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

Evaluation Report:

Public Sector Electric Efficiency Custom Incentives Program

Presented to

The Illinois Department of Commerce and
Economic Opportunity

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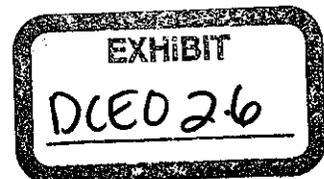
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Executive Summary

E.1. Evaluation Objectives

The goal of this report is to present a summary of the findings and results from the evaluation of the Program Year 3 Public Sector Electric Efficiency (PSEE) Custom Incentives program.¹ The primary objectives of this evaluation are to quantify gross and net impacts and to determine key process-related program strengths and weaknesses and identify ways in which the program can be improved.

Under the Illinois Energy Efficiency Portfolio Standard (EEPS), the Illinois Department of Commerce and Economic Opportunity (DCEO) administers the Illinois Energy Now (IEN) Public Sector Energy Efficiency program (PSEE)² program that provides incentives for public sector customers of ComEd and Ameren Illinois Utilities who upgrade their facilities with energy efficient equipment. There were two specific program elements that were available to customers during the program year: a Custom Incentives program and a Standard Incentives program.

- The Standard program provides an expedited application approach for public sector customers interested in purchasing efficient technologies. The program targets discrete retrofit and replacement opportunities in lighting, LED traffic signals, HVAC, motor, and refrigeration equipment. A streamlined incentive application and quality control process is intended to facilitate ease of participation.
- Custom program incentives are available to customers for less common or more complex energy-saving measures installed in qualified retrofit and equipment replacement projects.

Some tasks within the Standard and Custom program evaluations involved close coordination between the two efforts, but the evaluations were otherwise conducted through separate approaches. The Standard and Custom programs have evaluation results reported separately.

E.2. Evaluation Methods

Project-specific M&V was completed for a sample of 17 selected projects in order to assess the gross impacts achieved by the program, and ratio estimation was then applied to estimate program-level gross savings using the project M&V results. Net impact results were developed based on survey data collected for 39 projects. Four research activities were conducted in

¹ The Program Year 3 (PY3) program year began June 1, 2010 and ended May 31, 2011.

² The portfolio of programs has been branded as Illinois Energy Now and the former Public Service "Electric" Efficiency program was renamed to "Energy" because natural gas measures are added to the program for PY4.

support of the process evaluation: (1) interviews with program staff, (2) a quantitative telephone survey with 39 participating customers, (3) qualitative telephone interviews with 10 participating customers focused on the procurement process, and (4) qualitative interviews with five program drop-outs. Additional information about the evaluation data sources can be found in Appendix 5.2.

E.3. Key Findings and Recommendations

Table ES-1 below provides a summary of reported ex ante savings from the DCEO tracking system, and evaluation-adjusted gross and net annual savings for the Statewide PY3 Custom Incentives program. As shown in the table, the PY3 Custom program evaluation found that verified gross impacts were equal to 78% of the savings in DCEO's tracking system, as indicated by the realization rate (realization rate = ex post gross / tracking system gross). A realization rate for peak demand impact could not be estimated due to the fact that the program does not track kW savings.

Table ES-1. Program-Level Evaluation-Adjusted Net kWh Impacts for PY3

Ex Ante Gross kWh	Ex Post Gross kWh	kWh RR	Ex Post Net kWh	NTGR (ex post gross)
26,839,055	20,885,239	0.78	15,476,819	0.74

Source: Ex ante savings from DCEO tracking system, September 7, 2011. The values for RR and NTGR are rounded.

The chained realization rate (gross RR * NTG Ratio) is 0.58 for kWh (0.78 x 0.74). This indicates that the Custom program evaluation-based (ex post) estimate of net savings is equal to 58 percent of the value claimed in the DCEO tracking system for gross savings. The relative precision at a 90% confidence level for the 17 Custom projects in the gross impact sample is ± 9% for the kWh Realization Rate. The relative precision at a 90% confidence level for the program NTG ratio is ± 4% for the kWh Realization Rate. Utility specific impacts are provided in Appendix 5.1.

Table ES-2 below provides an overview of planned, reported ex ante, and evaluation-adjusted net savings impacts for the combined PY3 Custom and Standard programs.

Table ES-2. Comparison of Sector Electric Efficiency Program Net Savings

Net Savings Estimates	Standard MWH	Custom MWH	Combined MWH
DCEO PY3 Plan Target	128,821	20,000	148,821
DCEO Reported for PY3 (ex ante net)	42,908	21,471	64,379
Total PY3 Third-Year Evaluation-Adjusted Net Savings (ex post net)	38,237	15,477	53,714

Source: Plan target from Direct Testimony of Jonathan Feipel, DCEO, Docket No. 07-0541, Exhibit 1.2, November 15, 2007. DCEO's planned and reported net savings include a net-to-gross ratio of 0.8.

The PY3 evaluation-adjusted net savings of 15,477 MWH for Custom and 53,714 MWH for the Custom and Standard programs compares with the PY2 evaluation-adjusted net savings of 13,972 MWH for Custom and 43,191 MWH for the combined Custom and Standard programs. The PY3 ex post net savings for the Custom and Standard programs of 53,714 MWH is 0.58% of estimated 9,271,325 MWH non-low income public sector base usage.³

The energy realization rate of 0.78 is a significant increase from the PY2 level of 0.56. This shows DCEO has done a good job of improving the estimation of gross impacts for Custom energy efficiency projects in the program. PY3 energy savings realization rate results indicate that the largest projects (stratum 1 with a RR of 0.94) and the smallest projects (stratum 3 with a RR of 0.85) realized a greater proportion of the ex ante claims than the medium projects (stratum 2 with a RR of 0.57). . This is due to the complexity of the projects involved in stratum 2 that include technologies such as HVAC, VSDs and high efficiency blowers that require more in-depth technical reviews and pose a greater challenge for estimating savings accurately -- for example, due to varying operating conditions. Therefore, overall results suggest, and especially among complex projects in stratum 2 (n=7), that ex ante estimates could be further improved. Key evaluation conclusions and recommendations include the following:

E.3.1. Improvements to Ex Ante Impact Estimates

Finding. Program reported installed measures for two projects were not fully operational. For project (#486) the installed lighting control measure was not operational and for project (#3302) three from a total of 11 VFDs installed were not operational which significantly reduced the realized savings for these projects.

³ Communication from David Baker, DCEO, December 6, 2010 indicating public sector usage of 9,271,325 MWh for non-low income public sector energy consumption.

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- **Recommendation.** Program should conduct thorough site visits to confirm that all the installed measures are fully operational.

Finding. Program estimated annual energy savings were not representative of the typical annual operating conditions for several projects (e.g. #3093 (VSD), 3302 (VSD), #3386 (Lights, Sensors), #3609 (Ext LED) and #3344 (Aeration Blower)). The program calculations were also not normalized to account for changes in operating conditions from the pre retrofit period to the post retrofit period (e.g. #3447 (AHU Coil Cleaning)).

- **Recommendation.** To improve program calculations and realization rates, the program could do a better job of verifying that the estimated operating hours and energy usage represents typical annual operating conditions for the installed equipment. The program should also determine whether the energy savings will require normalization to properly adjust for changes in operating conditions from pre retrofit period to the post retrofit period. Additionally, the program should perform in-depth engineering review of the calculations and models submitted to verify the accuracy of savings for the largest projects.

Finding. For lighting projects, program estimated fixture wattages were different from the ex post verified fixture wattages for two projects (e.g. #3745 and #3335).

- **Recommendation.** Estimate fixture and lamp wattages from manufacturer data sheets or from standard wattage tables.

Finding. For high efficiency blower projects #3093 and #3344, the ex ante energy usage was estimated using incorrect input values such as full load amps, blower power at full load conditions (for baseline energy usage) or speed settings (for post retrofit energy usage) which resulted in overestimation of energy savings. Also, the operating hours were incorrectly estimated for project #3344 since the ex ante calculations did not account for seasonal variation of the load profile that resulted in reduced ex post operating hours.

- **Recommendation.** Use blower performance curves, to calibrate or to verify the baseline energy usage based on the actual (load profile) operating conditions of the facility. In addition for post retrofit conditions, verify the range of speed settings (VSD) or airflow profile for the blowers. Typically, customers have a good idea how they would program the blowers to operate (such as speed setting or speed range) for the post retrofit conditions. Adjust the estimated energy usage based on the information obtained through these additional verification steps.

E.3.2. Project Documentation

Finding. Project documentation was not detailed for many projects. In some cases, supporting calculations for projects were not clearly documented or were difficult to identify in the project

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documentation. For some projects, final applications did not include information about the adjustments made to initial savings estimates and therefore, the evaluators were not able to understand the reasons for observed ex ante savings adjustments (e.g. #3447 (AHU Coil Cleaning), #3223 (chill water controls) and #3224 (chiller loop)).

- **Recommendation.** DCEO should consider making project documentation available electronically. Final applications should include all calculations (spreadsheets, building models, etc) and documentation to support the estimated savings. If any changes are made to the submitted savings calculations – the documentation should include the reasons for these changes. This will allow the evaluators to better understand the reasons for project application updates and changes to savings estimates.

E.3.4. Peak Demand Estimation

Finding. Ex ante calculations did not estimate peak demand savings for any of the projects. The program should incorporate estimates of peak demand savings. Peak demand impact estimation is given a lower priority than energy savings due to the fact that incentive levels are tied to energy savings and not peak demand reduction. Peak demand savings are important because they reflect load reduction on the grid and are critical for utility power supply planning.

- **Recommendation.** Calculate peak demand savings for all projects by establishing an industry accepted set of program rules and definitions. The program should also track summer peak demand savings. For consistent reporting and tracking of peak demand savings for projects, the program should include dedicated fields in the custom project application form (for the applicant to report peak demand savings).

E.3.5. Net Impacts

Finding. Free-ridership levels for PY3 custom program (26%) are significantly lower than PY2 levels (35%). This free-ridership level is somewhat low for a Custom program. Program influence was high in many cases specifically for the large stratum 1 and stratum 2 projects. Participants report the program being a strong motivating factor in their decision to upgrade to efficient equipment at the time they elected to do so. However, mean free-ridership was relatively high across smaller projects (37% for sampling stratum 3).

- **Recommendation.** One approach to further reduce free ridership is for program administrators to simply exclude projects from the program that they believe have a high probability of being free riders. For example, incentives should not be provided to projects that are already installed. Similarly, if there is evidence that the program did not contribute significantly to the decision to install a particular project or equipment type then an incentive may not be warranted. Incentives might only be provided if the program process leads to a higher efficiency level than initially planned. Also, ensure

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that program incentives are not offered for measures and technologies that are industry standard practice or projects that were being implemented by end users as part of their regular facility upgrade requirements or due to facility energy efficiency practices.

E.3.6. Tracking System

Project Status Updates. One aspect of the tracking system that affected the evaluation was the delay in reporting status updates for Custom projects. The Custom program tracking system originally had 130 projects, one of which was cancelled and two were moved into PY4. Of the remaining 127 projects, only 100 were marked as "Complete", and the transition between "Final" and "Complete" status often occurred with significant changes in the reported kWh savings. This affected the sampling phase of the evaluation and significantly delayed field visits to sampled sites. The evaluator asked for updates periodically, but it turned out, for example, that some projects that were completed had not yet been entered into the tracking system.

- **Recommendation.** Enhanced electronic tracking of projects within the program is needed, including accurate real-time updates to the tracking system for completed projects.

E.3.7. Program Partnerships

Finding. In PY3, DCEO has continued to leverage partnerships with organizations such as the Illinois Association of Regional Councils and the Illinois State Board of Education. These partnerships have been successful in increasing participation by local governments and K-12 schools. Cooperation included shared marketing and outreach efforts and channeling participants into each others' programs.

- **Recommendation.** DCEO should exercise caution when seeking participation by projects that also receive funding from other public sources. While cooperation in marketing and outreach can be beneficial for both organizations, care should be taken that co-funding of projects does not create freeridership in the program. Results from the PY3 net impact analysis suggest that some of the projects that received funding from other government sources have relatively high rates of freeridership.

E.3.8. Trade Allies

Finding. In PY3, DCEO continued to make use of the utilities' and SEDAC's existing trade ally networks, but made a first attempt at developing its own network of contractors through a pilot effort under the Building Industry and Training Education Program (BITE). Program staff did not find this pilot effort to be a worthwhile use of program resources. In PY4, DCEO plans to build a trade ally network similar to that of the utilities, where trade allies are enticed to participate by being eligible for incentives themselves. Participant survey results confirm the

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importance of trade allies in channeling participants into the program, assisting them with the design of their projects, and supporting them through the application process.

- **Recommendation.** Development of a program-specific trade ally network is well-warranted. Based on procurement process interviews, trade allies are often involved at the project specifications stage and then again at the implementation stage. While trade allies have influence over the energy efficiency of equipment at the former stage, they rarely do at the latter stage since project details have already been determined. It is therefore important that DCEO's network include trade allies capable of helping at the project design stage, so that they have an opportunity to promote energy efficiency and participation in the PSEE program to public sector entities.

E.3.9. Marketing and Outreach

Finding. In PY3, the PSEE Program was re-branded as *Illinois Energy Now* (IEN). DCEO conducted marketing and outreach efforts through various means, including electronic media as well as in-person events and presentations.

Finding. Budget constraints are a key barrier to the installation of energy efficient equipment and participation in the program. The program developed limited marketing materials in PY2, but no new collateral was developed in PY3. Currently few materials highlight how energy efficient equipment can help budgets in the long run, and there are no materials specific to the various public sectors.

- **Recommendation.** While the increased PY4 incentive level will help reduce financial barriers for non-carve-out entities (federal and state government and universities), the upfront cost of energy efficient equipment is likely to remain a barrier to participation for many public sector entities. However, this barrier might be reduced if prospective participants had more collateral that demonstrates the savings that can be expected from the installation of energy efficient equipment. The program should consider developing short sector-specific case studies or fact sheets that provide examples of potential savings. This might be a useful tool for facility managers when seeking approval for energy efficiency upgrades.

E.4. Cost Effectiveness Review

Cost effectiveness is assessed through the use of the Illinois Total Resource Cost (TRC) test. Table 3-7 summarizes the unique inputs used to calculate the TRC ratio for the Public Sector Electric Efficiency Custom Incentives Program in PY3. Most of the unique inputs come directly from the evaluation results presented in this report. Measure life estimates were based on similar ComEd programs, third party sources including the California Public Utilities Commission (CPUC) developed Database of Energy Efficiency Resources (DEER) and previous

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Navigant evaluation experience with similar programs. Program costs data came directly from DCEO. Incremental costs were estimated from program, survey data and similar ComEd programs. Avoided cost data came from both ComEd and Ameren and are the same for all programs.

Table ES-3. Inputs to TRC Model for Public Sector Electric Efficiency Custom Incentives Program

Item	Value Used
Measure Life	12 years
Participants	127 ⁴
Annual Gross Energy Savings	20,885 MWh
Gross Coincident Peak Savings	2.71 MW
Net-to-Gross Ratio	74%
DCEO Administration and Implementation Costs	\$90,421
DCEO Incentive Costs	\$2,176,495
Net Participant Costs	\$3,899,688

Based on these inputs, the Illinois societal TRC for this program is 2.23 and the program passes the Illinois TRC test.

⁴ 127 projects conducted by 99 organizations.

Section 1. Introduction to the Program

This evaluation report covers the Custom Incentive (Custom) program element of the Public Sector Electric Efficiency incentive program.⁵

1.1 Program Description

The Illinois Department of Commerce and Economic Opportunity (DCEO) Public Sector Electric Efficiency program provides incentives for public sector customers of ComEd and Ameren Illinois Utilities who upgrade their facilities with energy efficient equipment. There were two specific program elements that were available to customers during the program year: a Custom program and a Standard program.

- **Custom Incentives** were available to customers for less common or more complex energy-saving measures installed in qualified retrofit and equipment replacement projects. Custom measure incentives were paid based on the first year energy (kWh) savings. Equipment installed includes lighting retrofits, aeration blower retrofits, HVAC measures such as VFDs, equipment controls, coil replacement, retro-commissioning of buildings, and other miscellaneous measure installations. Some of these measure installations are “True Custom” measures in the sense that simple deemed savings and/or simple-to-apply algorithms do not already exist for this homogenous measure segment of the program population.
- **Standard Program Incentives** provide an expedited application approach for public sector customers interested in purchasing efficient technologies. The program targets discrete retrofit and replacement opportunities in lighting, HVAC, motor, and refrigeration systems. A streamlined incentive application and quality control process is intended to facilitate ease of participation.

DCEO uses internal staff to manage, implement, and administer the program. Technical assistance is provided as needed through the Smart Energy Design Assistance Center (SEDAC). The PY3 program application form lists measures, eligibility criteria and incentive levels. The measure list and incentives matched those offered by the utilities (ComEd & Ameren), except that DCEO offered incentives for LED traffic signals.

In PY3, a few changes were made to the Custom incentive program. Program incentive caps were increased to \$300,000 (from \$200,000 in PY2). In PY2, all custom projects received a flat incentive rate of \$0.08/kWh. In PY3, the maximum incentive rate for custom projects was

⁵ The portfolio of programs has been branded as Illinois Energy Now and the former Public Service “Electric” Efficiency program was renamed to “Energy” for PY4 because natural gas measures are added to the program.

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increased from \$0.08/kWh to \$0.09/kWh for local governments, K-12 schools, and community colleges and to \$0.12/kWh for other types of entities.

The net MWh savings goals for the 2011 (PY3) Custom incentive program, as included in the Three-Year Plan approved by the Illinois Commerce Commission, are presented in Table 1-1.

Table 1-1. Public Sector Electric Efficiency Custom Program PY3 Planned Savings Goals

Utility	Plan Target Net MWh	Plan Target Net MW
ComEd Service Territory	14,742	1.9
Ameren Service Territory	5,258	0.7
Total	20,000	2.6

Source: Direct Testimony of Jonathan Feipel, DCEO, Docket No. 07-0541, Exhibit 1.3, November 15, 2007

DCEO operates the PSEE program with a joint goal for energy savings that combines Standard and Custom program results, not as separate goals for each program. The combined Standard and Custom goal for PSEE net energy savings is 148,821 MWh, which includes 128,821 MWh for Standard.

1.2 Evaluation Questions

The evaluation sought to answer the following key researchable questions:

Impact Questions

1. What are the gross impacts from this program?
2. What are the net impacts from this program?
3. Did the program meet its energy and demand goals? If not, why not?

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Process Questions:

The process evaluation questions focused on the following key areas:

1. Program participation
2. Program design and implementation
3. Program partnerships
4. Trade allies
5. Marketing and outreach
6. Barriers to participation
7. Program drop-outs
8. Public sector procurement process
9. Participant satisfaction

Section 2. Evaluation Methods

This section describes the analytic methods and data collection activities implemented as part of the PY3 process and impact evaluation of the Custom program, including the data sources and sample designs used as a base for the data collection activities.

Although participants consist of both ComEd and Ameren utility customers', the evaluation was planned and completed in such a way that it supports a single program-wide result and not individual utility results. However, examination of the tracking data identifies the following participation patterns and ex ante impact claim from each utility:

- There were 87 applications processed for ComEd customers involving an ex ante impact claim of 11.6 million kWh.
- There were 40 applications processed for Ameren customers involving an ex ante impact claim of 15.2 million kWh.

To support the gross impact evaluation objectives the PY3 evaluation activities performed on-site visits and detailed M&V for 17 Custom projects. Furthermore, telephone surveys were completed for 39 Custom projects to address evaluation net-to-gross and for 40 Custom projects to address evaluation process objectives. The key evaluation activities were:

- Conduct on-site visits and M&V activities. These activities seek to develop independent ex post estimates of savings, and to update, refine or replace the calculation procedures that were submitted as part of the final application submittal.
- Conduct CATI telephone surveys for 39 Custom projects to support the net impact approach (as described in greater detail in the Net Program Savings section, 2.1.2 below). Survey data collection purposefully includes all 17 gross impact points in an effort to coordinate NTG and gross impact-based conclusions and to obtain the best possible story line supporting both efforts. As was the case for PY1 and PY2, the Basic rigor NTG approach was predominantly used in PY3. For PY3 evaluation, only three Custom projects were sufficiently large to trigger a Standard rigor approach. These same CATI surveys support the process evaluation.

The sections that follow provide greater detail on the methods deployed.

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2.1 Analytical Methods

2.1.1 Impact Evaluation Methods

Gross Program Savings

The objective of this element of the impact evaluation is to verify the veracity and accuracy of the PY3 ex ante gross savings estimates in the Custom program tracking system. The savings reported in DCEO's tracking system was evaluated using the following steps:

1. Develop a site-specific M&V plan for a representative sample of program projects. Each M&V plan details the data collection and analysis approach to be undertaken, following a careful review of relevant documents stored in DCEO's tracking system, including the Final Application submittal and the application-based calculations.
2. Implement a site-specific data collection approach for each sampled project. The focus of the data collection is to verify and/or update the assumptions that feed into engineering algorithms used to estimate measure savings. Data collection also includes verification of measure installation and that the systems are functioning and operating as planned, and if not then in what way(s) there is variance.
3. Perform on-site measurement or obtain customer-stored data to support downstream M&V calculations. Measurement data obtained from the sites are used to calibrate engineering models or algorithms, as measured parameters typically have the least uncertainty of any of the data elements collected. Measurement includes spot measurements, run-time hour data logging, and post-installation interval metering. Customer-supplied data from energy management systems (EMS) or supervisory control and data acquisition (SCADA) systems are often used when available.
4. Complete ex post engineering-based estimates of gross annual energy (kWh) and summer peak demand (kW) impact for each sampled project. A site specific analysis is performed for each point in the impact sample. The engineering analysis methods and degree of monitoring will vary from project to project, depending on the complexity of the measures installed, the size of the associated savings and the availability and reliability of existing data. Gross impact calculation methodologies are generally based on IPMVP protocols, options A through D. At a minimum the ex post impact evaluation incorporates the following additional information that may not have been feasible to incorporate in Final Application submittal:
 - a. Verification that measures are installed and operational, and whether or not the as-built condition will generate the predicted level of savings.
 - b. Observed post-installation operating schedule and system loading conditions.
 - c. A thorough validation of baseline selection, including appropriateness of a retrofit vs. replace on burnout claim.
 - d. Development of stipulated and measured engineering parameters that contribute to the impact calculations.

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5. Prepare a detailed, site-specific impact evaluation report for each sampled site.
6. Carry out a quality control review of the ex post impact estimates and the associated draft site reports and implement any necessary revisions.

A verified gross realization rate (which is the ratio of the ex post gross savings-to-reported tracking savings) was then estimated for the sample, by sampling strata, and applied to the population of reported tracking savings, using sampling-based approaches that are described in greater detail in Sections 2 and 3 below. The result is an ex post estimate of gross savings for the Custom program.

Additional information regarding the gross impact methods can be found in Appendix 5.3.1 including baseline assessment, production adjustments, data collection and quality control methods.

Net Program Savings

The primary objective of the net savings analysis for the Custom program was to determine the program's net effect on customers' electricity usage. After gross program impacts have been assessed, net program impacts are derived by estimating a Net-to-Gross (NTG) ratio that quantifies the percentage of the gross program impacts that can reliably be attributed to the program. A customer self-report method, based on data gathered during participant phone surveys, was used to estimate the NTG ratio for this evaluation.

For PY3, the net program impacts were quantified solely on the estimated level of free-ridership. This requires estimating what would have happened in the absence of the program. The existence of participant spillover was examined in PY3, but not quantified as a component of the NTG ratio for each point in the sample.

Once free-ridership has been estimated the Net-to-Gross (NTG) ratio is calculated as follows:

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

Additional information regarding the net impact evaluation methodology can be found in Appendix 5.3.2 including the table with summarized scoring approach and spillover assessment methodology.

2.1.2 Process Evaluation Methods

Four research activities were conducted in support of the process evaluation: (1) interviews with program staff, (2) a quantitative telephone survey with 39 participating customers, (3) qualitative telephone interviews with 10 participating customers focused on the procurement process, and (4) qualitative interviews with five program drop-outs. These activities are further described in Appendix 5.3.3.

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2.2 Sampling

The tracking data delivered for this evaluation was provided as a collection of SQL tables by DCEO on June 10, 2011 (for sampling purposes) and September 7, 2011 (providing the full population of PY3 projects and the final ex ante estimates). Seventeen Custom M&V sample points were selected based on the June 10 extract. The tracking data provided as a collection of SQL tables by DCEO on June 10, 2011 was used for selecting 17 M&V sample points.

2.2.1 Profile of Population

The final tracking data delivered for this evaluation was provided by DCEO on September 7, 2011. A total of 127 completed Custom projects, installed by 101 unique customers were identified in the tracking data. The total energy savings for the population of 127 completed projects is 26.8 million kWh.

Project applications were first sorted and placed in three strata using ex ante savings kWh to create three strata with roughly equal contributions to total program savings.

Table 2-1 presents each of the three strata developed for sampling within the Custom Program, which consist a total of 127 Custom project applications. The number of project applications is presented by strata, along with ex ante gross kWh claimed, and the amount of incentive paid. The twelve largest applications that make up all the strata 1 and 2 projects account for 67% of the kWh-based ex ante impact claim in the population.

Sampling by strata was completed for ex post gross M&V-based evaluation, and for a telephone survey supporting ex post net impact evaluation and the process evaluation. Due to overlapping customers in both the Prescriptive and Custom programs, those two samples were carefully coordinated to avoid contacting customers more than once.

Table 2-1. PY3 Custom Program Participation by Sampling Strata

Sampling Strata	Ex Ante kWh Impact Claimed	Percent of Total kWh Claimed	Project Applications	Incentive Paid to Applicant
1	8,493,421	32%	3	\$922,403
2	9,277,658	35%	9	\$1,062,311
3	9,067,976	34%	115	\$1,420,314
TOTAL	26,839,055	100%	127	\$3,405,028

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2.2.2 Gross Impact M&V Sample

The sample for the PY3 Custom program was selected from project data in the DCEO tracking system provided by DCEO on June 10, 2011. Data review was undertaken before the sample was selected to check for outliers and missing values. 57 projects contain both Custom and Standard measures (combined projects). The Custom and Standard Incentive programs were evaluated through different approaches by necessity, so the evaluation team included all custom measures within the Custom evaluation, and all standard measures within the Standard evaluation. The phone survey was coordinated by assigning combined projects to one evaluation or the other to avoid multiple contacts. Most of the combined projects were handled by the Custom evaluation, and 2 (only UIUC) projects required coordination between the two evaluations.

Program-level Custom savings data were analyzed by project size to inform the sample design for this population of heterogeneous measures. Projects were stratified by tracking record size using the ex ante kWh impact claim. Projects were sorted from largest to smallest Custom kWh claim, and placed into one of three strata in an effort to place roughly one-third of the program total kWh claim in each. Thus, the three largest projects comprising one-third of the program savings was assigned to strata 1, the next 9 largest projects comprising one-third of program savings were assigned to strata 2, and the smallest 115 projects were assigned to strata 3.

The Custom evaluation plan called for a target sample of 17 projects in the ex post gross impact M&V sample. This sample was drawn as follows: the three records in stratum 1 were selected, 7 of the 9 projects in strata 2 were randomly selected, and 7 projects out of 115 were randomly selected in strata 3.

Profile of the Gross Impact M&V Sample

Table 2-2 provides a profile of the gross impact M&V sample for the Custom program in comparison with the Custom program population. Shown is the resulting sample that was drawn, consisting of 17 projects, responsible for 16.8 million kWh of ex ante impact claim and representing 63% of the ex ante impact claim for the program population. Also shown are the ex ante based kWh sample weights for each stratum. Ex ante based kW weights were not developed because peak demand impact estimates are not tracked by the program. The sample points targeted were all completed.

Table 2-2. PY3 Custom Program Gross Impact Sample by Strata

Custom Population Summary				Sample		
Sampling Strata	Number of Projects (N)	Ex Ante kWh Impact Claimed	kWh Weights	n	Ex Ante kWh	Sampled % of Population kWh
1	3	8,493,421	0.32	3	8,493,421	100%
2	9	9,277,658	0.35	7	8,185,903	88%
3	115	9,067,976	0.34	7	203,181	2%
TOTAL	127	26,839,055	-	17	16,882,505	63%

2.2.3 CATI Telephone Survey

Sampling

Per the evaluation plan, the target for the participant survey was to complete 34 interviews in support of the net impact evaluation and 51 interviews in support of the process evaluation.

For telephone surveys, the unit of sampling is the project contact. To develop the sample of unique project contacts, duplicate contact names were removed from the sample where a single person was involved in more than one project application. In addition, contacts who also completed Standard Program projects could only be contacted once regarding one of the projects (or project components if the project yielded both Standard and Custom savings). Because so few Custom projects had been completed in comparison with the Standard Program, Custom projects were given preference over Standard ones. However, three contacts that had completed very large Standard projects were removed from the Custom sample to be used for the Standard survey. Ultimately, the Custom sample frame included 97 contacts.

Of the 97 contacts in the sample frame, two had completed large projects in stratum 1. These individuals were not included in the CATI survey but were interviewed by a professional interviewer.⁶ The resulting sample frame for the CATI survey therefore included 95 contacts, 9 in stratum 2 and 86 in stratum 3. In order to complete the target number of interviews, we called a census of unique customers.

Given that this is a census attempt, there is no need for estimating precision levels for the sampling effort. In other words, there is no sampling error and the error bounds are zero.

⁶ These interviews included net impact questions as well as a subset of process questions.

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Sample Weights

Table 2-3 summarizes the 39 participant interviews completed in support of the NTG analysis. The completed interviews represent 13.8 million kWh of ex ante impact claim, which is 51% of the ex ante impact claim of the program population.

Table 2-3. Profile of the Participant Survey Sample by Strata

Program Population Summary				Sample		
Sampling Strata	Number of Projects (N)	Ex Ante kWh Impact Claimed	kWh Weights by Strata	n	Ex Ante kWh	Sampled % of Population kWh
1	3	8,493,421	0.32	3	8,493,421	100%
2	9	9,277,658	0.35	4	2,554,339	28%
3	115	9,067,976	0.34	32	2,745,900	30%
TOTAL	127	26,839,055	-	39	13,793,660	51%

For process questions, the evaluation team determined that an un-weighted analysis provided the best representation of results, because survey respondents are reasonably representative of the population (see discussion below).

Survey Disposition

Table 2-4 below shows the final disposition of the 97 unique contacts targeted for completing the participant survey either through the CATI system or by professional interviewers. The survey was completed with 41% of the available contacts, resulting in a response rate of 44%.⁷ Contact was unable to be made with 11% of contacts for a variety of reasons including: no one answered the phone, an answering machine picked up, or the phone line was busy. On average, we attempted to reach each of these customers eight times through the CATI system. Eight contacts were ineligible due to incorrect phone numbers.⁸

⁷ Computed as the number of completed interviews divided by the number of eligible respondents. Eligible respondents include the following dispositions: (1) Completed Survey, (2) Unable to Reach, (3) Callback, and (4) Refusal.

⁸ Attempts to obtain replacement phone numbers for wrong or disconnected numbers were unsuccessful.

Table 2-4. Disposition for the Participant Survey

Sample Disposition	Customers	%
Sample Frame of Unique Contacts	95	
Completed Survey	39	40%
Unable to reach	11	11%
Callback	29	30%
Refusal	10	10%
Phone Number Issue	8	8%
<i>Response Rate</i>		44%

Source: ODC CATI Center.

Profile of Survey Respondents

The evaluation team compared attributes of those who completed the CATI survey to the full population of unique contacts who completed projects in PY3. This comparison provides an indication of how representative the completed interviews are of the final population.

Table 2-5 shows the comparison by project size. While two contacts had large projects, these were not included in the CATI sample frame and therefore did not complete the survey (see discussion above). The comparison shows that survey respondents are reasonably representative of the final population, with a slight over-representation of medium-sized projects, a slight under-representation of smaller projects, and no representation of the largest projects.

Table 2-5. Comparison of CATI Completed Interviews and Population by Project Size

Project Size	Population*		Completed Survey	
	#	%		%
Large Projects (Stratum 1)	2	2%	0	0%
Medium Projects (Stratum 2)	9	9%	5	14%
Small Projects (Stratum 3)	89	89%	32	86%
TOTAL	100		37	

**Note: The population represents the number of unique contacts who completed projects that could be used for survey fielding purposes (including those that were removed due to overlap with the Standard Program and those removed for professional interviewing.).*

Source: Program tracking database; results of CATI telephone survey

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Table 2-6 shows the comparison by sector. This comparison shows that the completed interviews are quite representative of the population.

Table 2-6. Comparison of CATI Completed Interviews and Population by Sector

Sector	Population*		Completed Survey	
	#	%	#	%
Local Government	68	67%	24	65%
K-12 Schools	19	19%	8	22%
Federal Government	2	2%	1	3%
College	6	6%	3	8%
University	4	4%	1	3%
State	1	1%	0	0%
TOTAL	100		37	

**Note: The population represents the number of unique contacts who completed projects that could have been used for survey fielding purposes (including those that were removed due to overlap with the Standard Program and those removed for professional interviewing).*

Source: Program tracking database; results of CATI telephone survey.

Based on these comparisons, we conclude that survey responses to process questions are reasonably representative of the PY3 population.

Section 3. Program Level Results

This section presents the Custom program impact and process evaluation results.

3.1 Impact

3.1.1 Tracking System Review

A review of the Custom Incentives program data in the DCEO tracking system was completed to identify issues that could affect program reporting and improve future evaluation efforts. Project data were reviewed for outliers and missing information, obvious errors and general usefulness for reporting accomplishments and conducting evaluation activities. Basic functionality of the tracking system was also assessed with respect to recording, tracking, and reporting impact data.

The tracking data for this evaluation consisted of a collection of SQL tables that DCEO updated and delivered on a periodic basis, and that Navigant read-into an Access Database. The review is based on versions sent by DCEO dated June 10, 2011 and September 7, 2011. The extracts contain project level details including measures, incentives, milestone dates and savings for each participating project, plus data surrounding the applicants (including project identifiers, customer identifiers and more).

DCEO implemented a major upgrade to its project tracking systems, converting them to a relational database structure. The evaluation team strongly endorsed the need for that effort but hopes that the following issues will be addressed in the new system in the future. DCEO uses this database as the tracking system for the Custom Incentives program. The database is used to record savings and incentives for each project, and track basic implementation milestones. Participant data and project details from the application package are retained in hard copy files at DCEO offices. While superior to the previous Excel-based system, this tracking approach has limited functionality for evaluation tasks such as analyzing data and drawing samples.

Database Development. The development of a program tracking database was a key activity in PY3. The new database system was intended to reduce administrative burden and allow multiple staff to enter data into the database at the same time. While the new database has helped with tracking projects, program staff reported that entering data into the system is more time consuming than the previous system (because more information is captured) and that many report automation capabilities that would be useful in conducting their work were not yet available in PY3.

- **Recommendation:** Continue the development of database functionalities to make it a more useful program management tool. While the database has allowed staff to be more efficient in a number of ways, it is not yet developed and used to its fullest potential as a

management tool. The program should continue to make database improvements and provide ongoing user training to program staff and any partners who might use it in the future (e.g., SEDAC).

Project Status Updates. One aspect of the tracking system that affected the evaluation was the delay in reporting status updates for Custom projects. The Custom program tracking system originally had 130 projects, one of which was cancelled and two were moved into PY4. Of the remaining 127 projects, only 100 were marked as "Complete", and the transition between "Final" and "Complete" status often occurred with significant changes in the reported kWh savings. This affected the sampling phase of the evaluation and significantly delayed field visits to sampled sites. The evaluator asked for updates periodically, only to be told that some projects that were completed had not yet been entered into the tracking system.

- **Recommendation.** Enhanced electronic tracking of projects within the program is needed, including accurate real-time updates to the tracking system for completed projects.

Measure Descriptions. Measure description information was populated in the tracking system but there is room for improvement in consistently labeling individual measures. Currently applications involving more than one measure appear as a single record and therefore the measure descriptions tend towards a mixture of rough information concerning the measures installed. There were a couple data accuracy issues identified where the data in the "Custom Incentive" table (contains individual project records) did not match "Projects" table records (contains tracking data). The evaluator tried to work with DCEO, but eventually had to resort to copying paperwork to reconcile these differences.

- **Recommendation.** Consideration should be given to enhancing the DCEO tracking system for Custom measures to ensure measure-level tracking, with use of common measure descriptions and "reporting" across projects. This might include tracking the relevant size, quantity and efficiency of each item-level measure installation, including the appropriate units. (For example, measure = chiller replacement, number of units = 2, total capacity = 600, units of capacity = rated cooling tons, efficiency = 0.60, efficiency units = kW/ton, and detailed measure type = rotary screw water-source chiller replacement.) Currently the tracking system still lists multiple measures under a single line item, and disaggregation for reporting is either very difficult or not feasible. Working towards a tracking system model that reports individual measure records would enhance reporting of measure installations, both within the program and within the annual evaluation. The current system also has inconsistencies between measure descriptions from the "Projects" table and those from the "CustomIncentive" table.

Peak Demand. DCEO does not track summer peak demand impact (kW). This prevents evaluators from confidently and accurately representing the program population using a

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sample of selected projects. To do so would require that DCEO consistently estimate summer peak demand, and then store those data in the tracking system.

- **Recommendation.** The program should estimate and track summer peak demand savings. For consistent reporting and tracking of peak demand savings for projects, the program should include dedicated fields in the custom project application form for the applicant to report peak demand savings.

One aspect of the tracking system that has improved compared to the previous year was the tracking of participating customer contact information in electronic format. This includes applicant contact name, applicant phone number, applicant e-mail and applicant address. Third-party vendor was similarly tracked as appropriate. However, DCEO should consider expanding the Contacts table, as many projects had only one contact person specified, and that person tended to be the "Signature Authority" for the project. Including a project manager or facilities director contact into the database would ensure that the evaluator does not make multiple phone calls to find the person who is most knowledgeable about each project.

3.1.2 Gross Program Impact Parameter Estimates

Ex post gross program impacts were developed for this evaluation based on detailed M&V for a selected sample of seventeen applications.

Realization Rates for the Custom Program

There are two basic statistical methods for combining individual realization rates from the sample projects into an estimate of verified gross kWh savings for the population when stratified random sampling is used. These two methods are called "separate" and "combined" ratio estimation.⁹ In the case of a separate ratio estimator, a separate gross kWh savings realization rate is calculated for each stratum and then combined. In the case of a combined ratio estimator, a single gross kWh savings realization rate is calculated directly without first calculating separate realization rates by stratum.

The separate ratio estimation technique was used to estimate verified gross kWh savings for the Custom program. The separate ratio estimation technique follows the steps outlined in the California Evaluation Framework. These steps are matched to the stratified random sampling method that was used to create the sample for the program. The standard error was used to estimate the error bound around the estimate of verified gross kWh. The results are summarized in Table 3-1 and Table 3-2 below. The realization rate for energy savings is 0.78.

⁹ A full discussion and comparison of separate vs. combined ratio estimation can be found in Sampling Techniques, Cochran, 1977, pp. 164-169.

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The relative precision and confidence intervals are estimated based on the program population. The relative precision at a 90% confidence level for the 17 Custom projects in the gross impact sample is $\pm 9\%$ for the kWh Realization Rate. A realization rate for peak demand impact could not be estimated due to the fact that the program does not estimate kW savings.

The energy savings realization rate of 0.78 for PY3 is a significant increase from the PY2 levels of 0.56. PY3 energy savings realization rate results indicate that the stratum 1 (RR = 0.94) and the stratum 3 (RR = 0.85) projects realized a greater proportion of the ex ante claims than the stratum 2 (RR = 0.57) projects. This is due to the complexity of the projects involved in stratum 2 that include technologies such as HVAC, VSDs and high efficiency blowers that require more in-depth technical reviews and pose a greater for estimating savings accurately -- for example, due to varying operating conditions.

Table 3-1. Gross Impact Realization Rate Results for the Selected Custom Sample

Sampled Application ID	Sample-Based Ex Ante kWh Impact Claimed	Sample-Based Ex Ante kW Impact Claimed	Sampling Strata	Ex Ante-Based kWh Gross Impact Weights by Strata	Sample-Based Ex Post Gross kWh Impact	Sample-Based Ex Post Gross kW Impact	Application-Specific Ex Post Gross kWh Realization Rate	Sample-Based Ex Post Gross kWh Realization Rate
3392	5,185,740	-	1	0.61	5,254,407	759	1.01	0.94
3745	2,763,640	-	1	0.33	2,674,819	-	0.97	
3447	544,041	-	1	0.06	14,673	2	0.03	
3223	2,212,170	-	2	0.27	1,094,995	106	0.49	0.57
314	1,750,540	-	2	0.21	2,146,465	182	1.23	
3279	1,609,380	-	2	0.20	261,244	4	0.16	
3224	815,125	-	2	0.10	505,405	163	0.62	
3302	662,724	-	2	0.08	129,244	5	0.20	
3093	619,910	-	2	0.08	233,360	22	0.38	
3344	516,054	-	2	0.06	256,696	39	0.50	
3335	90,950	-	3	0.45	66,602	-	0.73	0.85
3438	48,299	-	3	0.24	50,132	6	1.04	
3630	21,635	-	3	0.11	22,109	-	1.02	
3386	12,533	-	3	0.06	9,347	-	0.75	
3531	11,462	-	3	0.06	12,330	-	1.08	
3609	10,221	-	3	0.05	11,937	-	1.17	
486	8,081	-	3	0.04	0	-	0.00	
TOTAL	16,882,505	-	-	-	12,743,765	1,287	-	0.78

Table 3-2. Gross kWh Realization Rates and Relative Precision at 90% Confidence Level

Sampling Strata	Relative Precision			
	± %	Low	Mean	High
Stratum 1	0%	0.94	0.94	0.94
Stratum 2	25%	0.43	0.57	0.70
Stratum 3	17%	0.71	0.85	0.99
Total kWh RR	9%	0.71	0.78	0.85

3.1.3 Gross Program Impact Results

Based on the gross impact parameter estimates described in the previous section, the evaluation team derived gross program impacts for the PY3 Custom program.

The evaluation team has provided to DCEO site-specific M&V reports for each Custom gross impact sample point. These site-specific draft impact evaluation reports summarize the ex ante savings in the Final Application submitted, the ex post M&V plan, the data collected at the site, and all of the calculations and parameters used to estimate savings. While it probably is not reasonable to draw generalized conclusions from details in those reports, there may be valuable lessons to be learned in those reports as they relate to submitted impact calculations, the approach applied and parameters used.

Site specific observations from the gross impact sample include the following:

- For project #486, the ex post verification found that the installed lighting controls were not operational. Therefore, there were no savings for this project.
- For project #3302, three VFDs from the total of 11 VFDs installed were not operational. This reduced the total realized savings for this project.
- For project #3630, the ex ante estimated operating hours were different from the ex post verified operating hours. For projects #3745 and #3335, ex ante estimated wattages were different from the ex post verified wattages. The ex post savings for these projects were reduced due to these factors.
- For outdoor lighting projects ex ante operating hours were adjusted to be consistent with the actual dusk to dawn based operating hours. This increased the savings realized for these projects (e.g. #3531, #3609 and #3630)
- For projects #3223 and #3224, the ex ante reported delta T (difference between supply and return temperatures) estimates were smaller than the ex post findings. This resulted in reduced savings.

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- For project #3302, the VSD pumps were operating at almost the same rated speed as required under baseline conditions resulting in relatively low ex post savings. Another reason for the decrease in savings is that the ex ante calculation assumed the pumps operate 8,760 hours per year when in fact they cycle to fill a water tower.
- For project #3093 and #3344, the ex ante calculations overestimated the load factor (100% load) of the blower motor to calculate baseline energy usage, which was adjusted during the ex post analysis based on the actual load profile, blower curves and motor efficiencies. This resulted in lower ex post savings.
- For project #3279, ex ante baseline equipment selection was adjusted for this project. The baseline equipment selected was the existing system, which was found to be very old and in need of replacement. In this case, a standard efficiency unit was selected for the ex post baseline system.
- Savings for #3447 were significantly affected as the ex ante calculations made several incorrect assumptions to estimate savings for the RCx measures (cleaning AHU coils) that significantly reduced the ex post savings. For example, ex ante calculations assumed that the RCx measures would reduce cooling loads, but the RCx measures do not contribute to any reduction in the cooling load.
- Ex ante calculations did not estimate peak demand savings for any of the projects.
- We found that project #3438 exceeded the minimum payback period of 7 years that is required to be eligible for incentives.

In summary, estimates should be based upon appropriate verification of installed equipment, actual operating conditions, normalization of hours of operation, and careful application of assumptions made when estimating energy usage and savings.

3.1.4 Net Program Impact Parameter Estimates

The separate ratio estimation technique was used to estimate Net-to-Gross (NTG) Ratios for the Custom program. The separate ratio estimation technique follows the steps outlined in the California Evaluation Framework. These steps are matched to the stratified random sampling method that was used to create the sample for the program. The standard error was used to estimate the error bound around the estimate of verified NTG Ratio.

As mentioned before, the evaluation team estimated the NTG ratio for the PY3 Custom program using a customer self-report approach. This approach relied on responses provided by program participants during telephone surveys to determine the fraction of measure installations that would have occurred by participants in the absence of the program (free-ridership). The stratum and program level NTG Ratios, along with precision estimates, are shown in Table 3-3.