



Energy Efficiency / Demand Response Plan: Plan Year 3 (6/1/2010-5/31/2011)

Evaluation Report: Public Sector Retro-Commissioning Program

DRAFT

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Section E. Executive Summary

This report presents a summary of the findings and results from the Impact and Process Evaluation of the 2010 (PY3) Public Sector Retro-Commissioning Program¹ offered by the Illinois Department of Commerce and Economic Opportunity (DCEO). This program provides a platform to assist public sector energy customers improve performance and reduce energy consumption through the systematic evaluation of existing building systems. Low- and no-cost measures are targeted and implemented to improve system operation, reduce energy use and demand, and, in many cases, improve occupant comfort. The Public Sector Retro-Commissioning Program is an analog to the *Smart Ideas* Retro-Commissioning Program offered by ComEd in its service territory. The DCEO program is offered in the ComEd and Ameren Illinois service territories.

The Retro-Commissioning Program aims to streamline the typical retro-commissioning process in order to facilitate implementation of projects that yield savings in the program year they are initiated. Streamlining in this manner addresses the nature of Illinois program design which measures the spending and results primarily in the year of implementation.

The program in 2010 (PY3) represents the first year of delivery of the DCEO Retro-Commissioning Program. This evaluation considers only projects completed prior to May 31, 2011. Since program planning in 2008 some changes have been incorporated in the design based on experience with the ComEd program. These changes have facilitated participation and the ability of participants to complete improvements:

- Program administration has transitioned from the ComEd Program Administrator, Nexant, Inc., to the DCEO Program Administrator, Smart Energy Design Assistance Center and their sub-contractor 360 Energy (SEDAC/360 Energy).
- The program schedule was expanded for PY4 so that preliminary research can begin prior to the start of the program year (June 1). The longer research period gives participants and their contractors' time to fully investigate measures that might have only seasonal impacts. This change greatly benefits public sector facilities that have annual budget cycles that are relatively inflexible.
- The number of eligible Retro-commissioning Service Providers (RSPs) continues to expand. Three RSPs in addition to Nexant (the interim program administrator)

¹ The 2010 program year began June 1, 2010 and ended May 31, 2011.

completed projects for PY3. Currently, nineteen eligible RSPs are listed on the SEDAC program website².

- Program guidelines were disseminated to all DCEO Retro-commissioning Service Providers (RSPs) to help estimate savings consistently.

E.1 Evaluation Objectives

The primary objectives of the impact evaluation are to review reported savings for installed measures, to recommend general improvements to the savings estimation process, and to quantify gross and net savings impacts from review of the program tracking and engineering calculations. The Process Evaluation addresses key process-related program strengths and weaknesses and identifies ways in which the program can be improved.

E.2 Evaluation Methods

The primary data collection activities for the process evaluation were in-depth interviews with program management and implementation staff, as well as participating RSPs and customers. Impact evaluation activities focused on analyzing reports and data submitted in participant files and follow-up discussions with participants to learn about implemented measures.

E.3 Key Findings and Recommendations

Program Year 3 represents the first year with completed retro-commissioning projects for the Program. A total of nine sites encompassing twelve buildings participated in the program. About fifty measures were implemented among those sites. Program *ex ante* savings totaled 3,412 MWh. The average *ex ante* savings per project was 379 MWh per year, with individual projects ranging from 53 MWh to 837 MWh. Participants represented a range of building types: schools/universities, public services buildings, convention centers and museums. Figures E.1 and E.2 present key summary information about participants and energy savings implemented.

Ex ante electric energy savings implemented represent 2%-28% of site building electricity consumption among participants. *Ex ante* site gas savings was between 2% and 42% of annual consumption. The weighted average *ex ante* electric and gas savings represent 11% and 16% of site annual consumption, respectively.

² <http://smartenergy.illinois.edu/retro-commissioning.html>

Figure E.1 Distribution of Project Savings

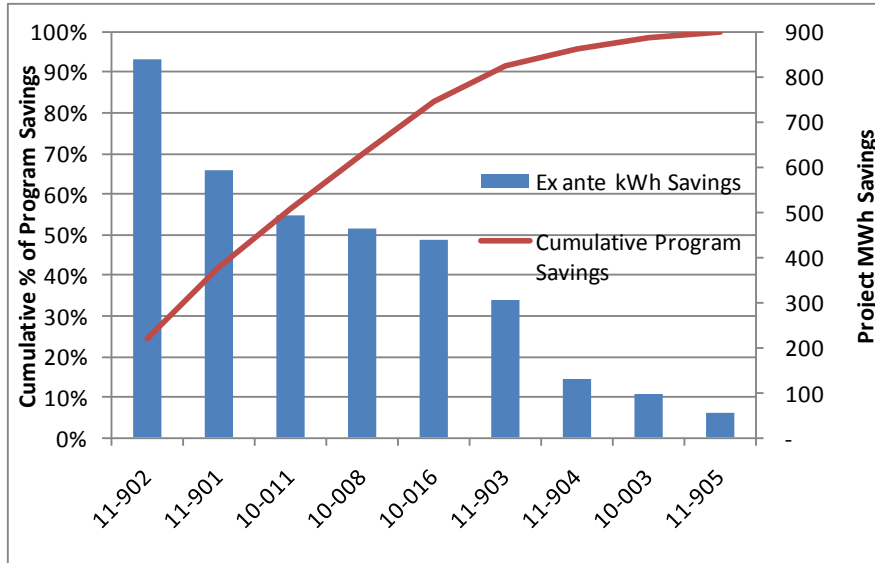
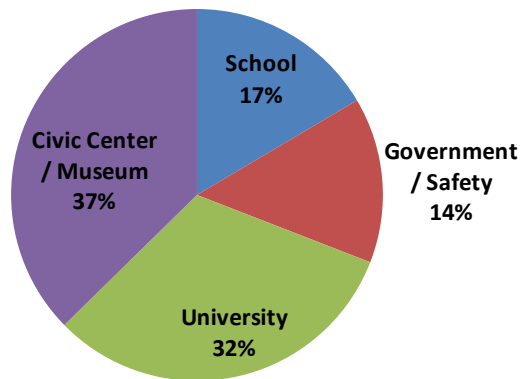


Figure E.2 Participation and Savings by Facility Type

Facility Type	% Savings	Count
School	17%	2
Government / Safety	14%	2
University	32%	2
Civic Center / Museum	37%	3



1.1.1 E.1.1 Key Impact Findings and Recommendations

Table E-2 shows PY3 gross *ex ante* energy savings for this program – both electricity and natural gas.

Table E-2. Ex Ante Program Savings

Participant Type	Count	Ex ante gross MWh	Ex ante gross therms
Public Sector Retro-Commissioning	9	3,412	130,617

Table E-3 provides the PY3 evaluation-adjusted gross and net savings estimates for the DCEO Retro-Commissioning Program.

Table E-3. Ex Post Program Savings

Gross and Net Parameter and Savings Estimates	PY3 <i>ex ante</i>	PY3 Evaluation Adjusted	Realization Rate
Participants	9	9	100%
Gross MWh Savings	3,412	2,712	79.5%
Gross kW Savings	1,027	105	10.3%
Gross Therm (natural gas) Savings	130,617	124,516	95.3%
Net-to-Gross Ratio (1-FR)	0.98		
Net MWh Savings	NA	2,658	77.9%
Net kW Savings	NA	103	10.0%
Net Therm Savings	NA	122,025	93.4%

† Based on *ex ante* gross savings.

The evaluation adjusted gross saving realization rate for electric energy savings is 77.9%. The reasons for a realization rate less than 100% include: infrequent errors in engineering calculations and inaccurate assumptions that affect those estimates. Among these factors are:

1. Overestimating savings due to night temperature set-back, air temperature reset controls and changes to economizer controls, in some cases.
2. Not always counting secondary effects of various control algorithms. For example, reducing fan static pressure and energy also reduces fan motor heating in the system or resetting chilled water temperature can increase pumping energy.
3. Double counting some savings with respect to scheduling and controls resets.

Furthermore, for several measures no supporting calculations or insufficiently documented savings estimates were submitted. Navigant’s estimation of savings with available data was different than the *ex ante* estimates.

- **Recommendation.** The Program Administrator should consider introducing standard assumptions and/or calculation templates for common measures to ensure consistent estimates among RSPs. The PA should enforce these criteria with rigorous and systematic review of calculations. Navigant would assist in this process, as needed.

Demand Savings. Demand savings is not tracked in the Program Tracking Spreadsheet because DCEO is not claiming demand savings for this program. Nonetheless, several project reports included demand savings for at least some measures. In some cases no demand savings was claimed when there would be some demand reduction. In other cases demand savings was claimed when there would be none because the measure does not affect peak hours. Navigant found little consistency in the demand savings estimation methods. The low realization rate is primarily the result of one measure with large demand savings that, in fact, does not affect peak operations.

- **Recommendation.** If DCEO does plan to track demand savings from the Retro-Commissioning Program, the Program Administrator should consider enforcing guidelines in the verification report calculations. Demand savings from retro-commissioning measures is highly site and measure specific.
- **Recommendation.** Even if demand savings is not a focus of the program, RSPs should continue to estimate demand for projects from the *participant* perspective as demand savings can significantly affect project payback.

Natural Gas Savings. The overall natural gas savings realization rate is near 100%. Several measures did not include furnace or boiler efficiency in the calculations, thus reducing estimated savings at the meter. Others did not provide supporting data for application of rules-of-thumb.

- **Recommendation.** The Program Administrator should consider establishing guidelines and default assumptions for calculating natural gas savings for common measures when actual performance data are in-determinant: boiler efficiency by size application and/or type, distribution losses, *etc.*

Each of the items that result in a measure or project-level realization rate other than 100% represents isolated errors of many types. Consistent application of methods and assumptions will enhance the repeatability, consistency, and veracity of savings estimates as the program

expands the number of third party Retro-Commissioning Service Providers (RSPs) who determine the savings estimates.

Free-Ridership. Free-Ridership with this program is very low. Budget constraints for public agencies limit the sort of investigation and effort that facility maintenance staff can dedicate to building tune-ups and retro-commissioning. In this budget environment the most common maintenance mode is to defer items that do not generate complaints.

1.1.2 E.1.2 Key Process Findings and Recommendations

Program Processes

The program was successful during its first year of operation, incorporating many lessons learned from the utility programs upon which it was built. Three of the main challenges associated with the participation process relate to project timing.

1. An abbreviated program year in PY3³ created issues, but it was a unique event and does not need to be addressed going forward.
2. The fixed implementation deadline (May 31) for all projects that come in during the program year makes it difficult for later-starting projects to complete work by the deadline. This is further complicated by the often more complex decision making processes public sector buildings have in comparison to their private sector counterparts.
3. In addition to challenges meeting the program year deadline, projects frequently did not meet intermediate deadlines for completing each phase of the project.
 - **Recommendation.** Consider re-evaluating the time requirements for each phase as most projects do not meet them and RSPs consider them too aggressive for the work required. If feasible, work on early enrollment with participants so that, at a minimum, all preliminary administrative tasks are complete prior to the beginning of the program year cycle.

Customer Satisfaction

Participants report very high satisfaction with the program. Interviewed customers were also satisfied with the timing of the different phases, with some stating that delays in meeting milestones were due to internal circumstances. In addition, customers are generally very

³ Delays in contracting resulted in a six month delay in the launch shortening the first year of the DCEO Retro-commissioning program from 12 months to 6 months.

satisfied with their RSPs and the results of the implemented retro-commissioning measures. Participants noted that the program's reports and its value in educating staff about their facilities' equipment and how it should be run was the most valuable part of participating in the program.

There was some indication that there may be a disconnect between the customer' goals and the goals of DCEO. DCEO is primarily focused on achieving energy savings while customers focused on meeting the \$10,000 commitment. This may lead customers to make shortsighted decisions in order to meet the spending threshold.

- **Recommendation.** Consider working on strategies to align DCEO and participant interests. Perhaps reduce the commitment threshold if high-savings and lower-cost measures are implemented quickly.
- **Recommendation.** If possible, maintain close PA engagement even into the implementation phase to keep projects on track and identify any participation problems early.

Retro-Commissioning Service Providers

The program selected three third-party RSPs who served projects in the Ameren utility territory. In the ComEd service territory, Nexant served as both the RSP and program administrator. The third-party RSPs were very satisfied with the program. They report overall satisfaction with their interactions with SEDAC/360 Energy although there was some feedback that the inclusion of a program administrator adds additional unnecessary layers and that there was at times varied interpretation of program requirements and lack of clarity around program expectations. RSPs noted that the program is constrained by the calendar-based program year deadline (May 31).

- **Recommendation.** SEDAC should consider clarifying policies and procedures so that there are no questions regarding program requirements. Policies should be enforced consistently

Data Tracking

Two data tracking spreadsheets were maintained for the program in PY3. Nexant tracked projects in the ComEd service territory, and SEDAC tracked projects in the Ameren Illinois service territory. In PY4 and subsequent years SEDAC will track all projects, statewide. Tracking systems ought to provide the DCEO with all data relevant to the program: active projects, status milestones, contact information for participants and RSPs, Program Administrator assignments, timing of milestones and status of PA reviews, measure implementation status, project savings and costs at the project and measure-level. The DCEO and the program evaluator need these data to adequately monitor and review the program

impacts and processes. The PY3 tracking systems were not optimal in almost all categories listed above. The Nexant database minimally tracked milestones and project-level savings and costs. The SEDAC database only tracked project savings and costs, and the final version of the spreadsheet in PY3 did not even include final implemented projects savings and costs.

Additionally, there appears to be no formal tracking of inquiries or project leads that come in over the course of the program year, but are not immediately approved. These leads might result in future participation. The data provided by the program administrator does not get input into the DCEO database.

- **Recommendation.** Since SEDAC is responsible for administering the program statewide in PY4 and beyond, it is incumbent on them to design and implement a tracking system that fulfills the needs of their client, the DCEO, and the program evaluator. Given the growth of the program goals, we might expect the number of projects to grow rapidly. Navigant strongly recommends using a more comprehensive program tracking system.
- **Recommendation.** Consider using multiple relational tables to track program data.
 - a. All leads, contact information and their resolution
 - b. RSP contact information and status by program year (active, inactive, withdrawn)
 - c. SEDAC review assignments and contact information
 - d. Savings and costs by measure at each program phase
 - e. Milestone dates, projected and actual, for all program phases and review milestones

Marketing and Outreach

While there was limited marketing for the DCEO program in PY3, participants found the program’s outreach to be effective, especially for those who had previously worked with DCEO. The program staff indicated that several leads came in during the pre-launch phase of the program, and they were able to mine that list as well as the DCEO past client lists for potential participants.

Savings Calculations

The two program administrators maintained different standards of transparency and rigor for calculations. SEDAC was less strict by both criteria, and will be responsible for future program documentation. SEDAC did not provide electronic versions of savings calculations in the project documentation for most projects. This made evaluation and verification of savings challenging. In many cases, Navigant could not check for proper engineering methods and

correct application of default parameters. Where Navigant could decipher calculations and methods, we sometimes found them overly simplified. PY3 and PY4 RSPs who have worked both in the ComEd and DCEO Retro-Commissioning Programs noted the more lax standards and quality control with respect to calculations in the DCEO program.

- **Recommendation.** Consider requiring RSPs to submit all savings calculations in electronic format and include these in the project documentation for the evaluators. SEDACs review of savings should include annotations in the spreadsheets to validate the review process.
- **Recommendation.** As feasible, the Program Administrator should go over calculation standards and assumptions with the RSPs during training and enforce those guidelines in the RSP work-product. If secondary energy effects are significant for a measure, they must be included in the net savings calculation.
- **Recommendation.** As the program expands and more RSPs participate, there will be more variation and irregularity to the savings estimation methods. SEDAC's quality reviews and the evaluation will become more difficult with this irregularity. SEDAC should consider issuing minimum calculation standards or templates for common calculations.

Section 1. Introduction to the Program

1.1 *Program Description*

The Department of Commerce and Economic Opportunity (DCEO) Public Sector Retro-Commissioning (retro-commissioning) Program provides a platform to assist local government, public schools (k-12), community colleges, public universities and state and federal facilities improve performance and reduce energy consumption through the systematic evaluation of existing building and industrial systems. Low- and no-cost measures are targeted and implemented to improve system operation, reduce energy use and demand, and, in many cases, improve occupant comfort. Improvements incurred through the DCEO Retro-Commissioning program reduce operating costs for publicly funded buildings, allowing operating revenues to be shifted to areas other than energy costs. The DCEO Retro-Commissioning Program aims to streamline the typical retro-commissioning process in order to facilitate timely turnaround projects that yield savings in the year they are initiated and to support the building manager/operator in “selling” the benefits of the program to those within their organizations who need to approve this expenditure; this can include city councils, boards, etc.

Program Year 3 (PY3) represented the first year DCEO operated the Retro-Commissioning program. While the program is designed to run over the course of 12 months, delays in contracting resulted in a six month delay in the launch shortening the first year of the DCEO retro-commissioning program from 12 months to 6 months.

During PY3 the program administration was split between two providers. This decision was made in response to the contracting delays noted above, and allowed for a quick launch of the program within the tight timeframe of the abbreviated program year. For PY4 the program will be entirely managed by the Smart Energy Design Assistance Center (SEDAC), known to most participants as 360 Energy. In PY3, those projects implemented in the Ameren electric service territory were served by SEDAC/360 Energy while those completed in the ComEd electric service territory were served by Nexant. Going forward the program will be fully implemented by SEDAC/360 Energy using third-party RSPs. Because of this shift in the program administration in PY4, this report primarily focuses on the experience and feedback provided by the third-party retro-commissioning service providers that worked with SECAC/360 Energy. As appropriate, findings from the Nexant Administered projects are included and noted as such.

1.1.1 Implementation Strategy

The program is open to public sector customers in the ComEd or Ameren electric service territories including units of local government, K-12 school districts, community colleges, public universities, and State and Federal buildings. All public sector facilities taking electrical delivery service from Ameren or ComEd are eligible for this program. Additional eligibility requirements include:

- Execution of a Program Agreement with the customer that they will spend at least \$10,000 to implement recommended measures with a simple payback of 18 months or less.
- Commitment to invest 60 to 100 hours of senior facility manager time over the course of a 10 to 12 month period that includes access to the facility, personnel assigned to interface with the RSP, and assistance with the collection and reporting of information relevant to the retro-commissioning.

Additional considerations for participation in the program include:

- The facility should have accessible and up-to-date building documentation and records
- The facility should have relatively high energy usage compared to the average energy usage of buildings of the same class and/or a low ENERGY STAR® rating from Portfolio Manager
- The facility should be at least 5 years old and exceed 150,000 ft² in air conditioned floor space
- The facility should be free of major problems requiring capital repairs or replacements and have no planned major system renovations or retrofits
- The facility should have no planned major renovation defined as a change in facility use or where the existing system will not meet owner/customer projected requirements within existing facility square footage
- The facility should have an existing and functional building automation system (BAS) or energy management system (EMS) with direct digital control (DDC)

Meeting these requirements qualifies the participant for 100% reimbursement of the retro-commissioning service fees.

Unlike Prescriptive or Custom Programs that focus on new efficient equipment, the Retro-Commissioning Program focuses on using existing equipment more effectively to save energy while still delivering the required services to support the building occupants. Successful retro-commissioning frequently requires experienced service providers and cooperation and buy-in of the facility staff to implement operational changes. The DCEO Retro-Commissioning Program accomplishes this by assembling two teams. This includes the “program team” –

which is assembled for each project to provide oversight, technical support, and the program-related retro-commissioning services to the customer – and the “customer team” – which provides access to the facility and system data and the expertise or management to implement recommendations.

Day-to-day administration of the PY3 DCEO Retro-commissioning Program was performed by two third-party program administrator (PAs), Nexant, Inc. and the Smart Energy Design Assistance Center (SEDAC) and their implementation contractor 360 Energy. The PAs were responsible for all aspects of the program including participant coordination, technical resources, RSP recruitment and training⁴, logistical support and technical review at each phase of the program.

Table E-2. Program Teams

Service Territory	Project Team	Customer Team
ComEd	<ul style="list-style-type: none"> Program Administrator (Nexant) acting both as manager and RSP 	<ul style="list-style-type: none"> Facility manager/engineer Mechanical, electrical and/or controls contractor
Ameren	<ul style="list-style-type: none"> Program Administrator (SEDAC) Retro-Commissioning Service Providers 	<ul style="list-style-type: none"> Facility manager/engineer Mechanical, electrical and/or controls contractor

Program Timeline

The program is delivered in four main phases.

1. Application Phase
2. Planning Phase
3. Implementation Phase
4. Verification Phase

The phases are described with original planning expectations for timing. In practice, the timing benchmarks are difficult to attain in a standard program year of 12-months. The compressed timeframe for the DCEO retro-commissioning program in PY3 exacerbated this challenge.

⁴ For those projects managed by Nexant, Nexant provided the RSP service.

Application Phase. The facility owner or representative completes the application material and submits paperwork to the Program Administrator. Based on the application material and some follow-up with the site, the PA selects sites that have the highest likely savings opportunities. Staff at DCEO review and have final approval on all projects. After accepting a project for the Program, a Retro-Commissioning Service Provider (RSP) is assigned, if necessary.^{5,6} Projects that are screened out are given detailed reasons for non-acceptance. If other DCEO or utility programs are more appropriate, the customer is directed to applicable programs.

This phase lasts about 1-2 weeks.

Planning Phase. The project planning phase commences after the customer completes the application. Activities include a kick-off meeting with the PA, the RSP, and the customer team during which expectations are described and roles and responsibilities are defined. A site assessment and data acquisition plan is also completed by the RSP during this phase. The findings of this plan are used to generate the Retro-Commissioning Plan for the project and assess potential measures and project economics.

The Retro-Commissioning Plan establishes the framework and direction for the Implementation Phase. Upon completion of the retro-commissioning plan, another meeting is held with the owner representative and engineering staff to review the scope of the plan and the impacts and economics of the identified potential measures. At the completion of the Planning Phase, the facility manager enters into the formal Program Agreement. The Program Agreement includes several components that define the roles and responsibilities of each party. The primary requirement is that the participants commit to spending – \$10,000 – for agreed-upon retro-commissioning measures that result in a bundled estimated simple payback of 1.5 years or less.

For projects that are not started within the same fiscal year as the start of the project and not completed within 12 months, the customer will be expected to refund the costs of the retro-commissioning study. Additionally, the agreement acts as a decision point at which the customer selects measures from the Planning report that they wish to pursue for further investigation in the next phase.

The planning phase takes about 4 to 6 weeks

Implementation Phase. This phase takes the consensus decisions from the Planning Phase and builds on them. Additional field data is gathered to better define, augment, add to, or discard

⁵ In ComEd's service territory, Nexant acted as the RSP for all projects.

⁶ In Ameren's service territory, if an RSP generated the lead, they were the default RSP for the project. Assignment only occurs when the customer is not yet working with an RSP.

measures presented in the Plan. After additional investigation is completed, the RSP and customer's team members work together to implement the measures in the Plan. This may involve coordination of multiple contractors to ensure that the Plan measures are executed to save energy.

This phase takes 8 to 20 weeks.

Verification Phase. After measures are implemented, the RSP evaluates data from the facility to determine that measures are operating as intended to save energy. These data might be observations of installed and/or repaired equipment, trend data from an automation system, or data from dataloggers installed after the measure was implemented. The RSP prepares a report describing the status of implementation and revised savings estimates based on observations and measurements.

Verification can take 3 to 10 weeks depending on the month in which verification activities are completed.

The purpose of the tight timeframe is to maintain engagement with the customer to see the measures implemented. One of the key challenges of the PY3 retro-commissioning program was the abbreviated timeframe during which the participant was required to do a full analysis and then implement and verify installed measures. Studies done for other retro-commissioning programs across the country frequently span 12-24 months. However, this longer cycle can create problems for Program success, such as personnel turn-over, lack of focus, and changing customer priorities, and, for public sector buildings, changes in fiscal years and funding cycles. Other programs have needed to supplement incentives to get measures implemented after completion of the study portion of the retro-commissioning process.⁷ Keeping to the Program schedule helps ensure accountability of all parties and tracks measures through implementation.

Program Delivery Mechanisms and Marketing Strategy

There was limited marketing for the DCEO program in PY3. The program staff indicated that several leads came in during the pre-launch phase of the program and that they were able to mine that list for potential participants. This was especially true on the ComEd side of the program where the PA brought in all four projects using a list of leads they had in advance of the program. On the Ameren side, the PA was able to search for participants using their past client lists, word of mouth, and via one of their RSPs. Staff at DCEO indicated that there was more need to "pound the pavement" for SEDAC/360 Energy to get participants. In the end,

⁷ Xcel Energy, 2007-2009 retro-commissioning program. Email communication to retro-commissioning trade allies October 2009 and January 2010 and others. Incentives were increased for measures implemented within prescribed time limits and payback incentive criteria were relaxed to include measures with as short as nine month payback to encourage measure implementation.

SEDAC/360 Energy brought in five total participants, one more than the original goal. SEDAC/360 Energy staff indicated that they used word of mouth, presentations, and their monthly newsletter to help promote the program to the target audience.

Retro-Commissioning Service Provider (RSP) Participation

A total of three third-party RSPs participated in the SEDAC/360 Energy portion of the program in PY3. All three RSPs were recruited into the program through an RFQ released at the start of the program year. In the Nexant portion of the program, Nexant staff acted as the RSP. The decision to use PA staff was in direct reaction to the shortened program year and the desire to quickly launch the program and meet the PY3 goals. During PY4 all services will be provided through SEDAC/360 Energy, and third-party RSPs will be assigned to all projects.

1.2 Evaluation Questions

The Evaluation Team identified the following key researchable questions for PY3.

Impact Questions:

1. What is the level of gross and net annual energy (kWh) and peak demand (kW) savings induced by the program?
2. What is the level of free ridership associated with this program? How can it be reduced? Is spillover an effect for this program?
3. Did the program achieve its goals? Why and why not?

Process questions:

The process evaluation questions focused on six key areas:

1. Has the program, as implemented, changed from the plan filed on November 15, 2007? If so, how, why, and was this an advantageous change?
2. What challenges have occurred in Program implementation and how were they handled?
3. How effectively is the program being administered? What methods could be implemented to improve the efficacy of program delivery?
4. Are the program processes effective for smoothly providing incentives to customers and motivating RSPs to participate?

5. What are key barriers to participation for eligible customers? How can they be addressed by the program?
6. How did customers become aware of the program? How did eligible RSPs become aware of the program? What marketing strategies could be used to boost program awareness and participation, if needed?

The full list of researchable questions can be found in the Evaluation Plan.

Section 2. Evaluation Methods

This evaluation of the DCEO Retro-Commissioning (retro-commissioning) Program reflects the first year of the program. During program year 2010 (PY3), which ran from June 1, 2010 – May 31, 2011, nine public facilities participated in the Program. Among those nine sites, about fifty retro-commissioning measures (RCMs) were implemented and verified, thus qualifying the sites for waiver of retro-commissioning service costs. The nine program participants were shepherded through the program by four⁸ different retro-commissioning service providers (RSPs).

2.1 Analytical Methods

Measures implemented through this program are diverse and not amenable to prescriptive or deemed savings estimates due to the unique circumstances of each participant and measure. Therefore, the impact evaluation included engineering review of documentation for each measure installed. The Process evaluation utilized surveys with key personnel at the Illinois DCEO; Nexant, Inc. and SEDAC, the Program Administrators; third-party RSPs; and program participants. Program planning and marketing materials were also analyzed.

2.1.1 Impact Evaluation Methods

Measure impacts were each examined individually for a census of program participants. Navigant requested detailed data and engineering calculations for each measure, and Navigant reviewed the calculations for accuracy and completeness, where sufficient data were made available⁹. In most cases when there was climate dependency in the savings estimates, measure savings were estimated with temperature bin calculations and typical meteorological year data.

Gross Program Savings

Each implemented measure and many proposed¹⁰ measures at the sampled projects were individually reviewed. The evaluation verified that appropriate algorithms, methods, and data sets were used. During the review Navigant compared calculation parameters to realistic assumptions and applied prescribed parameter defaults as needed when measure calculations deviated from expect norms. Navigant verified and/or adjusted measure savings, as needed, for

⁸ Nexant was the RSP for all four projects in the ComEd service territory.

⁹ Nexant supplied all calculations and data for four projects in the ComEd service territory. SEDAC/360 Energy restricted Navigant's access to calculations and data.

¹⁰ Even measures that were not implemented contain key information about facility operations, setpoints and interactive effects among energy end-uses.

each implemented measure for each participant. Gross savings were examined on a participant level, measure end-use level, and measure-type level. Aggregate savings of the individual measures comprise the program gross savings.

Net Program Savings

Net-to-gross (NTG) savings research is based on self-report methods where participants answer questions about their awareness of the measures identified and their inclination to pursue corrective actions for those measures. Navigant applied installation-specific NTG ratios where our research found free-rider influence. The evaluation team attempted interviews with a census of program participants. Participant interviews also sought for evidence of spill-over savings.

2.1.2 Process Evaluation Methods

Key methods used for the process evaluation included interviews with key personnel at DCEO, SEDAC/360 Energy, and Nexant, Inc. In addition, the evaluation team performed interviews with program's third-party RSPs and a sample of participating customers. Program design, implementation, training, and marketing materials were also reviewed.

2.2 Data Sources

Table 2-1. Principal Data Sources Contributing to the PY3 Evaluation

Data Collection Type	Targeted Population	Sample Frame	Sample Design	Sample Size	Timing
Desk Engineering Review	Census (9)	Census (9)	Census (9)	Census (9)	September-October 2011
In-depth Telephone Interviews	DCEO Program Manager	Contact from DCEO	Program Manager	1	September 2011
	ComEd Program Implementer	Contact from DCEO	Nexant Program Manager	1	September 2011
	Ameren Program Implementer	Contact from DCEO	SEDAC Program Manager	3	September 2011
	Third-party Retro-Commissioning Service Providers	Tracking Spreadsheet	Attempted census (3)	2	October 2011
	Program Participants	Tracking Spreadsheet	Attempted census (9)	4	October 2011

Program and Implementer Staff Interviews

The evaluation team conducted three in-depth interviews with implementation staff to support the process evaluation, one with the DCEO Retro-Commissioning Program Manager, one with the two staff members at SEDAC/360 Energy, and one with the Nexant implementation manager. The interviews focused on program processes to better understand the goals of the program, how the program was implemented, challenges encountered, and the perceived effectiveness of the program.

Review of Program Materials

As part of the evaluation process, the evaluation team reviewed program materials developed by SEDAC/360 Energy and Nexant. These are summarized in Table 2-2.

Table 2-2. Program Materials Reviewed for PY2 Process Evaluation

Category	Materials Reviewed
Program design and implementation	Program design document PY3 application PY3 participant manual PY3 RSP manual List of Retro-commissioning service providers Examples of planning, implementation, and verification reports
Program marketing	SEDAC Newsletters

Interviews with RSPs

The evaluation team conducted in-depth interviews with two of the three third-party PY3 retro-commissioning service providers (RSPs) and with Nexant, who acted as both the program administrator and the RSP for projects in the ComEd service territory. The two third-party RSPs implemented four of the five PY3 projects in Ameren’s service territory while Nexant implemented the four projects in ComEd’s service territory. Our RSP questions focused on program awareness, program processes, free-ridership, marketing and outreach, training, RSP performance review approaches, barriers to participation, and general feedback and recommendations. The guide used for these interviews is included in [Appendix X.X](#).

Interviews with Participants

The evaluation team also completed interviews with four of the nine PY3 program participants who completed all of the program phases. Our questions focused on program awareness, program participation, marketing and outreach, free-ridership and spillover, benefits and barriers to participation. The survey guide used for these interviews is included in [Appendix X.X](#).

2.3 *Sampling Plan*

The impact evaluation reviewed savings from a census of implemented measures from all nine PY3 participants. No sampling plan was necessary for the impact evaluation because we analyzed reports for all participants.

The process evaluation team attempted interviews with a census of the three RSPs and nine participant customers in the PY3 program. No sampling plan was necessary for the process evaluation because an attempt was made to reach all participants.

2.3.1 Statistical Confidence and Precision

Statistical confidence and precision is based on the sample size relative to the population. For both the impact and process analysis, all participants were included in the sample, thus the sampling approach was a census attempt. Given that this is a census attempt, there is no sampling error and the error bounds are zero; therefore, there is no need for estimating precision levels for the sampling effort. However, it should be noted that for the process evaluation there is a potential for non-response bias. Given the small population and resulting number of completed interviews, it is best to consider these results to be primarily qualitative.

Section 3. Program Level Results

3.1 *Impact Results*

The program impact evaluation has several different levels of review. Measure Verification and Due Diligence looks at the methods used to estimate savings. Review of the program tracking database ensures all key data are captured and recorded accurately.

3.1.1 **Verification and Due Diligence**

Measure installation verification for the Retro-Commissioning (retro-commissioning) Program is an iterative process that involves the customer, RSP, PA and finally the evaluator. The customer must implement sufficient measures to gain the incentive which waives the retro-commissioning study costs. The RSP must guide the customer through implementation and check that measures are installed to get paid for services performed, and the PA must verify savings for DCEO. The evaluator's task is, thus, simplified to checking measures verified by previous parties and ensuring that measures are indeed complete and savings are accurately estimated.

In general, the evaluators conclude that the Verification Reports and supporting data and calculations provided sufficient confirmation that the measures were installed as described. In some instances, Navigant confirmed certain details with contacts listed in the reports and project documentation.

Due diligence work for this evaluation focused on the savings calculations for each measure. Navigant performed detailed reviews of all calculations and assumptions. In general, where Navigant had electronic versions of calculations and data, we found the calculations accurately constructed, based on measured data rather than rules of thumb and transparent in spreadsheet form. In rare instances, we found calculation errors due to erroneous inputs and omissions of relevant impacts and inconsistencies in assumptions from measure to measure on the same system. Projects that did not have documentation in electronic format or had less detail with respect to measured data were more challenging, and the due diligence results are less certain. Navigant re-estimated savings in cases where measure implementation details were not consistent with the results or parameters in the report.

Consistency of savings estimation approaches among RSPs varied. Calculation spreadsheets varied from comprehensive to fairly simple, and content and inputs were not always consistent among RSPs. Navigant recommends the following steps to make savings methods more uniform and consistent.

- Consider standardizing weather data sets. Different data sets can provide different results. TMY3¹¹ data sets are the latest issued by NOAA for energy calculations and should be utilized in all subsequent projects. TMY3 data includes sufficient data for determining psychrometric parameters like enthalpy, humidity ratio, dew point temperature, and wet bulb temperature.
- The PA should consider issuing and enforcing default values for key engineering parameters when measured values are not available, for example: motor loading; motor, fan, and pump efficiency (by size); VFD efficiency; chiller efficiency (by age and/or type); and the “adjusted cube-law exponent” for measures that include VFDs. Consider avoiding permitting rules-of-thumb as those rules vary among RSPs. PA guidelines should state a clear priority in input parameters for calculations: (1) measured data; (2) estimates from manuals, nameplates and equipment schedules; and (3) default values.
- Consider including latent cooling estimates and secondary energy impacts, where appropriate.

Despite the range of approaches in PY3, there were very few apparent lapses in engineering methods. Measures that did not include electronic versions of calculations have less certain impacts.

3.1.2 Tracking System Review

Because of the unique nature of retro-commissioning measures, Retro-Commissioning Program participants and projects are not tracked within the overall DCEO program tracking database. Both Nexant and SEDAC/360 Energy used a spreadsheet to track the program in PY3. Both spreadsheets are inadequate data for evaluation, but this review will focus on the SEDAC/360 Energy spreadsheet since SEDAC/360 Energy will be the sole program administrator in the future. The SEDAC/360 Energy tracking spreadsheet only lists electric savings, cost savings and implementation costs at the project level for the investigation phase (recommended), the customer selection phase and the implementation phase. No data were yet tracked at the implementation phase in the spreadsheet nearly three months after the end of the program year and no tracking of verified savings was provided. The evaluation referenced full project verification reports to determine *ex ante* savings. Furthermore, no data were provided in the

¹¹ The TMY3s are data sets of hourly values of solar radiation and meteorological elements derived from a 1976-2005 period or record for a 1-year period. Their intended use is for computer simulations of solar energy conversion systems and building systems to facilitate performance comparisons of different system types, configurations, and locations in the United States and its territories. ... Wilcox, S. and W. Marion. User's Manual for TMY3 Data Sets, NREL/TP-581-43156. April, 2008. Golden, Colorado: National Renewable Energy Laboratory (www.wikipedia.com)

tracking spreadsheet about the customer contacts, the RSP contacts, milestone dates, measure implementation and project status.

A more comprehensive and sort-able tracking system such as a relational database or a more sophisticated spreadsheet is needed to support future evaluations.

3.1.3 Gross Program Impact Parameter Estimates

Savings estimates are made at four different stages of the retro-commissioning program process. In the Planning Phase, the RSP estimates saving for all RCMs identified are based on the limited information from the site survey and interviews with facility staff. These estimates provide an input to the decision whether or not the project will proceed to the Program Agreement with the customer and implementation of selected measures.

Savings estimates are repeated during the Implementation Phase based on new data developed through research that might cause differences in how the measures are implemented versus how they were planned. The *ex ante* savings estimates are developed during the Verification Phase based on performance data acquired after implementation. The SEDAC/360 Energy program tracking spreadsheet did not track savings during the implementation or verification phases.

Finally the evaluation contractor determines *ex post* savings based on the reported *ex ante* savings estimates and supplemental review and research.

3.1.4 Gross Evaluated Program Impact Results

The following figures and tables present information about the sites and retro-commissioning measure impacts. Navigant examined all calculations provided and reviewed data submitted as part of the verification of savings from the RSP. Our due diligence on the calculations determined that the estimates are, generally, well-developed and defensible, with some changes – either increasing or decreasing gross savings.

Table 3-1. Savings and Realization Rates by Participant

	Verification Phase		Evaluation		Realization Rates	
	kWh	therms	kWh	therms	kWh	therms
School 1	96,302		80,483	7,575	84%	
University 1	490,890	39,941	496,061	39,632	101%	99%
Government/Safety 1	438,651	6,937	247,793	10,500	56%	151%
School 2	465,733	20,106	444,454	22,591	95%	112%
University 2	593,264		593,264		100%	
Civic Center/Museum 1	837,242	58,044	439,980	33,442	53%	58%
Civic Center/Museum 2	306,767		273,436		89%	
Civic Center/Museum 3	130,449	4,636	89,460	5,734	69%	124%
Government/Safety 2	52,944	953	47,237	5,042	89%	529%
Total	3,412,242	130,617	2,712,168	124,516	79.5%	95.3%

Realization Rates on a participant- level are within expected ranges with a couple of notable exceptions.

- Government / Safety 1 *ex ante* electric savings estimates do not reflect changes to the scope of one measure, as some equipment schedules could not be changed. *Ex ante* gas savings underestimate heating loads from ventilation.
- Civic Center/Museum 1 had realization rates less than 100% for gas and electric. This is a result of an unsupported rule-of-thumb estimate applied on a measure that claimed large savings.
- Government/Safety 2 gas realization rates are a result of a measure that was completed correctly as a result of the verification visit, but was not included in *ex ante* savings.

Other smaller errors were discovered *infrequently* during the evaluation that had lesser impact on overall savings. The types of errors included:

- Improper estimates of after hour loads and set-backs.
- Failure to include furnace and/or boiler efficiency in some calculations.

- Failure to include reduced fan heat contribution to the energy balance when fan operation was changed.

None of the errors Navigant discovered through the evaluation process were systematic. Additional diligence by the PA will be needed in the future during the Verification Report review as the program grows. If the PA issues calculation templates and requires default parameters, these types of errors will be reduced.

Navigant grouped the implemented retro-commissioning measures into seven broad end-use categories that include most types of measures included in retro-commissioning. Figure 4-3.1 shows the distribution of *ex post* savings among measure end-uses.

- **Chiller** includes such measures as chilled water temperature reset, compressor staging, and water-side economizers.
- **Cooling tower** includes fan and cell staging and condenser water temperature control.
- **Economizer and Ventilation Control** includes economizer repair and optimization and ventilation control based on CO₂ levels in return air.
- **Air-handler** includes measures that change the schedule of fan operation and fan control setpoints such as air temperatures, minimum airflows and/or static pressure setpoints.
- **Fans** include operation of special use fans such as dedicated exhaust or make-up air equipment.
- **Heating** are measures that include boiler pumps or terminal box setpoints and/or control.
- **Pump** measures that include primary-secondary pumping controls, variable primary pumping, impeller trimming and proper pump speed control based on feedback parameters.

In addition to thinking of measures by end-use, Navigant grouped the measures according to their upgrade type. Figure 4-3.2 shows the distribution of *ex post* savings among measure types.

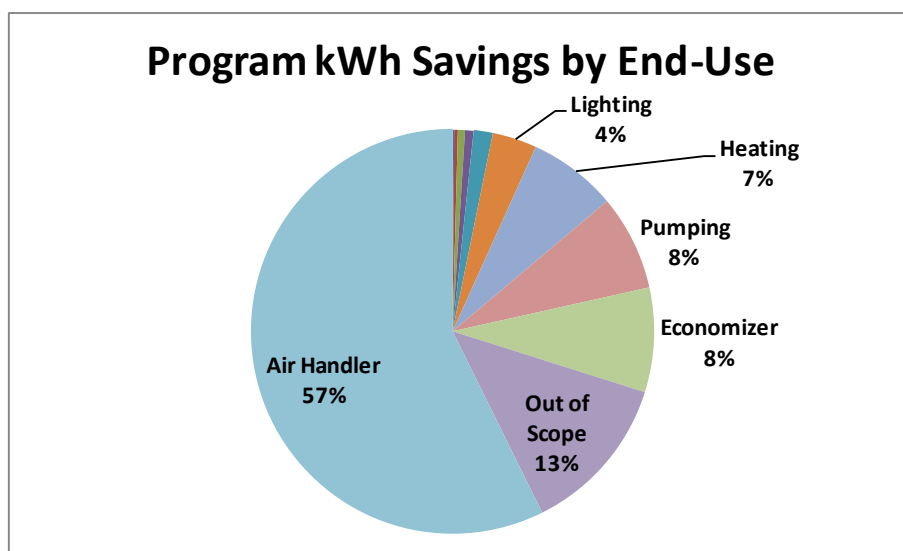
- **Scheduling** measures are those that merely turn off equipment (HVAC, compressed air lighting) when their service is not required for occupants.
- **Optimization** includes measures that improve control algorithms, or setpoints.

- **Repairs** are measures that address broken equipment such as failed actuators or sensors. Low cost new equipment is also included in this category, including: addition of sensors or filter media changes.

Among the RCMs implemented at the PY3 sites, air handlers are the largest energy savers by end-use. The end-use “Out of Scope” is mostly economizer or air handler scheduling savings, but the savings were identified at university campus buildings not in the RSP’s scope of work. This might be considered spill-over savings except that the RSP included these measures in their reported *ex ante* savings. Reporting savings out of scope should be discouraged as it opens the door for double counting savings in the future, and corrupts metrics such as savings per facility, per study, per area or per Retro-commissioning Service Provider.

Very few chiller or cooling tower measures were identified or implemented in PY3, probably as a result of the compressed program schedule that limited the summer investigation phase and the opportunity to implement chilled water measures before May 31.

Figure 4-3.1. Program Evaluated Savings (kWh) by End-Use Category¹²

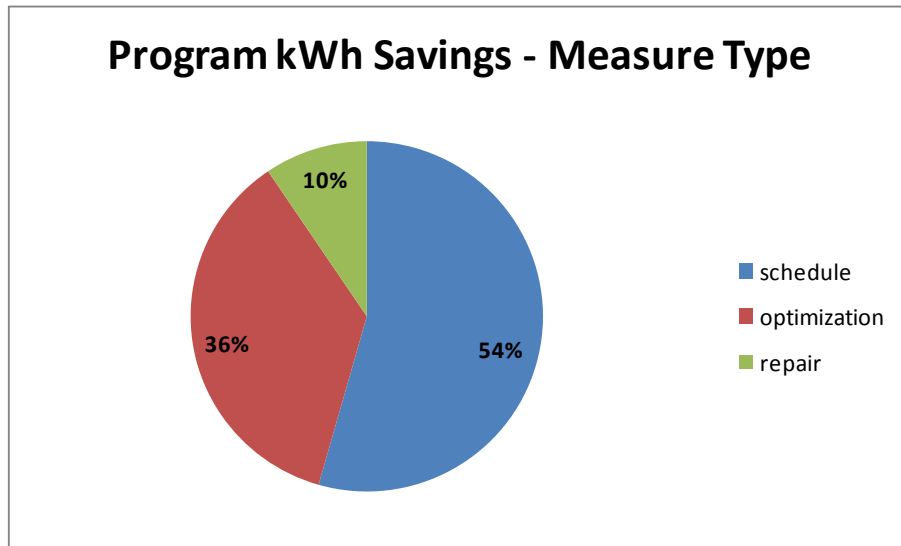


Scheduling measures dominate the savings by measure type. This observation is in contrast to the ComEd version of the program for commercial and industrial customers where optimization measures dominate the types of measures implemented. This might reflect the compressed program timeline in PY3 since optimization measures usually take more time and

¹² End-Use categories fans, chillers, cooling towers, miscellaneous and boilers comprise 3% of program savings, combined and they are not labeled in the figure

expertise to identify. Furthermore, the public sector buildings tended to have a larger amount of equipment that runs continuously for no apparent reason.

Figure 4-3.2. Program Evaluated Savings (kWh) by Measure Type



3.1.5 Net Program Impact Results

Once gross program impacts have been estimated, net program impacts are calculated by multiplying the gross impact estimate by the Net-to-Gross (NTG) ratios.

$$\text{NTG Ratio} = 1 - \text{Free-ridership} + \text{Spillover}$$

Among participants interviewed for the process evaluation, the Navigant Team determined site-level NTG. The overall program NTG is a saved kWh-weighted average of the NTG of the sites interviewed.

$$\text{NTG}_{\text{overall}} = \frac{\sum \text{NTG}_{\text{site}} \times \text{kWh}_{\text{site}}}{\sum \text{kWh}_{\text{site}}}$$

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Among participants interviewed for the process evaluation, the Navigant Team determined site-level NTG. The overall program NTG is a saved kWh-weighted average of the NTG of the sites interviewed.

$$NTG_{\text{overall}} = \sum NTG_{\text{site}} \times kWh_{\text{site}} / \sum kWh_{\text{site}}$$

Free-Ridership

Free-ridership determination is a combination of three attributes investigated during the participant survey.

1. The importance of various program factors in the customer's decision to conduct the study and commit the funding to perform Retro-commissioning activities;
2. Whether the participant would have addressed the issues identified in the retro-commissioning study of which they were aware, absent the program; and
3. What would have been the timing for addressing those issues, absent the program?

The evaluation completed interviews with four participants of an attempted census (9). The free-ridership questions established a free ridership rate of zero for three of the projects and a rate of 0.10 for one project.

Three of the four interviewed participants were already aware of some of the performance issues identified by the Retro-commissioning study and two were already aware of some of the recommended solutions. The fourth interviewed participant was not aware of the performance issues identified by the study. Regardless of their previous knowledge of the performance issues and recommended measures, none of the four interviewed participants would have implemented any of the retro-commissioning measures if the DCEO Retro-commissioning program had not been available. In addition, all but one respondent rated at least one of the program factors about which they were asked (the free Retro-commissioning study, a recommendation from the RSP/SEDAC, the continued technical assistance from the RSP/SEDAC, a recommendation from a utility account manager, and program information) as extremely important (a 10 on a scale of 0 to 10) in their decision to do the retro-commissioning at their facility.

Interviewed RSPs thought that the program played a large part in the decision making process of participants. They noted that some participants may have had a general awareness of their equipment performance issues but had little specific knowledge of how to rectify the issues. Without the program's study, RSPs believe that few of the participants would have implemented the retro-commissioning measures on their own.

Spillover

The Evaluation Team also researched the question of program spillover. In our interviews with PY3 participants we asked about any additional retro-commissioning measures implemented at the facility or other facilities that did not receive incentives through any utility or government program.

Two of the four interviewed participants reported that they performed additional retro-commissioning without an incentive. Both reported that the DCEO Retro-Commissioning program greatly influenced them in taking these additional actions, with each rating the influence as 10 on a scale of 0 to 10. One participant tested the functionality of all sensors and the building automation system, then tested and balanced the water, air, cooling, and heating systems, and then made any required adjustments. This work was performed for two facilities.¹³ The other participant adjusted the scheduling of their kitchen HVAC system. Both participants stated that their additional retro-commissioning projects were based on what they learned from participating in the DCEO Retro-Commissioning program. Although the other two interviewed participants did not perform additional non-incented retro-commissioning work at their facilities, both installed additional energy efficient equipment that received incentives from DCEO.

The indications for spill-over retro-commissioning are strong, but limited information about the projects and the complexity of measures makes an estimate of spillover impossible. Net Program savings, are reported in Table 3-2.

¹³ This participant also planned to retro-commission four additional buildings through the DCEO program.

Table 3-2 Program Net Savings

Gross and Net Savings Parameters	PY3	Realization Rate
Evaluation-Adjusted Gross MWh Savings	9	100%
Evaluation-Adjusted Gross kW Savings	2,712	79.5%
Evaluation-Adjusted Gross Therm Savings	105	10.3%
Net-to-Gross Ratio (1-FR+SO)	0.98	
Evaluation-Adjusted Net MWh Savings	2,658	77.9%
Evaluation-Adjusted Net kW Savings	103	10.0%
Evaluation-Adjusted Net Therm Savings	122,025	93.4%

Channeling

As part of the retro-commissioning study process, RSPs identify potential energy efficient equipment upgrades and list them in the study. Additionally, all RSPs promote the DCEO's C&I Standard Offer programs to participants as an opportunity to receive incentives for qualifying measures. RSPs often also continue to encourage participants to implement these measures after the retro-commissioning project concludes, although this appears to be stronger for RSPs with existing relationships with their clients.

Two of the four interviewed participants installed additional energy efficient equipment at their facility that received incentives from DCEO. Both of the participants stated that their decision to install these measures was greatly influenced by the Retro-Commissioning program

3.2 Process Evaluation Results

The process component of the DCEO Retro-Commissioning Program evaluation focused on program design and implementation, program processes, marketing and outreach, RSPs, and participant satisfaction. The primary data sources for the process evaluation were review of

program materials and interviews with program and implementation staff, RSPs, and participating customers.

3.2.1 Program Participation

In PY3, the Retro-commissioning program completed projects at nine facilities. Only projects accepted into the program were included in the program tracking spreadsheets provided to the evaluation team.

The nine completed PY3 projects resulted in *ex ante* energy savings of 3,412 MWh per year. The program did not have a specific MWh goal in PY3, but rather had a project completion goal of eight projects. The average savings per project was 379 MWh per year, with individual projects ranging from 53 MWh to 837 MWh. The original program plan did include an energy saving goal of 6,080 MWh in the filing for PY3 but staff at DCEO indicated that this was an error and that once planning for the program began it became clear that this goal would not be achieved. A participation goal of 8 projects was set instead of a savings goal. The nine participating facilities represented a range of building types and included auditoriums and civic centers, public schools, university buildings, and a public safety building. The facility floor area ranged from 35,400¹⁴ to 900,000 square feet. Annual electric energy usage ranged from 635,000 to 9,598,000 kWh.

Figure 3.3 and Figure 3.4 present key summary information about participants and energy savings implemented.

¹⁴ Two projects were included in the program, despite being under the program size limit because of the large potential for energy savings.

Figure 3.3. Distribution of Project Savings

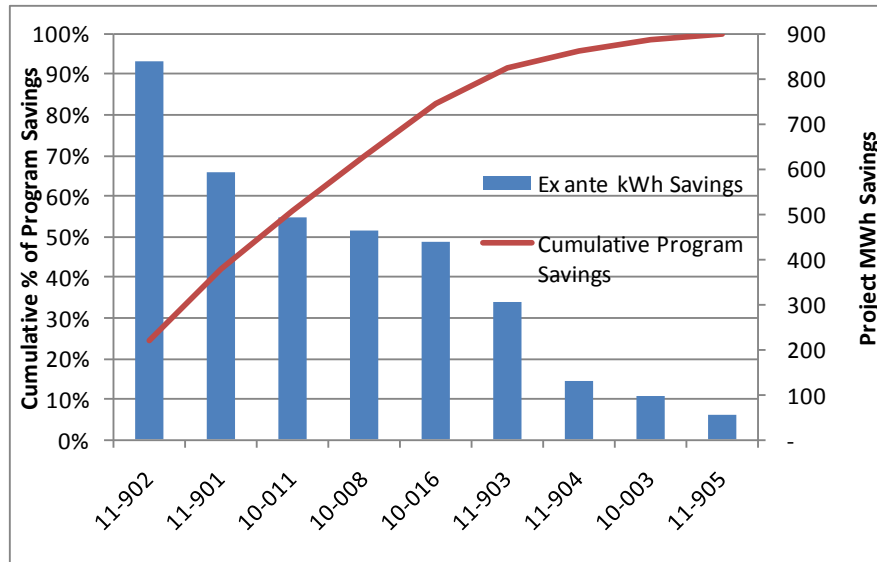
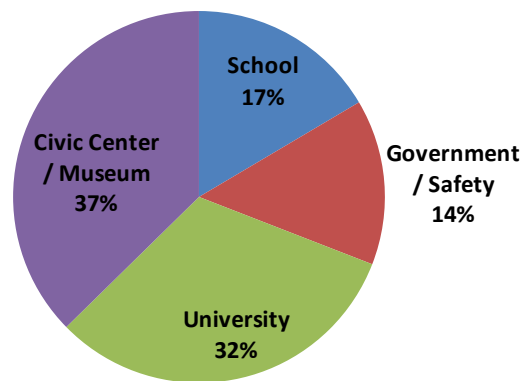


Figure 3.4 Participation and Savings by Facility Type

Facility Type	% Savings	Count
School	17%	2
Government / Safety	14%	2
University	32%	2
Civic Center / Museum	37%	3



3.2.2 Program Processes

Participation Process

Customers and RSPs were generally very satisfied with the program and its processes. Participants indicated that the participation process was smooth and that they felt they received ample feedback and support throughout the program. RSPs indicated general satisfaction with

the program and the process for participation. There was some indication that the constraints that the calendar-based program deadline puts on the program and conflicting goals between DCEO and the customer are potential program challenges. Specifically feedback indicated that customers measure success by meeting the \$10,000 commitment while DCEO measures success by energy savings. This is discussed in more detail below.

Participants reported no significant trouble funding the improvements identified in the retro-commissioning study. One interviewed participant used an energy efficiency block grant, another covered the cost of improvements in their annual operating budget, and two participants used a combination of their annual capital improvement budget and their annual operating budget. It is important to note that participants, by definition, had already found funding for the improvements, however there may be some eligible customers that could have trouble meeting the funding requirement. DCEO may want to consider identifying the budgetary strategies that work well for participants and provide those as tips or recommendations to potential participants who are or may be facing project funding issues.

Program Timelines

The participation process is broken into four phases: the application phase, the planning phase, the investigation phase, the implementation phase, and the verification phase. The Participant Manual lists target timelines for each phase. However, according to the program managers, these deadlines were not usually met in PY3. Delays are often customer oriented and include challenges getting internal approval to invest funding in the project, staffing issues and turn over, and delays in the availability of equipment needed for the project. The program managers noted that the program has started to gain traction in PY4 and that the slippages in schedule have decreased (but they are still present) as the RSPs gain experience with the program.

Exact project durations for the DCEO projects were difficult to ascertain. The data provided to the evaluation team was limited. The SEDAC/360 Energy data provided only the recommended and achieved savings by site, with little information in the tracking sheets available to allow a comparison of the actual time it took each project to complete each phase, to the expected time. Data provided by Nexant included the dates the applications were accepted and the date of the kick off meeting but no additional information on the dates for each phase was completed. As a result, it was difficult for the evaluation team to measure actual to estimated project completion timeframes.

A second challenge in the program timeline was the abbreviated 6 month first year timeline. This shortened first year caused challenges in completing the monitoring needed to confirm the savings during the verification phase. As a result several projects were given extensions allowing them to complete monitoring after May 31, 2011. This was necessary, especially in

cases where buildings had not needed to turn on their chillers in advance of the end of the program year, a situation exacerbated in 2011 by the cool spring.

RSPs reported that meeting the program’s timelines was difficult, but that most projects were completed on time. They found that the program’s calendar-based schedule was challenging because any projects not started early in the program year were forced into a compressed schedule to meet the May 31 deadline. Despite the challenges, one interviewed RSP met the deadlines for both PY3 projects while the other required an extension from the program on one project due to changes in the customer’s staffing during the implementation phase.

Participants were generally pleased with the program’s timelines. One participant, a school district, noted that all decisions had to be endorsed by the Board of Education which meets monthly, resulting in long delays. This participant also said that, ideally, verification could have started in the summer when school was in recess, but that the program’s timeline prevented this.

Data Tracking

The DCEO program manager indicated that he is satisfied with the timeliness and quality of the data he receives from the implementers. The program manager notes that he has enough information to know what is going on with the program, stating that information includes the “*financial and the kilowatt hour savings*”. It was also noted that the data provided by the program administrator does not get input into the DCEO database at this point because it would need to be manually input. There was acknowledgement by DCEO staff that as the program grows this will need to be addressed, but given the small size of the program to date there is little justification for investing in the upfront cost to make a revision to the internal DCEO databases to support this program.

Data provided to the evaluation team was limited, including only the information the program manager at DCEO indicated was of most importance, e.g., the recommended and achieved savings and expected dollar savings. There was little information in the tracking sheets on project timelines, building size, energy use, building type, etc. In addition there appears to be no formal tracking of inquiries or project leads that come in over the course of the program year, but are not approved.

3.2.3 Retro-Commissioning Service Providers

In the ComEd service territory, the RSP role was fulfilled by Nexant staff. In the Ameren territory, where SEDAC/360 Energy managed the projects, third-party RSPs were used to provide the Retro-Commissioning services.

Third-party RSPs were recruited through an RFQ. Potential RSPs learned about the RFQ through their previous participation in DCEO programs, or participation in the utility Retro-commissioning programs operating in the ComEd and Ameren service territories. To be considered for selection, prospective RSPs were required to have experience with building retro-commissioning projects with an emphasis on energy efficient practices. This included the requisite knowledge to identify and analyze low cost tune-ups and adjustments that would improve the efficiency of existing public buildings' operating systems. Bidding RSPs were scored on experience, references, and cost effectiveness.

Program participants state that they were very satisfied with their service providers and would recommend them to other firms. Satisfaction is similar for participants with or without a prior working relationship with the RSP.

Training

RSPs are not offered any formal training in advance of participating in the retro-commissioning program. Service providers interviewed by the evaluation team indicated that they do not feel that they currently need training. One RSP stated that this was due to their firm's experience and advanced level of expertise in retro-commissioning. However, the other interviewed RSP said that, while they do not need training now, it would have been very helpful when they first participated in the program. The RSP found that the program only provides RSPs with program documentation but that the documentation may not be current and that a short webinar to describe the program requirements and any changes not included in the documentation would be beneficial.

RSPs also reported that they did not receive any calculation templates or other support that could have aided their participation in the program. One service provider noted that calculation templates would be very valuable to their firm and that they currently use the calculation templates from the ComEd program or those developed their own.

RSP Satisfaction

The two interviewed third-party RSPs stated that they are very satisfied with the program. They report interfacing exclusively with SEDAC/360 Energy and are satisfied overall with their interaction. One RSP stated that the presence of a program administrator (360 Energy) adds a layer to participation and it may be simpler to work with DCEO directly. This RSP found that SEDAC/360 Energy varied in their interpretation of program requirements and did not always clearly explain their expectations.

Service providers report general satisfaction with the program processes. As discussed earlier, one RSP felt that projects could be constrained by the calendar-based program year deadline (May 31, 2011). Another RSP identified the implementation phase as a potential program challenge due to the conflicting goals of the program and customer. This RSP stated that DCEO is primarily interested in energy savings while the customers view the \$10,000 commitment as the goal of the implementation phase. Because of this, customers often make shortsighted decisions (that may be less cost effective than others) in order to meet the spending threshold. Because many public sector project decisions are based on committees, RSPs find there is less opportunity to educate decision-makers compared to private sector projects. This RSP suggests requiring a certain level of energy savings for projects in addition to the spending threshold.

3.2.4 Marketing and Outreach

There was limited marketing for the DCEO program in PY3. The PAs were able to recruit most of the participants using previous contacts and lists of customers who had called in advance of the program launch to enquire about the program. In addition, on the SEDAC/360 Energy side the team used word of mouth marketing and their monthly newsletter to bring in potential participants. In one case a participant was brought in through the RSP. Participants indicated they learned about the retro-commissioning program in a variety of ways. Of the four interviewed participants, one learned about the program through their RSP (Nexant), one from SEDAC/360 Energy, and two through their prior interactions with DCEO. Participants found the program's outreach to be effective, especially for those who had previously worked with DCEO.

RSPs are selective in their promotion of retro-commissioning. One interviewed RSP performs many energy audits and will only promote the DCEO program to clients if the program meets their needs and if they have enough potential energy savings to meet the program participation requirements. Another interviewed RSP states that, due to the time constraints (the calendar year timing) and fuel constraints (electric only) they only promote the program to customers that really need the free Retro-commissioning study to complete work. Further, they noted that they do not promote the program to customers who understand the program's value is saving energy and not the free Retro-commissioning study. In other words they felt that the program is more useful for customers who are driven to participate because they have financial constraints that keep them from conducting Retro-commissioning and are less worried about the value of the ROI for the work done (first cost versus savings driven customers).

Marketing Materials

The program did not develop specific marketing materials for PY3, instead relying on word of mouth, presentations and in the case of SEDAC/360 Energy the monthly newsletter. All participants were provided a manual that outlined the participation process and expectations. The staff indicated that explaining the program and process in person made for the most meaningful sales tool. Because the program was in its infancy during PY3 and participation goals were quite small, the decision to limit investment in marketing was intentional. As the program expands over the next few years, there may be a need to increase the marketing tools available to both the program administrator and the RSPs.

3.2.5 Customer Satisfaction

Interviewed participants reported very high satisfaction with the program. They found the application process to be easy and clearly explained. Participants were satisfied with the participation process as well as the reports provided. Several participants noted that they now use the reports as reference guides for their systems and equipment. All interviewed participants were satisfied with the performance of their service providers.

The interviewed participants were also very pleased with the results of the implemented retro-commissioning measures. Several participants noted that, while energy savings were the primary reason for participation, they found that another major benefit of the program was educating their staff about their facilities' equipment and systems and how they should be properly run and monitored. One participant stated that this education was more valuable than the simple payback of the actual retro-commissioning.

Participants suggested some ways to improve the program. One noted that the program's savings estimates tended to be high while the cost estimates tended to be low, resulting in a higher cost than originally anticipated. In this instance, the participant had a stable funding source, but noted that this may not always be the case for public sector projects.

3.2.6 Barriers to Participation

According to service providers, the primary barrier preventing public sector entities from performing retro-commissioning is that they typically are not as conscious of the "bottom line" as private sector companies, especially concerning facilities; as a result, they may not have as much impetus to find and correct equipment performance issues. RSPs comment that decision making among public sector clients is often much slower than private sector customers as many decisions are made by committee or involve additional layers of decision making, as well as

utilizing limited or uncertain funding. These are barriers not only to conducting retro-commissioning studies and services, but also to participation in the program.

3.3 Cost Effectiveness Review

[to be completed at a later date]

Section 4. Conclusions and Recommendations

The DCEO Retro-Commissioning Program completed its first year of implementation, and it has started with promising results. The program included nine projects in public sector buildings, and achieved about 2,700 MWh of net savings

4.1 Program Impacts

4.1.1 Ex ante Results

The Retro-Commissioning Program implemented savings at nine participants and achieved *ex ante* energy savings of 3,412 MWh per year, plus significant electric demand reduction and natural gas savings. Final program savings results are shown in Table 4-1.

Table 4-1 Ex Ante Program Savings

Participant Type	Count	<i>Ex ante</i> gross MWh	<i>Ex ante</i> gross therms
Public Sector Retro-Commissioning	9	3,412	130,617

In cases where the program tracking system contained final program year data, they accurately recorded savings detailed in the program Verification Phase. The tracking system does not track savings at the measure level.

4.1.2 Ex post Gross Savings Results

The evaluation-estimated gross savings are based on detailed reviews of project documents. In general, we found all but a few measures implemented as described in the reports. The evaluation found that Service Providers and the Program Administrators are accurately calculating and presenting measure savings to customers and the DCEO. Minor details in calculations were adjusted during the evaluation, but they seldom represented significant changes, and they did not represent systematic problems with judgment or estimation techniques.

Telephone interviews with PY2 participants indicate minimal free-ridership plus the potential for some program spillover as some participants have conducted their own building tune-ups independent of the program. Evaluation gross and net results are presented in Table 4-2.

4.1.3 Freeridership

Overall, three of four interviewed participants were already aware of some of the performance issues identified by the retro-commissioning study. None of them reported that measures would have been implemented in the short-term absent the program.

Table 4-2 Ex Post Program Savings

Gross and Net Parameter and Savings Estimates	PY3 ex ante	PY3 Evaluation Adjusted	Realization Rate
Participants	9	9	100%
Gross MWh Savings	3,412	2,712	79.5%
Gross kW Savings	1,027	105	10.3%
Gross Therm (natural gas) Savings	130,617	124,516	95.3%
Net-to-Gross Ratio (1-FR)	0.98		
Net MWh Savings	NA	2,658	77.9%
Net kW Savings	NA	103	10.0%
Net Therm Savings	NA	122,025	93.4%

4.2 Impact Evaluation Conclusions and Recommendations

Navigant submits the following conclusions about program impacts and recommendations for improvements to future impact analyses.

Savings estimates (General). The continuing Program Administrator provides inadequate documentation for savings calculations and inferred methods demonstrate mixed and inconsistent engineering methods.

Recommendation. Consider submitting electronic versions of all calculations used to claim savings in the program to the program evaluators. Electronic annotation of review

comments from the PA should be left in the spreadsheet to clarify the consensus approach agreed to by the RSP and PA reviewer.

Recommendation. The Program Administrator should consider introducing standard assumptions and/or calculation templates for common measures to ensure consistent estimates among RSPs. The PA should enforce these criteria with rigorous and systematic review of calculations.

Demand Savings. Demand savings are not tracked in the Program Tracking Spreadsheet because DCEO is not claiming demand savings for this program. None-the-less, several project reports included demand savings for at least some measures. Navigant found little consistency in the demand savings estimation methods.

Recommendation. If DCEO does plan to track demand savings from the Retro-Commissioning Program, the Program Administrator should consider enforcing guidelines in the verification report calculations. Demand savings from retro-commissioning measures is highly site and measure specific.

Recommendation. Even if demand savings is not a focus of the program, RSPs should continue to estimate demand for projects from the *participant* perspective as demand savings can significantly affect project payback.

Spillover. Since many of the participants represent larger public entities with multiple facilities, there is a high potential for program spillover. Some spillover is reported at two of four sites that participated in our interviews.

Recommendation. Consider how spillover might be quantified and reported in future years. The complexity and details of retro-commissioning measures makes broad generalization of spillover savings difficult.

Recommendation. Consider prohibiting RSPs for claiming savings outside of their scope of work, though they can mention where spillover might be present. Claiming out-of-scope savings raises the potential for double-counting savings in the future and inflates the current projects' status.

4.3 *Process Evaluation Conclusions and Recommendations*

Program Processes

The program was successful during its first year of operation, incorporating many lessons learned from the utility programs upon which it was built. Three of the main challenges associated with the participation process related to project timing. First, the abbreviated

program year in PY3 created issues, but it was a unique circumstance and does not need to be addressed going forward.

Second, the implementation deadline (May 31, 2011) for all projects that came in during the program year made it difficult for projects that came in later in the program year to complete work by the deadline. This is further complicated by the often more complex decision making processes public sector buildings have in comparison to their private sector counter parts.

Recommendation: Funding and contracting cycles create a challenge for some projects. If feasible, consider re-evaluating the need to have projects that come in during one program year finish that same year. Allow projects to come in during one year and complete in the next (ComEd is now allowing this approach in their program; this may serve as a model).

Third, there were challenges meeting the program year deadline. Projects had trouble meeting the deadlines for completing each phase of the project, and in most cases these deadlines were not met.

Recommendation: Consider reevaluating the time requirements for each phase as it appears that most projects do not meet them and RSPs consider them too aggressive given the often slow decision making and approval processes in public sector buildings. Consider pre-enrolling customers so that administrative steps with enrollment are completed before the start of the program year.

Customer Satisfaction

Participants report very high satisfaction with the program. Interviewed customers were also satisfied with the timing of the different phases, with some admitting that delays in meeting milestones were due to internal circumstances. In addition, customers are generally very satisfied with their RSPs and the results of the implemented retro-commissioning measures. Participants noted that the program's reports and its usefulness in educating staff about their facilities' equipment and how they should be run were the most valuable parts of participating in the program.

There was some indication that there may be a bit of a disconnect between the customers' goals and the goals of DCEO. DCEO is primarily focused on achieving energy savings while the customers view the \$10,000 commitment as the goal of the implementation phase. This may lead customers to make shortsighted decisions in order to meet the spending threshold.

Recommendation: Set a target energy savings goal for each project, in addition to the spending goal; attempt to ensure that those measures with the biggest savings potential are completed.

Feedback indicated that some of the energy savings were overstated and costs for the improvements understated in the Retro-commissioning reports. This can cause customers to expect lower project costs than incurred and higher savings on utility bills than achieved

Recommendation: To help make sure the programs savings estimates are not overstated and cost estimates understated, consider developing calculation templates for the RSPs to use to mitigate inconsistencies in calculations and savings.

Retro-Commissioning Service Providers

The program selected three third-party RSPs who served those projects completed in the Ameren utility territory. In the ComEd service territory, Nexant served as both the RSP and program administrator. The third-party RSPs were very satisfied with the program. They report overall satisfaction with their interactions with SEDAC/360 Energy, although there was some feedback that the inclusion of a program administrator may add additional layers, and that there was at times varied interpretation of program requirements and lack of clarity around program expectations.

Recommendation: As the number of RSPs participating in the program and the number of projects increases, consider developing a short training webinar that describes the program participation requirements and provides updates on any changes to the program from one year to the next. In addition, continue to ensure strong communication and feedback practices, including:

- Consider sharing of technical or process issues with RSPs and participants as soon as possible, either in the initial meetings about the project or in RSP trainings. This will help lower the learning curve for newer RSPs by relaying the lessons learned from past projects.
- Consider a more formal review or rating of the RSP's performance. This is a helpful tool for the program to evaluate service providers and ensure that they are active in the program and deliver high quality work.
- Consider soliciting more formal feedback from customers about the program as well as their RSP.

Data Tracking

The program databases provided DCEO with the data needed to track the program from a financial and energy savings perspective. However, there was little timing information tracked, making it difficult to compare the actual time it took each project to complete each phase, to the expected time. Understanding how projects fair in meeting program deadlines may help support program design changes in future years, including revising timelines or providing

greater support in those phases where customers most often miss the completion deadline. This more detailed tracking can also help the program manage projects to goal, understanding more clearly whether project are likely to complete in the program year, given project trends in meeting program deadlines.

Recommendation: As program participation increases, more robust data tracking should be considered. This should include tracking project progress toward meeting the timelines associated with each phase of the project as well as specific project information like pre-participation annual energy use, building type, and square footage. While much of this information was available in the RSP reports, including it in the program database would ease analysis and help track more detailed information about the buildings applying for participation in the program.

The project and tracking data provided by the program administrator to DCEO does not get input into the DCEO database. It was acknowledged that as the program grows data tracking issues will need to be addressed. However due to budget constraints there is no plan to add Retro-commissioning to the central tracking system.

Recommendation: Carefully track the program growth; consider the value to cost of including the Retro-commissioning program in their internal databases as the program size and amount of collected data increases.

Marketing and Outreach

While there was limited marketing for the DCEO program in PY3, participants found the program's outreach to be effective, especially for those who had previously worked with DCEO. One participant noted that decision makers are not often technical and program materials should be developed in a manner that makes it easy for decision makers to understand the program and its benefits. The program staff indicated that several leads came in during the pre-launch phase of the program and they were able to mine that list as well as the DCEO past client lists for participants.

Recommendation: While the current level of marketing and outreach worked for PY3, more marketing and outreach may be needed to garner participation as the program's participation goals increase. This may include increasing the amount of direct outreach to potential participants.

Decision makers are not often the people directly involved in the day to day operations of the facility, which may be a board, city council or other public sector body. These decision makers may not be technical and may not understand the value to investment retro-commissioning can provide, which may make them hesitant to approve funding for the project.

Recommendation Given the decision makers in public sector buildings are not typically the technical experts, materials and information should highlight the program and its benefits in language that a lay person can understand. Materials should also provide customers support for “selling” the program to the decision makers providing information that identify the budgetary strategies that have worked well for past participants.

Section 5. Appendices

5.1 *Data Collection Instruments*