

**Joint Utility
Retro-Commissioning Program
EPY6/GPY3 Evaluation Report**

Final

**Energy Efficiency / Demand Response Plan:
Electricity Plan Year 6 / Gas Plan Year 4
(6/1/2013-5/31/2014)**

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

March 18, 2015

Prepared by:

Roger Hill
Navigant Consulting, Inc.

www.navigant.com



Submitted to:

ComEd	Nicor Gas Company	Peoples Gas and North Shore Gas
Three Lincoln Centre	1844 Ferry Road	200 East Randolph Street
Oakbrook Terrace, IL 60181	Naperville, IL 60563	Chicago, IL 60601

Submitted by:

Navigant Consulting, Inc.
30 S. Wacker Drive, Suite 3100
Chicago, IL 60606

Contact:

Randy Gunn, Managing Director
312.583.5714
Randy.Gunn@Navigant.com

Jeff Erickson, Director
608.497.2322
Jeff.Erickson@Navigant.com

Disclaimer: This report was prepared by Navigant Consulting, Inc. ("Navigant") for ComEd, Nicor Gas, Peoples Gas, and North Shore Gas based upon information provided by the utilities and from other sources. Use of this report by any other party for whatever purpose should not, and does not, absolve such party from using due diligence in verifying the report's contents. Neither Navigant nor any of its subsidiaries or affiliates assumes any liability or duty of care to such parties, and hereby disclaims any such liability.

Table of Contents

E.	Executive Summary	1
E.1.	Program Savings	1
E.2.	Program Savings by Utility.....	2
E.3.	Impact Estimate Parameters for Future Use.....	2
E.4.	Program Volumetric Detail.....	3
E.5.	Results Summary	4
E.6.	Key Findings and Recommendations.....	4
1.	Introduction	7
1.1	Program Description.....	7
1.2	Evaluation Objectives	8
1.2.1	Impact Questions	8
1.2.2	Process Questions	8
2.	Evaluation Approach.....	9
2.1	Overview of Data Collection Activities.....	9
2.2	Verified Savings Parameters.....	10
2.2.1	Verified Gross Program Savings Analysis Approach.....	11
2.2.2	Verified Net Program Savings Analysis Approach	11
2.3	Process Evaluation	12
3.	Gross Impact Evaluation	13
3.1	Tracking System Review	13
3.2	Program Volumetric Findings.....	14
3.2.1	Development of the Verified Gross Realization Rate	15
3.3	Gross Program Impact Parameter Estimates.....	16
3.4	Verified Gross Program Impact Results.....	17
4.	Net Impact Evaluation	18
5.	Process Evaluation	19
5.1	Program Marketing.....	19
5.2	Program Satisfaction.....	19
5.3	Program Timing – Participation Duration.....	20
5.4	Program Benefits	20
5.5	Program Barriers	21
5.6	Participant Comments.....	21
6.	Findings and Recommendations	22
7.	Appendix	24

- 7.1 Detailed Impact Results 24
 - 7.1.1 Research Findings Net Program Impact Results 27
 - 7.1.2 Channeling..... 29
- 7.2 Survey Instruments..... 30
 - 7.2.1 Participant Survey 30
 - 7.2.2 Service Providers Interview Guide 43

List of Figures and Tables

Figures:

Figure 3-1. Number of Measures and Savings Installed by Energy Source and Measure Type.....	15
Figure 5-1. Participant Satisfaction (>7 on 0-10 scale) with Program Elements	20
Figure 7.1. Ex Ante Electric Savings (MWh) Project Savings Histogram.....	25
Figure 7.2. Ex Ante Gas Savings (Therm) Project Savings Histogram.....	25
Figure 7.3. Ex Ante Electric Savings (kWh) by End-Use Category.....	26
Figure 7.4. Ex Ante Energy Savings (kWh and therm) by Measure Type	27

Tables:

Table E-1. EPY6/GPY3 Total Program Electric Savings.....	1
Table E-2. EPY6/GPY3 Total Program Gas Savings.....	2
Table E-3. EPY6/GPY3 Program Results by Utility.....	2
Table E-4. Impact Estimate Parameters for Future Use.....	3
Table E-5. EPY6/GPY3 Volumetric Findings: Participants and Measures Installed.....	3
Table E-6. EPY6/GPY3 Volumetric Findings Detail: Measure Type.....	4
Table E-7. EPY6/GPY3 Results Summary	4
Table 2-1. Primary Data Collection Activities.....	9
Table 2-2. EPY6/GPY3 NTG Parameter Estimates	11
Table 3-1. EPY6/GPY3 Volumetric Findings Detail	14
Table 3-2. Volumetric Findings since Program Inception.....	14
Table 3-3. EPY6/GPY3 Impact Sampling Design.....	16
Table 3-4. EPY6/GPY3 Impact Sampling Final	16
Table 3-5. Verified Gross Savings Realization	17
Table 4-1. EPY6/GPY3 Deemed Net to Gross Ratio Values Estimates	18
Table 4-2. EPY6/GPY3 Program Results by Utility	18
Table 6-1. EPY6/GPY3 Total Program Electric Savings.....	22
Table 6-2. EPY6/GPY3 Total Program Gas Savings	22

E. Executive Summary

This report presents a summary of the findings and results from the Impact and Process Evaluation of the EPY6/GPY3¹ Joint Utility Retro-Commissioning Program. The Northern Illinois Joint Utility Retro-Commissioning Program (Retro-Commissioning Program) is offered in partnership between ComEd, Nicor Gas, Peoples Gas and North Shore Gas. The Retro-Commissioning Program helps commercial and industrial customers improve the performance and reduce energy consumption of their facilities through the systematic evaluation of *existing* building systems. Low- and no-cost measures are targeted and implemented to improve system operations, reduce energy use and demand and, in many cases, improve occupant comfort. The Retro-Commissioning Program aims to streamline the typical retro-commissioning process in order to facilitate implementation of projects that yield savings in the program year they are initiated.

The EPY6/GPY3 program is essentially unchanged from the EPY5/GPY2 program. One project was submitted through the Monitoring-Based² option.

E.1. Program Savings

Table E-1 and Table E-2 summarize the electric and natural gas savings from the Retro-Commissioning Program. Table E-3 details key factors and breaks out savings by utility.

Table E-1. EPY6/GPY3 Total Program Electric Savings

Savings Category	Energy Savings (MWh)	Demand Savings (MW)	Peak Demand Savings (MW)
Ex Ante Gross Savings	26,459	TBD	0.832
Verified Gross Savings	25,302	TBD	0.636
Verified Net Savings ³	26,314	TBD	0.662

Source: ComEd tracking data and Navigant team analysis.

¹ The Electricity PY6 and Gas PY3 program year began June 1, 2013 and ended May 31, 2014.

² Monitoring-based retro-commissioning (MBCx) is ComEd's and Nicor Gas' alternative offering where participants enter into longer-term (18 months or more) contracts with a retro-commissioning service provider (RSP) to review and analyze data monitored by the participant's automation system. The MBCx service providers are approved separately from RCx SPs, although there is overlap. The monitoring software provides feedback to the RSP about the building's energy performance. Measures are implemented on a rolling basis and divergent data are investigated to determine if there are un-intended changes or errors introduced into the building controls. In this manner, errors are caught early before they affect long-term building performance.

³ Net savings is based on consensus evaluation framework research performed in EPY4/GPY1 which found net-to-Gross ratios equal to 1.04 and 1.02 for electricity and gas, respectively.

Table E-2. EPY6/GPY3 Total Program Gas Savings

Savings Category	Nicor Gas (therms)	Peoples Gas (therms)	North Shore Gas (therms)
Ex Ante Gross Savings	739,312	260,508	23,123
Verified Gross Savings	706,362	264,763	23,123
Verified Net Savings ³	720,490	270,058	23,585

Source: ComEd tracking data and Navigant team analysis.

E.2. Program Savings by Utility

Table E-3 presents the savings by utility⁴. ComEd electric savings are summed across all utilities

Table E-3. EPY6/GPY3 Program Results by Utility

Savings Category	ComEd	Nicor Gas	Peoples Gas	North Shore Gas
Ex Ante Gross Savings (therms)	NA	739,312	260,508	23,123
Ex Ante Gross Savings (MWh) *	13,735	7,741	4,325	658
Ex Ante Gross Peak Demand Reduction (MW)	0.473	0.041	0.209	0.108
Verified Gross Savings (therms) ‡	NA	706,362	264,763	23,123
Verified Gross Savings (MWh) ‡*	13,135	7,403	4,136	629
Verified Gross Peak Demand Reduction (MW) ‡*	0.362	0.031	0.160	0.083
Verified Gross Realization Rate (therms) ‡	NA	96%	102%	100%
Verified Gross Realization Rate (MWh) ‡*			96%	
Verified Gross Realization Rate (MW) ‡*			76%	
Net to Gross Ratio (NTGR)	Electricity 1.04 †	Gas 1.02 †	†	†
Verified Net Savings (therms)	NA	720,490	270,058	23,585
Verified Net Savings (MWh)*	13,660	7,699	4,301	654
Verified Net Demand Reduction (MW)*	0.376	0.033	0.166	0.086

Source: ComEd tracking data and Navigant team analysis.

† A deemed value. Source: ComEd PY5-EPY6/GPY3 Proposal Comparisons with SAG.xls, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>

‡ Based on evaluation research findings.

* All electric savings, electric only and joint projects, are attributed to ComEd.

E.3. Impact Estimate Parameters for Future Use

In the course of our EPY6/GPY3 research, the evaluation did research on parameters used in impact calculations including those in the Illinois TRM. Some of those parameters are eligible for deeming for future program years or for inclusion in future versions of the TRM. The evaluation team's parameters recommended for future use are shown in the following table.

⁴ The ComEd data include electric-only projects across ComEd's service territory. The gas utility data include gas savings for respective service territories and ComEd electricity savings for the projects with *both* gas and electric service in respective service territories. Total electricity savings would be a sum across all columns.

Table E-4. Impact Estimate Parameters for Future Use

Parameter	Value	Data Source
NTG - Electricity	0.95	Self-report interviews with participants and service providers

Source: Evaluation Analysis

The new NTG – electricity value will be considered for prospective application for EPY8. The same data could be used for revising NTG – Gas, but updating NTG – Gas was not part of the evaluation scope for the gas utilities.

E.4. Program Volumetric Detail

The program had 50 participants in EPY6/GPY3. Among these participants forty-nine receive electricity service from ComEd, 22 are joint utility projects and they receive natural gas service from Nicor Gas, Peoples Gas or North Shore Gas. Twenty-seven participants have installed electric-only projects. One Nicor Gas customer receives electric service from the City of Naperville Utilities. Though the project had electric savings, it is counted as a gas-only project for the Joint Utility Program.

As in prior years the majority of measures and savings can be categorized as optimization through set-point changes that allow the building to meet comfort conditions with less energy consumption. Schedule changes, where equipment is operated fewer hours based on the time-of-day or day-of-the-week, comprise most of the other measures and savings⁵.

Table E-5. EPY6/GPY3 Volumetric Findings: Participants and Measures Installed

Participation	ComEd Only	Nicor Gas	Peoples Gas	North Shore Gas
Participants	27	12	9	2
Total Installed Measures	130	50	54	9
Number of Measures/Project	4.8	4.2	6.0	4.5

Source: ComEd tracking data and Navigant team analysis.

Table E-6 shows measures by type and energy source. Individual measures that save both natural gas and electricity are counted for each energy source.

⁵ Repair measures fix broken equipment, such as a stuck damper or valve, or replace a relatively inexpensive actuator. Low-cost retrofit measures include using alternate filter media or notched belts.

Table E-6. EPY6/GPY3 Volumetric Findings Detail: Measure Type

Measure Type	Measure Count		% Savings	
	Electric	Gas	Electric	Gas
Schedule	48	14	21%	10%
Optimization	165	27	75%	86%
Repair	9	4	1%	4%
Low-Cost Retrofit	8	1	3%	0%
Total	230	46	100%	100%

Source: ComEd tracking data and Navigant team analysis.

E.5. Results Summary

The following table summarizes the key metrics from EPY6/GPY3.

Table E-7. EPY6/GPY3 Results Summary

Participation	Units	ComEd	Nicor Gas	Peoples Gas	North Shore Gas
Net Savings	MWh or Therms	26,315	720,490	270,058	23,585
Net Demand Reduction	MW	0.661	NA	NA	NA
Gross Savings	MWh or Therms	25,303	706,362	264,763	23,123
Gross Demand Reduction	MW	0.654	NA	NA	NA
Program Energy Realization Rate	%	96%	96%	102%	100%
Program Demand Realization Rate	%	76%	NA	NA	NA
Program NTG Ratio †	#	1.04	1.02	1.02	1.02
Customers Touched	#	49	12	9	2

Source: ComEd tracking data and Navigant team analysis.

† A deemed value. Source: ComEd PY5-EPY6/GPY3 Proposal Comparisons with SAG.xls, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>

E.6. Key Findings and Recommendations

In general, the EPY6/GPY3 evaluation finds a mature program that has adjusted to the market over the years to include customers⁶ that would benefit from the program, when they might otherwise not participate. Program participation and savings are stable. Participants and service providers are extremely satisfied with the program. The following provides insight into key program findings and recommendations.⁷

⁶ Examples of program adjustments include “campus aggregation” of smaller buildings and guidelines for allowing consumers of district energy to participate.

⁷ Numbered findings and recommendations in this section are the same as those found in the Findings and Recommendations section of the evaluation report for ease of reference between each section.

Program Energy Impacts

Finding 1. Energy realization rates continue to be relatively high. There are no patterns for verification adjustment except that some implemented measures are changed after the operators have run the building with the measures for a while.

Recommendation 1. Finalize implementation earlier so that operators can fine-tune measures prior to verification.

Finding 2. A minor, but widespread, error is incorrectly applied weather data. The metro-Chicago area has two well-researched TMY3 weather sets to draw on for energy calculation – O’Hare AP and Midway AP. The sets are comparable, but the Midway AP set has fewer extreme hot and cold hours due to moderation by Lake Michigan. An economizer measure using Midway AP data will show more savings than using O’Hare AP data. Most calculations use the O’Hare weather set, but most projects are downtown Chicago where the Midway weather is more representative.

Recommendation 2. Standardize the weather sets used for locales in the northern Illinois service territories. In order to distinguish projects that experience “lake effect” climate more accurately, Navigant recommends using Midway AP TMY3 files for all projects within 3 miles of Lake Michigan.

Finding 3. Demand savings estimates continue to be a challenge. Peak demand savings are estimated when none is warranted. Inappropriate peak conditions are used in estimates. ComEd’s interest in “total demand savings” will confuse the issue further.

Recommendation 3. Standardize and enforce estimation methods for total and peak demand savings. Proscribe peak demand saving for certain measures (*e.g., economizers*). Track and report total demand savings in verification reports and in the tracking database.

Process Evaluation.

Finding 4. Projects take a long time from application to final verification – more than a year in many cases. This leads to fatigue and potential loss of key project personnel.

Recommendation 4. Look for ways to speed the projects along⁸:

- Engage controls contractors earlier to implement measures.
- Require completion of measure implementation earlier (March) so there is time to verify and perhaps revise measures before the program year-end.
- Combine the planning and investigation phases or modify the expectations for both so that redundancy is minimized.
- Create fast-track options for smaller projects.

Finding 5. Volumetric parameters show a persistent downward trend in the number of implemented measures and the electric savings per site. The evaluators have not had the scope to research these longitudinal trends to determine causes – whether measure identification, measure implementation, measure aggregation, the types of projects submitted in the program or some other influence.

⁸ Many of these recommendations are in process for EPY7/GPY4.

Recommendation 5. Scope longitudinal analysis of program data for the EPY7/GPY4 evaluation cycle or as a separate stand-alone analysis.

1. Introduction

1.1 Program Description

The ComEd Retro-Commissioning Program has been offered each of the six electric program years. Electric Program Year 6 (EPY6) also marked the third natural gas program year where the program was offered as a joint utility program with the gas utilities where service areas overlap ComEd's. The overlapping territories include Nicor Gas, Peoples Gas and North Shore Gas. The Retro-Commissioning Program offering is a natural fit for joint delivery due to the intensive investigation and analysis of heating, ventilation and air-conditioning (HVAC) systems. Individual measures frequently save both electricity and natural gas and analyzing one power source, while neglecting the other, would be a lost energy savings opportunity.

The program helps commercial and industrial customers improve the performance and reduce energy consumption of their facilities through the systematic evaluation of existing building systems. Generally, the program pays for 100% of a detailed retro-commissioning study. This payment is contingent upon a participant's commitment to spend a defined amount of their own money implementing recommendations in the study that have a payback of 18 months or less. Retro-commissioning recommendations typically include low-cost or no-cost HVAC measures like (1) scheduling equipment with occupancy, (2) optimizing temperature set points and controls to operate equipment efficiently and (3) repairing worn-out or failed components⁹ that manifest themselves as energy waste rather than affecting the ability of the whole system to maintain comfort. The measures can usually be implemented in the course of normal maintenance or through enhancements to sensors or control sequences with existing building automation systems (BAS).

The program is co-managed by ComEd and the gas utilities with a single Implementation Contractor (IC), Nexant Inc. (Nexant). The IC manages the day-to-day operation of the program including marketing, interacting with customers, working with program-approved retro-commissioning service providers (RSPs), and reporting progress and savings to the utilities. The gas utilities and their respective ICs, Franklin Energy and Nexant, participate in bi-weekly program operation calls and work with their respective customers.

The program is open to all customers who meet the eligibility requirements, *which are as follows*:

- Facilities must receive electricity delivery service from ComEd (*regardless of energy supplier*), and, if participating in gas retro-commissioning, receive gas delivery from Peoples Gas, North Shore Gas or Nicor Gas;
- Have a peak demand of 500 kW or greater¹⁰;

⁹ For example, broken damper linkages that permit introducing too much ventilation air in extreme weather conditions. Servicing or replacing the linkages so they perform as intended would be a retro-commissioning measure.

¹⁰ Peak demand requirement may be met by combining several smaller buildings in close proximity, for example a college campus.

- Be served under a ComEd commercial rate schedule;
- Applicants must be part of a non-public organization¹¹;
- Facility owners must commit to spend between \$15,000 and \$30,000, (*depending on the RSP fees*) to implement retro-commissioning measures that result in a bundled estimated project simple payback of 18 months or less, based upon electric and natural gas savings;
- Applicants must agree to use a pre-approved Retro-Commissioning Service Provider (RSP);
- The facility owner must send at least one staff member to Building Operator Certification™ (BOC) training. The staff member must receive BOC Level I Certification;
- The facility owner must provide access to the facility and time for the facility personnel to interface with the RSP as well as assist with the reporting and collection of information pertaining to the operation of the facility during all phases of the project; and,
- The facility owner must implement Recommended Conservation Measures (RCMs) according to the scope and outlined procedures within six months of being accepted into the program.

1.2 Evaluation Objectives

The Evaluation Team identified the following key researchable questions for EPY6/GPY3:

1.2.1 Impact Questions

1. What is the level of gross and net annual energy (kWh), total and peak demand (kW) and natural gas (therm) savings achieved by the program?
2. Did the program achieve its goals?

1.2.2 Process Questions

The evaluation plan for the Retro-Commissioning Program called for a process evaluation in EPY6/GPY3, focusing on overall program and electric service offerings. This is the fifth process evaluation over the six year experience with the program. Over time, the program has evolved and changed on the margins, but the core program structure and program delivery remains the same. The evaluation team conducted interviews with key program staff, retro-commissioning service providers and participants to explore the following process questions:

1. Is the program implementation effective at generating projects and savings?
2. Are the program design and processes suitable for the program?
3. Has program satisfaction changed over time as program adjustments have been made to engage more participants?
4. What areas could the program improve to create a more effective program for customers and/or RSPs and help increase the energy and demand impacts?

¹¹ Public buildings such as government, municipal, and public schools are eligible for similar retro-commissioning incentives through the Illinois Department of Commerce and Economic Opportunity (DCEO);

2. Evaluation Approach

This evaluation of the Retro-Commissioning Program reflects the sixth year ComEd has offered the program and the third year of its joint offering with the gas utilities. During EPY6/GPY3, 50 facilities participated in the Retro-Commissioning Program. Among the 49 RCx sites and 1 MBCx sites, more than 240 retro-commissioning measures (RCMs) were implemented and verified; thus, participant sites were qualified for waiver of retro-commissioning service costs. The participants were led through the program steps by twelve different RSPs.

2.1 Overview of Data Collection Activities

The core data collection activities included: engineering reviews of program impacts, participant on-site verification and interviews, as well as interviews with service providers, key members of the utility and implementation staff. The full set of data collection activities is shown in the following tables.

The primary data for the impact evaluation came from the program implementation contractor, Nexant. Data reviewed for the impact analysis includes:

- Program guidelines¹² that described expected savings estimation techniques and assumptions when site-specific data were not available;
- Exports from Nexant’s program tracking system in spreadsheet format including project-level and measure-level descriptions and savings; and
- Electronic versions of reports, invoices, submittals and savings calculations.

Navigant supplemented this data with on-site inspections at a sample of sites and requests for supplemental data from participants and/or RSPs, as needed, to fully understand the implemented measures.

Table 2-1. Primary Data Collection Activities

What	Who	Target ¹³ Completes	Completes Achieved	When	Comments
Program Tracking Database	Participants	50	50	Sept. 2014	
In Depth Interviews	Program Manager/ Implementer Staff	4	3	Sept-Dec 2014	
Onsite M&V Audit	Participants	Up to 14	8	Sept 2014	<i>Sites are relatively homogeneous</i>
Engineering Review	Participants	27	23	Sept-Oct 2014	<i>Sites are relatively homogeneous</i>
Telephone Survey	RCx Participants	30 (census)	18	Oct. 2014	
Telephone Survey	Service Providers	12 (census)	9	Oct. 2014	

¹² Smart Ideas for Your Business Commercial Retro-Commissioning Calculation and M&V Guidelines.

¹³ Based on preliminary participation estimates.

2.2 Verified Savings Parameters

Research Findings Gross Savings (*energy and coincident peak electric demand*) resulting from the EPY6/GPY3 Retro-Commissioning Program were calculated using custom algorithms based on engineering principles and extrapolated to “typical” full-year savings with TMY3 weather data sets. Each measure type will have its own inputs. Many measures will have multiple aspects of savings. For example, reducing the hours of operation for an air handler will save fan power and heating and cooling for outdoor air introduced to the building system.

Fan kWh savings = Σ Fan kW savings * HOU

Where:

The calculation can be summed hourly or based on bins of climate conditions

- Fan kW = constant, variable or discrete differences pre and post, depending on the application, climate and controls.
- HOU = Annual Hours of Use at each Fan kW savings level

Heating savings = Σ 1.08 * CFM * (T_{OA} – T_{EA}) – fan energy savings

Where:

The calculation is summed hourly or based on bins of climate conditions

- 1.08 = constant includes specific heat and density of air and time conversion.
- CFM = cubic feet per minute of outdoor air introduced to the building system – variable hourly or constant depending on the system and operating conditions
- T_{OA} = Outdoor air temperature
- T_{EA} = Exhaust air temperature
- Fan energy ultimately becomes heat in the building system, thus this energy is accounted for in the fan savings.
- The calculation is summed hourly or based on bins of climate conditions

Resulting savings, in BTU-required, is converted to input energy of the appropriate units.

Cooling savings = (Σ 4.5 * CFM * (h_{OA} – h_{DA}) + fan energy savings (BTU)) /12,000 (Btu/ton) * cooling system efficiency (kW/ton)

Where:

The calculation is summed hourly or based on bins of climate conditions

- 4.5 = constant includes density of air and time conversion.
- CFM = cubic feet per minute of outdoor air introduced to the building system – variable hourly or constant depending on the system and operating conditions
- h_{OA} = Outdoor air enthalpy (Btu/lb air)
- h_{EA} = discharge air enthalpy (Btu/lb air)
- Cooling efficiency includes auxiliaries and performance at differing climate conditions
- Fan energy ultimately becomes heat in the building system, thus during the cooling season it is an additional load on the cooling system that is avoided
- The calculation is summed hourly or based on bins of climate conditions

2.2.1 Verified Gross Program Savings Analysis Approach

Navigant selected a representative sample of projects for an engineering review of savings. Evaluation staff reviewed gross program impacts with a project-by-project and measure-by-measure approach. Evaluators reviewed submitted written materials data to understand operations and limitations of measures and their implementation. Navigant then reviewed calculations to ensure the savings are accurately estimated and include reasonable assumptions, as required. In many cases this review involves analysis of time-series trend and measured data pre- and post- implementation.

For a nested sample of projects (*selected from projects sampled for engineering review*), Navigant performed on-site inspections of measures to determine whether they were still operating as described in project documentation (*set-points, affected equipment, hours of operation, etc.*). Where we found differences, our research findings savings estimates reflect those new inputs.

Navigant aggregated project-level savings with projects in the same sampling strata and determined strata-by-strata realization rates which we applied to the population strata for overall program savings estimates.

2.2.2 Verified Net Program Savings Analysis Approach

Verified net energy and demand (*coincident peak and overall*) savings were calculated by multiplying the verified gross savings estimates by a net-to-gross ratio (NTGR). In EPY6/GPY3, the NTGR estimates used to calculate the net verified savings were based on past evaluation research and defined through a consensus process through SAG as documented in a spreadsheet.¹⁴

Verified net savings utilize deemed net-to-gross ratios depending on fuel type.

Table 2-2. EPY6/GPY3 NTG Parameter Estimates

Parameter	Electricity	Natural Gas
Net-to-Gross Ratio †	1.04	1.02
Source	EPY4 research	GPY1 research

Source: <http://www.ilsag.info/net-to-gross-framework-1.html>.

† Deemed values

Navigant conducted additional NTG research in EPY6 for future application to program electricity savings. The methodology combines participant and RSP survey results. Research for both groups uses a self-report method where participants and RSPs answer questions about the program. The participant survey instrument asks about awareness of the measures identified and their inclination to pursue corrective actions for those measures absent the program. The electricity net-to-gross research method and result are located in Appendix 7.2.1. The gas utilities did not participate in this research objective.

¹⁴ Source: ComEd PY5-PY6 Proposal Comparisons with SAG.xls, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>

2.3 Process Evaluation

The process evaluation included in-depth interviews with key actors in the program including Nicor Gas, Peoples Gas, and North Shore Gas program managers, the IC, program-approved RSPs and telephone surveys of program participants. These interviews dealt with overarching satisfaction with the program and details about program operations, marketing, training, and market potential for retro-commissioning services. The process evaluation also reviewed documents related to the program such as program application forms.

3. Gross Impact Evaluation

The EPY6/GPY3 impact evaluation included verifying gross savings and a review of the program tracking systems and files, reports and calculations related to the project. Our review of savings calculations examined the methodology and accuracy of the calculations. Measured and assumed calculation inputs were evaluated for reasonableness. If inputs were not reasonable (*for example, including the incorrect units*) we made adjustments to the calculation or confirmed inputs with the participant or RSP staff. Savings were further researched with on-site inspection on a sub-set of the evaluation sample. If measures were not found during on-site verification as described in the ex ante reports, we asked the participant contact about operations and made necessary adjustments to savings estimates.

In general, we find the databases and savings estimates do a good job of tracking program activity and recording accurate energy savings estimates. The relatively high realization rates for both electricity and gas energy savings indicates the systems used are performing well for the program.

3.1 Tracking System Review

The EPY6/GPY3 impact evaluation included verifying gross savings and a review of the program tracking systems. Data tracking for the Retro-Commissioning Program is based on sequential databases – one populated with detailed data that are summarized and uploaded to utility-specific tracking systems. Summary fields in ComEd’s, Nicor Gas’ and Peoples Gas’ and North Shore Gas’ databases are populated with data from a TrakSmart database, which is maintained by the implementation contractor for detailed program tracking. Navigant reviewed the secondary database summary information and spreadsheet exports from the TrakSmart database.

In general, the databases accurately report project savings based on project reports. Navigant reviewed each of the measure-level details for the sampled projects. In one case savings from one project was mis-assigned to the project at a sister site. Program savings were not affected, though site-level savings needed reconciliation. In general, we find the tracking system adequate to the task, and utility program managers are satisfied with the data reporting.

- Projects are tracked from preliminary contact through internal implementation verification with appropriate intermediate updates.
- Key actors for each project are easily identified with contact information.
- Project savings are tracked from the point of original goals to planning savings based on observation to final verified savings.
- Measure history is complete: the fate of each measure is tracked with associated implementation costs and savings. It is possible to determine at what stage a measure is dropped from a project, and measures added at a later stage of analysis are picked up and included in project summaries.

Navigant’s review was based on exports from the TrakSmart system into detailed spreadsheets. The structure of the database was not reviewed. Navigant has no recommendations for the tracking system at this time.

3.2 Program Volumetric Findings

Review of the database and project files determined the volumetric parameters for the program shown in Table 3-1. It should be noted that among the projects submitted, one Nicor Gas project is a gas-only project where the electricity savings were attributed to an electric utility other than ComEd (*City of Naperville Utilities*). At least two projects are follow-on retro-commissioning measures for projects submitted in prior years. The latitude to submit savings for measures in separate years was made in order to accommodate the long implementation cycle of some measures.

Table 3-1. EPY6/GPY3 Volumetric Findings Detail

Participation	ComEd Only	Nicor Gas	Peoples Gas	North Shore Gas
Participants	27	12	9	2
Electric measures	130	47	50	9
Gas Measures	0	19	20	2
Total Installed Measures	130	50	54	9
Number of Measures/Project	4.8	4.2	6.0	4.5

Source: ComEd tracking data and Navigant team analysis.

Among 243 measures implemented, 236 had electricity saving for the program, including 34 with both electricity and natural gas savings. Seven measures only saved natural gas for the program. Table 3-2 shows volumetric findings since PY2. The number of participants has held steady for the past three years. The number of measures per participant has declined, though it is not clear whether this metric reflects decreasing opportunities, a decreasing scope implemented by RSPs, more prevalent aggregation of similar measures under a single item or the effects of allowing completion of measures over multiple program years.

Table 3-2. Volumetric Findings since Program Inception

Participation	EPY2 ¹⁵	EPY3	EPY4/GPY1	EPY5/GPY2	EPY6/GPY6
Participants	13	29	50	46	50
Total Measures	125	215	338	252	243
Number of Measures/Project	9.6	7.4	6.8	5.5	4.7

Source: EM&V analysis

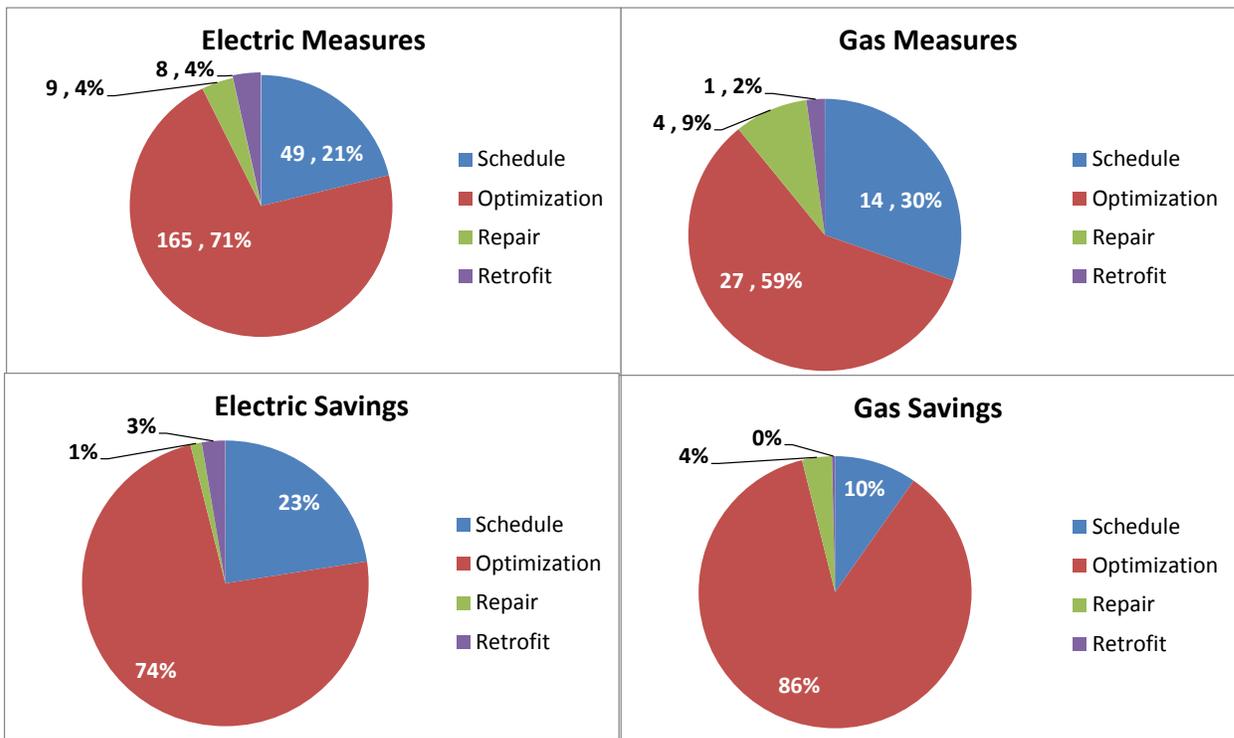
Figure 3-1 shows the distribution of electricity and gas measure counts by type (schedule, optimization, repair and retrofit) and savings.

¹⁵ The program was electric only prior to EPY4/GPY1. EPY1 was a pilot program with five participants.

Key findings include:

1. Both electricity and gas savings are strongly weighted toward the no-cost/low-cost optimization measures. These measures include setpoint changes in the controls and are the key attribute of retro-commissioning versus “standard offer” programs.
2. Among sampled projects, the average energy savings versus baseline consumption is 5% and 11% for electricity and gas, respectively.

Figure 3-1. Number of Measures and Savings Installed by Energy Source and Measure Type



Source: Evaluation Analysis

3.2.1 Development of the Verified Gross Realization Rate

Verified gross realization rates are based on engineering review of algorithms used to estimate ex ante savings and on-site verification. Review of all 50 projects and 243 measures is cost-prohibitive, thus Navigant developed a sampling plan for projects. The impact sample uses a stratified ratio estimator approach. All of the projects were sorted by magnitude of savings by utility and divided into three strata (large (A), medium (B) and small (C) savers) for each utility. Navigant randomly sampled within each strata to achieve desired statistical confidence and precision – 90/10 respectively – for each utility (Table 3-3). This approach tends to select a near-census of large savers and a balanced number of projects in the medium and small saver strata. Sampling for three utilities independently does not guarantee that a project sampled for one utility will also be sampled for its corresponding utility of the other fuel type. Navigant’s approach was to sample for 90/10 for ComEd and, subsequently, to sample *additional* sites for the gas utilities to achieve targeted precision for each utility. Since some of the gas utility sample was not

chosen with the ComEd sample, subsequent addition of gas sites tends to over-sample for ComEd. Precision at 90% confidence for the final sample is shown in Table 3-4.

Table 3-3. EPY6/GPY3 Impact Sampling Design

	ComEd	Nicor Gas	Peoples Gas	North Shore Gas ¹⁶
Total Population	49	12	9	2
Stratum A	5	2	2	
Stratum B	7	2	3	1
Stratum C	6	2	2	1
Total sample	18	6	7	2

Source: EM&V research

Table 3-4. EPY6/GPY3 Impact Sampling Final

	ComEd	Nicor Gas	Peoples Gas	North Shore Gas
Total Population	49	12	9	2
Stratum A	6	2	2	0
Stratum B	11	3	3	1
Stratum C	6	1	2	1
Total sample	23	6	7	2
Sample Precision at 90% confidence	6.6%	5.9%	6.1%	0%

Source: EM&V research

For each sampled project, Navigant reviewed all measures. All measure savings for a project were rolled-up into project-level realization rates. Navigant subsequently rolled-up project-level results by stratum - weighted on savings - for strata-level realization rates. These rates were then applied to the population of projects in each stratum to determine research findings gross realization rates for the program.

3.3 Gross Program Impact Parameter Estimates

There are few program-level impact parameter estimates for the Retro-Commissioning Program. All analysis is rolled up to realization rate impact parameter estimates for electric energy, electric demand and natural gas energy savings. As explained in Section 2, energy and electric demand savings are estimated with custom algorithms, frequently using hourly weather data and time-series trend data. As such, the EM&V team conducted research to validate the savings individually for all measures in the evaluation sample.

¹⁶ North Shore Gas analysis included a census of projects.

3.4 Verified Gross Program Impact Results

Among the sampled projects, Navigant compared *ex ante* savings to annual energy consumption prior to program participation. For electricity and gas energy use, we found approximately 5% and 11% implemented savings, respectively. Site specific results varied between 1% and about 26%. The total program verified gross savings is shown in Table 3-5. The table presents savings at the customer-level. Realization rates are the results of analyzing 23 projects including more than 140 measures.

Table 3-5. Verified Gross Savings Realization

Savings Category	ComEd MWh	ComEd MW	Nicor Gas (therms)	Peoples Gas (therms)	North Shore Gas (therms)
<i>Ex Ante</i> Gross Savings ¹	26,459	0.832	739,312	260,508	23,123
Verified Gross Realization Rate	0.956	0.765	0.955	1.016	1.000
Verified Gross Savings ²	25,302	0.636	706,362	264,763	23,123

¹ Source: Tracking systems

² Source: Evaluation

There are a couple reasons why realization rates are other than 1.0. Most of the difference between *ex ante* and *verified* is due to on-site verification steps that determined the measures have been implemented somewhat differently than reported. This might entail modified schedules, setpoints or a misunderstanding between the RSP and the customer. An example of the latter is a recommendation to turn off a cooling water pump all winter, when the pump must operate at extreme temperatures to avoid freezing the chilled water coils. Changes in schedule or setpoint were mostly due to operator adjustment in order to maintain occupant comfort.

Occasional calculation or engineering errors also affected the realization rates. Only one type of engineering error was repeated among the fan measures we reviewed. In a fan system, the static pressure setpoint was reduced which resulted in reduced fan speed to maintain setpoint. The RSP mistakenly applied “cube-law” savings for the reduced fan speed (*fan power is proportional to the third exponent (cube) of air volume, other factors being equal*). In fact, air volume does not change much in this measure, and the power versus pressure relationship is not a cube relationship. In the cases of this error, Navigant corrected the calculations and reported revised *verified* savings.

The RSPs’ selection of the weather data set for their analyses does not seem to be tailored to individual sites. Most often O’Hare airport TMY3 data are used for all projects in and around Chicago. An alternate data set for Midway airport is also available, and this set tends to represent the “lake effect” climate of the downtown area more accurately than the O’Hare data. In the Midway data there are fewer hours of extreme temperatures as the thermal mass of Lake Michigan tends to cool areas closer to the water in the summer and keep temperatures a little warmer in the winter. The differences are not large, but they do matter. Navigant recommends using the Midway AP data, which better represents the lake effect climate, for all buildings closer to Lake Michigan than, say, 3 miles.

4. Net Impact Evaluation

SAG determined¹⁷ that the NTG values for this program should be deemed prospectively and used to calculate verified net savings. Table 4-1 below shows the deemed NTG values and the EPY6/GPY3 verified net savings.

Table 4-1. EPY6/GPY3 Deemed Net to Gross Ratio Values Estimates

Parameter	Electricity	Natural Gas
Net-to-Gross Ratio	1.04	1.02
Source	EPY4 research	GPY1 research

Source: <http://www.ilsag.info/net-to-gross-framework-1.html>.

The NTGR used by all the utilities were determined in the EPY4/GPY1 evaluation by self-report interviews with program participants and RSPs. Verified net savings, calculated with NTG values in Table 4-1 are shown in Table 4-2.

Table 4-2. EPY6/GPY3 Program Results by Utility

Savings Category	ComEd MWh	ComEd MW	Nicor Gas Therms	Peoples Gas (Therms)	North Shore Gas (Therms)
Ex Ante Gross Savings ¹⁸	26,459	0.832	739,312	260,508	23,123
Verified Gross Realization Rate ‡	0.956	0.765	0.955	1.016	1.000
Verified Gross Savings	25,302	0.636	706,362	264,763	23,123
Net to gross ratio (NTG) †	1.04	1.04	1.02	1.02	1.02
Verified Net Savings ‡	26,314	0.662	720,490	270,058	23,585

Source: Utility tracking data and Navigant analysis.

† A deemed value.

‡ Based on evaluation research findings.

¹⁷ Source: ComEd PY5-PY6 Proposal Comparisons with SAG.xls, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>

¹⁸ From Tracking System

5. Process Evaluation

The process component of the Retro-Commissioning Program evaluation focused on program design and implementation, program processes, marketing and outreach, and participant satisfaction. Utility-specific process questions were asked with respect to ComEd only, as the gas utilities elected to forego process research in GPY3. The primary data sources for the process evaluation were a review of program materials and interviews with program and implementation staff and RSPs, as well as a survey of participating customers.

Among 44 unique customer contacts, we were successful interviewing 18, comprising 21 projects and 55% of program savings. Most interview contacts were financial decision makers or property managers, though some operating engineers participated in interviews. Similarly, we were able to interview nine of 12 participating RSPs comprising 43 projects (86%). In general the process results continue findings from prior evaluations, with respect to marketing, awareness and satisfaction.

5.1 Program Marketing

The program introduced more marketing materials this year for the RSPs. The RSP can customize case studies and co-brand material with the utilities to help sell projects. All RSPs think the marketing material is useful. About half see benefits from co-branding. The Retro-Commissioning Program continues to be driven by marketing by RSPs. Fifty-five percent of respondents credit the RSP with introducing the program to them. Twenty-eight percent cite contact from utility representatives and the remainder mention internal corporate directives, word of mouth and personal experience with retro-commissioning as main drivers. RSPs are citing word-of-mouth more often than previous years and several RSPs credit the program with raising awareness and knowledge about retro-commissioning.

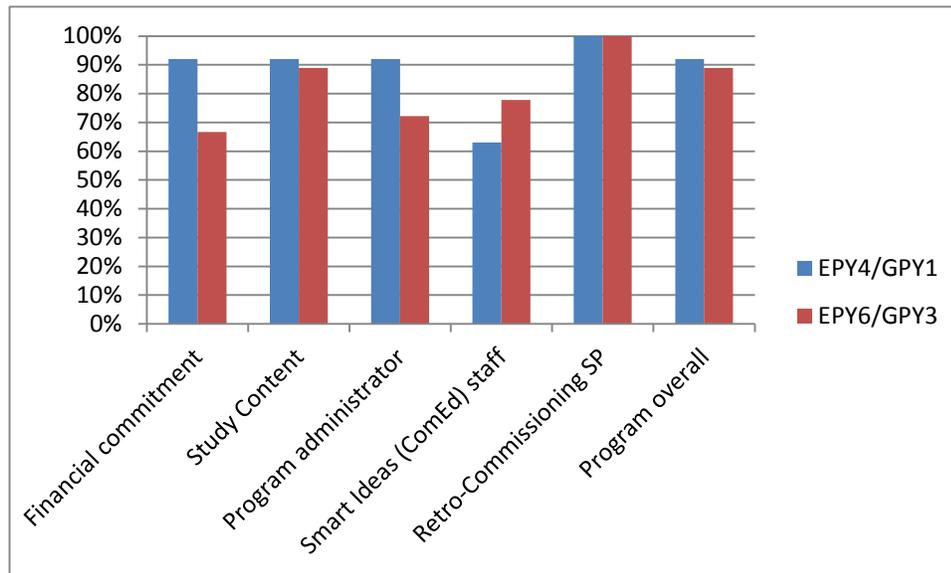
Half of participants recall program marketing material from ComEd with fact sheets, direct mail and other program collateral each comprising 30-40% of material they remember (*multiple responses allowed*). The fact sheets were the most influential marketing material with 70% of respondents citing the material as “most useful.” In general, these participants felt that, other than RSP outreach, ComEd could market the program best through direct contact by Key Account Executives and by email.

5.2 Program Satisfaction

In general, participants were satisfied with the program. On a scale of 0-10 with 0 = “Not at all satisfied” and 10 = “Extremely satisfied,” all key program elements scored 8 or higher for a sizable majority of respondents. Even those who were less enthusiastic about the financial incentives did not voice specific negative opinions – all rated 5 or higher. These satisfaction results are similar to EPY4/GPY1 research, given the small populations represented. The EPY4/GPY1 satisfaction results are also presented in Figure 5-1.

Likewise, all interviewed participating RSPs indicated satisfaction with the program with many noting positive program influences for marketing and participant education.

Figure 5-1. Participant Satisfaction (>7 on 0-10 scale) with Program Elements



One hundred percent of respondents would recommend the program to peers.

5.3 Program Timing – Participation Duration

The most detrimental attribute of retro-commissioning is the long duration for participation. Many projects continue a year or more between application and final verification. This is partly due to the research and monitoring required to ensure thorough research, efficient resource management and reliable results. One third of interviewed RSPs noted the drawn-out phases. One suggested giving more latitude to combine the planning and investigation phases. Three customers and all interviewed program staff also noted the long project completion timeline.

5.4 Program Benefits

RSPs had many positive comments about the program in terms of their business and services. Several noted that the program allows for more depth and complete investigation of issues than they might have been able to do without the program. Several note that they have been able to improve their services and knowledge due to the program. Four of nine interviewed RSPs specifically mentioned expansion, hiring and increased business as a result of the program.

RSPs note that customers are more willing to implement measures with the program. Four of nine respondents estimate participant customers are more likely to implement measures than retro-commissioning customers who do not participate in the program.

Program participants also agreed that various program attributes were benefits, when listed by the interviewer. Fifty percent cited the cost and energy benefits of the program or the overall payback. Twenty to thirty-five percent cited the free study, the training aspect for staff or improved equipment performance as benefits. Combined, these non-fiscal/non-energy benefits were cited by 72% of respondents, indicating additional program value for the customer.

5.5 Program Barriers

Among barriers, one or two of the 18 interviewed participants cited burdensome paperwork and rigidity on the financial commitment, i.e. they would like to see mechanisms to reduce the financial commitment.

Five of nine RSP respondents noted some program burden as barriers: long review process, too much effort on planning and investigation phases.

5.6 Participant Comments.

The following are a census of participant open-ended recommendations for the program.

- Make scheduling more flexible.
- Minimize the program time period, especially if moving towards real-time data analysis.
- Suggest customer transition into monitoring-based commissioning directly after retro-commissioning.
- Streamline the process to make it more seamless.
- Shorten the data-logging period.
- Keep working to reduce duration of the process.
- It took a lot of time and Facility Manager's resources to assist the RSP and fill out paperwork.
- Require coordination between RSP and control contractors.
- Streamline the message in getting it out to people. ComEd needs to engage more. It feels like the RSP has never talked to ComEd at all. People are paying for this anyway, so they need to really streamline the message.
- The program processes are too convoluted.
- Lower the financial commitment thresholds.
- Refine the contracts.

6. Findings and Recommendations

This section summarizes the key impact and process findings and recommendations.

The findings reflect a mature program that has operated for six years with minor changes and improvements. Overall participation and savings has held relatively level for the past three years, though there has been variation by utility. The program has achieved significant savings as shown in the following tables.

Satisfaction among participants and RSPs is apparent from all survey respondents. All participants would recommend the program to their peers. All RSPs compliment the program and four of nine interviewed RSPs note increases to their business revenue, and/or hiring and expansion due to the program. Key staff and several RSPs note that they do not need to introduce “the retro-commissioning process” as aggressively as awareness of the benefits of retro-commissioning has spread.

Table 6-1. EPY6/GPY3 Total Program Electric Savings

Savings Category	Energy Savings (MWh)	Demand Savings (MW)	Peak Demand Savings (MW)
Ex Ante Gross Savings	26,459	TBD	0.832
Verified Gross Savings	25,303	TBD	0.636
Verified Net Savings ¹⁹	26,315	TBD	0.661

Source: ComEd tracking data and Navigant team analysis.

Table 6-2. EPY6/GPY3 Total Program Gas Savings

Savings Category	Nicor Gas (therms)	Peoples Gas (therms)	North Shore Gas (therms)
Ex Ante Gross Savings	739,312	260,508	23,123
Verified Gross Savings	706,362	264,763	23,123
Verified Net Savings ²	720,490	270,058	23,585

Source: ComEd tracking data and Navigant team analysis.

Program Energy Impacts

Finding 1. Energy realization rates continue to be relatively high. There are not patterns for verification adjustment except that some measure implementation changes after the operators have run the building with the measures for a while.

Recommendation 1. Finalize implementation earlier so that operators can fine-tune measures prior to verification

Finding 2. A minor, but widespread, error is incorrectly applied weather data. The metro-Chicago area has two well-researched TMY3 weather sets to draw on for energy calculation

¹⁹ Net savings is based on consensus evaluation framework research performed in EPY4/GPY1 which found net-to-Gross ratios equal to 1.04 and 1.02 for electricity and gas, respectively.

– O’Hare AP and Midway AP. The sets are comparable, but Midway AP set has fewer extreme hot and cold hours due to moderation by Lake Michigan. An economizer measure using Midway AP data will show more savings than using O’Hare AP data. Most calculations use the O’Hare weather set, but most projects are downtown Chicago where the Midway weather is more representative.

Recommendation 2. Standardize the weather sets used for locales in the northern Illinois service territories. In order to distinguish projects that experience “lake effect” climate more accurately, Navigant recommends using Midway AP TMY3 files for all projects within 3 miles of Lake Michigan.

Finding 3. Demand savings estimates continue to be a challenge. Peak demand savings is estimated when none is warranted. Inappropriate peak conditions are used in estimates. ComEd’s interest in “total demand savings” will confuse the issue further.

Recommendation 3. Standardize and enforce the estimation methods for total and peak demand savings. Proscribe peak demand saving for certain measures – economizers for example. Track and report total demand savings in verification reports and in the tracking database.

Process Evaluation.

Finding 4. Projects take a long time from application to final verification – more than a year in many cases. This leads to fatigue and potential loss of key project personnel.

Recommendation 4. Look for ways to speed the projects along:

Engage controls contractors earlier to implement measures.

Finish implementation earlier (March) so there is time verify and perhaps revise measures before the program year-end.

Combine the planning and investigation phases or modify the expectations for both so that there is not as much redundancy.

Create fast-track options for smaller projects.

Navigant note: Many of these recommendations are in process for EPY7/GPY4

Finding 5. Volumetric parameters show a persistent downward trend in the number of implemented measures and the electric savings per site. The evaluators have not had the scope to research these longitudinal trends to determine causes – whether measure identification, measure implementation, measure aggregation, the types of projects submitted in the program or some other influence.

Recommendation 5. Scope longitudinal analysis of program data for the EPY7/GPY4 evaluation cycle or as a separate stand-alone analysis.

7. Appendix

7.1 Detailed Impact Results

Program impacts are tracked through the several phases of the program with the IC giving feedback and requiring changes along the way. Thus, the evaluator's task is to check a sample of measures verified by the RSPs and IC and ensure that measures are indeed complete and savings are accurately estimated.

The evaluators conclude that the Verification Reports and supporting data and calculations provided sufficient confirmation that the measures were installed as described. Navigant identified eight projects within the impact sample for on-site verification.²⁰ Evaluators visited all eight of these sites in September 2014 and verified implementation and observed actual operation of measures. In most cases measure implementation persists. In a couple cases, setpoints and schedules were modified due to comfort or occupancy requirements of the buildings. In one case the operators described a miscommunication about the frequency with which they must start the building early (*reducing measure savings*) in order to maximize savings from day-ahead pricing.

For all 23 sites in the sample, Navigant reviewed measure implementation plans, assumptions and calculations in detail. In general, Navigant found the calculations accurately constructed, based on clearly measured data rather than rules-of-thumb and transparent in spreadsheet form. In rare instances, we found calculation errors due to spreadsheet equation errors, erroneous inputs, omissions of relevant impacts and inconsistencies in assumptions from measure to measure on the same system.

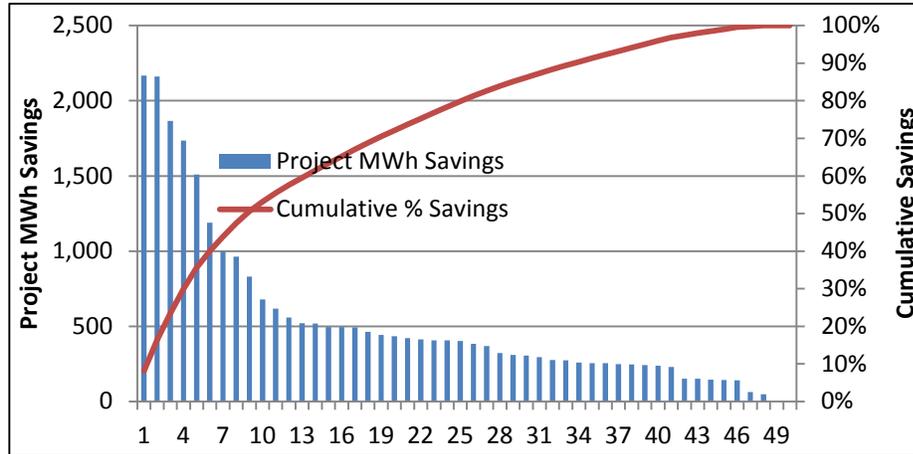
Savings estimation approaches among RSPs were mostly consistent. Most calculation spreadsheets were comprehensive, though some were excessively complex and others overly simple. Despite the range of approaches in EPY6/GPY3, there were very few lapses in engineering methods. When faced with the need to make engineering assumptions, RSPs are often more conservative than the program guidelines. A conservative approach, such as this, is common to retro-commissioning analysis. Some measures are so simple to implement and the primary effects generate sufficient savings that there is no inclination to analyze secondary and tertiary effects of an action. From the RSPs' and customer's perspectives this approach makes sense. Less time spent on analysis of simple cost-effective measures frees resources for analyzing more complex measures. From the perspective of the sponsoring utility, however, these additional savings are real and should be counted. Where there was no further justification for overly conservative estimates, the evaluation team restored guideline defaults and/or supplemented estimated savings with secondary effects of the measures as could be determined with available data.

The distribution of electric and gas savings are somewhat different, as shown in Figure 7.1 and Figure 7.2. While there were a few very large electric savings projects, there is a large mid-range of savings in the distribution and nine of 50 projects comprise 50% of program savings. For the gas utilities the largest

²⁰ On-site verification projects were selected based on project savings size, measure type and facility type. Large projects were selected because of their impact on program goals. Projects with chilled water and cooling tower measures were selected because their full functionality would not necessarily have been verifiable before May 31. Diverse facility types were selected to capture a range of operating strategies and participant requirements (for example year-round cooling for equipment intensive sites or 24 hour operation for hospitals).

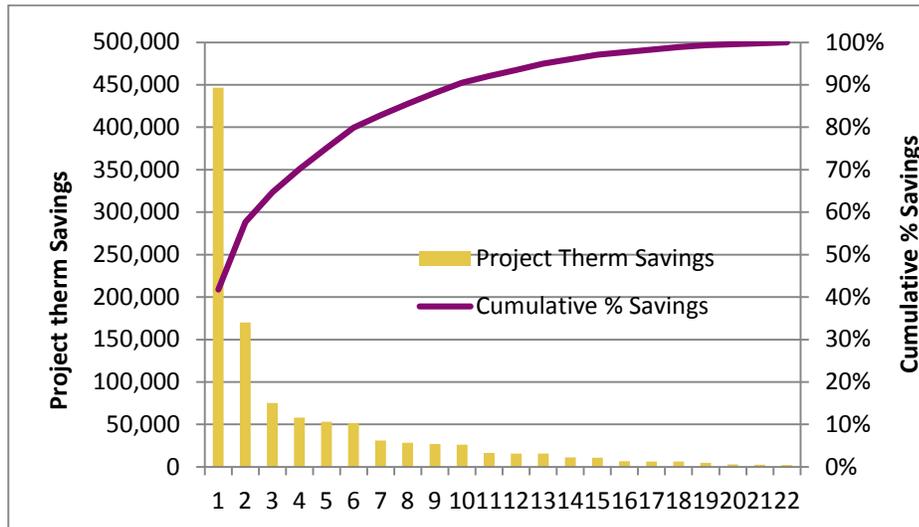
project saves almost three times as much as the next largest project. Together the two largest gas projects save 58% of the program total

Figure 7.1. Ex Ante Electric Savings (MWh) Project Savings Histogram



Source: Utility tracking data.

Figure 7.2. Ex Ante Gas Savings (Therm) Project Savings Histogram



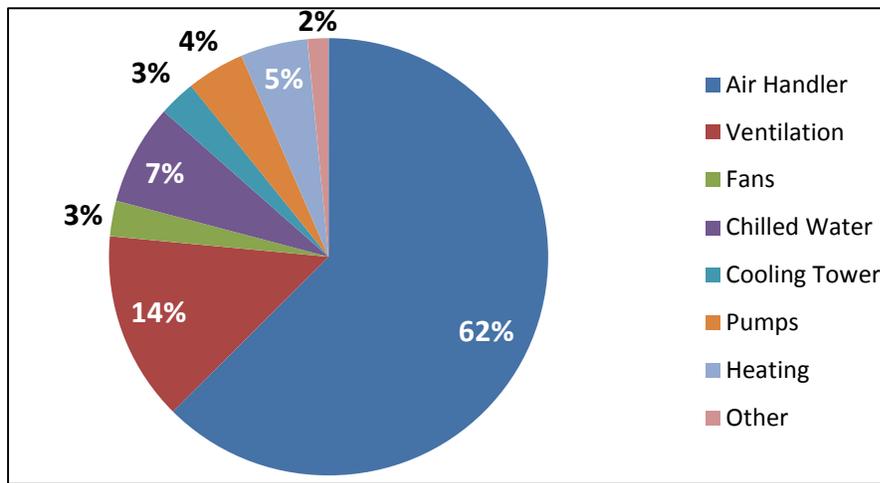
Source: Utility tracking data.

As part of the impact analysis, Navigant grouped the retro-commissioning measures into six broad end-use categories that include most types of measures included in retro-commissioning. Figure 7.3 shows the distribution of *ex ante* savings among measure end-uses. Secondary effects, such as heating savings from reduced ventilation when an air-handler is turned off, count in the primary end-use category.

- **Air-handler** includes measures that change the schedule of fan operation and fan control setpoints such as air temperatures, minimum airflows and/or static pressure setpoints.

- **Chiller** includes such measures as chilled water temperature reset, compressor staging, and water-side economizers.
- **Cooling tower** includes fan and cell staging and condenser water temperature control.
- **Heating** includes measures like boiler pumps or terminal box setpoints and/or control.
- **Other** measures include pumping, lighting, and domestic hot water measures.
- **Economizer and Ventilation Controls** include economizer repair and optimization and ventilation control based on CO₂ levels in return air.

Figure 7.3. Ex Ante Electric Savings (kWh) by End-Use Category



Source: Utility tracking data and Navigant analysis.

In addition to analyzing measures by end-use, Navigant grouped the measures according to their upgrade type. Figure 7.4 shows the distribution of *ex ante* savings among measure types.

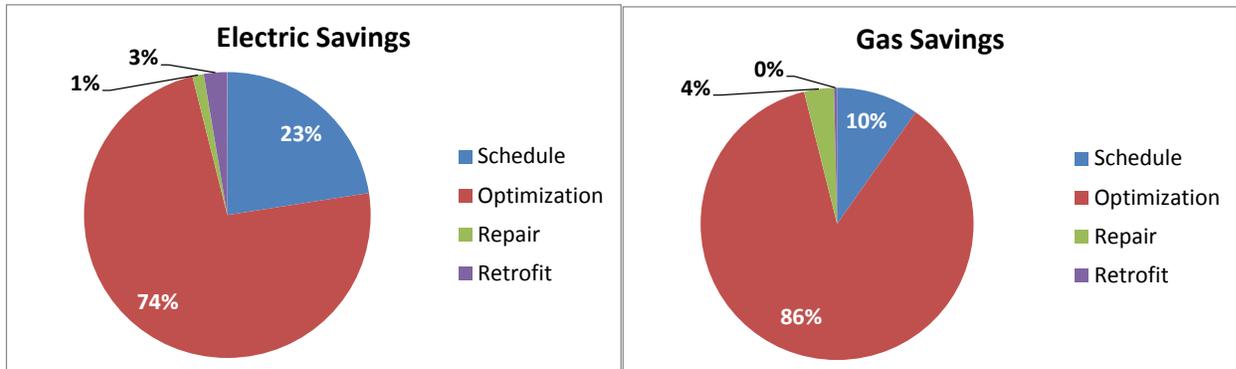
- **Scheduling** measures are those that merely turn off equipment (HVAC and lighting) when their service is not required for occupants.
- **Optimization** includes measures that improve control algorithms, or setpoints.
- **Repairs** are measures that address broken equipment such as failed actuators or sensors.
- **Retrofit** measures in retro-commissioning are relatively few and generally fairly inexpensive for retrofit measures. In EPY4/GPY1 equipment retrofit measures included new filter media, added sensors for CO or CO₂ ventilation control or wet-bulb temperature sensors for cooling tower controls.

Among the RCMs implemented at the EPY6/GPY3 sites, air handlers and economizers are the largest electric energy savers by end-use (76% of savings combined) and chilled water measures comprise an additional 7% of program savings. For gas savings, almost 93% of savings was due to air handler

measures, such as reduced run-time, discharge air temperature resets and minimizing simultaneous heating and cooling.

Optimization measures dominate the electricity and gas savings by measure type, and most of the optimization measures involve air-handler control algorithms and set-point optimization. A relatively small portion of the identified savings relates to the cooling systems.

Figure 7.4. Ex Ante Energy Savings (kWh and therm) by Measure Type



Source: Utility tracking data and Navigant analysis.

7.1.1 Research Findings Net Program Impact Results

Once gross program impacts have been estimated, research findings net program impacts are calculated by multiplying the research findings gross impact estimate by the NTG ratio calculated from EPY6 research for ComEd, which combined free-ridership (FR) and spillover (SO). Navigant included equally weighted participant and service provider NTG estimates in the final program NTG ratio.

$$\begin{aligned} \text{Site NTG} &= \text{NTG}_{\text{site}} = 1 - \text{FR}_{\text{site}} + \text{SO}_{\text{site}} \\ \text{RSP NTG} &= \text{NTG}_{\text{RSP}} = 1 - \text{FR}_{\text{RSP}} + \text{SO}_{\text{RSP}} \end{aligned}$$

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

$$\text{NTG}_{\text{overall}} = \left(\frac{\sum \text{NTG}_{\text{site}} \times \text{kWh}_{\text{site}}}{\sum \text{kWh}_{\text{site}}} + \frac{\text{NTG}_{\text{RSP}} \times \text{kWh}_{\text{RSP}}}{\sum \text{kWh}_{\text{RSP}}} \right) / 2$$

7.1.1.1 Free-Ridership

Free-ridership determination is a combination of three attributes investigated during the participant survey, combined with two parallel aspects investigated with the service provider survey. The service provider survey does not address the timing question, since that is solely participant-driven.

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

The evaluation completed interviews with 18 participants of an attempted census (44). The free-ridership questions established a participant free ridership rate of zero for five of the projects, and a rate between 0.02 and 0.42 for the others. The weighted average participant free-ridership is 8.6%. The sites that had the highest indications of free-ridership all had equipment deficiencies known to the appropriate people in the company. The companies stated that they would have conducted the study and implemented measures within one to two years even if the program had not been available.

Similarly, RSP estimates of free-ridership are very low – approximately 9.5%. RSPs mostly estimated that participants would not have performed studies and they are relatively un-aware of savings opportunities, though awareness of the retro-commissioning process is increasing. Future NTG research will need to determine whether this awareness is program-driven or more general awareness across the commercial property industry, which might indicate an element of free-ridership. . Participants interviewed account for 53% of electric savings. Interviewed RSPs thought that the program played a large part in the decision making process of participants. Without the program’s study, RSPs believe that few of the participants would have implemented the retro-commissioning measures on their own. Interviewed RSPs account for 92% of electric savings. The final EPY6 free-ridership ratio is an equally weighted average of savings-weighted participant and RSP free-ridership. Overall free-ridership, equally weighted by participant and service provider, is 0.09 for electric savings.

7.1.1.2 Spillover

Navigant also researched the question of program spillover. Our EPY6/GPY3 participant survey asked about spillover, including any energy efficient equipment and additional retro-commissioning measures implemented at the facility that did not receive incentives through any utility or government program.

Only one interviewed participant reported they installed energy efficient equipment that did not receive incentives, and none performed additional retro-commissioning without an incentive. This reported spillover is less than what was found in EPY4. Follow-up revealed few quantifiable details on these actions. Given the low attribution to the program for retro-commissioning measures and other energy efficiency measures we conclude that spillover is not a major factor for participants.

RSPs were also asked about spillover, both their own activities and observations of the regional retro-commissioning market. Three RSPs reported they completed more projects without incentives than they would have without the program. The projects were generally smaller, with RSPs saying their work was for facilities that fell below the program size guideline or had insufficient automation capabilities for the program. Nonetheless, the *additional* retro-commissioning work was attributed to capacity and awareness built by the program. RSP spillover is calculated for each instance as the product of number *additional* projects, percent of identified savings implemented, relative size of the projects to other studies performed by the RSP. The RSP results are weighted by their projects contribution to the overall program savings. The additional savings contribute a spillover factor of 0.04. Thus,

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

$$\text{NTG} = 1 - 0.09 + 0.04 = 0.95$$

7.1.2 Channeling

As part of the retro-commissioning study process, RSPs identify potential energy efficient equipment upgrades and list them in the study. Additionally, all RSPs promote ComEd, Nicor Gas, Peoples Gas and North Shore Gas Commercial and Industrial Prescriptive and Custom programs to participants as an opportunity to receive incentives for qualifying measures. RSPs often also continue to encourage participants to implement these measures after the retro-commissioning project concludes, although this appears to be stronger for RSPs with existing relationships with their clients. Seventy-five percent of interviewed participants report installing energy efficient equipment upgrades in the past year. Of these 42% of the sites say these measures were recommended in the retro-commissioning study and received incentives from ComEd or the gas utilities. The remainder of the upgrades were not mentioned in the study and may or may not have received incentives.

The amount of channeling due to the program is ultimately indeterminate, as we do not know which of these measures would have been installed without the awareness brought by retro-commissioning.

7.2 *Survey Instruments*

7.2.1 Participant Survey

ComEd / Joint Utility C&I Retro-Commissioning Program

RCx Participant Survey

October 27, 2014

Introduction

Hello, this is _____ from Navigant calling on behalf of ComEd [if natural gas = 1 “and <gas utility>] regarding your company’s participation in the Retro-Commissioning Program. May I please speak with <CONTACTNAME>?

Our records show that <COMPANY> participated in the Smart Ideas for Your Business Retro-Commissioning Program run by ComEd [if natural gas = 1 “and <gas utility>] , and we are calling to conduct a follow-up study about your firm’s participation in this program. I was told you’re the person most knowledgeable and the most involved with the decision to participate in the program. Is this correct? [IF NOT, ASK TO BE TRANSFERRED TO DECISION MAKER OR SOMEONE FAMILIAR WITH THE BASIS FOR THE DECISION TO PARTICIPATE. RECORD NAME & NUMBER.]

[IF NEITHER DECISION MAKER OR SOMEONE FAMILIAR WITH THE BASIS FOR THE DECISION TO PARTICIPATE, TERMINATE AND CALL REFERRAL

This survey will take about 25 minutes. Is now a good time? [If no, schedule call-back]

(IF NEEDED: Is it possible that someone else dealt with the retro-commissioning project?)

Retro-Commissioning NTG

I would like to ask you a few questions about your company’s decision to perform retro-commissioning at your facility.

[Do Not Read. These data given to you for reference.]

M1	Measure 1:	Scheduling Measures (when you turn things on/off)
	M1a.	Cost
	M1b.	Savings kWh
	M1c.	Savings Therms
M2	Measure 2:	Setpoint Optimization Measures
	M2a.	Cost
	M2b.	Savings kWh
	M2c.	Savings Therms

A1 First, according to our records, you participated in the Smart Ideas for Your Business Retro-Commissioning Program run by ComEd [if natural gas = 1 “and <gas utility>] between June 1, 2013 and May 31, 2014. [IF NEEDED: The Retro-Commissioning Program promotes energy efficiency improvements in commercial facilities. The program offers technical assessments to help identify applicable measures – mostly low-cost and no-cost – analysis to quantify energy and cost savings of recommended measures, and incentives to help cover the cost of the assessment and analysis.] Do you recall participating in the Smart Ideas for Your Business Retro-Commissioning Program?

- 1 Yes
- 2 No
- 88 (Don't know)
- 99 (Refused)

[ASK IF A1=1]

A2 Next, I'd like to confirm the following information regarding your participation in the RCx Program. I understand that you retro-commissioned &FACILITY. The RCx study was completed in about &DATE by &CXAGENT and you implemented about &NO OF MEASURES measures, including &MEASURE1, &MEASURE2, &MEASURE3.) Does that sound right?

- 1 Yes
- 2 No
- 88 (Don't know)
- 99 (Refused)

Project Background

B1. Before I ask you specific questions about your decision, please tell me why you decided to retro-commission this facility?

00. (RECORD VERBATIM) _____: Were there any other reasons?

98. (Don't know)

99. (Refused)

B2A. Before learning about the ComEd [if natural gas = 1 "and <gas utility>] Retro-commissioning Program, had your company ever conducted retro-commissioning at this facility or any of your other facilities in Illinois?

1. Yes, at this facility

2. Yes, at other facilities

3. Yes, at both this and other facilities

4. No

8. (Don't know)

9. (Refused)

[SKIP TO B2BB IF B2A=4. SKIP to B5 if B2A= 98, 99]

B2B. Did you receive an incentive or another form of utility or government financial support for performing this previous retro-commissioning work?

1. Yes

2. No

8. (Don't know)

9. (Refused)

IF B2A=4, THEN ASK. ELSE B5.

B2BB. What were the main factors that kept you from performing retro-commissioning in prior years? [DO NOT READ]

1. Was not aware of retro-commissioning

2. Did not understand the procedures and benefits of retro-commissioning

3. The cost of having a retro-commissioning audit and report prepared was too high

4. Had insufficient in-house staffing to carry out recommendations made in retro-commissioning report

5. Had inadequate in-house expertise to carry out recommendations made in retro-commissioning report

6. Not aware of qualified providers

7. Management was against having retro-commissioning done

00. (Other, specify)

98. (Don't know)

99. (Refused)

B5. My next questions are about your awareness of the energy efficiency opportunities identified through your retro-commissioning study PRIOR to conducting it. Would you say you were aware of all, some, or none of the issues before the study?

1. All

2. Some

3. None

8. (Don't know)

9. (Refused)

[SKIP TO B6ab IF B5=1, 3, 8, 9].

- B6. Which of the following opportunities were you previously aware of? Were you aware of the issues with your... (1=Yes, 2=No, 8=Don't know, 9=Refused)
- a. Air handler [ASK IF AIRHAND=1]
 - b. Boiler [ASK IF BOILER=1]
 - c. Chiller [ASK IF CHILL=1]
 - e. Cooling tower [ASK IF CTOWER=1]
 - f. Economizer [ASK IF ECON=1]
 - g. Fans [ASK IF FAN=1]
 - h. Heating system [ASK IF HEAT=1]
 - i. Lighting system [ASK IF LIGHT=1]
 - j. Pumps [ASK IF PUMP=1]
 - k. [Ask if Natural Gas = 1] Other Gas-related opportunities

- B6ab What were the main factors that kept you from addressing the opportunities in prior years? [DO NOT READ]
- 1. Was not aware of the opportunity
 - 2. the complexity of addressing the opportunity
 - 3. Did not understand benefits of addressing the opportunity
 - 4. The cost of addressing the opportunity was too high
 - 5. Had insufficient in-house staffing to address the opportunity
 - 6. Had inadequate in-house expertise to address the opportunity
 - 7. Not aware of qualified contractors
 - 8. Management was against making changes
 - 00. (Other, specify)
 - 98. (Don't know)
 - 99. (Refused)

- B6A. Before participating in the utility Retro-Commissioning program, did you undertake specific activities or studies in order to identify the retro-commissioning measure you just mentioned?
- 1. Yes
 - 2. No
 - 8. (Refused)
 - 9. (Don't know)

[SKIP TO B6B IF B6A=2, 8, 9]

- B6AA. What specific activities or studies had you completed?
- 00. RECORD VERBATIM
 - 8. (Refused)
 - 9. (Don't know)

- B6B. In the past, have you hired any private contractors to perform an energy audit or to perform extensive data trending in any of your buildings?
- 1. Yes
 - 2. No
 - 8. (Refused)
 - 9. (Don't know)

[SKIP TO N2 IF B6B= 2, 8, 9]

B6BB. Please briefly describe these studies and when were they done?

00. RECORD VERBATIM

8. Refused

9. Don't know

Decision Influences

N2 Did you learn about your organization’s eligibility for the Retro-Commissioning Program BEFORE or AFTER you decided to complete retro-commissioning at this facility?

- 1 Before
- 2 After
- 88 (Don't know)
- 99 (Refused)

N4. Now I’m going to ask you to rate the importance of several factors that might have influenced your decision to conduct the study and commit the funding to perform retro-commissioning at your facility. On a scale from 0 to 10, where 0 means ‘not at all important’ and 10 means ‘extremely important’, how important were the following in your decision to conduct the study and commit the funding for retro-commissioning. [FOR N4a-e, RECORD 0 to 10; 96=Not Applicable; 98=Don’t Know; 99=Refused][If needed: How important in your DECISION to conduct the study and commit the funding to perform the ComEd [if natural gas = 1 “and <gas utility>”] sponsored retro-commissioning was...]

[ROTATE N4A-N4E]

N4A. The free retro-commissioning study

N4B. The recommendation from the retro-commissioning service provider

N4C. The information from the Retro-Commissioning Program

N4D. The recommendation from your ComEd [if natural gas = 1 “or <gas utility>”] Account Manager

N4E. The continued technical assistance to address the opportunity offered by the retro-commissioning service provider <NAME OF FIRM> after the study phase {IF NEEDED EXPLAIN THE RSP IS THE FIRM THEY WORKED WITH ON THE RETRO-COMMISSIONING STUDY}

N4F. Were there any other factors that we haven’t discussed that were influential in your decision to perform retro-commissioning? [OPEN END; 96=Nothing else influential, 98=Don’t know, 99=Refused]

[SKIP TO N9a IF N4F=96, 98, 99]

N4FF. On a scale from 0 to 10, where 0 means ‘not at all important’ and 10 means ‘extremely important’, how important was this factor in your decision to conduct the study and commit the funding for retro-commissioning? [RECORD 0 to 10, 96=Not Applicable; 98=Don’t Know; 99=Refused]

Actions Without the Program

Now we would like you to think about actions you might have taken if the Program had not been available.

N9a. If you had not received the utility-sponsored Retro-commissioning study, would you have undertaken it on your own?

- 1. Yes
- 2. No
- 8. (Don’t know)
- 9. (Refused)

IF N9a=1, THEN ASK.

N9aa. Without the program, when do you think you would have conducted the Retro-commissioning study on your own? [READ]

1. At the same time
2. Later
97. Other (RECORD VERBATIM)
98. (Don't know)
99. (Refused)

[ASK IF N9aa=2]

N9ab. Would you say...?

1. less than 1 year later
4. one to two years later
5. More than 2 years later
8. (Don't know)
9. (Refused)

IF N9a=1, THEN ASK.

N9b. If the ComEd [if natural gas = 1 "and <gas utility>"] Retro-commissioning program had NOT been available, would you have taken all, some, or none of the retro-commissioning actions that were implemented as the result of the utility-sponsored study?

1. All
2. Some
3. None
98. (Don't know)
99. (Refused)

IF N9b=2, THEN ASK.

N10. Which measures or behaviors would you have implemented? Would you have implemented the measures or actions related to the... (1=Yes, 2=No, 8=Don't know, 9=Refused)

- aa. MEASURE1
- bb. MEASURE2
- a. Air handler <AIRHAND2> [ASK IF AIRHAND=1]
- b. Boiler <BOILER2> [ASK IF BOIL=1]
- c. Chiller <CHILL2> [ASK IF CHILL=1]
- e. Cooling tower <CTOWER2> [ASK IF CTOWER=1]
- f. Economizer <ECON2> [ASK IF ECON=1]
- g. Fans <FAN2> [ASK IF FAN=1]
- h. Heating system <HEAT2> [ASK IF HEAT=1]
- i. Lighting system <LIGHT2> [ASK IF LIGHT=1]
- j. Pumps <PUMP2> [ASK IF PUMP=1]
- k. [Ask if natural gas = 1] Gas-related measures

BEGIN MEASURE NTG LOOP

Loop 1 Measure X = "Scheduling Measures"

Loop 2 Measure X = "Setpoint Optimization Measures"

Now I would like you to think specifically about two types of actions you took, which were part of all the retro-commissioning actions that were done at your facility.

N10a. Thinking about <Measure X> and using a likelihood scale from 0 to 10, where 0 is "Not at all likely" and 10 is "Extremely likely", if the ComEd [if natural gas = 1 "and <gas utility>"] Retro-commissioning program had NOT been available, what is the likelihood that you would have performed <Measure X>? [RECORD 0 to 10; 96=Not Applicable; 98=Don't Know; 99=Refused]

[SKIP IF N9b= 3, 98, 99]

N11. Without the program, when do you think you would have performed <Measure X>? Would you say...?

1. At the same time
2. Earlier
3. Later
4. (Never)
8. (Don't know)
9. (Refused)

[ASK IF N11=3]

N12. Would you say...?

1. 1 to 3 months later
2. 4 to 6 months later
3. 7 to 12 months later
4. 13 to 24 months later
5. More than 2 years later
8. (Don't know)
9. (Refused)

[REPEAT NTG LOOP FOR MEASURE 2, IF APPLICABLE]

Spillover and Channeling

Now I would like to discuss additional energy efficiency measures installed since your participation in the Retro-Commissioning program.

CH1. Have you installed any additional **efficient equipment**? [1=Yes, 2=No, 8=Don't know, 9=Refused] [Multiple response]

[If yes, Ask CH1a through CH1d]

- CH1a Did you install...
- a. Lighting
 - b. Cooling
 - c. Motors
 - d. Refrigeration
 - e. Compressed Air
 - f. Fans
 - g. Controls
 - h. Heating
 - i. Something else (specify verbatim)
- CH1b Was this (Were these) measure suggested in the retro-commissioning study?
- CH1c Did you receive an incentive to help implement this measure(s)? [1=Yes, 2=No, 3=Some, 8=Don't know, 9=Refused]
- CH1d If yes, was it a gas utility, electric utility or government incentive?
- CH2 Have you implemented any additional **retro-commissioning measures** (operations or very low-cost measures) (or augmented those suggested through the study)? [1=Yes, 2=No, 8=Don't know, 9=Refused]
[Multiple response]
[If yes, Ask CH1a through CH1d]
- CH2a Which systems did the additional measures affect [Multiple Response]:
- a. Lighting
 - b. Cooling
 - c. Motors
 - d. Refrigeration
 - e. Compressed Air
 - f. Fans
 - g. Controls
 - h. Heating
 - i. Something else (specify verbatim)
- CH2b Was this measure suggested in the retro-commissioning study?
- CH2c Did you receive an incentive to help implement this measure? [1=Yes, 2=No, 8=Don't know, 9=Refused]
- CH2d If yes, was it a gas utility, electric utility or government incentive?
- [SKIP TO CH6 IF CH1=2, 8 or 9]
- CH3. On a scale of 0 to 10, where 0 means "Not at all influential" and 10 means "Extremely influential", how influential was your participation in the Retro-Commissioning Program in your decision to install additional energy efficient equipment? [SCALE 0-10; 98=Don't know, 99=Refused]
- [ASK IF CH3=8,9 or 10; ELSE SKIP TO CH5]
- CH4. How did the Retro-Commissioning Program influence your decision to make these additional changes? [OPEN END; 98=Don't Know; 99=Refused]

CH6. On a scale of 0 to 10, where 0 means “no influence” and 10 means “greatly influenced,” how much influence did your participation in the Retro-Commissioning Program have on your decision to implement the additional retro-commissioning measures? [SCALE 0-10; 98=Don’t know, 99=Refused]

[ASK IF CH6=8, 9 or 10; ELSE SKIP TO CH8]

CH7. How did the Retro-Commissioning Program influence your decision to make these additional changes? [OPEN END; 98=Don’t Know; 99=Refused]

CH8. Did your experience with the Retro-commissioning Program influence you to recommend the retro-commissioning process to other facilities within your organization? ... [1=Yes, 2=No, 8=Don’t know, 9=Refused]

[ASK IF CH8=1; ELSE SKIP TO S1]

CH9. Please describe this recommendation and the number of facilities involved. [record verbatim]
[Prompt for timing, location (in or out-of-state), as part of or external to the Retro Commissioning Program and size of facility(ies) relative to this one]

Process Module

- S1. How did you first hear about the Retro-Commissioning Program?
1. Retro-commissioning service provider, “RSP”
 2. ComEd program representative
 3. [if natural gas = 1] <gas utility> “program representative”
 4. ComEd Account manager
 5. [if natural gas = 1] <gas utility> “Account Manager”
 6. ComEd Website
 7. [if natural gas = 1] <gas utility> “Website”
 8. Friend, colleague, or word of mouth
 9. Contractor
 10. Utility marketing material – case studies overview sheets, marketing video
 11. Nexant – the program administrator
 00. (Other, specify)
 98. (Don’t know)
 99. (Refused)

Marketing and Outreach

- MK1. Do you recall seeing or receiving any marketing materials or other information for the Retro-Commissioning Program?
1. Yes, ComEd materials
 2. [if natural gas = 1] “Yes, <gas utility> materials”
 3. Yes, both ComEd and <gas utility> materials
 4. No
 8. (Don’t know)
 - 9 (Refused)

[ASK IF MK1=1, 2 or 3 ELSE SKIP TO MK4]

MK1A. What types of materials do you remember? [MULTIPLE RESPONSE, UP TO 4]

1. Presentation or workshop
2. Program overview sheet

- 3. Case Study
- 4. Utility website(s)
- 5. Direct Mail
- 6. Fact sheets
- 7. Program Forms
- 00. (Other, please specify)
- 98. (Don't know)
- 99. (Refused)

MK2. On a scale of 0 to 10, where 0 means “Not at all useful” and 10 means “Extremely Useful”, how useful were these materials in providing information about the program? [SCALE 0-10; 98=Don’t know, 99=Refused]

[ASK IF MK2=1, 2]

MK3. What materials were the most useful to you? [MULTIPLE RESPONSE, UP TO 3]

- 1. Presentation or workshop
- 2. Brochure
- 3. Case Study
- 4. Utility website(s)
- 5. Direct Mail
- 6. Fact Sheets
- 7. Program Forms
- 00. (Other, specify)
- 98. (Don’t know)
- 99. (Refused)

MK4. What are the best ways of reaching companies like yours to provide information about energy efficiency opportunities? [DO NOT READ?] [MULTIPLE RESPONSE, UP TO 3]

- 1. (Bill inserts)
- 2. (Flyers or mailings)
- 3. (E-mail)
- 4. (Telephone)
- 5. (Key Account Executive)
- 6. Ads
- 7. (Industry events or shows)
- 00. (Other, specify)
- 98. (Don’t know)
- 99. (Refused)

Program Satisfaction

PS3. On a scale of 0 to 10, where 0 is very dissatisfied and 10 is very satisfied, how would you rate your satisfaction with...? [SCALE 0-10; 96=not applicable, 98=Don't know, 99=Refused]

- a. The level of financial commitment required to receive the free study (if needed, note the required commitment was \$15,000 - \$30,000 depending on the project)
- b. The information provided in the retro-commissioning study
- c. Nexant (the program administrator)
- d. The Smart Ideas for Your Business Program (ComEd) staff
- e. [if natural gas = 1], <gas utility> program representative or staff
- f. Your Retro-Commissioning Service Provider
- g. The Retro-Commissioning program overall
- h. ComEd overall
- i. [if natural gas = 1], <gas utility> overall

[ASK IF PS3a, b, c, d, e, f, g, h, i < 4 or PS3a, b, c, d, e, f, g, h, i > 7]

PS4a. Why did you rate it this way? [OPEN END; 98=DK; 99=REF]

Benefits and Barriers

B1. What do you see as the main strengths of the Retro-Commissioning Program? [DO NOT READ; MULTIPLE RESPONSE, UP TO 3]

1. Helps reduce the company's energy bills
2. save energy
3. Free study
4. Improves the performance of equipment
5. Trains facility staff on building operations
00. (Other, specify)
98. (Don't know)
99. (Refused)

B2. What concerns do you have about the program? [DO NOT READ; MULTIPLE RESPONSE, UP TO 3]

1. Paperwork too burdensome
2. Incentives or free study not worth the effort or required financial commitment
3. Program is too complicated
00. (Other, specify)
96. (No concerns)
98. (Don't know)
99. (Refused)

Feedback and Recommendations

R1. Based on your experience, would you recommend the Retro-Commissioning program to your peers inside or outside of your organization?

1. Yes
2. No
3. (Maybe)
8. (Don't know)

9. (Refused)
- R2. Do you have any suggestions for ways to improve the program, and if so, what are they? [DO NOT READ; MULTIPLE RESPONSE, UP TO 4]
1. (More flexibility on study costs)
 2. (Reduce the required financial commitment to implement measures)
 3. (Greater publicity)
 4. (Advance payment)
 5. (Longer engagement with RSP to implement more measures)
 6. (Key Account Executives provide more information)
 96. (No recommendations)
 00. (Other, specify)
 98. (Don't know)
 99. (Refused)

Firmographics

I only have a few general questions left.

- F2 Does your company own, rent or only manage this facility?
- 1 (Own)
 - 2 (Rent)
 - 3 (Manage)
 - 00 (Other, specify)
 - 98 (Don't know)
 - 99 (Refused)
- F5. Which of the following best describes your facility? This facility is...
1. my company's only location
 2. one of several locations owned or operated by my company
 3. the headquarters location of a company with several locations
 8. (Don't know)
 9. (Refused)
- F6. In comparison to other companies in your industry, would you describe your company as...
1. A small company
 2. A medium-sized company
 3. A large company
 4. (Not applicable)
 8. (Don't know)
 9. (Refused)

Those are all of the questions I have. Thank you very much for your participation!

7.2.2 Service Providers Interview Guide

ComEd C&I Retro-Commissioning Program –RSP Interview Guide October 24, 2014

Service Provider Guide PY6

Name of Interviewee: _____ Date: _____

Title: _____ Company: _____

[Note to Reviewer] The Interview Guide is a tool to guide process evaluation interviews with utility staff and implementation contractors. The guide helps to ensure the interviews include questions concerning the most important issues being investigated in this study. Follow-up questions are a normal part of these types of interviews. Therefore, there will be sets of questions that will be more fully explored with some individuals than with others. The interviews will be audio taped.

Introduction

Hi, may I please speak with [name from list]?

My name is ___ and I'm calling from Navigant Consulting, an independent research firm, on behalf of ComEd and Nicor Gas and Peoples and North Shore Gas. We're talking to **contractors who are currently service providers** for the ComEd Smart Ideas for your Business Retro-Commissioning Program that is offered jointly by Nicor Gas and Peoples and North Shore Gas. **We may have spoken with you or someone from your firm in past years as a part of the process evaluation** completed at that time. This is a refresh of that prior survey.

We are interested in any feedback you may have regarding your firm's involvement in this program and any feedback you have received about the program from your customers. ComEd and the Gas Utilities plans to use this information to continue to improve the energy efficiency programs and services it offers to its business customers.

Would you be willing to speak with me for about 30 minutes? Your responses will be kept strictly confidential.

I. Program Processes

1. In general how satisfied have you been with the program participation process? *[PROBE FOR: Application phase, planning phase, investigation phase, implementation phase, verification phase]*
Are there aspects of the program that you think work particularly well? Please explain.

- 1a. Are there aspects of the program that could be improved? Please explain.

2. What are the strengths of the Service Provider participation process? [PROBE FOR: Training, calculation templates, support with customers, RSP review process]
3. Did you have any difficulty meeting the required deliverables for each program phase (*probe for timeline, required information*)? If so, please explain.

II. Effects of Program on Business Practices

4. Of the [XX] customers with whom you completed utility-sponsored retro-commissioning projects in Electric Program Year 6 / Gas Program Year 3 (June 2013 to May 2014), approximately how many did you have a prior working relationship with?
5. On a scale of 0 to 10 where 0 is “not at all important” and 10 is “extremely important”, how important has the program been on how frequently you recommend and perform RCx services for all your customers in ComEd, Nicor Gas, Peoples Gas and North Shore Gas service territory?
6. Have you made any changes to your business as a result of your participation in the RCx program? [PROBE: *hired more staff, opened up new offices, changed marketing, changed approach to retro-commissioning investigations.*]

III. Net-To-Gross

- A1. Thinking about the [XX] studies that you conducted as part of the Retro-Commissioning Program in EPY6/GPY3, did your customers participation in the Retro-Commissioning Program in any way influence the type, quantity or efficiency level of the measures that you recommended to customers at those sites? In other words would you have done this project differently without the utility program?
[Expect a Y/N response]
- A2. Please briefly describe the most significant ways in which the Retro-Commissioning Program influenced your decision to incorporate efficient designs/practices /measures at your customers' sites.
[Record verbatim]
- A3. On a scale of 0 to 10 where 0 is NOT AT ALL IMPORTANT and 10 is EXTREMELY IMPORTANT, how important was the Retro-Commissioning Program, including program services and the customer spending commitment, in influencing your level of marketing and selling of retro-commissioning projects in Northern Illinois?
[SCALE 0-10, Don't Know=888, Refused=999]
- A4. Absent the Retro-Commissioning Program, approximately what percent of your Illinois customers, which participated in the Retro-Commissioning program, would have contracted with your company for retro-commissioning services? **[0-100%]**

Measure-Specific Naturally Occurring Baseline and Free Ridership Questions

[Ask the following questions for each measure category below. Prior to calling, review records for the contractor in terms of the number of projects that made recommendations for each measure category, and the total expected savings for those measures. Use that to guide questions and focus interview. If respondent is only responsible for some of firm's studies, attempt to use only those studies for these questions.]

Navigant has reviewed all measures recommended and installed through the Retro-Commissioning Program and we have identified four main measure types: repairs, schedule changes, optimizations, and lower-cost retrofits that we would like to ask you some more detailed questions about.

1. **Repairs** are items that affect existing equipment that has failed in some way that needs *maintenance* to restore proper operation, for example, stuck, or broken damper actuators or faulty sensors.
2. **Scheduling** items are recommendations based on *time-of-day* occupancy or operations, for example scheduling run-time with occupancy rather than 24x7 operations or programming the controls system with night-setback mode or optimal start/stop routines.
3. **Optimization** items are recommendations *utilizing existing sensors and control system* to improve system efficiency, for example chilled water or discharge air temperature reset, economizer or condenser water set-point optimization.
4. **Retrofit** measures might include new filter systems or added sensors to implement more efficient controls. [if necessary – “Retro-commissioning retrofits are generally lower-cost and less-intrusive than more traditional equipment retrofits like lighting and variable frequency drives.”]

[LOOP 1 <MEASURE TYPE> = Optimization]

[LOOP 2 <MEASURE TYPE> = Scheduling Changes]

B2. Thinking about energy studies your firm completed **prior to your involvement** with the program, about what percentage of recommended savings did customers choose to implement among <MEASURE TYPE> measures? [If necessary, “Estimate to the nearest 10%, if you can.”]

RECORD PERCENTAGE

- 888. Don't Know
- 999. Refused

B6. **Since your involvement** with the program, how often do you *recommend* that customers implement <MEASURE TYPE> measures, when appropriate for the site? Would you say that you recommend these measures always, often, sometimes, seldom, or never? Please think about all your customers, *including but not limited to* the participants in the Retro-Commissioning Program.

- 1. Always
- 2. Often
- 3. Sometimes
- 4. Seldom
- 5. Never/Only in response to direct customer inquiries
- 000. Other: (verbatim)
- 888. Don't Know
- 999. Refused

B7. **Since your involvement** in the program, about what percentage of recommended savings from <MEASURE TYPE> measures do your customers choose to *implement*? Please think about all your customers, *including but not limited to* the participants in the Retro-Commissioning Program.

RECORD PERCENTAGE

- 888. Don't Know
- 999. Refused

B8. About what percentage of recommended savings from <MEASURE TYPE> measures among *participants in the Retro-Commissioning Program* is actually implemented?

RECORD PERCENTAGE

- 888. Don't Know
- 999. Refused

B9. Using a 0 to 10 likelihood scale where 0 is NOT AT ALL LIKELY and 10 is EXTREMELY LIKELY, *if the program had not been available*, what is the likelihood that you would have been recommending the same <MEASURE TYPE> measures?

ENTER RATING 0 - 10

- 888. Don't Know
- 999. Refused

B10. Using that same 0 to 10 likelihood scale where 0 is NOT AT ALL LIKELY and 10 is EXTREMELY LIKELY, if the program had not been available, what is the likelihood that your customers would have chosen to implement the same <MEASURE TYPE> measures?

ENTER RATING 0 - 10

- 888. Don't Know
- 999. Refused

[Only ask of people with multiple measure categories; IF <MEASURE TYPE 2 or 3> is blank, skip to C1]

B11. The questions I just asked focused on <MEASURE TYPE>, but our records indicate that you have also worked on projects involving <MEASURE TYPE X> for the Retro-Commissioning Program.

[LOOP for <Measure TYPE>]

[End Loop]

Project Level Free Ridership

C1. On a scale of 0 to 10, where 0 means “not at all influential” and 10 means the “extremely influential”, how influential do you think *your recommendation and technical assistance* were in your customers’ decision to implement retro-commissioning measures?

ENTER RATING 0 - 10

- 888. Don't Know
- 999. Refused

C2. On a scale of 0 to 10, where 0 means “not at all influential” and 10 means “extremely influential”, how influential do you think the *utility retro-commissioning program incentives and implementation commitment* were in your customers’ decision to implement retro-commissioning measures?

ENTER RATING 0 - 10

- 888. Don't Know
- 999. Refused

C3. Now I'd like to ask you about the total energy savings achieved in all of your projects which participated in the Retro-Commissioning Program during the program year ending May 2014. I

recognize that this is difficult to estimate, but try to think about what share of those energy savings would have been achieved in these projects even if the program and your technical assistance and required customer spending commitment did not exist. What is your best estimate of the percent of energy savings that would have been achieved, even without the program? (Enter %)

[If needed for clarification] For example, 50% means that half of the savings from the retro-commissioning measure would have been achieved anyway, even if the program did not exist.

[If needed for clarification]: How much of the savings generated by your customers in the program would have been achieved if they had not participated in the program?

D. OUTSIDE SPILLOVER

D1. Did your experience with the Retro-Commissioning Program in any way influence you to perform similar studies at other facilities in Illinois that did NOT participate in the Joint Utility Retro-Commissioning Program or the Ameren or DCEO Public Sector Retro-Commissioning Programs? I'm asking here strictly about facilities that did not receive any technical assistance or funding from any of these programs.

[If D1 = "no", SKIP to E1]

D2. **[If D1 = "yes"]**

Approximately how many of these additional retro-commissioning projects have been completed in the past year? [Enter #]

D2a. Were the measures installed, or only recommended through other retro-commissioning studies? **[Probe for knowledge of those that were recommended and installed and those that were recommended but not installed]**

D2b. Approximately how many of these additional retro-commissioning projects have **started** in the past 12 months? [Enter #]

D3. Please briefly describe how the Retro-Commissioning Program has influenced you to retro-commission other facilities in Illinois that did NOT participate in the Retro-Commissioning Programs.

Why did these projects NOT participate in the Illinois programs? [Probe: Was it something about the program processes or program offerings?]

D4. On average, would you estimate the energy savings from these other non-program facilities to be less than, similar to, or more than the energy savings from the retro-commissioning measures incorporated through the average Joint Utilities Retro-

Commissioning Program projects you conducted? **[Confirm percentages are based on all installed, not recommended, measures]**

[If possible review the total estimated savings from installed measures]

[e.g., if the same measures/designs were implemented in a facility twice as big, then savings would be 200%. Be sure to emphasize that this is savings “on average” not in aggregate across the many buildings that might be affected]

E. NON-PARTICIPANT SPILLOVER

- E1. Do you believe that other engineering firms that are not participating in the Retro-Commissioning Program are increasing the number of implemented retro-commissioning projects and measures because of the influence of the Retro-Commissioning Program? In other words, are they doing more with retro-commissioning than they would have if the Program did not exist?
- E2. **[If E1 = “yes”]** Please briefly describe how the Retro-Commissioning Program is influencing the market for retro-commissioning measures in Illinois.
[Probe for availability, A&E market, type of equipment, timing, quantity, and efficiency]

IV. Marketing and Outreach

- 11. How do customers typically learn about the Retro-Commissioning Program? *[Probe with: Do you tell them about it? Colleagues? Marketing materials from ComEd or gas utilities? Are they already aware of the program?]*
- 12. Do you feel the program provides sufficient support to RSPs to help them promote the program?
 - 12a. Do you use the fact sheets and case studies that the utilities provide? If so, how effective do you think they are?
 - 12b. How valuable is the option to link your retro-commissioning services to the utility brand name (co-branding)?
 - 12c. Is there anything that the program administrator (Nexant) or the utilities could do to help you promote this program to your customers?

V. Channeling into Other C&I Programs

- 13. Is your firm currently registered as a service provider or trade ally for other C&I program offerings from ComEd or the Gas utilities? [Yes / No]
- 14. On a scale of 0-10 with 0 meaning “never” and 10 meaning “always,” approximately, how often do equipment upgrade recommendations from the retro-commissioning study result in implementation of that measure within **1** year?
[SCALE 0-10, Don’t Know=888, Refused=999]

15. On a scale of 0-10 with 0 meaning “never” and 10 meaning “always,” approximately, how often do equipment upgrade recommendations from the retro-commissioning study result in implementation of that measure within 2 years?
[SCALE 0-10, Don’t Know=888, Refused=999]

VI. RSP Training

16. Did you participate in any of the RSP training offered by the program this past year?

1. Yes
2. No

888. Don’t Know

999. Refused

16a. What training did you participate in? *[Probe for implementation training, safety training.]* Was the training helpful? *[Probe by class.]* Please explain.

16b. What training would you like to have offered in the future?

17. Did you make any changes in your practices as a result of the training? Did the training provide ways or resources to help you market or deliver the Retro-Commissioning program to customers? If yes, please explain.

18. Are there any technical issues or barriers that you have experienced in your participation in the program that could be overcome with more training or guidance from the program?

19. Overall, how would you rank the value of training on a scale of 0 to 10 where 0 is not at all valuable and 10 is highly valuable?
[SCALE 0-10, Don’t Know=888, Refused=999]

VII. Participation Barriers

20. What do you view as the main barriers to retro-commissioning for your customers?

20a. Does this vary by customer type or size? Anything else?

20b. What could be done to overcome these barriers?

21. What do you view as the main barriers to customer participation in the Retro-Commissioning Program?

21a. What could be done to overcome these barriers?

21b. What do you perceive to be the demand for the services provided by the program?

VIII. Program Feedback and Recommendations

22. Have you received any other feedback from customers on the participation process? If so can you please share?
23. In general, how satisfied are you with the Retro-Commissioning program? Has it met your expectations? Please explain.
24. Do you have any additional recommendations or feedback for the evaluation?

Thank you for taking the time to discuss the Retro-commissioning Program