



Complete System Replacement PY6 Evaluation Report

Final

**Energy Efficiency/Demand Response Plan:
Plan Year 6
(6/1/2013-5/31/2014)**

**Presented to
Commonwealth Edison Company**

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Executive Summary

This report presents a summary of the findings and results from Navigant Consulting, Inc.'s (Navigant's) impact and process evaluation of the Commonwealth Edison Company (ComEd) Complete System Replacement (CSR) program's sixth program year (PY6).¹ Under the CSR program, ComEd offers cash incentives to encourage their customers to purchase high efficiency air-conditioning systems rated SEER 14.5 or above. ComEd offers this program in conjunction with high-efficiency furnace rebates through the Home Energy Efficiency Rebates (Home EER) program offered by Nicor Gas and the Residential Prescriptive Rebate Program offered by Peoples Gas and North Shore Gas (PGL-NSG). This report focuses solely on the electric savings from the program.

E.1 Program Savings

Table E-1 summarizes the electricity savings from the CSR program.

Table E-1. PY6 Total Program Electric Savings

Savings Category	Energy Savings (MWh)	Demand Savings (MW)	Peak Demand Savings (MW)
Ex Ante Gross Savings	5,633	N/A	N/A
Verified Gross Savings	5,515	7.95	4.05
Verified Net Savings	3,254	4.69	2.39

Source: Navigant analysis of ComEd tracking data

E.2 Program Savings by Channel

Table E-2 below summarizes program electricity savings in PGL-NSG and Nicor Gas service areas.

Table E-2. PY6 Program Results by Channel

Savings Category	PGL-NSG	Nicor Gas
Ex Ante Gross Savings (MWh)	610	5,023
Ex Ante Gross Peak Demand Reduction (MW)	N/A	N/A
Verified Gross Savings (MWh)	845	4,669
Verified Gross Demand Reduction (MW)	1.12	6.83
Verified Gross PJM Peak Demand Reduction (MW)	0.57	3.48
Verified Gross Realization Rate**	139%	93%
Net to Gross Ratio (NTGR)*	0.59	0.59
Verified Net Savings (MWh)	499	2,755
Verified Net Demand Reduction (MW)	0.66	4.03
Verified Net PJM Peak Demand Reduction (MW)	0.34	2.05

Source: Navigant analysis of ComEd tracking data

* A deemed value. Source: ComEd PY5-PY6 Proposal Comparisons with SAG.xls, available on the IL SAG website: <http://ilsag.info/net-to-gross-framework.html>

** Based on evaluation research findings.

¹ PY6 began June 1, 2013, and ended May 31, 2014.

E.3 Program Volumetric Detail

The CSR program had 10,706 participants in PY6 and distributed rebates for one measure through 11,152 projects, as shown in Table E-3. Navigant found that five of the projects in the tracking data had been duplicated. Therefore, Navigant counted these projects only once. Of the 11,152 projects analyzed, 291 projects had been carried over from PY5. These projects were not previously accounted for in the PY5 analysis, because they had a status of “Batched” or “In Process” at the time of analysis. Navigant also discovered discrepancies in the tracking database, as well as assumptions used for project-level full load hours (FLH). Details are discussed in Section 3 of the report. Adjustments made based on these discrepancies resulted in a program level realization rate of 98 percent.

Table E-3. PY6 Volumetric Findings Detail

Detail	PGL-NSG	Nicor Gas	Total
Participants	1,852	8,854	10,706
Installed Projects	1,856	9,296	11,152

Source: Navigant analysis of ComEd tracking data

E.4 Results Summary

Table E-4 summarizes the key metrics from PY6.

Table E-4. PY6 Results Summary

Participation	Units	PY6
Net Savings	MWh	3,253
Net Demand Reduction	MW	4.69
Gross Savings	MWh	5,514
Gross Demand Reduction	MW	7.95
Gross Peak Demand Reduction	MW	4.05
Program Realization Rate	%	98%
Program NTGR*	#	0.59
Early Replacement Units	#	7,601
Early Replacement Gross Savings	MWh	4,816
Replace on Burnout Units	#	3,551
Replace on Burnout Gross Savings	MWh	698
Participants	#	10,706

Source: Navigant analysis of ComEd tracking data

*A deemed value from “ComEd PY5-PY6 Proposal Comparisons with SAG.xls,” available on the IL SAG website: <http://ilsag.info/net-to-gross-framework.html>

** Based on evaluation research findings.

E.5 Findings and Recommendations

The following includes program findings and recommendations.²

- » **Tracking Database**
 - **Finding 1.** The database ComEd uses to track the CSR program obtains two sets of data from three gas utilities. The data is often incomplete or is inconsistent across the programs.
 - **Recommendation 1.** Navigant recommends that the program continue to refine the tracking database to make it functional for all parties. This includes agreed upon savings assumptions, database fields, and common language for those fields. Navigant recognizes that with PY7 program delivery changes, this recommendation may become obsolete.

- » **Demand Reduction Estimates**
 - **Finding 2.** The CSR program did not estimate demand savings.
 - **Recommendation 2.** Navigant recommends that ComEd track ex ante demand savings for this program in their tracking database.

- » **Gross Savings Estimates**
 - **Finding 3.** For projects in the PGL-NSG area, some were missing information or appeared to include a placeholder value in the tracking system. Updating the placeholder value and including additional project information increased program savings and accounted for a verified gross realization rate of 139 percent.
 - **Recommendation 3.** The implementation contractor should review deemed savings assumptions for the Central Air Conditioning measure in the Illinois TRM to ensure that proper savings estimates are being recorded.

 - **Finding 4.** For projects in the Nicor Gas service area, the main adjustment to the realization rate was due to adjusting project full load hours (FLH) assumptions using a zip code reference. For example, gross energy savings for some projects within the Rockford zip code area were calculated using deemed Chicago full load hours (FLH) where the Rockford FLH would be more applicable. The adjustment to FLH accounts for the 93 percent gross realization rate for projects in the Nicor Gas service area.
 - **Recommendation 4.** The implementation contractor should review the program's FLH assumptions and use the Rockford FLH for applicable projects using the list of site zip codes if needed.

² For ease of reference between each section, the numbered findings and recommendations in this section are the same as those found in the Findings and Recommendations section of the evaluation report.

1 Introduction

1.1 Program Description

Under the Complete System Replacement (CSR) program, Commonwealth Edison Company (ComEd) offers incentives and education to encourage upgrading central air-conditioning systems. ComEd offers this program in conjunction with high-efficiency furnace rebates through the Home Energy Efficiency Rebates (Home EER) program offered by Nicor Gas and the Home Energy Rebate Program offered by Peoples Gas and North Shore Gas. ComEd designed the CSR program to conserve electricity and natural gas and to lower participants' monthly energy bills. Both rental and owner-occupied dwellings are eligible for rebates for furnaces and air-conditioning systems. In order to receive these rebates, customers must be active residential customers of ComEd and one of the aforementioned gas utilities, and they must use premises in existing buildings for residential purposes.

The CSR program promises customers a six-week turn-around rebate to invest in long-term savings through better technology. The program offers rebates for the installation of high efficiency central air-conditioning systems rated SEER 14.5 or above replacing existing central air conditioning systems in conjunction with high-efficiency furnaces rebated by PGL-NSG or Nicor Gas. The dollar amount of the rebate depends on the size and efficiency of the replacement measures. This evaluation covers the sixth program year (PY6) of the CSR program, which ran from June 1, 2013, through May 31, 2014. The CSR program rebates range from \$250 to \$500 for the ComEd component, depending on the gas utility, furnace efficiency level, and central air-conditioning (CAC) unit efficiency level.

1.2 Evaluation Objectives

The evaluation team identified the following key researchable questions for PY6.

1.2.1 Impact Questions

1. What are the program's net and gross savings?
2. Are the Illinois Statewide Technical Reference Manual for Energy Efficiency Version 2.0 (Illinois TRM v2.0) algorithms applied appropriately and the tracking system calculating savings correctly?

2 Evaluation Approach

Navigant calculated the ex ante gross savings estimates by totaling all paid CSR projects installed during PY6 from the tracking database. To determine verified gross savings by measure, the evaluation team applied the algorithms found in Section 2.2 from the Illinois TRM v2.0. The evaluation compared ex ante to ex post savings to find the measure and program level realization rates for the CSR program. The net-to-gross ratio (NTGR) for this program year was approved through the Illinois Stakeholder Advisory Group (IL SAG) stakeholder consensus process.

2.1 Overview of Data Collection Activities

The core data collection activities included an engineering analysis of the program tracking data. Table 2-1 and Table 2-2 show the full set of data collection activities.

Table 2-1. Primary Data Collection Activities

What	Who	Target Completes	Completes Achieved	When
Program Tracking Database	Participants	Census	Census	August – September 2014

Source: Navigant

Table 2-2. Additional Resources

Reference Source	Author	Application	Gross Impacts	Process
Illinois Statewide Technical Reference Manual for Energy Efficiency Version 2.0	N/A	Engineering Analysis	X	

Source: Navigant

2.2 Verified Savings Parameters

Navigant calculated the verified gross and net savings (energy and coincident peak demand) resulting from the CSR program PY6 using the following algorithms as defined by the Illinois TRM v2.0.³

Equation 2-1. Time of Sale Energy Savings

$$kWh\ Savings = \left(FLH_{cool} \times Btu/hr \times \left(\frac{1}{SEER_{base}} - \frac{1}{SEER_{ee}} \right) \right) / 1000$$

Equation 2-2. Time of Sale Demand Savings

$$kW\ Savings = \left(Btu/hr \times \left(\frac{1}{EER_{base}} - \frac{1}{EER_{ee}} \right) \right) / 1000 \times CF$$

³ Available here: <http://www.ilsag.info/technical-reference-manual.html>

Equation 2-3. Time of Sale Demand Savings⁴

$$kW\ Savings = \left(Btu/hr \times \left(\frac{1}{EER_{base}} - \frac{1}{EER_{ee}} \right) \right) / 1000 \times CF_{PJM}$$

Equation 2-4. Early Replacement Energy Savings

$$kWh\ Savings = \left(FLH_{cool} \times Btu/hr \times \left(\frac{1}{SEER_{exist}} - \frac{1}{SEER_{ee}} \right) \right) / 1000$$

Equation 2-5. Early Replacement Demand Savings

$$kW\ Savings = \left(\frac{Btu}{hr} \times \left(\frac{1}{EER_{exist}} - \frac{1}{EER_{ee}} \right) \right) / 1000 \times CF$$

Equation 2-6. Early Replacement Demand Savings⁴

$$kW\ Savings = \left(\frac{Btu}{hr} \times \left(\frac{1}{EER_{exist}} - \frac{1}{EER_{ee}} \right) \right) / 1000 \times CF_{PJM}$$

Where:

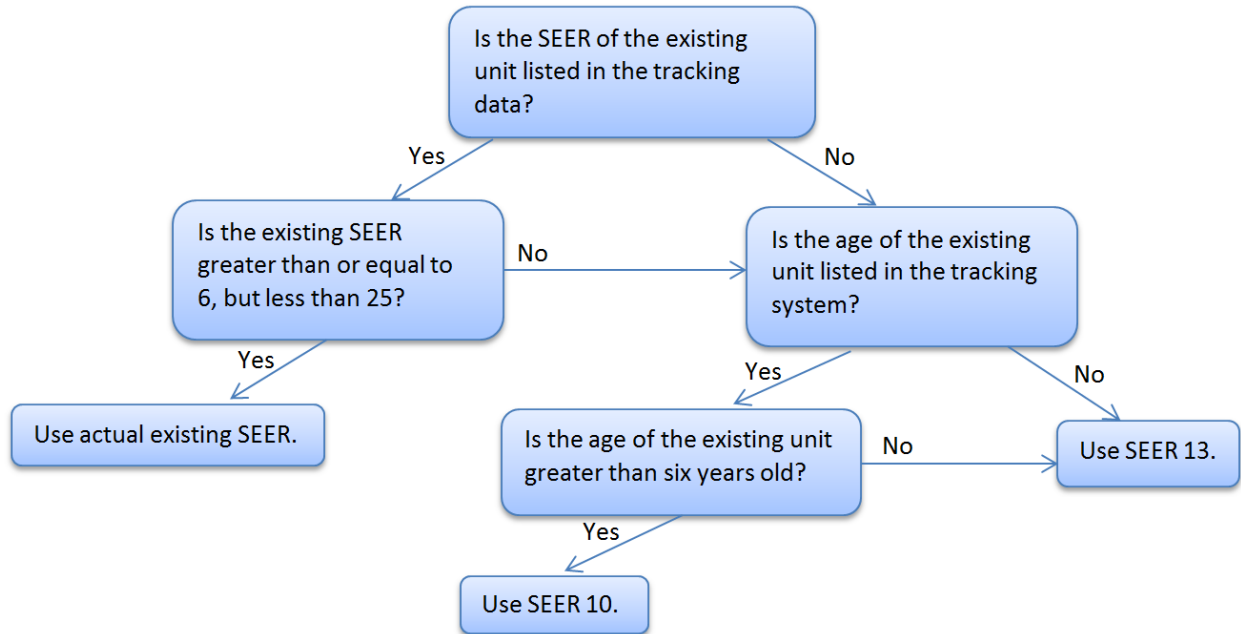
FLH =	Full load hours for cooling; based on location and dwelling type
Btu/hr =	Air-conditioner unit capacity, use actual; if blank, < 15,000, or > 65,000, assume 33,600
SEER _{base} =	Seasonal energy efficiency ratio (SEER) rating of base air-conditioner unit; 13
SEER _{ee} =	SEER rating of energy efficient air-conditioner unit, use actual; if blank, < 14.25, or > 25, assume 14.5
EER _{base} =	EER rating of base air-conditioner unit, calculated based on SEER _{base} ; see Equation 2-7
EER _{ee} =	EER rating of energy efficient air-conditioner unit, calculated based on SEER _{ee} ; see Equation 2-7
CF =	Summer system peak coincidence factor (during system peak hour); 0.915
CF _{PJM} =	PJM summer peak specific coincidence factor (average during PJM peak period); 0.466
SEER _{exist} =	SEER rating of existing air-conditioner unit, see Figure 2-1; logic provided by ComEd
EER _{exist} =	EER rating of existing air-conditioner unit, calculated based on SEER _{exist} ; see Equation 2-7

Equation 2-7. SEER to EER Conversion

$$EER = -0.02 \times SEER^2 + 1.12 \times SEER$$

⁴ The summer system peak coincidence factor is used to determine verified peak demand reduction, while the PJM summer peak coincidence factor is used to calculate PJM peak demand reduction.

Figure 2-1. SEER_{exist} Logic Tree



Source: Navigant based on logic provided by ComEd

Table 2-3 presents the parameters that Navigant used in the verified gross and net savings calculations and indicates which were examined through evaluation activities and which were deemed.

Table 2-3. Verified Savings Parameter Data Sources

Gross Savings Input Parameters	Data Source	Deemed or Evaluated
ΔkWh	PY6 EM&V Program Tracking Data Analysis	Evaluated
FLH_{cool}	Illinois TRM v2.0	Deemed from Illinois TRM v2.0
Capacity	PY6 EM&V Program Tracking Data Analysis	Evaluated
$SEER_{base}$	PY6 EM&V Program Tracking Data Analysis	Evaluated
$SEER_{exist}$	PY6 EM&V Program Tracking Data Analysis	Evaluated
$SEER_{ee}$	PY6 EM&V Program Tracking Data Analysis	Evaluated
ΔkW	PY6 EM&V Program Tracking Data Analysis	Evaluated
EER_{base}	PY6 EM&V Program Tracking Data Analysis	Evaluated
EER_{exist}	PY6 EM&V Program Tracking Data Analysis	Evaluated
EER_{ee}	PY6 EM&V Program Tracking Data Analysis	Evaluated
CF	Illinois TRM v2.0	Deemed from Illinois TRM v2.0

Source: Navigant analysis

2.2.1 Verified Gross Program Savings Analysis Approach

Navigant performed a tracking system review to determine if the system provided all necessary information for evaluation purposes. Because there were blank fields in the tracking system, Navigant used savings algorithms and assumptions provided by ComEd. To determine ex ante gross savings estimates, Navigant totaled the energy savings listed for all paid projects in PY6. Navigant calculated the verified gross savings using algorithms from the Illinois TRM v2.0, assumptions provided by ComEd, as well as actual values from the tracking database. Some projects were missing information in the ComEd tracking system. In these cases, Navigant used default values that ComEd provided. The verified gross realization rate is the ratio of the verified gross savings estimates by the ex ante gross savings estimate.

2.2.2 Verified Net Program Savings Analysis Approach

Navigant calculated verified net energy and demand (coincident peak and overall) savings by multiplying the verified gross savings estimates by a NTGR. In PY6, the NTGR estimates used to calculate the net verified savings were based on past evaluation research and approved through the IL SAG consensus process.⁵

2.3 Process Evaluation

Navigant's interview with the utility program manager was primarily focused on program impacts.

⁵ "ComEd PY5-PY6 Proposal Comparisons with SAG.xls," available on the IL SAG website: <http://ilsag.info/net-to-gross-framework.html>

3 Gross Impact Evaluation

3.1 Tracking System Review

Navigant performed a tracking system review to determine if the system provided all necessary evaluation information. All the necessary fields for calculating energy and demand savings are present, but many times not all fields held values. In these cases, Navigant had to assume default values.

The key findings of the tracking system review include the following:

1. The majority of batched, in process, or paid projects in PY6 did not list an existing SEER value or were far out of the accepted range (greater than six and less than 25). In these cases, Navigant used default existing values of SEER 10 for early replacement projects, or SEER 13 for time of sale projects.
2. The majority of batched, in process, or paid projects in PY6 either did not list a new system capacity or listed a new system capacity that was out of the accepted range (greater than 15,000 Btu/hr and less than 65,000 Btu/hr). In these cases, Navigant used a default new system capacity of 33,600 Btu/hr, as detailed in the Illinois TRM v.2.0.
3. The ex-ante kWh savings for PGL-NSG projects in the tracking database appear to show no correlation to the individual project variables. For instance, many projects have the same savings value listed even if their unit capacities or SEER rating are radically different. This may be a data transfer issue or perhaps a column shift problem. Navigant was unable to determine the exact cause for this discrepancy. This discrepancy resulted in a verified gross realization rate of 139 percent for PGL-NSG projects.

3.2 Program Volumetric Findings

The CSR program had 10,706 participants in PY6 and distributed rebates for one measure through 11,152 projects, as shown in Table 3-1. Navigant found that five of the projects in the tracking data had been duplicated. Therefore, Navigant counted these projects only once. Of the 11,152 projects analyzed, 291 projects had been carried over from PY5. These projects were not previously accounted for in the PY5 analysis, because they had a status of “Batched” or “In Process” at the time of analysis. The total number of projects in PY6 (11,152) is 139 percent more than the number of projects for the fifth program year (4,675 projects).

Table 3-1. PY6 Volumetric Findings Detail

Detail	Nicor Gas	PGL-NSG	Total
Participants	8,854	1,852	10,706
Installed Projects	9,296	1,856	11,152

Source: Navigant analysis of ComEd tracking data

3.3 Gross Program Impact Parameter Estimates

The evaluation team conducted research to validate the parameters that the Illinois TRM v2.0 did not specify. Table 3-2 shows the results.

Table 3-2. Verified Gross Savings Parameters

Input Parameters	Value	Default*	Source
FLH _{cool}	Chicago, Single Family	570	570 Illinois TRM v2.0
	Chicago, Multi-Family	506	
	Rockford, Single Family	512	
	Rockford, Multi-Family	467	
Capacity	Actual if within the range of greater than 15,000 Btuh and less than 65,000 Btuh	33,600	Evaluated*
SEER _{base}	Actual if within the range of greater than 6 and less than 25	13	Evaluated*
SEER _{exist}	Actual if within the range of greater than 6 and less than 25	10	Evaluated*
SEER _{ee}	Actual if within the range of greater than 14.25 and less than 25	14.5	Evaluated*
EER _{base}	Actual based on SEER _{base} ; calculated	11.18	Evaluated*
EER _{exist}	Actual based on SEER _{exist} ; calculated	9.2	Evaluated*
EER _{ee}	Actual based on SEER _{ee} ; calculated	12.0	Evaluated*
CF	91.5%	91.5%	Illinois TRM v2.0
CF _{PJM}	46.6%	46.6%	Illinois TRM v2.0

*Navigant used default values if actual data was not available in the tracking system. The source of the default values was the Illinois TRM v2.0.

Source: Navigant analysis

3.4 Verified Gross Program Impact Results

To determine the verified gross savings, Navigant calculated savings for each project using the Illinois TRM v2.0 algorithm and assumptions shown in Section 2.2. The resulting total program verified gross savings is 5,514 megawatt-hours (MWh) and 7.95 megawatts (MW). Navigant found that five of the projects in the tracking data had been duplicated.⁶ Therefore, Navigant counted these projects only once.

Table 3-3. PY5 Verified Gross Impact Savings Estimates

Savings Category	PGL-NSG	Nicor Gas	Total
Ex Ante Gross Savings (MWh)	610	5,023	5,633
Ex Ante Gross Demand Reduction (MW)	N/A	N/A	N/A
Ex Ante Gross Peak Demand Reduction (MW)	N/A	N/A	N/A
Verified Gross Savings (MWh)	845	4,669	5,515
Verified Gross Demand Reduction (MW)	1.12	6.83	7.95
Verified Gross Peak Demand Reduction (MW)	0.57	3.48	4.05
Verified Gross Realization Rate	139%	93%	98%

Source: Navigant analysis

⁶ For reference, the duplicate projects have the following rebate numbers: 79858, 85894, 95381, 89547, and 80327.

4 Net Impact Evaluation

Table 4-1 shows the deemed NTGR values and the PY6 verified net savings.

Table 4-1. PY6 Verified Net Impact Savings Estimates

	Energy Savings (MWh)	Demand Savings (MW)	Peak Demand Savings (MW)
Ex Ante PY6 Gross Savings	5,633	N/A	N/A
Realization Rate**	98%	N/A	N/A
Verified Gross Savings	5,515	7.95	4.05
NTGR*	0.59	0.59	0.59
Verified Net Savings	3,254	4.69	2.39

Source: Navigant analysis

*A deemed value from "ComEd PY5-PY6 Proposal Comparisons with SAG.xls," available on the IL SAG website: <http://ilsag.info/net-to-gross-framework.html>

** Based on evaluation research findings.

5 Findings and Recommendations

This section summarizes the key impact findings and recommendations.² The program had 10,706 program participants that received 11,152 rebates and achieved verified net savings of 3,253 MWh, exceeding its net energy savings target of 1,900 MWh.

» Tracking Database

- **Finding 1.** The database ComEd uses to track the CSR program obtains two sets of data from three gas utilities. The data is often incomplete or is inconsistent across the programs.
- **Recommendation 1.** Navigant recommends that the program continue to refine the tracking database to make it functional for all parties. This includes agreed upon savings assumptions, database fields, and common language for those fields. Navigant recognizes that with PY7 program delivery changes, this recommendation may become obsolete.

» Demand Reduction Estimates

- **Finding 2.** The CSR program did not estimate demand savings.
- **Recommendation 2.** Navigant recommends that ComEd track ex ante demand savings for this program in their tracking database.

» Gross Savings Estimates

- **Finding 3.** For projects in the PGL-NSG area, some were missing information or appeared to include a placeholder value in the tracking system. Updating the placeholder value and including additional project information increased program savings and accounted for a verified gross realization rate of 139 percent.
- **Recommendation 3.** The implementation contractor should review the deemed savings assumptions for the Central Air Conditioning measure in the Illinois TRM to ensure that proper savings estimates are being recorded.
- **Finding 4.** For projects in the Nicor Gas service area, the main adjustment to the realization rate was due to adjusting project full load hours (FLH) assumptions using a zip code reference. For example, gross energy savings for some projects within the Rockford zip code area were calculated using deemed Chicago full load hours (FLH) where the Rockford FLH would be more applicable. The adjustment to FLH accounts for the 93 percent gross realization rate for projects in the Nicor Gas service area.
- **Recommendation 4.** The implementation contractor should review the program's FLH assumptions and use the Rockford FLH for applicable projects using the list of site zip codes if needed.