconsin Public Service Commission. Draft report will be available for public comment in August 2009.
[41] http://www.cee1.org/com/com-lt/com-lt-id.pdf
[42] Source: Consortium for Energy Efficiency. http://www.cee1.org/com/com-lt/com-lt-id.pdf

2, 4ft T8 (80% BF)	$26	$27.70	Internet sources
2, 4ft T8 w/Reflector (90% BF?)	Not Available	$27.70	Internet sources
4, 4ft T8 (80% BF)	Not Available	$37.60	Internet sources
2, 2ft U-tube T8	Not Available	$23.60	DEER 2008
2, 2ft T8 w/Reflector	Not Available	$58.17	DEER 2008

3.2 Compact Fluorescent Lamps (CFLs)

For compact fluorescent lamps (CFLs), the M&A Document cites the ENERGY STAR website, which has one assumed value for all wattages and styles of CFL. This is part of an ENERGY STAR cost analysis tool, and is not applicable to the diversity of products in the OPA SCDIP.

Retail CFL pricing has been documented by Glacier Consulting[43] and found a substantial decrease in price per lamp when purchased in multipacks with price per lamp. The Glacier study showed that the average CFL was sold in a multipack of 6.61 lamps, with each bulb costing approximately $1.85. This price per bulb in a pack was substantially lower than the price for a single bulb.

The 2008 revised Database for Energy Efficient Resources (DEER2008) also has detailed retrofit cost information for CFLs of various wattages and types (standard lamps and reflector-style lamps), listed below in Table 61. DEER provides measure costs specifically applicable do direct install programs. KEMA referenced the "direct installation measures, only material cost" field of the database to collect the CFL measure costs.

Additional measure costs were obtained from two internet sources: www.1000bulbs.com and www.ballastwise.com, which carry lamps and ballast prices from different lighting manufacturers. Average costs were derived from these sources.

Table 61: Measure Cost of CFLs

CFLs, by wattage and style	OPA M&A Document[44]	KEMA Review	Source
11W Standard CFL	$3.50	$4.30	Internet sources

[43] Winch, Rick and Tom Talerico, "Second Annual Comprehensive CFL Market Effects Study – Final Report", Glacier Consulting Group, LLC, September 30, 2008

[44] ENERGY STAR. http://www.energystar.gov/index.cfm?c=cfls.pr_cfls

13W Standard CFL	$3.50	$4.00	Internet sources
23W Standard CFL	$3.50	$5.60	Internet sources
28W Standard CFL	$3.50	$8.00	Internet sources
13W Reflector CFL	$3.50	$12.11	DEER 2008
18W Reflector CFL	$3.50	$12.73	DEER 2008
26W Reflector CFL	$3.50	$14.17	DEER 2008
13W Flood CFL	$3.50	$12.11	DEER 2008
18W Flood CFL	$3.50	$12.73	DEER 2008
23-28W Flood CFL (25W used)	$3.50	$14.17	DEER 2008
26W Flood CFL (25W used)	$3.50	$14.17	DEER 2008

In addressing stakeholder concern that DEER costs are too high, the DEER staff provide the following response on their website: "DEER costs are intended to represent a reasonable cost that an end use customer would pay for a device. As such, the costs presented for direct installation programs are based on customer invoice costs, before any program cost reduction is applied and represent a reasonable average based on a review of seven direct installation programs. The costs presented in the DEER database accurately reflect what customers pay for lighting equipment installed through various program delivery methods. We also recognize that cost vary between programs operating within a specific program delivery method, such as direct installation programs, and that margins on material may vary from contractor to contractor."

Although DEER values are found to be on the high side, they appear to be most applicable to the direct install conditions and have undergone substantial peer review. KEMA recommends utilizing the DEER measure cost values.

3.3 Halogen Lamps

For Halogen General Service Lamps, the M&A Document cites a report by Marbek Resources, Ltd[45]. This report was unavailable to KEMA, so the values cannot be corroborated. However, the M&A Document lists the price of Halogens at $7, which is reasonable. Since very few energy efficiency programs have done direct installation projects with Halogen general service lamps, there is very little documentation regarding their price. As summarized below in Table 62, preliminary analysis of prices listed on popular lighting retailer websites suggests that $7/lamp is accurate for the purposes of the OPA SCDIP.

[45] Marbek Resources Ltd., "ERIP Lighting Technology Review and Custom Lighting Calculation Methodology and Tool Development: Final Report", November 2008.

Table 62: Measure Cost of Halogen Lamps

LED Exit Signs	OPA M&A Document	KEMA Review
Measure Cost	$7	$7
Source	Marbek Resources[46]	Review of retail distributors support this estimate

3.4 LED Exit Signs

For LED exit sign measure cost, the M&A Document cites the ENERGY STAR website. The value cited could not be found, but another value in an ENERGY STAR cost analysis tool listed on the referenced web page was found to be $39. In any case, the value cited by the M&A document is not the most current or accurate value. For LED exit signs, the retrofit cost listed in the 2008 revised Database for Energy Efficient Resources (DEER2008) is $38.34. A comparison of the values and sources are shown below in Table 63.

Table 63: Measure Cost of LED Exit Signs

LED Exit Signs	OPA M&A Document	KEMA Review
Measure Cost	$57	$38.34
Source	ENERGY STAR[47]	DEER2008[48]

3.5 Water Heater Tank Insulation & Pipe Insulation

For water heater tank insulation and pipe insulation, the M&A Document cites PG&E workpapers from June 13, 2005. KEMA reviewed PG&E's 2005 workpapers, and did not find the savings values listed by the OPA. The 2008 revised Database for Energy Efficient Resources (DEER2008) has detailed retrofit cost information for both tank insulation and pipe insulation measures. For 1 inch thick tank insulation, for both low and high temperature situations, the cost of nonresidential tank insulation is listed at $23.25.

For pipe insulation, the most appropriate value is listed in DEER2008 as a residential measure. The nonresidential measure is for pipes with diameter larger than 2 inches, which is seldom

[46] http://www.energystar.gov/index.cfm?c=exit_signs.pr_exit_signs
[47] http://www.energystar.gov/index.cfm?c=exit_signs.pr_exit_signs
[48] http://www.deeresources.com/index.php?option=com_content&view=article&id=65&Itemid=57

found in the small commercial sector. For pipe insulation, the measure cost listed in DEER2008 is $0.88 per linear foot. All values and sources are listed below in 3.5

Table 64: Measure Cost of Water Heater Tank Insulation and Pipe Insulation

Insulation	OPA M&A Document	KEMA Review
Tank	$0.36 per sq ft	$23.25 per tank
Pipe	$0.36 per sq ft	$0.88 per linear ft
Source	PG&E Workpapers[49]	DEER2008[50]

3.6 Low Flow Faucet Aerators

For low flow faucet aerators, the M&A document claims that the measure cost is between $0.50 and $5.00. The referenced source (a Penn State School of Forest Resources document) actually claims that, “A low-flow faucet aerator installed on existing faucets will cost $0.50 to $3”. However, rather than revise the measure cost to reflect the values in the cited source, KEMA recommends that 2005 DEER Cost Values be used. The 2005 DEER Cost Values (this measure was removed from DEER 2008) list the price of a low flow faucet aerator at $7.12 for low volume purchases and $2.14 for high volume purchases. DEER defines “high volume purchases” as, “A quantity purchase that may result in a discount on the price”. KEMA recommends using the high volume purchase value because the direct install model requires contractor installation, and contractors typically purchase equipment in quantities that may result in a discounted price.

Table 65: Measure Cost of Low Flow Faucet Aerator

Low Flow Faucet Aerator	OPA M&A Document	KEMA Review
Measure Cost	$0.50 - $5	$2.14
Source	Penn State[51]	2005 DEER[52]

[49] PG&E Workpapers, June 13, 2005.
[50] http://www.deeresources.com/index.php?option=com_content&view=article&id=65&Itemid=57
[51] http://pubs.cas.psu.edu/FreePubs/pdfs/XH0004.pdf
[52] http://www.deeresources.com/index.php?option=com_content&view=category&layout=blog&id=36& Itemid=53

3.7 Conclusions

Almost all of the measure cost information identified was based on U.S. studies. Ontario Power Authority may consider sponsoring a measure cost study to assess whether prices are similar enough between the two countries to warrant the continued use of U.S. based costs.

Appendix D – Description of Net-to-Gross Methodology

Evaluators in California have developed an algorithm for calculating free-ridership based on a "Self-Report Approach" (SRA). This algorithm and a modified series of questions are the basis for KEMA's net-to-gross assessment of the OPA's Small Commercial Direct Install (SCDI) Program.

KEMA conducted a CATI survey for both the process and impact evaluation of the OPA SCDI Program. Within the survey are multiple different approaches for quantifying free-ridership as part of the impact evaluation. These different approaches allow the evaluator to understand the opinions, motivations, and actions of the program participants. The main components of the free-ridership assessment include a series of yes/no questions and a series of 0-10 questions, all geared towards understanding the efficiency, quantity and timing factors of their theoretical decision-making in absence of the program influence.

Free-ridership is characterized as the proportion of a project's or program's net energy savings that are not the direct result of the program's activities and influence. Each project is given a free-ridership rate of $0 \leq FR \leq 1$. The resulting project level net-to-gross ration is $1 - FR$. Therefore, the net-to-gross ratio represents the proportion of project-level net savings directly attributable to the program efforts. When weighted to the population, the net-to-gross ratio represents the proportion of program-level net savings directly attributable to the program efforts.

To quantify free-ridership – and therefore determine net-to-gross – participant responses to CATI questions are coded between 0 and 1, and then combined and averaged based on the following algorithm description.

Algorithm Description

KEMA used a telephone survey of program participants to gather data for the algorithm. This section references specific questions listed in the survey tool, which can be found in Appendix F.

The following questions and coinciding step-by-step description of the algorithm outline the methodology KEMA used in determining free-ridership based on survey responses. The overall outcome from section A is combined with results from section B to calculate the ultimate free-ridership rate for each participant.

A. MEASURES BASED ON YES/NO QUESTIONS

1. Yes / No Questions that Directly Determine Free-ridership

Question FR1 determines what actions the participant had already taken towards installation of the energy efficient equipment that they ultimately received through the program. The question states the following:

FR1. At the time that you first heard about the assistance through **<LDC_NAME>**'s Power Saving Blitz Program, had you…?

1. Already been thinking about purchasing this/these type(s) of equipment?
2. Already begun to collect information about this/these type(s) of equipment?

3a. Already selected the equipment you were going to get (for participants with lighting measures and/or low flow faucet aerators)?

3b. Already decided to buy the insulation wrap (for participants with pipe wrap and/or tank wrap)?

4. Already installed the energy efficient equipment?

If a participant responded "Yes" to number 4 – they had already purchased the energy efficient equipment – they would be considered free-riders based on the yes/no questions. This is very unlikely due to the nature of direct install programs.

Question FR4A determines whether or not the participant would have purchased the same type of equipment at all in absence of the program. The question states the following:

FR4A. If the assistance from **<LDC_NAME>**'s Power Saving Blitz Program had not been available, would you still have purchased this/these type(s) of equipment?

1. Yes
2. No

If a participant would not have bought the same type of equipment at all without the program, then they are not considered free-riders at all, based on the yes/no questions.

If the free-ridership yes/no factor has not already been determined based on the above series of questions and answers, then it is determined based on efficiency, quantity, and timing factors, outlined below in section 2.

2. Calculation of Efficiency, Quantity, and Timing Factors Based on Yes / No Questions

The results from a series of Yes / No questions, and follow-up questions when more information is needed, allow the quantification of efficiency, quantity, and timing factors. These factors are multiplied together in order to determine the free-ridership yes/no factor, if not already determined from the above yes/no questions that directly determine free-ridership.

Question FR4D determines the efficiency of the equipment the participant would have purchased in absences of the program. The question states the following:

> FR4D. If the assistance from **<LDC_NAME>**'s Power Saving Blitz Program had not been available, would you still have purchased the same quantity as you received through the program?
>
> 1. Yes
> 2. No

If a participant would have installed less efficient equipment in absence of the program, then the participant is not a free-rider based on the efficiency factor. If they would have installed the same equipment at the same level of efficiency (or more efficient), then the participant is a free-rider based on the efficiency factor.

Question FR4C determines if the participant would have installed the same quantity of equipment in absences of the program. If not, the follow up question FR4C1 determines if they would have bought more or less equipment. The questions state the following:

> FR4C. If the assistance from **<LDC_NAME>**'s Power Saving Blitz Program had not been available, would you have purchased the same quantity as you did?
>
> 1. Yes
> 2. No (skip FR4C1)
>
> FR4C1. Would you have bought more or less?
>
> 1. Yes
> 2. No

If a participant would have installed the same amount of equipment in absence of the program, then they are not a free-rider in this sense. If the program influenced them to install more equipment, then they are a partial free-rider based on the quantity factor. If they would have

purchased less equipment without the program, then they are not a free-rider, based on the quantity they received.

Question FR4B determines if the participant would have purchased and had the equipment installed at the same time as they did with the program. The follow up questions, FR4B1 and FR4B2, determine if they would have purchased the equipment earlier or later without the program, and by how many years and months. Question FR3 also plays a roll, because the participant's decision making process would be different if they had to change their existing plans (if they had existing plans) to install certain equipment in order to fit the program. The questions state the following:

FR4B. If the assistance from **<LDC_NAME>**'s Power Saving Blitz Program had not been available, would you have purchased this/these type(s) of equipment at the same time as you did?

1. Yes (skip FR4B1 and FR4B2)
2. No

FR4B1. If the assistance from **<LDC_NAME>**'s Power Saving Blitz Program had not been available, would you have bought this/these type(s) of equipment earlier than you did, or later?

1. Earlier
2. Same Time (repeat FR4B)
3. Later

FR4B2. How much **[earlier/later]** would you have bought this/these type(s) of equipment?

_____ Years [AND/OR] _____Months

FR3. Did you have to make any changes to your existing plans in order to receive this assistance through **<LDC_NAME>**'s Power Saving Blitz Program?

1. Yes
2. No

If a participant would have purchased the same type of equipment earlier or at the same time as it was provided by the program, then they are free-riders based on the timing/acceleration factor. If the program influenced them to install the equipment before they would have in absence of the program, it is important to understand how long it would have taken them to naturally install the equipment. If a participant had to change their pre-existing plans to install the type of equipment that the program provided them, the free-ridership timing/acceleration factor accounts for this by giving a partial free-ridership score $0 \leq FR \leq 1$, based on *1 – (the*

amount of time it would have taken / 2 years, the typical acceleration window). If they did not have to change their plans at all, and would have installed the equipment within the two year acceleration window, then they are free-riders, based on the timing factor. If they did not have to change their plans but would have installed it much later (over 2 years), then they are not considered free-riders.

The final free-ridership yes/no factor is either the result of section 1 – they either already had the equipment and are considered free-riders, or they had no plan to install this type of equipment and are not at all free-riders – or the product of the efficiency factor, quantity factor, and timing factor (scores are all $0 \leq FR \leq 1$). The result from this section will be included in the final free-ridership estimation, explained at the end of this appendix. For simplicity, the free-ridership yes/no factor is referenced as F[Y/N] in subsequent sections.

B. MEASURES BASED ON 0-10 SCALES

Similar to the above methodology, the first estimate from section B relies on timing, quantity, and efficiency factors. Both the timing and quantity factors from the above methodology are combined with the results from question FR5 in order to determine another free-ridership factor, F[FR5]. Question FR5 states:

> FR5. On a 0 to 10 scale, with 0 being not at all likely and 10 being very likely, how likely is it that you would have bought the same equipment if you had not received any assistance from the Power Savings Blitz Program?
>
> RECORD RESPONSE (0 – 10) _____

This question determines the likelihood that the participant would have – at an undetermined time, and in an undetermined quantity – purchased the same equipment (at the same efficiency). Since this question is not a simple yes/no question, the results are treated differently. The response is divided by 10 in order to get the fraction of free-ridership ($0 \leq FR \leq 1$), to be multiplied by the above timing and quantity factors. The resulting F[FR5] will be combined with other 0-10 parts of section B, at the end.

The level of agreement with the statement in FR10 contributes to the free-ridership estimate, and is similarly combined with the timing and quantity factors from above. The question states:

> FR10. On a scale of 0 to 10, where 0 is strongly disagree and 10 is strongly agree, how much do you agree with the statement, “There may have been several reasons for my installation

decision. But the assistance from **<LDC_NAME>**'s Power Savings Blitz Program was a critical factor in my decision to install the high efficiency/energy efficient products"?

RECORD RESPONSE (0 – 10) _____

This question determines the affect the program had on the participant's decision to install energy efficient equipment. Similar to F[FR5], the response to FR10 is divided by 10 in order to get the fraction of free-ridership ($0 \leq FR \leq 1$). It does not include timing and quantity information, so it is combined with the quantity and timing factors from section A. The resulting F[FR10] is combined with F[FR5] and F[Y/N], per section 3, below.

3. Calculate the Final Combined Free-ridership Estimate from Sections A and B

The mean of all non-missing values calculated above give the participant-level combined free-ridership estimate, shown below:

$$F[FINAL] = mean(F[FR5], F[FR10], F[Y/N])$$

The participant-level combined free-ridership estimate is then weighted to the population for the final program-level free-ridership estimate for all measures in the program.

Appendix E – Sampling Strategy

E1. CATI Participant Survey Sampling Plan

OPA staff provided us access to the tracking database of Power Savings Blitz Participants for the 2008 program year. LDC categories were created, based on the number of customers with <50 kW General Service Customers for the LDC. Small, Medium and two of the largest LDCs were aggregated into categories, with the remaining three largest having their own category. Table 66 summarizes the number of work orders present in the program tracking database for each LDC category.

Table 66: Work Orders by LDC Category

LDC Category	Work Orders	
	Number	Percent
Small	2,922	30%
Medium	2,250	23%
Large - Toronto Hydro	1,558	16%
Large - Hydro One Networks	1,295	13%
Large - Horizon Utilities	1,212	12%
Large - PowerStream and Hydro Ottawa	621	6%
Total	9,858	100%

Measure categories were created to reflect the combinations of measures indicated in the tracking database. The categories were organized by aggregating combinations of measures based on the measure with the lowest frequency of being installed. Participants with multiple work orders were assigned to the measure category that had the smallest population, to insure that we would collect data on those measures.

The sample allocations (targeted completes) were proportional to the population of the number of projects within that strata. Participants with multiple projects were interviewed about only one of their projects. Post-survey weighting was used to insure that aggregate results were representative of the population of projects.

Table 67 summarizes the number of program participants that were available for sampling (population), the number of completed surveys we planned to obtain (targeted completes) and the number of completed surveys we actually obtained from each combination of measure category and LDC category.

Table 67: Population Counts, Targeted Completes, and Actual Completes by Measure Category and LDC Category for Participant CATI

Measure Category	LDC Category	Total Population*	Proportion of Category	Target Completes	Actual Completes
Faucet plus others	Hydro One, Toronto Hydro, Horizon	11	13.6%	2	2
	PowerStream, Hydro Ottawa	16	19.8%	3	3
	Small	54	66.7%	10	10
Halogens plus others	Hydro One	37	36.6%	5	5
	Toronto Hydro,PowerStream, Hydro Ottawa, Horizon	30	29.7%	5	5
	Small, Medium	34	33.7%	5	5
Pipe wrap plus others	Hydro One,Toronto Hydro,PowerStream, Hydro Ottawa, Horizon	112	51.1%	8	8
	Medium	44	20.1%	3	3
	Small	63	28.8%	4	4
Tank wrap plus others	Hydro One Hydro One Networks	23	18.7%	3	3
	Toronto Hydro , PowerStream, Hydro Ottawa, Horizon	26	21.1%	3	3
	Medium	14	11.4%	2	2
	Small	60	48.8%	7	7
Exit sign plus others	Hydro One,PowerStream, Hydro Ottawa,Horizon	315	27.9%	11	11
	Toronto Hydro Toronto Hydro	207	18.3%	8	8
	Medium	269	23.8%	10	10
	Small	338	29.9%	12	12
CFLs, with T8s, plus others	Hydro One,PowerStream, Hydro Ottawa,Horizon	530	25.1%	19	19
	Toronto Hydro Toronto Hydro	371	17.5%	14	14
	Medium	549	26.0%	20	20
	Small	664	31.4%	24	24
T8s only	Hydro One, PowerStream, Hydro Ottawa	1112	18.2%	41	41
	Toronto Hydro Toronto Hydro	931	15.3%	34	35
	Horizon Horizon Utilities	965	15.8%	35	35
	Medium	1372	22.5%	50	50
	Small	1711	28.1%	62	62
Total		**9858**		**400**	**401.0**
		* includes all projects (multiples for participants)			

E2. CATI Non-Participant Survey Sampling Plan

For this study, Power Savings Blitz non-participants were defined as customers that had been contacted about the program, but did not participate. The OPA requested contact information for non-participants from several LDCs and Service Providers. We received lists of non-participants representing twelve LDCs and one Service Provider. The non-participant list was reduced to 2,506 non-participants based on unique phone numbers, after having omitted sixty non-participants without phone numbers and three non-participants for having phone numbers matching program participant phone numbers. The sample was stratified by LDC or the Service Provider. Allocations for target completes were assigned proportionately to the number of non-participants by LDC or Service Provider.

Table 68 below summarizes the number of non-participants that were available for sampling, the number of completed surveys we planned to obtain, and the number of completed surveys we actually obtained. Post-survey weighting was used to adjust for the 125 interviewees that when interviewed were self-identified as participants in the Power Savings Blitz Program and to insure that aggregate results were representative of the population.

Table 68: Population Counts, Targeted Completes and Actual Completes by LDC/Service Provider for Non-Participant CATI

LDC/Service Provider	Non-Participants		Target CATI Completes	Completes	
	Number	Percent		Number	Percent
Toronto Hydro-Electric System Ltd.	899	35.9%	143	74	29.0%
Power Stream	438	17.5%	70	41	16.1%
Waterloo North Hydro Inc.	259	10.3%	41	41	16.1%
Veridian Connections Inc.	149	5.9%	24	10	3.9%
Cambridge and North Dumfries Hydro Inc.	144	5.7%	23	23	9.0%
Kitchener-Wilmot Hydro Inc.	139	5.5%	22	15	5.9%
Guelph Hydro Electric Systems Inc.	132	5.3%	21	17	6.7%
Hydro One Networks Inc.	125	5.0%	20	9	3.5%
Whitby Hydro Electric Corp.	69	2.8%	11	8	3.1%
Hydro Ottawa Ltd.	61	2.4%	10	8	3.1%
NEPA	54	2.2%	9	4	1.6%
Festival Hydro Inc.	24	1.0%	4	4	1.6%
Oshawa PUC Networks Inc.	13	0.5%	2	1	0.4%
Total	**2506**	**100.0%**	**400**	**255**	**100.0%**

Appendix F – Interview Guides

Included in this section are the following interview and survey guides:

F1. LDC Program Manger Interview Guide

F2. Market Actor Interview Guide

F3. Participant CATI Survey Instrument

F4. Participant In-depth Interview Guide

F5. Non-Participant CATI Survey Instrument

F6. Non-Participant In-depth Interview Guide