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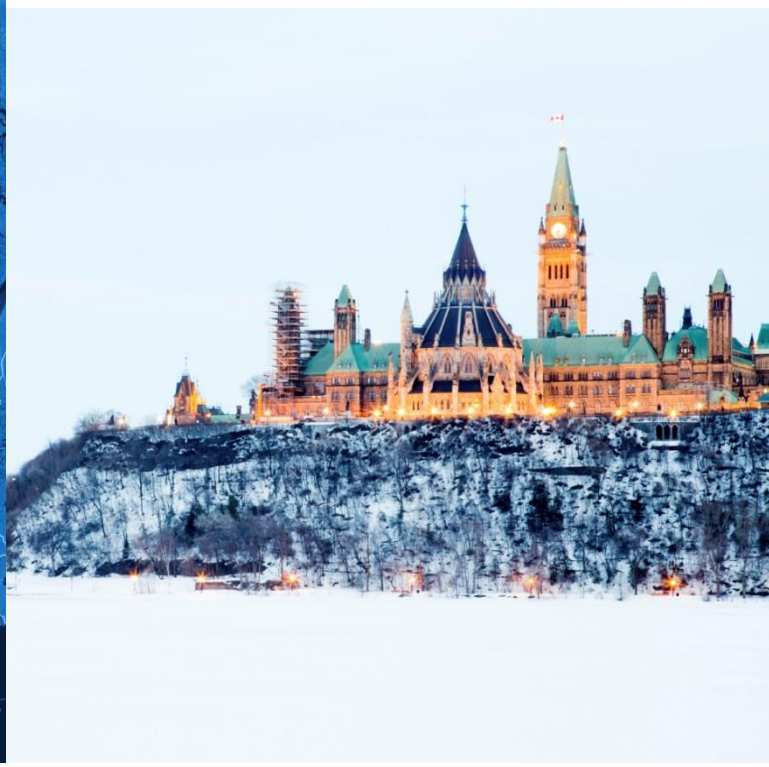

2016 Program Evaluation Report: Toronto Hydro OPsaver Pilot

Submitted to Independent Electricity System Operator

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Contents

1 Goals and Objectives

The goals and objectives of the 2016 evaluation of Toronto Hydro's OPsaver Pilot are to:

- Verify energy and demand savings with a high degree of confidence, taking into account;
  - All measures implemented as part of the pilot
  - Spillover savings and pilot-enabled savings
  - Savings from interactive effects
- Review and evaluate key pilot elements;
- Conduct annual cost-effectiveness analyses;
- Report and attribute savings due to the pilot.

To estimate gross verified energy savings, the evaluation team conducted desk reviews of project documentation and facility-level billing analysis for all projects included in the population. To estimate the direct influence of the pilot in generating energy savings, the evaluation team conducted attribution surveys to calculate the rates of free ridership and spillover. This information was used to calculate a net-to-gross ratio, which was then applied to the gross verified savings to calculate the net savings.

2 Pilot Description

The primary objective of the OPsaver pilot is to compare the approaches taken by various energy management consulting firms that worked with participants to establish operational and maintenance energy efficiency best practices in order to achieve long-term sustained energy savings. Consultants were asked to help participants develop a comprehensive energy management plan, perform facility benchmarking and employ measurement and verification approaches that enable a holistic 'whole building' approach towards energy savings. These are requirements fundamental to the Continuous Energy Improvement (CEI) process, to the advantage of the CEI consultant. Pilot participants were split into two groups:

1) The **Structured** consultant provides a CEI curriculum that focusses on change management, employee engagement and training. They have a demonstrated program approach which has achieved results with a number of North American incentive programs and pilots. The consultant that worked with the Structured group is referred to throughout this document as the Continuous Energy Improvement (CEI) consultant. The Structured participants were provided with an incentive of $0.02 per kWh, up to $24,000, as well as costs associated with consulting services which amounted to approximately $30,000 per participant.
2) The **Unstructured** group of consultants took a more conventional approach, which tended to focus more on technology-centric means of energy efficiency and less on occupant behavior and engagement. Consultants that worked with the Unstructured group are referred to throughout this document as Energy Efficiency (EE) consultants. The Unstructured group was offered incentives at a rate of $0.04 per kWh of annual electricity savings achieved over a twelve month period, to a maximum of $50,000.

3 Methodology

The sections below describe the methodologies used to complete the impact and process-related components of the evaluation.

3.1 Impact Evaluation Methodology

3.1.1 Project Reviews and Evaluation

The Nexant team estimated gross verified savings for all four facilities enrolled in the Structured group and one facility enrolled in the Unstructured group. The Nexant team's approach utilized hourly interval meter data provided by Toronto Hydro and observed hourly weather conditions obtained through the National Oceanic and Atmospheric Administration (NOAA) to perform a pre-post regression analysis to estimate weather normalized annual energy consumption during the pre-retrofit and post-retrofit periods. This approach is consistent with the International Performance Measurement and Verification Protocol (IPMVP) Option C.

One advantage of utilizing hourly consumption data as opposed to monthly billed utility data is that it enables the evaluation to account for more granular variations in observable conditions, such as building occupancy or operation patterns, which allows for a more detailed assessment of energy use during specific times and/or under specific conditions. In order to account for temporal variations in building occupancy conditions, the Nexant team defined three distinct daily period types: weekdays, Saturdays, and Sundays/Holidays. Similar regression models were run separately on each individual facility and period type in order to define the relationship between temperature and usage during each period type. This approach resulted in a total of 15 separate regressions (five facilities × three period types). The three regression outputs for each facility were then combined to produce a total annual savings estimate for each facility.

Nexant used linear regression analysis to establish a relationship between outdoor air temperatures and hourly energy use at the meter for each facility and during each occupancy period type. The regression coefficients, which define the relationship between weather and energy use during each period, were then applied to typical weather year data (TMY3) for the Toronto weather station in order to estimate annual energy savings for a typical weather year. Estimates for each period type were aggregated to calculate a total annual energy savings value separately for each of the six participating facilities.

In order to estimate savings at the site level, a linear regression model is used on each facility's data separately. The model specification is shown in Equation 3-1.

Equation 3-1: Regression Model Specification

$$kWh_{it} = \beta_0 + \beta_1(Post)_{it} + \beta_2(CDH)_{it} + \beta_3(Post \times CDH)_{it} + \beta_4(HDH)_{it} + \beta_5(Post \times HDH)_{it}$$

Where:

kWh = average hourly kWh for site *i* during time period *t*
CDH = average cooling degree hours
HDH = average heating degree hours
Post = indicator of pre- or post-measure implementation
$B_{0\text{-}5}$ = regression coefficients

The series of regressions were used to produce savings estimates at an annual level for each time period (weekdays, Saturdays, Sundays/holidays), which were then summed to produce total annual savings for each facility under normal weather conditions.

3.1.2 Net-to-Gross (NTG) Methodology

To calculate net savings, the portion of gross verified savings that were specifically attributable to the pilot were evaluated. Net savings were determined by multiplying the gross verified savings by the net-to-gross (NTG) ratio, as shown in Equation 3-2. This equation and general methodology are the same for estimating energy and demand savings.

Equation 3-2: Net Savings

$$Savings\ \text{net} = Savings\ verified \times NTG$$

Where:

Savings net = Net savings impact (kW or kWh)

Savings verified = Gross verified energy savings (kW or kWh)

NTG = Net-to-gross ratio

To estimate the direct influence of the OPsaver pilot in generating net energy savings, an attribution survey was implemented to calculate the free ridership (FR) and spillover (SO) rates, assessed as percentages of total reported savings. Free ridership represents pilot savings that would have occurred without pilot incentives. Spillover refers to savings that occurred because of pilot influence but without pilot incentives. For any group, the NTG ratio is defined by Equation 3-3, where FR is the free ridership percentage and SO is the spillover percentage:

Equation 3-3: Net-to-Gross Ratio

$$\text{NTG} = 100\% - FR + SO$$

For the OPsaver pilot, spillover is calculated for a single incented project for each sampled participant.[1]

3.2 Process Evaluation Methodology

The process evaluation focused on the design, implementation, and delivery of the OPsaver pilot. Program processes were evaluated through interviews with pertinent pilot actors including Toronto Hydro staff, pilot delivery partner, and participants (Table 3-1). For each population, a unique interview guide was developed to ensure responses produce comparable data and to allow the evaluation team to draw meaningful conclusions.

Table 3-1: Process Evaluation Primary Data Sources

Respondent Type	Methodology	Targeted	Completed
Toronto Hydro Program Staff	Phone	1	1
Program Implementer	Phone	1	1
OPsaver Participants	Phone	4	4

3.2.1 Program Staff and Implementer

The evaluation team completed one phone interview with a Toronto Hydro program staff in May 2017, and one telephone interview with the program implementer, Strategic Energy Group, in July 2017. The purpose of the interviews was to better understand how the program was administered in 2016, and to attain program staff and implementer perspectives regarding design and implementation. Topics covered include staff roles, any changes to the program, supply channel engagement, barriers to implementation, and perspectives on the success of the program. The evaluation team identified the appropriate staff to be interviewed in consultation with the IESO evaluation staff. The Toronto Hydro program staff interviewed oversees the planning and implementation strategy while the program staff from Strategic Energy Group oversees the program's implementation. The interviews each took approximately one half-hour to complete.

3.2.2 Participants

Four of the five buildings that participated in the OPsaver pilot in 2016 were associated with the same contact for the participant survey, while the fifth building was associated with an alternate

[1] Note that no spillover savings were identified for the OPsaver pilot in 2016.

contact. This fifth contact was nonresponsive to requests for pilot feedback therefore the participant survey results are the perspective of one individual. This survey was conducted over the phone. Table 3-2 below summarizes participation counts.

Table 3-2 OPSaver Participant Population Disposition, 2016

Item	Number
Total Projects	5
Unique Participant Addresses	5
Unique Participant Contact Names	2
Web-based emails sent	N/A
Phone surveys	4 properties, 1 contact

4 Participation

Participants in the OPsaver pilot were split into two groups:

- Four facilities were enrolled in a 'Structured' approach and
- Six were enrolled in an 'Unstructured' approach.

The Structured Group worked with a consultant who has demonstrated success through a number of North American Continuous Energy Improvement (CEI) programs. The Unstructured Group included participants that worked with Energy Efficiency consultants who undertook more conventional approaches towards operational energy management. Of the ten facilities that were enrolled in the OPsaver pilot, five delivered energy savings that are contributing towards Toronto Hydro's reported savings – four structured and one unstructured.

Toronto Hydro provided IESO with enough hourly building level meter data, for both pre- and post-measure implementation periods, to enable the evaluation to use IPMVP Option C. Therefore, contacting the participants for the purposes of verifying measure implementation was not needed and not performed.

5 Impact Evaluation Results

5.1 Energy Savings

Each of the five projects included a unique mix of measures, including lighting and equipment scheduling, lighting occupancy controls, HVAC optimization, and improved operation and maintenance. On average, approximately eight measures were installed per site.

The ratio of gross verified savings to the pilot's reported savings is the program's "realization rate." The pilot-level realization rate is the weighted average for all projects in the pilot. Total pilot-level gross verified savings are therefore the product of the pilot's reported savings and its realization rate, and they reflect the direct energy impact attributable to the pilot's operations. The pilot-level realization was 104% indicating that the verified savings estimated by the Nexant team, in general agreed, with the reported savings.

As one would expect, the evaluation's analysis further revealed that the vast majority of the savings at each facility are derived from the weekday time period during hours when occupancy and building operations are typically heightened.

Table 5-1: Pilot Reported and Verified Savings

Facility Name (Type)	Reported kWh Savings	Verified kWh Savings	Project Specific Realization Rate	Verified kWh Savings with Program RR Applied (RR = 104%)
Structured 1	706,000	411,018	58%	734,049
Structured 2	98,000	221,821	226%	101,893
Structured 3	857,000	885,776	103%	891,048
Structured 4	438,000	521,299	119%	455,402
Unstructured 1	656,000	824,541	126%	682,063
Pilot	**2,755,000**	**2,864,454**	**104%**	**2,864,455**

5.2 Lifetime Savings

Due to only building-level energy use data being available, it was not possible to quantify the savings impact of each individual measure. Correspondingly, the effective useful life (EUL) for each project could not be weighted by measure level savings, and instead was calculated as a simple average of the measures implemented at each site. All of the measures implemented were classified in one of four categories listed in Table 5-2. The resulting EULs for each project in the evaluation are presented in Table 5-3. Because the savings for each project are expected to last for at least 8.9 years on average across the program, the program's net 2020 annual

savings are expected to be the same as the first year annual net savings presented in Table 5-1.

Table 5-2: Measure EUL Categories

Measure Type	EUL (Years)	Data Source
Equipment Scheduling	15	Measures and Assumptions List[2]
HVAC Controls	10	Measures and Assumptions List
Lighting Controls	8	Measures and Assumptions List
Operation and Maintenance	3	Database for Energy Efficiency Resources[3]

Table 5-3: EUL by Project

Project	EUL
Structured 1	12.9
Structured 2	9.6
Structured 3	10.1
Structured 4	8.9
Unstructured 1	11.4
Average	**10.6**

5.3 Net-to-Gross

5.3.1 Free ridership

The survey asked respondents when they had learned about the incentives offered by Toronto Hydro's OPsaver pilot and what their business would have done had they not learned about the pilot. All four respondents stated they learned about the pilot *before they started planning this upgrade.* Without the pilot, every respondent said they would have delayed the upgrade by at least one year.

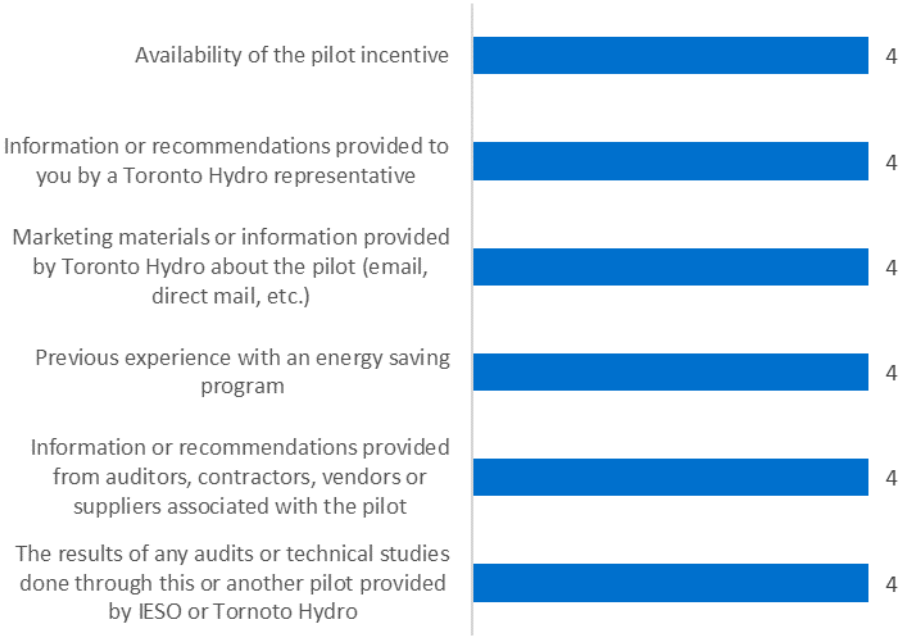
The survey asked respondents how much of a role certain factors played in the decision to do the upgrades. They responded using a scale of 1 to 5, where 1=played no role and 5=played a great role. Every respondent indicated that the availability of the pilot, representative information and marketing materials from Toronto Hydro, and previous participation in an energy-saving pilot played great roles (5 rating) in their decision to upgrade. Results from audits, technical

[2] *Prescriptive Measures and Assumptions List*, Independent Electricity System Operator, version October 2015.

[3] *Database for Energy Efficient Resources (DEER),* California Public Utilities Commission, version 2014.

studies, and information from auditors, contractors, and vendors also played a role (4 rating) in their decision-making (Figure 5-1).

Figure 5-1: Influence on Upgrade Decision (n=4)
(Rating of 4 or 5 on a scale of 1 to 5)



5.3.2 Spillover

The participant survey did not find evidence of spillover.

5.3.3 Net Savings

The one survey respondent answered the net-to-gross (NTG) survey questions individually for each of the four buildings that participated in the program. The results from these surveys are presented in Table 5-4 below.

Table 5-4: Net-to-Gross Survey Results

Savings Type	NTG Ratio	Relative Precision at 90% Confidence Level
Energy	100.0%	0.0%
Demand	100.0%	0.0%

5.4 Cost Effectiveness

The evaluation team conducted a cost effectiveness analysis for the OPsaver pilot. This analysis was completed in accordance with the IESO requirements as set forth in the IESO CDM Cost Effectiveness Test Guide and using IESO's CDM Energy Efficiency Cost Effectiveness Tool. The energy and demand savings results from the impact evaluation were inputs into the IESO Cost Effectiveness Tool as well as budget information supplied by the IESO. Cost effectiveness results are presented in Table 5-5. The pilot passed the Total Resource Cost (TRC) and Program Administrator Cost test with both benefits exceeding their respective costs.

Table 5-5: Cost Effectiveness Results

Cost Effectiveness Test	Value
Total Resource Cost (TRC)	
TRC Costs ($)	438,180
TRC Benefits ($)	1,148,441
TRC Net Benefits ($)	710,261
TRC Net Benefit (Ratio)	2.62
Program Administrator Cost (PAC)	
PAC Costs ($)	438,180
PAC Benefits ($)	998,644
PAC Net Benefits ($)	560,464
PAC Net Benefit (Ratio)	2.28
Levelized Delivery Cost	
$/kWh	0.018
$/kW-yr	-5,641

The large negative levelized cost by peak demand savings is due to the pilot's very low verified peak demand savings (1.6 kW).

6 Process Evaluation Results

The sections below provide the process evaluation results.

6.1 Program Staff Perspectives

The evaluation team interviewed the Toronto Hydro program staff and the implementer to better understand how the program was administered in 2016 and to attain program and implementer staff perspectives regarding pilot design and implementation. Feedback from the interviews is summarized below.

6.1.1 Barriers to Implementation

The program and implementer staff discussed some of the barriers to implementation of the pilot. In general, program and implementer staff felt that the program has been successful in terms of saving energy, and that the main barrier identified was participation recruitment and expectations of participants. Selling the merits of the pilot and convincing participants to participate, while not duplicating efforts by other existing programs, made recruitment challenging. A short time frame to undertake recruitment was also a challenge for energy managers to achieve desired participation. Participants' upfront expectations were not well aligned with what was achieved, and a proposed improvement is to let the energy manager inform the participant upfront about expected outcomes.

6.1.2 Success of the Program to Date

Program and implementer staff was asked for their perspectives on the success of the pilot to date. They viewed it as successful in attaining energy savings, especially in cases where the energy managers involved in the pilot were selected by Toronto Hydro. The energy managers selected by the participants were not as successful to achieve desired energy savings. Potential improvement for a future program include: a) selection of energy managers by the LDC and providing a list of approved energy managers; and b) allow energy managers to recruit participants and provide relevant information upfront to participants.

6.2 Participant Perspectives

The evaluation completed a telephone interview with one OPsaver participant, representing four participating properties, to better understand participant perspectives related to pilot delivery. Feedback from the interview is summarized below.

6.2.1 Pilot Outreach and Marketing

The participant survey respondent for the OPsaver pilot holds the title of Senior Real Estate Manager and has both primary and shared responsibility for budget or expenditure decisions for the pilot and related activities. This individual initially heard about the OPsaver pilot from a Toronto Hydro representative who contacted him directly

6.2.2 Participation Motives and Decision Making

A summary of the respondent's rating of the role of motivations for participating in the OPsaver pilot is presented in Table 6-1. The participant stated several pilot factors played a great role: confidence in an incentivized service, to save energy or lower energy bills, to be associated with green or sustainable actions, and to adhere to a sustainability or energy efficiency policy at their organization. When asked to expand on the details of this sustainability or energy efficiency policy, the participant stated they have a "mandate to a 3-5% reduction in energy usage year over year".

Table 6-1 Rated Role of Given Motivations for Participating in the OPsaver Pilot (n=1 Respondent Representing 4 Projects)

Motivation for Participating	1=No Role	2	3	4	5=Great Role
Because it was easy to participate in the pilot			X		
Because you knew that any equipment or service Toronto Hydro or IESO would incentivize must be reliable					X
To save energy or lower your energy bills					X
To be associated with "green" or "sustainable" actions					X
To increase comfort and/or productivity				X	
To adhere to a sustainability/energy efficiency policy at your organization					X

6.2.3 Participant Satisfaction

The participant ranked most of the pilot-related factors with a high level of satisfaction, as summarized in Table 6-2. Regarding the energy savings achieved from the operational changes, the respondent stated that two buildings had a large reduction in energy consumption as a result of the pilot (therefore a given rating of complete satisfaction with the pilot), whereas two other buildings had lower savings (therefore these were rated as a 3 and 4, respectively).

Table 6-2 Satisfaction with OPsaver Pilot Components (n=1 Respondent Representing 4 Projects)

Satisfaction	1= Not at All Satisfied	2	3	4	5= Completely Satisfied
The time it took to receive the incentive					X
The dollar amount of the incentive					X
The interactions you had with the energy management consultant or service provider					X
The interactions you had with representatives from Toronto Hydro					X
The content and presentation of any technical study or report related to the pilot					X
The energy savings achieved from the operational changes			X	X	X, X
The pilot overall				X	

When asked how likely the respondent would be to recommend the pilot to others, a rating of 5 “extremely likely” was given.

7 Key Findings and Recommendations

7.1 Impact Evaluation

7.1.1 Other Impact Key Findings

Key findings and recommendations from the 2016 pilot analysis include:

- Demand savings were not reported for the pilot. Nexant found almost zero summer peak demand savings, but found approximately 500 kW winter peak demand savings.

  Recommendation: *It is recommended that future program implementers calculate and present peak demand savings using IESO's peak demand definition.*

- Energy realization rate was 104% indicating the verified savings regression model found very similar pilot level savings to the reported savings model.

  Recommendation: *The large amount and granularity (hourly) of project-level data available to both the implementer and evaluator enabled both analyses to use their own robust approaches on the same dataset. If possible, it is recommended to maintain this approach to minimize any deviances between reported and verified savings approaches due to assumptions made from lack of data.*

7.1.2 Net-to-Gross Key Findings

The key findings from the 2016 pilot impact evaluation pertaining to net-to-gross include:

- Participant feedback is indicative of low free ridership. The respondent stated he learned about the pilot before planning the respective upgrade for each of the four buildings. Without the pilot, the respondent would have delayed the upgrade by at least one year for all buildings. The respondent rated most program-related factors, such as the incentive, and recommendations from Toronto Hydro, as influential in their decision to participate in the pilot.
- The participant survey did not find evidence of spillover.

7.2 Process Evaluation

The key findings and recommendations from the 2016 pilot process evaluation include:

- In general, program and implementer staff felt that the program has been successful in terms of saving energy, and that the main barrier identified was participation recruitment and participant expectations.

Recommendation: *Create standard topics energy managers should cover prior to participating in the program, and ensure the energy manager informs the participant upfront about expected outcomes.*

- Representative and marketing outreach from Toronto Hydro were participants' primary source of information.

  Recommendation: *A tandem of strategies where the LDC continues to conduct outreach via marketing materials and direct contact via informed representatives is recommended.*

- The desire to save or reduce energy bills, to be associated with "green" or "sustainable" actions, to adhere to the organization's sustainability / energy efficiency policy, and confidence in recommendations from Toronto Hydro were the major influences in the participation of the program.

  Recommendation: *Continue to promote energy savings information in marketing materials and talking points.*

- The survey respondent was satisfied overall with the pilot, and rated most satisfaction elements as high. The energy savings achieved were awarded a range of satisfaction ratings, since the achieved savings compared to expected savings also varied for the different projects.

  Recommendation: *As energy savings were greater when project energy managers were selected by LDC as opposed to by the participant, LDC could provide a pre-approved list of energy managers for participants to select. These energy managers can recruit participants and provide relevant information up-front to potential participants.*

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