Commercial Recommissioning Program Evaluation: Accurate and Timely Results by Combining Qualitative Research with Statistical Analysis of Big Data

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ABSTRACT

BC Hydro evaluated its Continuous Optimization (C.Op) energy conservation program, which was designed to help commercial building owners and operators implement improvements to their energy management practices and maintain those practices over time. The key focus of the program was operational conservation measures. Energy savings were largely tied to improving the performance of the building's heating, ventilation and air conditioning systems, as well as lighting and refrigeration systems.

To understand the participant experience, explore market effects, and understand program influence, the evaluation used semi-structured interviews with program participants, recommissioning consultants, and energy management information system vendors. To estimate average net savings, the evaluators employed a statistical analysis of hourly interval metering consumption data of the 433 participating buildings for which quality data were available.

The evaluation results indicated that suitable assignment of roles and responsibilities, including responsibility for energy management, among employees of participating organizations was a success factor. C.Op participants with a dedicated energy manager in place may have responded faster to the program than did participants without this position. Engaged building operators were a key ingredient in achieving program goals.

Average net evaluated weekday electricity savings per participant were between 4% and 5% of building electric energy consumption. Universities, hospitals and hospitality buildings achieved savings earlier did office buildings. Program participants who were concurrently enrolled in another BC Hydro energy conservation program also achieved savings earlier than did those who were not.

Introduction

BC Hydro provides electrical service in the province of British Columbia (BC), Canada. In 2009, BC Hydro launched the Continuous Optimization (C.Op) energy conservation program to help commercial building owners and operators implement improvements to their energy management practices and maintain those practices over time. The key focus of the program is operational conservation measures, where implementation does not require the purchase and installation of new equipment, and costs are generally limited to labour. The C.Op program was offered in collaboration with the province's natural gas utility, Fortis BC, and provided opportunities for participants to achieve both gas and electricity savings. However, this evaluation scope covered electricity savings only.

The program offering was available to commercial buildings larger than 50,000 square feet, and since 2010, over 500 buildings have enrolled in the program, with the majority of these buildings continuing through the program stages and components further described below. Program participants included offices, retail, healthcare, education, hospitality, and recreation.

The C.Op program fully funded two components: 1) recommissioning the building and 2) installing an Energy Management Information System (EMIS).

As part of the recommissioning component, consultants worked with participating customers to identify and implement electric and natural gas energy conservation measures and to prioritize their implementation based on simple payback. Customers committed to implementing, at their own expense, all recommended measures with simple paybacks under two years. Recommissioning consultants commonly identified and recommended multiple measures, and the program did not apply a penalty if participants did not implement all low cost measures within a specific period of time. Each customer engagement lasted up to five years, requiring ongoing customer interaction, document reviews, and administration. The main steps of the recommissioning component were: studying the building, recommending low- or no-cost energy efficiency improvements, reviewing the energy conservation measures with operations staff, implementing measures, validating implementation of measures through site inspections, and conducting up to four quarterly follow-up coaching sessions to ensure energy savings continued.

The EMIS component[1] was an energy information tool that took interval data from the customer's whole building meter and provided analysis and reporting on the building's energy use . BC Hydro selected the EMIS vendors, and by extension the EMIS systems that were used, through a process of identifying and partnering with qualified suppliers. A total of three EMIS vendors partnered with the program. EMIS energy use analysis always included electricity, and natural gas if applicable. The EMIS vendors installed the EMIS and configured it to provide information that allowed building operators to identify processes that had a substantial impact on energy consumption and provided a good opportunity for energy savings.

Reported savings for the program were determined by the recommissioning consultants, based on custom engineering estimates for each site and validated to some extent through site inspections.

Literature Review

This paper builds on the work of various evaluations and published protocols, where the following analytical methods were identified as being applicable to commercial building operation conservation measures: on-site equipment Measurement & Verification (M&V), engineering simulation, ENERGY STAR Portfolio Manager Benchmarking Tool, and quasi-experimental design with variation in adoption.

In its chapter on Retrocommissioning Evaluation, the US Department of Energy Uniform Methods Project (2014) recommends using M&V approaches following the International Performance Measurement and Verification Protocol (IPMVP).

Engineering simulation was used by researchers (Chen 2007) at Texas A&M University in their case study to estimate savings attributable to the continuous commissioning of the Campus Domestic Hot Water System Program, in which an un-calibrated engineering simulation was conducted under different load scenarios. Engineering simulation is useful in both the commissioning design and evaluation process because it simulates energy usage performance under different scenarios and estimates counterfactual energy usage without the commissioning intervention. However, engineering simulation modelling requires very detailed dynamic operating variables of individual buildings and it has been only applied in case studies where there are a small number of buildings.

The ENERGY STAR Portfolio Manager® is an online tool created by the Environmental Protection Agency (EPA) in the U.S. which allows users to track and assess energy and water consumption of their buildings. In July 2013, the EPA and Natural Resources Canada (NRCan) together released a Canadian version of the ENERGY STAR Portfolio Manager®. The primary mechanism of the tool is a weighted ordinary least square regression, which evaluates whole building source energy use intensity (EUI) relative to business activity (e.g., operating hours, number of workers, climate). Although the ENERGY STAR score has been widely accepted and applied in evaluating the energy performance of an individual facility, recent studies conducted by Dr. John H. Scofield at Oberlin College (ACEEE 2014, IEPEC 2015)

[1] Note that an EMIS is distinct from, and additional to, building automation systems used to operate the mechanical and lighting systems in commercial and institutional buildings.

concluded that in the EPA model, the ENERGY STAR regression variables were not statistically reliable predictors and that models failed to be cross-validated by an earlier year's data.

The State & Local Energy Efficiency Action Network Energy Efficiency Program Impact Evaluation Guide (2012) presents variation in adoption (VIA) as an approach to quasi-experimental design that takes advantage of variation in the timing of program adoption in order to compare the energy use of participating facilities that opt in to the program with the energy use of facilities that have not yet opted in, but will ultimately opt in at a later point. It relies on the assumption that in any given period, participants that have already opted in and participants that will opt in soon share the same observable and non-observable characteristics. This method was introduced to the energy conservation field by Harding and Hsiaw (2012) in a study on the effect of goal-setting on energy savings.

Methods and Data

The evaluation included several discrete research objectives. Methods and data for each objective are discussed in the following sections.

Method and Data for Assessing Program Participation and Energy Conservation Measures

The evaluation methods used to assess program participation and energy conservation measures were engineering desk reviews and trend analysis of program tracking data and project files. Program tracking data were available on all program participants and included information on business type, participation dates, building characteristics, and engineering estimates of electricity savings. These data were used to analyze trends in participation and to identify a selection of projects for further review.

A number of projects were selected for engineering desk review to represent a cross-section of participants based on business sector and building size, and to cover a wide variety of energy conservation measures. Projects selected were not intended to represent a statistically valid sample because the intention of this evaluation objective was to understand how the program achieved energy savings, and the results of this review were not used in the evaluation of net savings.

Method and Data for Understanding the Participant Experience, Exploring Market Effects and Program Influence

Interviews of 22 participating organizations were conducted to understand the participant experience. Because many of the interviewees were from organizations which had multiple buildings or entire campuses participating in the C.Op program, the interviewees represented approximately 340 participating buildings. The interviewee list was developed to include a cross-section of participants by region, sector, building type, and level of engagement. Efforts were also made to interview both Energy Managers and facilities staff to obtain a range of perspectives on the participant experience.

In addition to input from the interviews conducted with program participants, semi-structured interviews were also conducted with recommissioning consultants and EMIS vendors to explore market effects and program influence. A total of 5 recommissioning consultants (out of 22 program-approved service providers) and all 3 program-approved EMIS vendors who were involved with the program were interviewed for this study, with 2 of the consultant interviews taking place in-person and the balance of the consultant interviews and all of the EMIS vendor interviews taking place by phone. The interviewed consultants were estimated to have provided C.Op services at over 200 participating buildings.

The research findings from the semi-structured interviews are qualitative and designed to be illustrative rather than statistically representative in nature. For this reason, response rates by research area are not provided.

Method and Data for Evaluating Net Savings

Net savings were evaluated by conducting a statistical analysis of the 433 participating buildings for which quality data were available. The analysis involved five steps:

1) Obtain hourly consumption and program tracking data and prepare it for analysis,
2) Group the buildings by load shape,
3) Set up a quasi-experiment,
4) Model program effects, and
5) Calculate net electricity savings.

This evaluation method produced a reliable estimate of average net savings per participant. Net savings were defined as electricity savings achieved at participating facilities, due to the program, accounting for free ridership and participant spillover. Non-participant spillover is not accounted for in the estimate of net savings.

Step 1: Program tracking data was obtained from program administrators and the BC Hydro demand side management (DSM) program tracking system. The program tracking data used in the estimation of net savings included the building size (square feet) and an indicator of whether or not the building was concurrently participating in another BC Hydro DSM program. The original source of the building size data was a declaration made by the customer or the customer's representative upon application to the program.

Hourly electricity consumption data was obtained from the three EMIS vendors. These data covered the period from program enrollment through March 31, 2015. These data were collected and managed by the EMIS vendors, who provided web portals to monitor and manage buildings in real time. The data was reconciled with BC Hydro account and program participation data to ensure validity.

Because the EMIS was installed up to several years before measures were implemented, hourly electricity data was available for at least 12 months, and more commonly up to several years, prior to the date at which program savings were expected to be achieved at individual buildings. Plotting the hourly electricity data over time indicated that electricity savings were observed at some buildings right after the first 12 months of the baseline data collection period. Therefore, the first twelve months of available data collection were defined as the baseline period and energy savings in any period after the baseline period were evaluated.

Step 2: The 433 participating buildings were then grouped by load shape. Because the C.Op program targets operational measures, operating hours were identified as the appropriate indicator of business type, and load shapes were identified as a suitable basis to group participants. Load shapes depict the pattern of electricity use over a specified time period (24 hours for the purpose of this analysis) and are closely linked to operating hours.

The program tracking data on building area was used to normalize the electricity consumption data (kWh) for building size, by converting it to an energy use intensity basis (kWh/square foot). Although some participating buildings also used natural gas, natural gas data and natural gas savings were not included in the scope of this evaluation. Note that once enrolled, participants continued to engage with the program for several years. None of the participants included in the analysis of net savings exited the program over the time period evaluated.

Step 3: A quasi-experiment was designed. Designing a quasi-experiment involves creating a comparison group that is equivalent to the treatment group on a range of observable factors that are thought to influence the outcome of program participation. Electricity consumption of the comparison group is then compared to electricity consumption of the treatment group (i.e., participants who are active in the program) to estimate savings. The primary challenge of designing a reliable quasi-experiment is identifying an equivalent comparison group. Variation in adoption is a powerful method of designing such a comparison group. This method can be used in programs where participation is staggered over time, which was the case for the C.Op program. The basic approach is to use later period participants as a comparison group for earlier period participants.

BC Hydro's 2010 fiscal year (ending March 31, 2010 – F2010) was the first year for which a substantial number of customers enrolled in the program. For all participants, a lag of one year or more occurred between enrollment in the program and implementation of energy conservation measures. This lag was dictated by the program design, which required a number of steps between enrollment and energy conservation measure implementation. These steps included one year for the EMIS to collect baseline data, as well as time to engage a recommissioning consultant to identify and quantify energy conservation measures. Therefore, participants who started in F2010 were not expected to achieve savings until F2011 or later.

In F2011 a new batch of participants enrolled in the program. For the duration of F2011, these participants were undergoing the steps described above that occurred between enrolment and energy conservation measure implementation. Concurrently, some F2010 participants may have started to implement energy conservation measures. The nature of this program design and timing provides an opportunity to use quasi-experimental design with variation in adoption, whereby the new participants in F2011 are used as a comparison group for participants who enrolled in F2010 and started to achieve savings in F2011. The same approach can be replicated in subsequent years, so long as a sufficient number of new participants keep enrolling in the program each year. Shown below in Table 1 are the number of new participants, and the number of treatment and comparison group buildings in each year analyzed.

Table 1. Set up of the Quasi-experiment

Fiscal Year	New Participating Buildings	Treatment Group Buildings	Comparison Group Buildings
2010	111	0	0
2011	94	111	94
2012	107	205	107
2013	59	312	59
2014	45	371	45
2015	17	416	17

As noted above, quasi-experimental design requires the treatment and comparison groups to be comparable on factors that influence program outcomes. Step 2 of this analysis grouped the participants by load shape. By doing so, treatment and comparison groups could be created that were equivalent on the basis of operating hours. However, additional potential differences between the treatment and comparison groups were identified. Step 4, analysis of covariance (ANCOVA) modeling, as further described below, was used to control for these additional differences.

Step 4: Modeling program effects was done in two stages: ANCOVA modeling, followed by simple contrast. ANCOVA modeling is a commonly used modelling approach for quasi-experimental design based energy program evaluation that allows for the estimation of differences between groups, controlling for a range of relevant factors. ANCOVA modeling was used to control for building size, weather, concurrent participation in another BC Hydro DSM program, and electrical loads unaffected by the program. These factors were identified as having the potential to influence electricity consumption and be different in the treatment and control groups set up in Steps 1 and 2 described above. The ANCOVA model was run separately for each load shape group and year evaluated.

Step 5: Net electricity savings were calculated as the product as the ANCOVA model outputs and the participating building area, by load shape type and year.

Assessing savings over time was investigated by analyzing trends in savings both for individual participating buildings and the program overall. Participants continued to be engaged with the program over the time period analyzed.

Results and Findings

The evaluation included several discrete research objectives. Results and findings for each objective are discussed in the following sections.

Results for Objective 1: Assess Program Participation and Energy Conservation Measures

Program tracking data for F2011 to F2013 revealed that four customer segments accounted for over 80% of participating buildings and 77% of expected savings: universities/colleges, offices, schools, and hospitals. Buildings participating in the program achieved energy savings by implementing energy conservation measures related to building operations, with the most common being: reduction in excessive equipment operation (38% of total measures implemented), building systems controls optimization (18%), and equipment load reduction or efficiency increase (15%). The majority of the energy conservation measures focused on four building systems: ventilation (67%), lighting (11%), boiler plants (9%), and chiller plants (6%).

Results for Objective 2: Understand the Participant Experience

The application process was noted to be straightforward by the majority of participants. Where there were issues, they were generally related to administrative and procurement restrictions and difficulties in aligning an offering that spans multiple fiscal years with the participating customers' internal processes.

Despite the program's guideline that no changes to the building operation occur during the 12 month baseline data collection phase, the majority of participants acknowledged that some changes were made during this phase. Institutional health care participants highlighted that their facilities are continuously undergoing changes due to reprogramming of spaces and the critical nature of maintaining occupant health and comfort. In other cases where operational issues were identified during the baseline phase and easy to fix, such repairs were made as soon as these problems were identified. Consultants confirmed the high incidence of modifications to buildings during the baseline collection phase and were generally able to adjust the baseline to correct for these changes.

Most participants reported that implementation of measures was relatively straightforward, and that the types of measures implemented were consistent with program objectives. However, most organizations did not implement all of their identified measures due to cost considerations or complexity of implementation of some measures. There were also some challenges to implementation, such as limitations of a building's HVAC control system and the presence of obsolete controls. Some participants also noted internal organizational challenges with implementing C.Op measures, including: finding internal resources to implement projects, lack of capital, lack of an internal process (as C.Op tended to cut across multiple departments within an organization), lack of qualified programmers to implement changes to building controls, limited knowledge of operational staff, staff turnover, and the need for developing internal support for the program.

Feedback on the coaching phase varied widely. While most participants expressed the opinion that coaching was an important phase of the project, feedback on coaching varied from "a disappointment" to "excellent". Negative feedback focused on the limited value of coaching and a lack of commitment or follow through by the consultants. Positive feedback focused on the importance of increasing engagement, great consultants and knowledge of the operational staff. It was generally acknowledged by participants (mainly utility customer Energy Managers) that the success of the coaching was heavily dependent on the level of engagement of operational staff and that there was a high level of diversity among operators related to their interest and abilities. Based on feedback from consultants and participants, it appeared that coaching was a success for about half the projects.

Overall, participants, consultants, and EMIS vendors reported having a very positive experience with the C.Op program. Where challenges were noted, it was due primarily to the organization's internal structure or internet security requirements – things the C.Op program could not influence or control. Participants expressed some frustration at the paperwork and meetings required for program participation but also recognized the need for bureaucracy to maintain accountability. Participant experience with consultants was generally positive to excellent, with a number of participants commending the consultants as being extremely knowledgeable and responsive. Finally, there were very strong commendations to the staff of BC Hydro who designed and implemented the program, with this sentiment expressed by many of the participants interviewed.

Results for Objective 3: Explore Market Effects and Program Influence

The qualitative research suggests that minimal free ridership occurred in the C.Op program. Participants reported that little to no recommissioning measures would have been implemented without the program's support. Likewise, the recommissioning consultants reported minimal recommissioning activity before the program and minimal activity outside of the program during its operation.

Multiple participants highlighted the importance of C.Op in increasing building operators' awareness of the performance of their facilities, and that checking building performance using EMIS was now part of the operators' weekly activities. Many participants also noted that positive organizational changes had occurred as a result of participation. Specifically, there were positive changes in terms of improved capacity of organizations to monitor the energy performance of their buildings on an ongoing basis and to maintain energy savings. Many participants reported that C.Op provided a structure for Energy Managers to work more closely with building operational staff, and for some organizations this had been a key objective of participation in the program. The EMIS also provided a tool to communicate energy performance to operators and senior managers, increasing their awareness of energy conservation and interest in making further improvements.

However, there was significant variation in the reported level of engagement by operational staff. There was mixed feedback about the program from some building operators. It was noted that operators were generally motivated by reducing complaints and maintaining occupant comfort and not with optimizing the building's energy performance. Feedback was that operators were too busy keeping the buildings running to focus on energy efficiency, were not concerned with energy efficiency, or did not have sufficient training to implement energy efficiency measures. Overall, the participants' opinion was that operators were critical to maintaining energy savings and in finding new opportunities, but that operators were not sufficiently invested to make this happen. Consultants reported similar observations.

Only a few participants owned or were even aware of the existence of EMIS prior to participation in C.Op. The EMIS vendors reported that the market for EMIS grew significantly in BC from the beginning of the C.Op program up to 2012 after which it plateaued, and they attributed this growth to the C.Op program. All consultants were of the opinion that there was limited recommissioning before C.Op and the market developed rapidly for recommissioning services while C.Op was in place, with the majority of this growth directly from C.Op participation. Participants expressed some uncertainty about their organizations' willingness to pay for an EMIS or for recommissioning consultants without utility funding.

Results for Objective 4: Estimate Net Savings

One of the program goals was to use the EMIS functionality for quantifying energy savings to measure savings for the program overall. That goal was ultimately not achieved because collecting and maintaining the required data was challenging for some participating buildings, and completing the required detailed investigation to validate the EMIS savings estimates was costly and slow.

Barriers to using the EMIS to reliably estimate savings included the fact that many participants did not track the data on occupancy and usage changes that would be required to make baseline adjustments, and did not have the resourcing or capacity to manage the EMIS model over time. As a result, on occasion, the EMIS savings estimates varied greatly from expected values and the variance reasons were unclear. For example, for a selection of ten participating buildings analyzed, the EMIS estimated savings ranged from -675% to +437% of the expected savings based on the recommissioning consultants reports and validated through site inspection. The cost and time involved in investigating the discrepancies and refining the EMIS models was cost prohibitive for a large scale program with hundreds of participants.

While the EMIS did measure savings in some buildings as intended, ultimately the data, time and resource requirements presented barriers to using the EMIS to measure savings for the program overall that could not be overcome. Large scale billing analysis with quasi-experimental design did not require individually modelling each participating building, and ultimately provided a practical and cost efficient alternate method to evaluating program level savings.

A summary of statistically significant program effects, in terms of net reductions in daily average EUI across all load shapes and years is presented below. Savings results were either positive and statistically significant or they were nil. Statistical significance was assessed based on the p value of model outputs, with a minimum acceptable level of 20% as per BC Hydro's Conservation and Energy Management Impact Evaluation Standard. Program effects are the overall average effects across all facilities analyzed. Results are presented in separate tables for weekends and weekdays.

Table 2. Net Evaluated Week Day Savings (kWh / Square Foot / Week day), by Fiscal Year, Load Shape, and for Participants who either participated in C.Op Alone, or Participated in C.Op and an Additional Program

	Day and Evening Operations		Day Operations		Overnight Operations	
Fiscal Year	C.Op Alone	C.Op Additional	C.Op Alone	C.Op Additional	C.Op Alone	C.Op Additional
2011	0	0	0	0	NA	NA
2012	0	0.0057	0	0	NA	NA
2013	0.0037	0.0037	0	0.0044	NA	NA

No statistically significant weekday savings were found in F2011. However in F2012, statistically significant weekday savings were found for buildings with Day and Evening Operations that also participated in other DSM programs. In F2013, statistically significant weekday savings were found for three groups of buildings:

- Day and evening operations that only participated in C.Op;
- Day and evening operations that participated in C.Op and other DSM programs; and
- Day operations that participated in C.Op and other DSM programs.

Due to the small sample size, savings for the Overnight Operations group could not be estimated.

These results indicated that universities, hospitals and hospitality buildings (within the Day and Evening Operations group) achieved savings earlier than did office buildings (within the Day Operations group). C.Op program participants who were concurrently enrolled in another BC Hydro DSM program also achieved savings earlier than did those who were not. This result may be due to the fact that the additional DSM program that C.Op participants most commonly enrolled in was the Power Smart Partners – Commercial Program, which provides funding for Energy Managers. Energy Managers may have taken an active role in promoting and supporting the implementation of energy conservation measures through the C.Op program.

Table 3. Net Evaluated Weekend Day Savings (kWh / Square Foot / Weekend day), by Fiscal Year, Load Shape, and for Participants who either participated in C.Op Alone, or Participated in C.Op and an Additional Program

Fiscal Year	No Operations		Day Operations		Day and Evening Operations	
	C.Op Alone	C.Op Additional	C.Op Alone	C.Op Additional	C.Op Alone	C.Op Additional
2011	0	0	0	0	0	0
2012	0	0.0055	0	0	0	0
2013	NA	NA	NA	NA	NA	NA

For weekends, the only group of buildings that showed statistically significant savings was the No Weekend Operations group that participated in other DSM programs, and only in F2012.

Evaluated net electricity savings across all participants were 32.4 GWh/yr in F2012, increasing to 36.5 GWh/yr in F2013. These results are equivalent to average annual savings per participant of 4% and 5% of building electric energy consumption respectively.

Analysis of changes to savings over time among the earliest participating buildings (F2010 participants) showed that an increase in savings was observed from F2011 through F2015 (see Figure 2, below), supporting the hypothesis that gross savings persist for at least four years.

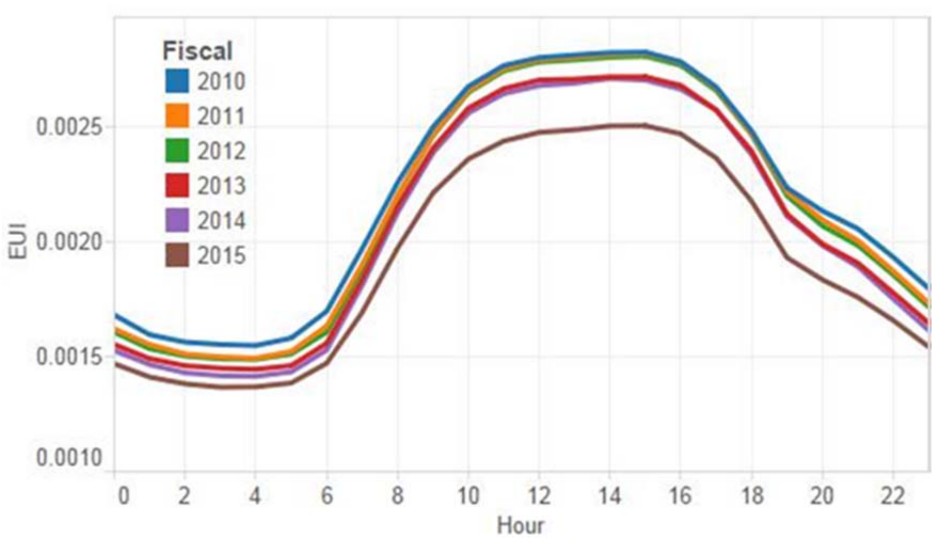

Figure 1. Average weekday EUI (kWh / Square Foot / Day) by year (for buildings which joined C.Op in F2010).

Analysis of electricity use for a number of participating buildings revealed trends that aligned with the results presented above, with many buildings demonstrating sustained and in some cases increasing savings over time. An example of such a building is provided below in Figure 2. As shown, this participating building maintained and increased savings over the four years following implementation.

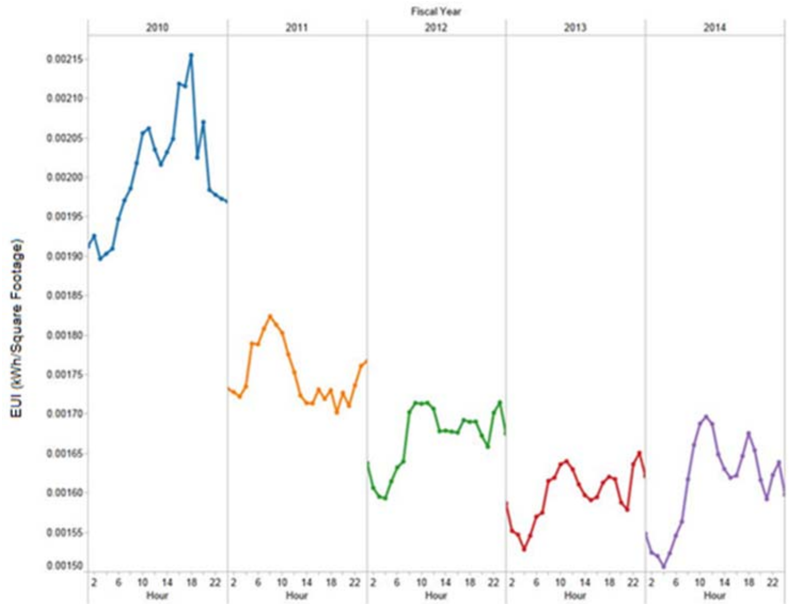

Figure 2. Change in Average 24-Hour Electricity Use Intensity Over Time for a Participating Building

Summary of Findings

- The most common energy conservation measure implemented in the C.Op program was to limit mechanical or lighting systems that ran longer hours than needed and ran during unoccupied periods. The majority of the energy conservation measures acted on four building systems: ventilation (67%), lighting (11%), boiler plants (9%) and chiller plants (6%).
- Program participants had a high level of awareness and understanding of key program milestones and a generally accurate understanding of the purpose and operation of the program's components, with the exception of the coaching phase. Feedback on the coaching phase varied widely. While most participants expressed the opinion that coaching was an important phase of the project, some indicated that it provided the limited value and that there was a lack of commitment or follow through on coaching by the recommissioning consultants.
- Overall, participants, consultants, and EMIS vendors reported having a very positive experience with the C.Op program. Participants also expressed very strong commendations to BC Hydro staff for designing and implementing a sound program.
- Evidence suggests that suitable assignment of roles and responsibilities, including responsibility for energy management, among employees of participating organizations is a success factor for the C.Op program. Participants with a dedicated energy manager in place may have responded faster to the program than did participants without this position. Although positive organizational changes had occurred at many organizations as a result of participation in the program, there was significant variation in the reported level of engagement of operational staff. Engaged building operators were a key ingredient in achieving program goals, but in some

cases the operators were too busy keeping the building running, were not concerned with energy efficiency, or did not have sufficient training.

- Average net evaluated weekday electricity savings per participant were between 4% and 5% of building electric energy consumption.
- There was variation in the speed with which participants responded to the program and started to achieve savings. Universities, hospitals and hospitality buildings achieved savings faster than did office buildings. C.Op program participants who were concurrently enrolled in another BC Hydro DSM program also achieved savings faster than did those who were not.
- The original program goal to verify program energy savings by aggregating EMIS savings estimates across participating buildings was not achieved. The savings estimates derived from EMIS commonly had large and unexplained variances from the engineering estimates developed by the recommissioning consultants.

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