



Coordinated Utility Public Sector Retro-Commissioning Program Bridge Period Impact Evaluation Report

Energy Efficiency / Demand Response Plan:
Electric Plan Year 9 (EPY9) / Gas Plan Year 6 (GPY6) - Bridge
Period (June 2, 2017 to December 31, 2017)

Presented to
Commonwealth Edison Company
Nicor Gas
Peoples Gas
North Shore Gas

FINAL

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TABLE OF CONTENTS

1. Introduction	1
2. Program Description	1
2.1 Eligibility	1
2.2 Bridge Period Program Activity	1
3. Program Savings.....	2
4. Program Savings by Measure.....	2
5. Impact Analysis Detail.....	3
6. Program Impact Analysis Findings and Recommendations	5
6.1 Impact Parameter Estimates.....	5
6.2 Other Impact Findings and Recommendations.....	5
7. Appendix 1. Impact Analysis Methodology	5
7.1 Verified Gross Program Savings Analysis Approach.....	5
7.2 Verified Net Program Savings Analysis Approach.....	6
8. Appendix 2. Impact Analysis Detail.....	6
9. Appendix 3. TRC Detail.....	7

LIST OF TABLES AND FIGURES

Figure 3-1. Number of Measures Installed by Type.....	4
Figure 3-2. Savings by Type	4
Table 2-1. EPY9/GPY6 Volumetric Findings Detail	1
Table 4-1. Bridge Period Total Annual Incremental Savings	2
Table 5-1. Bridge Period Energy Savings by Measure†.....	2
Table 5-2. Bridge Period Demand Savings by Measure†.....	3
Table 5-4. Bridge Period Therm Savings by Measure†.....	3
Table 8-1. Project Level Realization Rates.....	6
Table 9-1. Total Resource Cost Savings Summary.....	7

1. INTRODUCTION

This report presents the results of the impact evaluation of the coordinated utility Public Sector Retro-Commissioning (RCx) Program for the EPY9/GPY6 bridge period, June 2, 2017 through December 31, 2017. It presents a summary of the energy and demand impacts for the public sector program broken out by relevant measure and program structure details. The appendix presents the impact analysis methodology. The applicable technical reference manual (TRM) for this report is IL TRM version 5.0.

2. PROGRAM DESCRIPTION

The Public Sector Retro-Commissioning Program is operated through the Smart Energy Design Assistance Center (SEDAC) and managed by staff at the 360 Energy Group (360 Energy). The program helps customers improve the performance and reduce energy consumption of their facilities through the systematic analysis of *existing* building systems. Generally, the program pays for 100% of a retro-commissioning study, contingent upon a participant’s commitment to spend \$10,000 implementing a bundle of study recommendations having a simple payback of 18 months or less. The program does not provide incentives to the participant to implement the measures.

2.1 Eligibility

The RCx Program is available to public sector facilities that receive electrical service from Ameren Illinois or ComEd or natural gas service from Ameren Illinois, Nicor Gas, North Shore Gas, or Peoples Gas. In general, facilities must comprise at least 150,000 ft² of conditioned space and be at least five years old. However, newer and smaller buildings with an energy use profile suggesting a large potential for savings are also eligible for the program on a case-by-case basis. In addition to size and age criteria, buildings must have a functioning building automation system (BAS). Buildings with select characteristics are given preference for program: buildings direct-digital control BAS, absence of major planned system renovations or retrofits; and motivated and committed building owners and operators.

2.2 Bridge Period Program Activity

Two public sector retro-commissioning projects were completed during the bridge period and files were submitted to evaluators for review. All gas savings originates from Nicor Gas customers.

The volumetric findings are shown in the following table.

Table 2-1. EPY9/GPY6 Volumetric Findings Detail

Participation	DCEO
Participants	2
Electric Measures*	10
Gas Measures*	7
Total Measures*	11
Number of Measures/Projects	5.5

* Total measures include some with both gas and electric savings.
 Source: SEDAC tracking data and Navigant team analysis.

3. PROGRAM SAVINGS

Table 3-1 summarizes the incremental energy and demand savings the Public Sector RCx Program achieved in the bridge period. The net-to-gross ratio is established by the Illinois Stakeholder Advisory Group (SAG) and NTG values are deemed on a regular basis by the SAG. All gas savings originate from Nicor Gas customers.

Table 3-1. Bridge Period Total Annual Incremental Savings

Savings Category	Energy Savings (kWh)	Demand Savings (kW)	Peak Demand Savings (kW)	Gas Savings (Therms)
Ex Ante Gross Savings	245,937	22	22	22,355
Program Gross Realization Rate	0.82	0.50	0.50	0.80
Verified Gross Savings	200,539	11	11	17,888
Program Net-to-Gross Ratio (NTGR)	0.95	0.95	0.95	1.02
Verified Net Savings	190,512	10	10	18,246

Source: ComEd tracking data and Navigant team analysis.

4. PROGRAM SAVINGS BY MEASURE

During the bridge period the program completed two projects that encompass 11 custom, and mostly unique, measures. Measure-level savings for this small population have limited value summarized. Project savings are discussed in Section 7 (Appendix 1).

Table 4-1. Bridge Period Energy Savings by Measure‡

Measure Type	Research Category	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTGR *	Verified Net Savings (kWh)	Effective Useful Life (EUL)†
Optimization	Optimization	24,335	76%	18,564	0.95	17,636	7
Repair	Repair	53,007	107%	56,759	0.95	53,921	7
Retrofit	Retrofit	836	83%	694	0.95	659	7
Scheduling	Scheduling	167,759	74%	124,522	0.95	118,296	7
Total		245,937	82%	200,539	0.95	190,512	

* A deemed value. Source: ComEd_NTG_History_and_PY9_Recommendations_2016-02-26_Final.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>.

† EUL is a combination of technical measure life and persistence. There is currently no prior established EUL for RCx measures. The EUL value in this table is a project-level value based on established secondary research as described in the ComEd EUL research memo dated May 2018.

‡ Values may not sum due to rounding.

Source: ComEd tracking data and Navigant team analysis

Table 4-2. Bridge Period Demand Savings by Measure‡

Measure Type	Research Category	Ex Ante Gross Savings (kW)	Verified Gross Realization Rate	Verified Gross Savings (kW)	NTGR *	Verified Net Savings (kW)	Effective Useful Life (EUL)†
Optimization	Optimization	14	79%	11	0.95	10	7
Repair	Repair	8	0%	0	0.95	0	7
Retrofit	Retrofit	0	NA	0	0.95	0	7
Scheduling	Scheduling	0	NA	0	0.95	0	7
Total		22	50%	11		10	

* A deemed value. Source: ComEd_NTG_History_and_PY9_Recommendations_2016-02-26_Final.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>.

† EUL is a combination of technical measure life and persistence. There is currently no prior established EUL for RCx measures. The EUL value in this table is a project-level value based on established secondary research as described in the ComEd EUL research memo dated May 2018.

‡ Values may not sum due to rounding.

Source: ComEd tracking data and Navigant team analysis

Table 4-3. Bridge Period Therm Savings by Measure‡

Measure Type	Research Category	Ex Ante Gross Savings (Therms)	Verified Gross Realization Rate	Verified Gross Savings (Therms)	NTGR *	Verified Net Savings (Therms)	Effective Useful Life (EUL)†
Optimization	Optimization	5,277	100%	5,277	1.02	5,383	7
Repair	Repair	0	NA	0	1.02	0	7
Retrofit	Retrofit	5,743	72%	4,132	1.02	4,215	7
Scheduling	Scheduling	11,334	75%	8,479	1.02	8,649	7
Total		22,354	80%	17,888		18,246	

* A deemed value. Source: Nicor_Gas_GPY6_NTG_Values_2016-02-29_Final.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>.

† EUL is a combination of technical measure life and persistence. There is currently no prior established EUL for RCx measures. The EUL value in this table is a project-level value based on established secondary research as described in the ComEd EUL research memo dated May 2018.

‡ Values may not sum due to rounding.

Source: ComEd tracking data and Navigant team analysis.

5. IMPACT ANALYSIS DETAIL

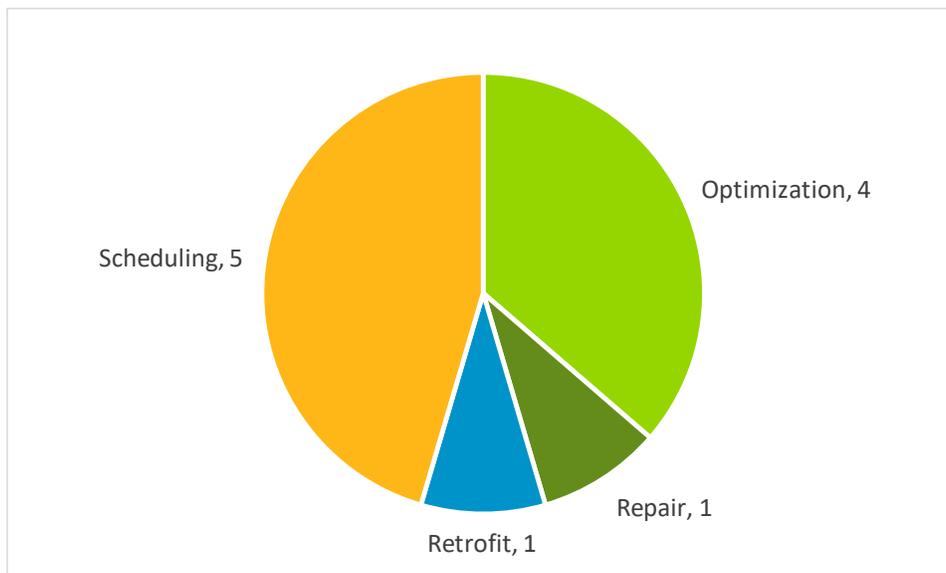
Navigant conducted an engineering review of reported impacts for both projects submitted during the bridge period. Each of the 11 reported measures were supported by custom calculations. The impact analysis included measure-by-measure calculation reviews to determine the accuracy of the methodology, analysis of data, and reasonableness of engineering assumptions.

Generally, retro-commissioning measures can be grouped into four broad categories.

- Scheduling measures are those based on improving energy consumption based on the time-of-day or year.
- Optimization measures utilize controls that monitor physical parameters for feedback to adjust operations to reduce energy use, such as duct pressure or outdoor conditions.
- Repair measures address missed or deferred maintenance of damaged or broken components, such as damper linkages.
- Retrofit and replacement measures include lower-cost equipment such as higher-quality filter media or broken occupancy sensors.

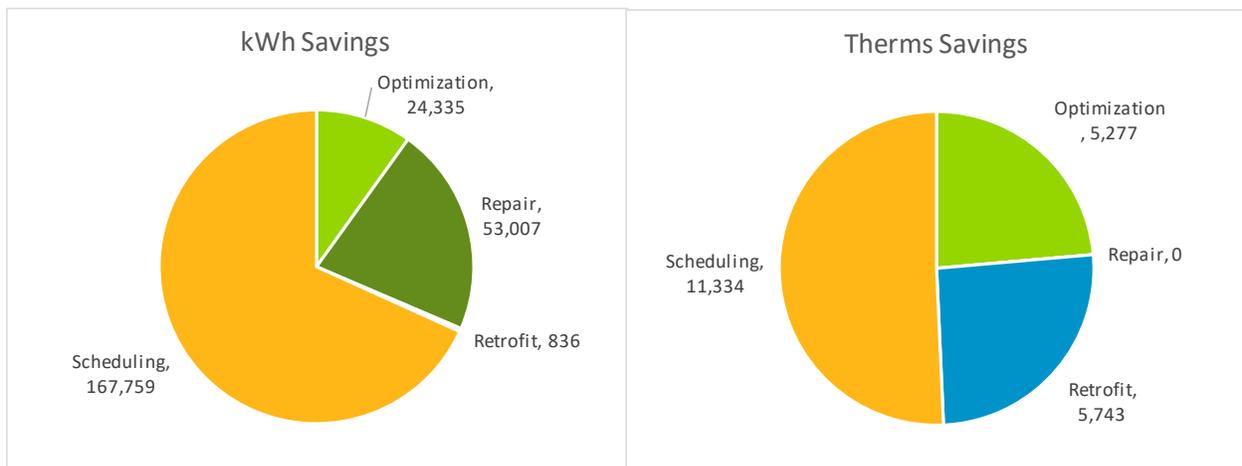
The public sector participation and measures are shown in the following tables and graphs. All gas savings originate from Nicor Gas customers. Figures summarize bridge period measures according to the categorization described here.

Figure 5-1. Number of Measures Installed by Type



Source: Evaluation Analysis

Figure 5-2. Savings by Type



Source: Evaluation Analysis

6. PROGRAM IMPACT ANALYSIS FINDINGS AND RECOMMENDATIONS

The following sections present program energy and demand savings.

6.1 Impact Parameter Estimates

The RCx Program uses custom calculations. There are no individual universal parameters to evaluate.

6.2 Other Impact Findings and Recommendations

Finding 1: Reported savings often did not match calculations submitted for evaluation and verification review.

Recommendation 1: Implement quality control protocols to ensure that reported savings match project documentation.

Finding 2: Savings rely heavily on assumptions and rules-of-thumb. These assumptions are inconsistently applied. For example, the calculations might include 70%, 85% or 100% motor loading at design conditions. Different values are used within measures and projects and between projects with no justification for differences.

Recommendation 2: Encourage more measurement of parameters rather than relying on rules-of-thumb and assumptions. Measured parameters and functional tests are the crux of retro-commissioning. Without measurements and tests, the program deliverable is only an energy study.

Recommendation 3: Choose and enforce consistent and conservative assumptions when measurements are not included. For example, research has shown average motor loading between 60% and 70% over many studies and situations. Other assumptions for fan, pump, motor and drive efficiency should also be based on research and tilt toward underestimating savings (conservative) when there is uncertainty. The Nexant M&V Guidelines for RCx programs encode best practice research findings and should be leveraged whenever site-specific measurements are not available.

Finding 3: Demand savings of 8.3 kW were reported for a variable frequency drive (VFD) repair measure, however there are no demand savings for this measure because the motor is expected to be running at maximum design speed during peak demand hours.

Recommendation 4: Demand savings will generally be low or zero for weather dependent control measures in summer peak periods, since equipment is expected to be running at full design operating points during peak weather conditions. In cases where demand savings are expected, provide clear backup measurements and calculations supporting the reported demand savings.

7. APPENDIX 1. IMPACT ANALYSIS METHODOLOGY

7.1 Verified Gross Program Savings Analysis Approach

For the EPY9/GPY6 bridge period, the Public Sector RCx Program impact evaluation included review of a census of two completed projects. Due to the limited results for the program during the bridge period, the evaluation consisted only of an engineering desk-review and no on-site verification. Evaluators reviewed gross program impacts with a project-by-project and measure-by-measure approach. Savings calculation reviews ensure the savings estimates are accurately modeled and include reasonable assumptions, as required. For projects where operating data are available, the impact evaluation includes analysis of time-

series trend and measured data, both pre- and post- implementation. The completed public sector projects were notable for their lack of measured or trended data.

All analysis is rolled-up to realization rate impact parameter estimates for electric energy, electric demand, and natural gas energy savings. Service providers estimate energy and demand savings with custom algorithms, frequently using hourly weather data and time-series trend data. As such, the Navigant team conducted research to validate the savings individually for all measures in the evaluation sample.

For the Public Sector RCx Program, Navigant reviewed a census of the two completed projects and associated measures. Navigant reviewed savings estimates to ensure calculations were accurate and based on data or reasonable assumptions, when necessary. No on-site verification was attempted with these projects. The lifetime energy and demand savings are estimated by multiplying the verified savings by the effective useful life for each measure. The Navigant team conducted research to validate the parameters that were not specified in the TRM.

7.2 Verified Net Program Savings Analysis Approach

Because the sample included a census of program savings, measure and project level evaluation results were summed and reported as gross savings without further adjustment. Deemed net-to-gross (NTG) ratios were applied to verified gross results to arrive at net impacts.

8. APPENDIX 2. IMPACT ANALYSIS DETAIL

For both public sector projects, Navigant reviewed measure implementation plans, assumptions and calculations in detail. In general, Navigant found the calculations accurately constructed and reasonably transparent in spreadsheet form, but based on rules-of-thumb and assumptions more than measured data. In some instances, we found calculation errors due to spreadsheet equation errors, erroneous inputs, and inconsistencies in assumptions. Documentation for both projects did not match reported savings for most measures. As a result, the evaluation worked with the documented estimates rather than the reported values.

Research findings gross realization rates are the result of analysis of individual measures for each project in the impact sample. Table 8-1 details the realization rates by project. Realization rates for energy varying by more than 10 percent from 1.0 are due to reasons noted. The wide variation in demand realization rates is caused by inconsistent ex ante calculation methodologies and is not discussed in detail in the table.

Both projects were submitted by the same service provider so ex ante methods were similar.

Table 8-1. Project Level Realization Rates

Project	Realization Rates			Notes on ex ante estimates
	kWh	kW	Therms	
School 1	76%	50%	75%	Reported savings for most measures did not agree with documentation. Motor loading estimates were high without supporting documentation. Demand savings were not fully coincident with summer peak hours.
School 2	103%	NA	122%	Reported savings for most measures did not agree with documentation. Motor loading estimates were high without supporting documentation.

9. APPENDIX 3. TRC DETAIL

The following data is for the calculation of the Total Resource Cost test benefit/cost ratios. Table 9-1 shows the total resource cost savings summary for the Public Sector RCx Program.

Table 9-1. Total Resource Cost Savings Summary

Projects	Units	Quantity	Effective Useful Life	Ex Ante kWh	Ex Ante kW	Ex Ante Therms	Verified kWh Savings	Verified kW Savings	Verified Therms Savings
ComEd	Project	2	9	245,937	22	NA	200,539	11	NA
Nicor Gas	Project	2	9	NA	NA	22,355	NA	NA	17,888

The Total Resource Cost (TRC) variable table only includes cost-effectiveness analysis inputs available at the time of finalizing this PY9 impact evaluation report. Additional required cost data (e.g., measure costs, program level incentive and non-incentive costs) are not included in this table and will be provided to evaluation later. Further, detail in this table (e.g., EULs) other than final PY9 savings and program data are subject to change and are not final.