



Energy Efficiency / Demand Response Plan: Plan Year 4 (6/1/2011-5/31/2012)

Evaluation Report: Smart Ideas for Your Business Data Centers Efficiency Program

FINAL

**Presented to
Commonwealth Edison Company**

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Table of Contents

E. Executive Summary	1
E.1 Evaluation Objectives	1
E.2 Evaluation Methods.....	1
E.3 Key Impact Findings and Recommendations	1
E.4 Key Process Findings and Recommendations	3
1. Introduction to the Program.....	4
1.1 Program Description.....	4
1.1.1 Implementation Strategy	4
1.1.2 Measures and Incentives for PY4.....	4
1.2 Evaluation Objectives	5
2. Evaluation Methods.....	6
2.1 Primary Data Collection.....	6
2.2 Impact Evaluation Methods	6
2.3 Process Evaluation Methods.....	8
2.4 Sampling.....	8
3. Evaluation Results	9
3.1 Impact Evaluation Results	9
3.1.1 Tracking System Review.....	9
3.1.2 Gross Program Impact Results.....	9
3.1.3 Net Program Impact Parameter Estimates	10
3.1.4 Net Program Impact Results	11
3.2 Process Evaluation Results	12
4. Findings and Recommendations	13
4.1 Key Gross Impact Findings and Recommendations	13
4.2 Key Process Findings and Recommendations	14

List of Figures and Tables

Tables:

Table E-1. PY4 Savings Estimates 1

Table 2-1. PY4 Data Collection Activities 6

Table 3-1. Gross Impact Realization Rate Results for Data Centers Projects..... 9

Table 3-2. NTGR Results for the PY4 Data Center Projects 10

Table 3-3. Program-Level Research Findings Net kWh Impacts for PY4 11

Table 3-4. Program-Level Research Findings Net kW Impacts for PY4..... 12

E. Executive Summary

E.1 Evaluation Objectives

ComEd’s Smart Ideas for Your Business suite of energy efficiency programs for business customers introduced a new program in program year four (PY4): Data Centers Efficiency program. The new Data Centers Efficiency program provides incentives to both new and existing data centers for implementing energy efficiency measures. During PY4, two companies completed projects under the new program. The goal of this report is to present a summary of the findings and results from the evaluation of the PY4 Data Centers program¹. The primary objectives of this evaluation are to quantify gross and net impacts and to determine process-related program strengths and weaknesses and identify ways in which the program can be improved

E.2 Evaluation Methods

For the PY4 impact evaluation, gross impact results were developed based on detailed M&V analysis performed for the two projects and net impact results were developed based on survey data collected for the two projects. As part of the process evaluation we collected feedback from telephone surveys with the two participants about program strengths and weaknesses.

E.3 Key Impact Findings and Recommendations

Table E-1 below provides reported ex ante and Research Findings (ex post) gross and net savings impacts for the PY4 Data Centers Efficiency program. The PY4 evaluation research findings gross realization rate for energy savings is 0.80 (realization rate = research findings gross / ex ante gross) and a net-to-gross ratio of 0.43 for energy savings. No realization rate was calculated for gross demand savings since there were no ex ante demand savings claims.

Table E-1. PY4 Savings Estimates

Savings Estimates	Energy Savings (kWh)	Peak Demand Savings (kW)
Ex ante Gross*	5,382,384	0
Ex ante Net**	4,305,907	0
Research Findings Gross	4,323,193	212
Research Findings Net	1,840,104	133

* Ex ante gross savings estimates reported by ComEd

** Ex ante net savings include an assumed net-to-gross ratio of 0.80

For gross and net impact analysis, the sampling approach was a census attempt. Given that the evaluation completed a census for gross and net impact analysis, there is no sampling error and the error bounds are zero; therefore, there is no need for estimating precision levels for the sampling effort.

¹ The Electric Program Year 4 (PY4) began June 1, 2011 and ended May 31, 2012.

Key evaluation impact findings and recommendations include the following:

Peak kW Savings

Finding: The program did not report peak kW savings claims for the PY4 projects.

- **Recommendation:** The program should calculate peak kW savings for all completed projects. The program should also ensure that calculated peak kW savings are reported consistently in the program tacking system.

Data Collection Activities

Finding: The program did a thorough job collecting data for the two projects.

- **Recommendation:** For data center projects, we found that the customer data collection system typically trends only the amperage data for the cooling equipment. We recommend that the program attempt to collect power factor and voltage readings through spot measurements in such cases. This will allow for an accurate estimation of the equipment power (kW) consumption. In addition, spot kW measurements can help verify or calibrate logged data.
- **Recommendation.** The program should continue to take measurements for pre retrofit and post retrofit equipment. Projects with measured program data (obtained from logging or from a customer's monitoring system) will be used by the evaluators to inform savings calculations models and also to assign values for critical parameters. Evaluators typically do not have access to pre-installation equipment and conditions; therefore, ex ante measured data can greatly benefit the accuracy of ex post savings calculations.

Project Eligibility Requirements Review

Finding: For project #11950, the payback period exceeded the maximum allowable payback period of seven years after the program updated the project savings.

- **Recommendation:** The program should review project eligibility requirements whenever there are changes to the scope or savings of the project. If any project that does not meet the program's payback period is approved, the program should provide reasons for approval in the project documentation.

Estimation of Load for New Construction Projects

Finding: For the new construction project #11950, the program estimated savings assuming that the facility would operate at 100% IT load.

- **Recommendation:** For new construction projects, the program needs to document the forecasted facility IT load. Impact estimates are affected by presumed facility IT loads. If the customer cannot provide strong evidence to support forecasted IT loads, then the program should estimate savings based on the typical industry average IT loads. Note that the evaluation team is conducting literature research to determine typical loading for (wholesale and colocation) data

centers. Based on the initial evaluation findings, the average loading for wholesale data centers in the U.S. market is 81%².

Key Net Impact Findings and Recommendations

Finding: The kWh NTG ratio for this program, 0.43, is low for this type of program.

- **Recommendation:** To increase the program NTG score, the program should attempt to minimize cases where the customer has already decided to install the same equipment at the same time in the absence of program incentives. The program implementer should interview the project decision maker to check how the program is influencing the customer's selection of equipment and also to verify if the program is significantly accelerating implementation of the project. If the implementers find that the program is not influencing either the timing or efficiency level of the selected equipment, then it is recommended that the implementers put forth additional efforts to influence higher efficiency levels and/or identify other qualifying projects that can be influenced by the program.

E.4 Key Process Findings and Recommendations

Program Strengths

Finding: As with other energy efficiency programs, the program provides a financial tool for helping convince management to implement the project. It helps the project to meet financial hurdles, specifically return on investment (ROI) requirements. By offering this program, ComEd is, in effect, endorsing the customer's project and its savings claims, which also helps validate the project in the eyes of management.

Program Weaknesses

Finding: The program implementation process has been very labor intensive for one customer. They were the first one to go through the program, and estimated they have spent 3 to 4 man-weeks so far on the project.

- **Recommendation:** The program should consider ways to streamline these processes, since they are very time-intensive for the customer, and may present a barrier to participation in the program by customers.

Finding: The program's performance based payment puts the entire risk onto the customer, whereby the payment is based on the loading of the facility.

- **Recommendation:** The program should consider a modified incentive formula that shares risk more equitably between the customer and the program. In conjunction with this, the program should develop a process for assessing project risk at the time participants are enrolled in the program, and should take steps to screen out projects with risks that it considers unacceptably high.

² <http://www.datacenterknowledge.com/archives/2012/06/12/report-wholesale-space-is-81-percent-occupied/>

1. Introduction to the Program

This section includes a description of the program and the PY4 evaluation objectives.

1.1 Program Description

The Commonwealth Edison Company (ComEd) Smart Ideas for Your Business program provides incentives for business customers who upgrade their facilities with energy efficient equipment. This incentive program is available to all eligible, nonpublic, commercial and industrial customers in ComEd's service territory.

ComEd's Smart Ideas for Your Business suite of energy efficiency programs for business customers introduced a new program in program year 4 (PY4): Data Centers Efficiency program. The new Data Centers Efficiency program provides incentives to both new and existing data centers for implementing energy efficiency measures. The PY4 Data Centers program began June 1, 2011 and ended May 31, 2012.

Data center energy efficiency measures must result in a reduction of electric energy usage due to an improvement in system efficiency. Projects that result in reduced energy consumption without an improvement in system efficiency are not eligible for incentives. However, projects that involve an automated control technology such as energy management system programming may be eligible for an incentive. All projects must meet ComEd's cost-effectiveness requirements.

1.1.1 Implementation Strategy

ComEd selected Willdan Energy Solutions (Willdan) as its program administrator (PA) responsible for day-to-day operations. The Data Centers Efficiency program was launched in June 2011. The PA is responsible for all aspects of the program including participant coordination, technical service provider recruitment and training, logistical support, marketing/outreach and technical review for projects in the program..

1.1.2 Measures and Incentives for PY4

ComEd's Smart Ideas for Your Business Data Centers program provides incentive payments for eligible energy efficiency projects. Incentives are available based on the project's kWh savings, assuming the project meets all program requirements. Incentives are based on the following formula:

- For eligible projects, the program pays an incentive of \$0.07/kWh down to a minimum payback of one year and up to a maximum payback of 7 years.

The project cost cap is defined as follows: Data Centers project incentives cannot exceed 50% of the total project cost (includes costs of equipment and contractor labor; excludes in-house labor) and 100% of the incremental measure cost. Customers may receive up to \$1,000,000 per program year (defined as June 1st through May 31st), per facility.

1.2 Evaluation Objectives

The following key researchable objectives were evaluated.

Impact Objectives:

- Estimate the program gross impacts
- Estimate the program net impacts

Process Objectives:

- Examine the program strengths
- Examine the program weaknesses

2. Evaluation Methods

This section describes the analytic methods and data collection activities implemented as part of the PY4 process and impact evaluation of the Data Centers program, including the data sources and sample designs used as a basis for the data collection activities.

2.1 Primary Data Collection

The data collected for the evaluation of the PY4 Data Centers program was gathered via on-site audits and telephone surveys to support impact and process analysis. Table 2-1 below provides a summary of the data collection activities including the targeted population, the sample size, and the objectives of the efforts.

Table 2-1. PY4 Data Collection Activities

Collection Method	Targeted Population	Sample Size Targeted	Sample Size Achieved	Gross Impact	Net Impact	Process
On Site Audit	Program participants	2	2	X	X	-
Telephone Survey	Program participants	2	2	X	X	X

Source: Evaluation Analysis

2.2 Impact Evaluation Methods

This section describes the analytic methods and data collection activities implemented as part of the PY4 impact evaluation of the Data Centers Efficiency program, including the data sources and sample designs used as a basis for the data collection activities.

To support the gross impact evaluation objectives the EM&V team performed on-site visits and detailed M&V for the program’s two projects. Telephone surveys were completed for two projects to address evaluation process and net-to-gross objectives.

Gross Program Savings

The objective of the gross program savings evaluation is to verify the veracity and accuracy of the PY4 ex ante gross savings estimates in the Data Centers program tracking system. The PY4 evaluation activities included on-site visits and detailed M&V for 2 projects. The savings reported for the completed PY4 projects were evaluated using the following M&V steps:

1. Develop a site-specific M&V plan for sampled projects. Each M&V plan details the data collection and analysis approach to be undertaken, following a careful review of relevant project documents, including the Final Application submittal and the application-based calculations. Sometimes each plan is further refined based on a brief interview with the customer representative over the phone.

2. Implement a site-specific data collection approach for each sampled project. The focus of the data collection was to verify and/or update the assumptions that feed into engineering algorithms of measure level savings. Data collection also included 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 the analyses, 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. Furthermore, measured data are obtained when available from the implementer.
4. Complete evaluation 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 evaluation 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; and
 - d. Development of stipulated and measured engineering parameters that contribute to the impact calculations.
5. Prepare a detailed, site-specific impact evaluation report for each sampled site.
6. Carry out a quality control review of the evaluation impact estimates and the associated draft site reports and implement any necessary revisions.

A gross realization rate was calculated for each project, and the program gross realization rate is calculated as a ratio of the total research findings kWh savings to the total ex ante kWh savings claimed for the PY4 Data Centers Efficiency program.

Net Program Savings

This program has not been evaluated before and so according to the NTG Framework the NTG is to be applied retroactively. The program falls under the following condition from the NTG Framework: For

existing and new programs not yet evaluated, and previously evaluated programs undergoing significant changes — either in the program design or delivery, or changes in the market itself^[1] — NTG ratios established through evaluations would be used *retroactively*, but could also then be used prospectively if the program does not undergo continued significant changes.

The primary objective of the net savings analysis for the ComEd PY4 Data Centers Efficiency 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 program's gross impact that can reliably be attributed to the program. A customer self-report method, based on data gathered during participant telephone surveys, was used to estimate the NTG ratio for this evaluation.

For PY4, 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 PY4 but no significant spillover activity was reported by participants, therefore, quantification was not warranted.

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

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

2.3 Process Evaluation Methods

One research activity was conducted in support of the PY4 process evaluation: a quantitative telephone survey with two participating customers. These represented a census of participants in PY4.

2.4 Sampling

The sampling approach for impact and process analysis was a census attempt consistent with the PY4 evaluation plan.

^[1] An example of a market change might be where baselines have improved significantly and the likely free riders are growing substantially because of it.

3. Evaluation Results

3.1 Impact Evaluation Results

This section presents Gross and Net impact results from the PY4 Data Centers Efficiency program evaluation.

3.1.1 Tracking System Review

Since the program was in an emerging phase in PY4, Evaluation team will conduct a tracking system review in PY5.

3.1.2 Gross Program Impact Results

In PY4, a total of two projects were completed as part of the Data Centers program. For the PY4 impact evaluation, gross impact results were developed based on detailed M&V analysis performed for the two projects and net impact results were developed based on survey data collected for the two projects.

Gross impact evaluation activities were completed for each of the two PY4 projects. Project-level gross impact evaluation results are summarized in Table 3-1.

The program gross realization rate is calculated as a ratio of the total Research Findings kWh savings to the total ex ante kWh savings claimed for the PY4 Data Centers program. The program level realization rate for energy savings is 0.80.

The program did not report ex ante kW savings for the two PY4 projects. However, the evaluation estimated kW savings for these two projects. A kW savings realization rate cannot be calculated with no ex ante kW savings claims.

Table 3-1. Gross Impact Realization Rate Results for Data Centers Projects

Project ID	Ex ante kWh Impact Claimed	Ex ante kW Impact Claimed	Research Findings Gross kWh Impact	Research Findings Gross kW Impact	Research Findings Gross kWh Realization Rate	Research Findings Gross kW Realization Rate
14368	2,913,591	0	1,564,700	178.6	0.54	N/A
11950	2,468,793	0	2,758,493	33.4	1.12	N/A
Total	5,382,384	0	4,323,193	212.0	0.80	N/A

Source: Evaluation Analysis

The evaluation team has provided to ComEd site-specific M&V reports for each verified project. These site-specific impact evaluation reports summarize the ex ante savings in the Final Application submitted,

the evaluation M&V plan, the data collected at the site, and all of the calculations and parameters used to estimate savings. The following are key observations based on site specific M&V analysis:

- For project #11950, the primary reason for the high realization rate is that the program calculations underestimated the data center cooling load.
- For project #14368, the primary reason for the low realization rate is that the program calculations did not account for all the rooftop units (RTU) serving the data centers in the post retrofit period. The program calculations accounted for only nine (9) RTUs instead of the 11 RTUs that were operating to estimate the total power (kW) usage for data center cooling in the post period which led to overestimation of savings.

3.1.3 Net Program Impact Parameter Estimates

In PY4, a total of two projects were completed as part of the Data Centers program. Net impact evaluation activities were completed for each of the two PY4 projects. The calculation of the program’s Net-to-Gross Ratio (NTGR) is a multi-step process. The NTGR was assessed using a self-report approach supported by data collected during participant phone surveys. The survey covers a battery of questions used to assess the net-to-gross ratio for a specific project. Responses from the survey are used to calculate a Program Components score, a Program Influence score and a No-Program score for each project for which a survey was completed. All three of these scores represent different ways of characterizing the program’s influence on the decision to install energy efficient equipment. These three scores can take values of 0 to 10 where a lower score indicates a lower level of program influence, (i.e., a higher level of free-ridership). The three scores are then averaged to come up with a project-level net-to-gross ratio. The project-specific NTGRs are shown in Table 3-2.

Table 3-2. NTGR Results for the PY4 Data Center Projects

Project ID*	Research Findings kWh NTGR	Research Findings kW NTGR
PY4 -DC 01	0.73	0.73
PY4 -DC 02	0.06	0.06
TOTAL	0.43	0.63

Source: Evaluation Analysis

*Actual Project IDs are not provided to protect customer confidentiality

The measured PY4 kWh NTG ratio was 0.43. The low NTG score is mainly due to one project having a very low NTGR. The project specific NTG score summaries are shown below. The PY4 NTG ratio based on kW weighting is 0.63.

PY4 DC-01 NTG score summary

NTG ratio = 0.73

This customer installed a Data center aisle containment project and made modifications to their HVAC equipment in order to realize significant energy savings. Key reasons for implementing this project included that the project would: (1) increase critical capacity (more power to use); (2) reduce their carbon

footprint; (3) reduce their utility usage and help the bottom line; and (4) enable them to provide better service to their clients.

The decision maker assigned the program’s importance a 5 out of 10 possible points. If the program had not been available, they gave a 0 in 10 likelihood of installing exactly the same equipment at the same time. However, the decision maker also reported that if the program had not been available, they would have installed the same equipment 1.5 to 2 years later. In addition the decision maker gave the importance of program incentives 7 out of 10 possible points.

PY4 DC-02 NTG score summary

NTG ratio = 0.06

This customer installed a Data Center Air Flow and Central Plant Optimization project involving air-side economizers, efficient chillers, and reduced pump operation. Their business model is ‘build to suit’ (for tenants), and optimizing energy use and costs is a goal in new construction projects of this type.

In general, the decision maker indicated they had already made decisions regarding selected equipment prior to learning about the program. However, they also indicated that their knowledge about the availability of incentives through the program may enable them to modify their designs going forward and to move to a more energy efficient design.

In terms of the program’s influence on their decision, the decision maker reported it was not very high, rating the program’s importance a 2.5 out of 10, and non-program factors a 7.5 out of 10. In addition, the decision maker reported that program implementers arrived after the decision was made to implement the measure. If the program had not been available, the decision maker gave a 10 out of 10 probability they would have installed the same project at the same time.

3.1.4 Net Program Impact Results

Net program impacts were derived by multiplying Research Findings gross program savings by the Research Findings Net-to-Gross Ratio (NTGR). Table 3-3 provides the program-level Research Findings net kWh impact results for the PY4 Data Centers program. The Research Findings gross realization rate for kWh savings is 0.80. The Research Findings NTGR for kWh savings is 0.43. The chained realization rate (gross RR * NTGR) is 0.34 for kWh. Table 3-4 provides the program-level Research Findings net kW impact results for the PY4 Data Centers program.

Table 3-3. Program-Level Research Findings Net kWh Impacts for PY4

	Ex Ante Gross kWh	Research Findings Gross kWh	Research Findings Gross kWh RR	Research Findings Net kWh	Research Findings kWh NTGR
Total	5,927,508	4,323,193	0.80	1,840,104	0.43

Source: Evaluation Analysis

Table 3-4. Program-Level Research Findings Net kW Impacts for PY4

	Ex Ante Gross kW	Research Findings Gross kW	Research Findings Gross kW RR	Research Findings Net kW	Research Findings kW NTGR
Total	0	212	N/A	133	0.63

Source: Evaluation Analysis

3.2 Process Evaluation Results

In PY4, we queried participants to obtain their views on program strengths and weaknesses, providing them with ample opportunity to discuss issues of concern. Based on the two completed participant interviews, the process evaluation results are discussed below.

Program Strengths

- As with other energy efficiency programs, the program provides a financial tool for helping convince management to implement the project. It helps the project to meet financial hurdles, specifically return on investment (ROI) requirements. By offering this program, ComEd is, in effect, endorsing the customer’s project and its savings claims, which also helps validate the project in the eyes of management.

Program Weaknesses

- Baseline determination is a major challenge. One respondent commented that in effect, they are trying to establish the baseline on a blank piece of paper, since there is no industry baseline for Data Centers.
- The program implementation process has been very labor intensive for one customer. They were the first one to go through the program and estimated they have spent 3 to 4 man-weeks so far on the project. The verification process continues since they have to provide performance information in order to receive an incentive payment from the program.
- The program’s performance based payment puts the entire risk onto the customer, whereby the payment is based on the loading of the facility. One customer said they would prefer a front loaded payment with a risk management deduction, to share some of the risk more equally. They noted they have yet to receive a payment from the program.
- There are many different entities for the customer to deal with, increasing the complexity and time required to interact with the program. One customer mentioned working with the ComEd program manager, the program implementer and the evaluation team, among others.

4. Findings and Recommendations

This section describes the key findings and recommendations from our PY4 evaluation activities.

4.1 Key Gross Impact Findings and Recommendations

Peak kW Savings

Finding: The program did not report peak kW savings claims for the PY4 projects.

- **Recommendation:** The program should calculate peak kW savings for all completed projects. The program should also ensure that calculated peak kW savings are reported consistently in the program tacking system.

Data Collection Activities

Finding: The program did a thorough job collecting data for the two projects.

- **Recommendation:** For data center projects, we found that the customer data collection system typically trends only the amperage data for the cooling equipment. We recommend that the program attempt to collect power factor and voltage readings through spot measurements in such cases. This will allow for an accurate estimation of the equipment power (kW) consumption. In addition, spot kW measurements can help verify or calibrate logged data.
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centers. Based on the initial evaluation findings, the average loading for wholesale data centers in the U.S. market is 81%³.

Key Net Impact Findings and Recommendations

Finding: The kWh NTG ratio for this program, 0.43, is low for this type of program.

- **Recommendation:** To increase the program NTG score, the program should attempt to minimize cases where the customer has already decided to install the same equipment at the same time in the absence of program incentives. The program implementer should interview the project decision maker to check how the program is influencing the customer's selection of equipment and also to verify if the program is significantly accelerating implementation of the project. If the implementers find that the program is not influencing either the timing or efficiency level of the selected equipment, then it is recommended that the implementers put forth additional efforts to influence higher efficiency levels and/or identify other qualifying projects that can be influenced by the program.

4.2 Key Process Findings and Recommendations

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