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Northern Illinois Joint Utility Retro-Commissioning Program EPY5/GPY2 Evaluation Report

Final

Energy Efficiency / Demand Response Plan:
Nicor Gas Plan Year 2
Peoples Gas and North Shore Gas Plan Year 2
Commonwealth Edison Company Plan Year 5
(6/1/2012-5/31/2013)

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

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E. Executive Summary

This report presents a summary of the findings and results from the Impact and Process Evaluation of the Electric Program Year 5 (EPY5)/Gas Program Year 2 (GPY2)[1] Northern Illinois Joint Utility Smart Ideas for your Business ® Retro-Commissioning Program offered in partnership between ComEd, Nicor Gas, Peoples Gas and North Shore Gas. The Northern Illinois Utilities Joint Retro-Commissioning Program (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.

Changes to the program, introduced in EPY4/GPY1, have increased its scope and market for services. Other changes have facilitated participation and the ability of participants to complete improvements before the end of the program year:

- Program practices successfully incorporated buildings served by district energy plants. Several of these customers participated in the program in EPY5/GPY2.
- Campus aggregation of smaller buildings has increased the number of eligible buildings and completed projects.
- The new database to track project progress has been used to good effect with current projects and has been retro-actively populated with prior program year data to trend program reach and effect over time.

E.1. Program Savings

Table E-1 and Table E-2 summarize the electric and natural gas savings.

Table E-1. EPY5 Total Program Electric Savings

Savings Category †	Energy Savings (MWh)	Coincident Peak Demand Savings (MW)
Ex Ante Gross Savings	26,203	2.818
Research Findings Gross Savings	24,788	1.801
Verified Net Savings	17,599	1.279

Source: Utility tracking data and Navigant analysis.
Net-to-gross ratio = 0.71, EPY3 research, http://www.ilsag.info/net-to-gross-framework-1.html
† See the Glossary in the Appendix for definitions

[1] The EPY5/GPY2 program year began June 1, 2012 and ended May 31, 2013.

Table E-2. GPY2 Total Program Natural Gas Savings

Savings Category †	Nicor Gas (therms)	Peoples Gas (Therms)	North Shore Gas[2] (therms)
Ex Ante Gross Savings	397,353	284,726	0
Research Findings Gross Savings	403,126	296,931	0
Verified Net Savings	411,189	302,870	0

Source: Utility tracking data and Navigant analysis.
Net-to-gross ratio = 1.02, EPY4 research. http://www.ilsag.info/net-to-gross-framework-1.html
† See the Glossary in the Appendix for definitions

E.2. Program Savings by Utility

The following two tables summarize the program savings results.

Table E-3. EPY5/GPY2 Program Results by Utility

Savings Category	ComEd MWh	ComEd MW	Nicor Gas (Therms)	Peoples Gas (Therms)
Ex Ante Gross Savings[3]	26,203	2.818	397,353	284,726
Research Findings Gross Realization Rate‡	0.946	0.639	1.015	1.043
Research Findings Gross Savings	24,788	1.801	403,126	296,931
Net to gross ratio (NTG) †	0.71	0.71	1.02	1.02
Verified Net Savings ‡	17,599	1.279	411,189	302,870

Source: Utility tracking data and Navigant analysis.
† A deemed value.
‡ Based on evaluation research findings.

E.3. Impact Estimate Parameters

To estimate evaluated gross and net savings, the evaluation used a variety of parameters in its calculations. A few of those parameters were deemed for this program year and most were examined or adjusted based on evaluation research. NTG ratios (ComEd @ .71 and gas utilities @ 1.02) are the key deemed parameters used in the analysis. Gross savings are evaluated each year, and are treated as custom measures (outside of the TRM).

[2] No projects were implemented with North Shore Gas customers, so they achieved zero savings through the program.
[3] From Tracking System

E.4. *Impact Estimate Parameters for Future Use*

The EPY5/GPY2 evaluation of the retro-commissioning program did not estimate any new parameters for prospective application.

E.5. *Participation Information*

The program had 46 participants in EPY5/GPY2 and implemented 252 measures as shown in Table E-4. The two natural gas only participants represent one project filed in EPY4/GPY1 that completed one gas measure in GPY2 and one project in the Nicor Gas service territory where ComEd is not the electric utility. In both of these cases there was electricity savings, which is not included in this report.

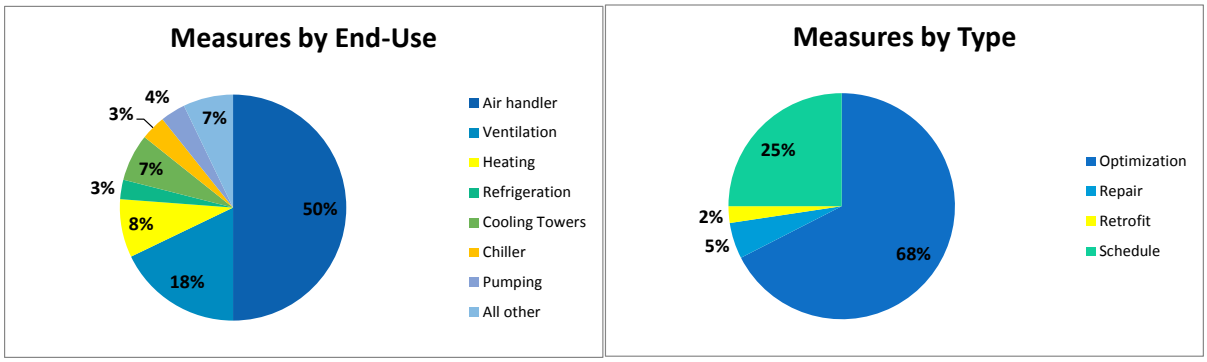
Table E-4. EPY5/GPY2 Primary Participation Detail

Participation	Electric Only	Electric & Natural Gas	Natural Gas Only
Participants	18	26	2
Total Measures	95	154‡	3

Source: Utility tracking data and Navigant analysis.
‡ Measures can save electricity, natural gas or both

Navigant categorized the data by end-use and type of measure as shown in Figure E-1. As in previous years, air handler and ventilation measures top the list. Similarly, optimization measures comprise a majority of measures implemented and savings achieved.

Figure E-1 Distribution of Retro-Commissioning Measures by End-Use and Type



E.6. *Conclusions and Recommendations*

The following provides insight into key program findings and recommendations

Program Savings Goals Attainment

Finding 1. Nicor Gas energy savings fell well-short of goals (1,024,308 therms), though program managers expect GPY3 savings will make up for some of this shortfall due to

long implementation lead times for some retro-commissioning measures.[4] The energy savings goals for Peoples Gas and North Shore Gas for the Retro-Commissioning Program were rolled into the Custom goals (Retro-Commissioning goals were revised down from the original plan to 300,000 therms for Peoples Gas, and 10,000 therms for North Shore Gas). No projects were implemented with North Shore Gas customers, so they achieved zero net savings from the program, while Verified Net savings for the Peoples Gas program were 99 percent of planned savings. ComEd energy savings fell just short of their gross energy savings goal of 29,500 MWh savings.[5] ComEd does not have demand savings goals for retro-commissioning.

Recommendation. Even though the EPY6/GPY3 pipeline of projects appears to be strong for all utilities, except North Shore Gas[6], goals attainment is very dependent on the number of projects processed by the program. EPY5/GPY2 projects involved two more retro-commissioning service providers (RSPs) than EPY4/GPY1 (11 versus 9), but that still leaves more than 50% of participating RSPs without a completed project. Working with the new RSPs to complete projects and enroll future participants should be a priority for meeting future goals.

Gross Realization Rates

Finding 2. A couple RSPs are recommending retrofit measures among their retro-commissioning measures that are covered in the Illinois Technical Reference Manual or might be included in future versions of the Manual. These measures include faucet aerators (TRM) and V-Bank filters for ventilation systems.

Recommendation. When measures are covered in the TRM consider using the algorithms there for *ex ante* estimates rather than custom methods for consistency. Consider proposing V-bank filters for deemed savings through the prescriptive program. Base deemed savings on research from pre- and post-installation measurements through retro-commissioning verification processes.

Demand Savings Estimates

Finding 3. ComEd does not report demand savings for the Retro-Commissioning program even though demand savings is tracked in the TrakSmart database and most RSPs estimate demand savings for their clients. The lack of focus on electric demand savings results in inconsistent methods for estimating savings and a low realization rate against the tracking system for demand savings. In many cases demand savings is reliably achieved, and not reporting demand savings can affect the benefit/cost tests for the program.

Recommendation. Consider reporting demand savings for measures that generate reliable savings – for example, fixing/changing minimum ventilation rates or turning off loads that were running at peak hours. Establishing clear guidelines for the kind of measures that ComEd would qualify for reporting can reduce the burden on RSPs and the implementation contractor for reviewing measures.

[4] ICC Quarterly Report 4th Quarter PY2 Final.xls, Nicor Gas, July 16 email.

[5] ComEd PY5 final cost_kWh.pdf, ComEd, October 10, 2013 email from David Nichols.

[6] North Shore Gas has one pipeline project in recent tracking review.

Finding 4. The inconsistent demand estimation methods resulted in low realization rates for electric demand savings and can result in misleading economic payback information for participants. Several measures that claimed significant demand savings are effective only during cooler or cold weather (enthalpy economizer controls and water-side free cooling) or diminish in savings potential as outdoor air temperatures rise and affect reset schedules (static pressure, chilled water and discharge air temperature resets).

Recommendation. Consider establishing and enforcing clear methods for estimating demand savings, where it is reliable. Reducing the scope when estimates are required and establishing clear methods will reduce the burden on RSPs to perform the estimates and give participants clear indications when measures will also achieve cost savings from demand reduction.

Service Provider Participation

Finding 5. Service providers drive program participation and goals attainment. The ratio of participating RSPs versus those registered with the program is less than 50%. Eleven RSPs participated in EPY5/GPY2. This is an increase from nine last year, but one RSP submitted almost 40% of projects and the top 4 active RSPs submitted 70% of projects while all others submit three or less. Tracking data show that 15 RSPs have pipeline projects including six that have not completed projects in the past.

Recommendation. Consider focusing marketing and follow-up efforts with new or less active RSPs to help them understand the value proposition for themselves and their customers for participating in the program.

Participant Building Operator Certification Training

Finding 6. One requirement of the program is successful completion of Level I Building Operator Certification training by at least one participant representative within one year of completing the retro-commissioning project. The training is well received, anecdotally, and serves to support savings persistence. Successful tracking of this requirement, however, has only recently been implemented. Data show that individuals representing thirty-three EPY4/GPY1 participants (of 50) have completed the training. For EPY5/GPY2 fifteen individuals, representing eleven participants, have completed the training. The one year window for compliance almost ensures this will be a recurring evaluation concern. Program leverage is weak on this requirement as the RSP is paid for the study long before the *participant* must comply.

Recommendation. Consider stronger tools for enforcing this program requirement – such as requiring participants to pay for training tuition prior to program completion. The program might collect the tuition in escrow and pay for the training when the participant enrolls.

Program Processes

Finding 7. One of the barriers identified by the program managers was coordination with the controls contractors, who are brought in to do much of the project work and in some cases, have not implemented projects correctly. Also, program managers identified that customer funding and customer staff availability continue to be barriers for the program. Despite the attractive program offering for the study, customer resources are required to participate in retro-commissioning efforts and implement measures.

Recommendation. Consider closer coordination with controls contractors, either by Nexant or also by utility staff. Closer coordination and more frequent monitoring will ensure that contractors are on track to implement projects successfully. Customer barriers might to stem from reluctant participant buy-in in some cases. This issue should diminish as retro-commissioning benefits are more widely understood and accepted.

Overall the program is addressing the barriers to retro-commissioning and operational savings in commercial buildings. There are a large number of registered service providers with varying degrees of activity in the service territory. Anecdotal comments suggest that participants are more aware of the program and the benefits of retro-commissioning, in general. 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. The result of the program is average implemented savings between five and seven percent of participant annual electricity and gas consumption.

1. Introduction

1.1 Program Description

The ComEd Retro-Commissioning Program has been offered each of the five electric program years. Electric Program Year 5 (EPY5) also marked the second year, GPY2, where the program was offered as a joint utility program with the gas utilities with service areas overlapping ComEd's: 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 gas, and analyzing one while neglecting the other would be a lost 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. In general, the program pays for 100% of a detailed retro-commissioning study contingent upon a participant's commitment to spend a certain 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 components[7] 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 improvements to sensors or control programs 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 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/or their respective ICs, Franklin Energy and Nexant, Peoples Gas and North Shore Gas and Nicor Gas, respectively participate in weekly program operations calls and work with their participating customers.

The program is open to all customers who meet the eligibility requirements:

- 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 greater.[8].
- Be served under eligible ComEd rate schedules.[9]

[7] 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.

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

[9] ComEd Rate schedules: A75, A76, A77, B75, B78, B95, B98, H75, H76, H77, H78, R75, R76, R77, R78.

- Applicants must be part of a non-public organization.[10].
- Facility owners must commit to spend between $15,000 and $30,000, (depending on the project size) 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.
- The facility owner must send one staff member to Building Operator Certification™ (BOC) training. Staff member(s) 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 EPY5/GPY2:

1.2.1 Impact Questions

1. What is the level of gross and net annual energy (kWh) 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 limited process evaluation in EPY5/GPY2. Navigant conducted full process evaluations in each of the four preceding years, including the pilot program. Over that time, the program has evolved on the margins, but its core structure and delivery remain the same. The evaluation team conducted interviews with key program staff to explore the following process questions:

1. Status of program implementation.

2. What steps have been taken to motivate RSPs to complete more projects within each program year?

3. Status and effectiveness of recent changes to the program design and processes
    a. Monitoring-based retro-commissioning: key barriers and opportunities;
    b. Effects of splitting large projects over multiple program years from the implementation perspective.
    c. Addition of new RSPs and the removal of inactive RSPs in EPY5/GPY2.

[10] 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 fourth full-scale year[11] of program operation. During EPY5/GPY2, 46 facilities participated in the Retro-Commissioning Program. Among the 46 sites, more than 250 retro-commissioning measures (RCMs) were implemented and verified, thus qualifying the sites for waiver of retro-commissioning service costs. The participants were shepherded through the program by eleven different RSPs.

2.1 Overview of Data Collection Activities

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

- Program guidelines[12] 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 these 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. Core Data Collection Activities

N	What	Who	Target Completes	Completes Achieved	When	Comments
Impact Assessment						
1	Engineering Review	Participants	26	26	August - October 2013	
2	Onsite M&V Audit	Participants	12	10	August - September 2013	
Process Assessment						
3	In Depth Interviews	Program Manager/Implementer Staff	4	4	May – September 2013	Includes staff for both Custom and Data Centers program.

2.2 Research Findings Savings Parameters

Research Findings Gross Savings (energy and coincident peak electric demand) resulting from the EPY5/GPY2 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.

[11] A small pilot program was conducted in EPY1 with Nexant serving as RSP and program implementer

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

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 * reduced 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 include 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

Most retro-commissioning measures have interactive effects with other buildings systems. For example, measures to reduce fan power will also reduce cooling energy required and increase required heating energy, if the fan motor is in the conditioned air stream. Measures to reduce reheating air may require additional fan power to deliver air to spaces that do not require heating. Except in cases where broken systems were repaired, Navigant found positive electricity and gas savings despite interactions, among all measures and projects reviewed. Rare retro-commissioning measures have deemed calculations, for example, faucet aerator retrofits.

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

Table 2-2. EPY5/GPY2 Parameter Estimates

Parameter	Electricity	Natural Gas
Net-to-Gross Ratio ‡	0.71	1.02
Source	EPY3 research	GPY1 research

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

‡ Deemed values

2.3 Research Findings 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. We then reviewed calculations to ensure the savings are accurately estimated. 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.

2.4 Verified Net Program Savings Analysis Approach

Verified net energy and electric demand (coincident peak) savings were calculated by multiplying the Research Findings Gross Savings estimates by respective net-to-gross ratios (NTGR). In EPY5/GPY2, the NTGR estimates used to calculate the Verified Net Savings were based on past evaluation research (EPY3 and GPY2, respectively) and defined through a consensus process through SAG as documented in complementary spreadsheets.[13]

2.5 Process Evaluation

The EPY5/GPY2 evaluation plan called for limited process research. General aspects of program processes were discussed with key program administrators from the utilities and the implementation contractor.

[13] http://www.ilsag.info/net-to-gross-framework-1.html.

3. Gross Impact Evaluation

The impact evaluation involved a couple of aspects in EPY5/GPY2. In addition to determining researched gross savings, the evaluation reviewed the program tracking systems. Data tracking for the Retro-Commissioning Program is based on two parallel databases – one populated with detailed data that are summarized and uploaded to another. Summary fields in the ComEd Frontier database are populated with data from the TrakSmart database, which is used for the program detailed tracking. Navigant reviewed the Frontier database summary information and spreadsheet exports from the TrakSmart database.

In general, both databases accurately report project savings based on project reports. Navigant reviewed each of the measure-level details for the sampled projects. For example, one measure had inaccurate savings entered into the TrakSmart database. This error was rolled up to the project level and reported in the Frontier database. A measure-by-measure review of the savings estimates were used to derive realization rates for electric energy and peak demand and utility-specific natural gas saving realization rates.

Table 3-1. Research Findings Gross Savings Realization

Savings Category	ComEd MWh	ComEd MW	Nicor Gas (therms)	Peoples Gas (therms)	North Shore Gas (therms)
Ex Ante Gross Savings[1]	26,203	2.818	397,353	284,726	0
Research Findings Gross Realization Rate	0.946	0.639	1.015	1.043	NA
Research Findings Gross Savings[2]	24,788	1.801	403,126	296,931	0

[1] *Source Tracking systems*

[2] *Source: Evaluation*

The low realization rate for peak demand savings is due to unreasonable estimates of summer demand savings for several measures and inconsistent methods for estimating the savings. For a couple projects, RSPs credited the projects with demand savings for measures such as enthalpy economizers and water-side free cooling. Measures such as these save energy, but only during cooler weather, and not coincident with peak demand periods. Realization rates other than 1.0 for energy were due to many different factors. Minor changes from ex ante estimates were due to:

- Different hours of operation or set points observed on-site by the EM&V team;
- Minor calculation errors;
- Failure to account for gas heating or mechanical cooling when ventilation equipment was turned off at night; and
- Failure to use TRM methods for measures covered in the TRM (faucet aerators)

The evaluation team made other changes based on more fundamental engineering questions.

- An RSP based demand controlled ventilation savings estimates on conditions when air-side systems are economizing.

- Some discharge air temperature reset schedules were poorly-specified with higher set points maintained up to 80°F which is not standard and can lead to comfort problems when ambient humidity is high and thus low persistence of savings.

Greater attention in the calculation reviews should minimize these causes of lower realization rates.

3.1 Tracking System Review

Navigant reviewed the tracking system exports for accuracy and completeness of data. In general, we find the tracking system adequate to the task.

- Projects are tracked from preliminary contact through internal implementation verification with appropriate mid-point 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. In subsequent evaluations Navigant would like to examine the TrakSmart system itself. Navigant has no recommendations for the tracking systems 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 3-2. Among the projects submitted, one is a gas-only project where the electricity savings were filed with an electric utility other than ComEd (Ameren Illinois Company). At least two projects are follow-on retro-commissioning measures for projects submitted in prior years. This latitude to submit savings for measures in separate years is one of the more recent modifications to the program, which was made in order to accommodate the long implementation cycle of some measures.

Table 3-2. EPY5/GPY2 Volumetric Findings

Participation	Electric Only	Electric & Natural Gas	Natural Gas Only	Total
Participants	18	26	2	46
Total Measures	95	154‡	3	252

Source: Utility tracking data and Navigant analysis.
‡ Measures can save electricity, natural gas or both

Table 3-3 shows volumetric findings since PY2. The number of participants has declined somewhat from last year and about 40 projects were reported in the pipeline for EPY6/GPY3 as of June 2013. The number of measures per participant has declined somewhat as well, though it is not clear whether

this metric reflects decreasing opportunity, 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 3-3. EPY5/GPY2 Volumetric Findings since Program Inception

Participation	EPY2[14]	EPY3	EPY4/GPY1	EPY5/GPY2
Participants	13	29	50	46
Total Measures	125	215	338	252
Measures per participant	9.6	7.4	6.8	5.5

Source: EM&V analysis

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 rates 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 for all measures in the evaluation sample.

3.4 Development of the Research Findings Gross Realization Rate

Research findings gross realization rates are based on engineering review of algorithms used to estimate ex ante savings. Review of a census of projects and 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 then randomly sampled within each strata to achieve desired statistical confidence and precision – 90/10 respectively – for each utility (Table 3-4). 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 for the gas utilities. 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. Sample precision at 90% confidence is shown in Table 3-5.

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

Table 3-4. EPY5/GPY2 Impact Sampling Design

	ComEd	Nicor Gas	Peoples Gas[15]
Stratum A	6	2	3
Stratum B	6	2	3
Stratum C	8	3	4
Total sample	20	7	10

Source: EM&V research

Table 3-5. EPY5/GPY2 Impact Sampling Final

	ComEd	Nicor Gas	Peoples Gas
Stratum A	6	2	3
Stratum B	8	2	3
Stratum C	12	4	4
Total sample	26	8	10
Sample Precision at 90% confidence	7.2%	7.5%	9.6%

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.

3.5 Research Findings Gross Program Impact Results

Among the sampled projects, Navigant compared *ex post* savings to annual energy consumption prior to program participation. For both gas and electric energy use, we found approximately 8% implemented savings. Site specific results varied between 1% and about 20%. The total program research findings gross savings is shown in Table 3-6. The table presents savings at the utility-level. Realization rates are the results of analyzing 26 projects including more than 160 measures.

[15] North Shore Gas had no participating customers, thus no projects sampled.

Table 3-6. Research Findings Gross Savings Realization

Savings Category	ComEd MWh	ComEd MW	Nicor Gas (therms)	Peoples Gas (therms)	North Shore Gas (therms)
Ex Ante Gross Savings[1]	26,203	2.818	397,353	284,726	0
Research Findings Gross Realization Rate	0.946	0.639	1.015	1.043	NA
Research Findings Gross Savings[2]	24,788	1.801	403,126	296,931	0

[1] *Source Tracking systems*

[2] *Source: Evaluation*

Reasons for realization rates other than 1.0 include are discussed in section 3.0.

4. Net Impact Evaluation

The following values were deemed by SAG[16] to be used to calculate EPY5/GPY2 verified net savings.

Table 4-1. EPY5/GPY2 Deemed Net to Gross Ratio Values Estimates

Parameter	Electricity	Natural Gas
Net-to-Gross Ratio	0.71	1.02
Source	EPY3 research	GPY1 research

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

The Net-to-gross ratio used by ComEd was determined in the EPY3 evaluation by self-report interviews with program participants. Those interviews represented a relative minority of program participants and savings from that program year. The EPY3 research was updated in EPY4/GPY1 for electricity. The gas utilities did not have prior research estimates for NTG, thus they are using the values determined with EPY4/GPY1 research in EPY5/GPY2. Verified net savings, calculated with NTG values in Table 4-1 are shown in Table 4-2.

Table 4-2. EPY5/GPY2 Program Results by Utility

Savings Category	ComEd MWh	ComEd MW	Nicor Gas Therms	Peoples Gas (Therms)
Ex Ante Gross Savings[17]	26,203	2.818	397,353	284,726
Research Findings Gross Realization Rate‡	0.946	0.639	1.015	1.043
Research Findings Gross Savings	24,788	1.801	403,126	296,931
Net to gross ratio (NTG) †	0.71	0.71	1.02	1.02
Verified Net Savings ‡	17,599	1.279	411,189	302,870

Source: Utility tracking data and Navigant analysis.
† *A deemed value.*
‡ *Based on evaluation research findings.*

[16] http://www.ilsag.info/net-to-gross-framework-1.html.
[17] From Tracking System

5. Process Evaluation

Process Evaluation research was not a focus of the program evaluation in EPY5/GPY2. Nonetheless, certain process information was discussed with the program managers from the utilities and the IC, Nexant. The following items are a summary of those discussions.

Table 5-1. Process Data Collection Summary

Data Collection Type	Targeted Population	Sample Frame	Actual Sample Achieved	Timing
In-Depth Interviews	Utility Program Staff	Contact from utilities	2	June 2013
	Implementation Contractor Staff	Contact from IC	1	June 2013

In addition to these interviews with key program personnel, Navigant conducted research for Nicor Gas to determine whether there were any factors, particular to Nicor Gas customers, that affected participation and savings opportunities.

5.1 Summary of Process Interviews

Program Delivery Mechanisms and Marketing Strategy
The program is still marketed primarily through one-on-one marketing to candidate facilities by the Program's qualified RSPs. Utility program staff and the IC contribute to program promotion. Utility account managers may refer a project or two each year but they are not considered a primary means for promotion. The IC and utilities collaborated to produce marketing materials, and the IC conducts marketing training for RSPs.

Outreach strategies included one-on-one meetings with customers, presentations and public meetings along with program collateral (fact sheets, tri-folds, case studies, brochures and web). A majority of the program activity however is driven directly by the RSPs. Sector-focused marketing to contractors and new and existing RSPs is also a primary focus.

Retro-Commissioning Service Provider (RSP) Participation
There were 24 commercial building RSPs registered with the program in EPY5/GPY2. Of those 24 providers, 13 were providers who had actively participated in the program in the past and 11 were new providers brought in through the RFP process that has been part of the program since its inception. In EPY5/GPY2 eleven RSPs completed projects with nearly a half dozen others actively working on projects in the program year that will be completed in EPY6/GPY3. Those RSPs who are not active will be given one more year to bring in a project. If they are not able to do so, they will need to re-bid in order to remain an eligible RSP.

Summary of Program Changes from EPY4/GPY1
Changes made between EPY4/GPY1 and EPY5/GPY2 included changes to the participating RSPs, the payment schedules for RSPs and the addition of the Commercial Building Incentive Assessment.

Key changes include:

- **Removal of 11 inactive RSPs and the addition of 11 new RSPs.** In EPY4/GPY1 the program had 23 service providers with only 11 who were active. In an effort to increase the number of active providers, the IC opened up an RFP process to new providers and asked 10 of the EPY4/GPY1 providers to re-bid in order to continue participation in EPY5/GPY2. As a result of this process 11 new service providers were added to the program with two of those who were asked to re-bid renewed.
- **Adjustment to the amount paid to RSPs at each stage of the process.** A key finding ComEd discovered during a survey they completed of RSPs in EPY5/GPY2 was that their investment through the planning phase was significant and the payment structure did not acknowledge the level of effort. In order to address this and to better acknowledge staff time RSPs put in up front, the IC adjusted the percent paid at some stages, this included:
    - Moving from 25% at planning to 35%
    - Moving from 45% to 35% at investigation
    - Staying at 30% for verification
- **Launching of the new Commercial Building Incentive Assessment.** In early 2013 the program launched the Commercial Building Incentive Assessment. This offering allows the RSPs to perform an audit of a building for capital and retrofit measures, primarily focusing on lighting and variable speed drives on the electric side, as well as ~~some~~ measures on the gas side. This takes advantage of the access that the RSPs have, to generate leads for the other utility program offerings, primarily the standard and custom programs.
- **Building out of a full program database.** In EPY5/GPY2 the program built out a full database of all projects going back to pilot year EPY1. This dataset created a rich source of data that allowed the program team to look at elements such as which measures are the most commonly seen, which measures are the most cost effective, how this differs by building sizes and building types, etc. This targeting effort was designed to help the program identify opportunities in buildings that are going to be most cost effective through the current program process.
- **Streamlining of the reporting template.** Feedback in EPY4/GPY1 and gathered through the RSP survey completed by ComEd during EPY5/GPY2 foundGPY2found that RSPs felt the reporting requirements were somewhat redundant. Based on this the IC is making changes to the reporting requirements.
- **Increased support through the agreement process**. The IC had identified getting the initial participation agreement signed as major barrier and delay factor to moving projects forward in previous years. Participants often require extensive legal review in advance of signing off on the agreement which was causing project delays. In an effort to address this fact, the IC began working with participants to ensure the agreement review process would begin immediately after the kick-off meeting and that any and all comments be provided by the mid-point of the planning phase. This change mitigated any risk that the program will fully invest in the cost of a planning phase that would not lead to a completed project because of issues with the participation agreement or in other less extreme cases lessens the number of projects delayed because of negotiations on the agreement.

- **Customized marketing tools for RSPs**. In the EPY4/GPY1 evaluation there was feedback from RSPs that more customized marketing material would be helpful. As a result the program recently launched a web tool that allows RSPs to log in to get customized collateral. This new offering gives RSPs the ability to build their own case studies (some past feedback was that RSPs don't like to use a case study on another RSP's work). The tool allows them to use boilerplate format, customized to their own project information, giving a more tailored marketing piece for their use.

Data Tracking, Reporting and Utility Coordination
The program manager and IC both reported that all program data, going back to EPY1 is now in TrakSmart. Previously the data had been tracked in disparate spreadsheets. All projects are also imported into the Frontier and Bensight database. Both the utilities and Nexant report that this process is working well and that they are able to gather and review the data needed to assess program progress and report results as needed.

Weekly calls continue to be an important piece of program coordination. Calls include all the utilities and Nexant. Topics rotate by week, where on one week, the focus is program operations where the discussion is focused on high-level strategy and issues, and the next call focuses on a project status, where they walk through each of the individual retro-commissioning projects in detail.

Training
In EPY5/GPY2 training continued for the Retro-Commissioning Program. Trainings included an in-person RSP training in November of 2012 that offered a morning session focused on on-boarding for the new providers and an afternoon session that focused on specific issues and changes for EPY5/GPY2, how RSPs can help shepherd participants through the application, and the results from the EPY4/GPY1 evaluation and lessons learned.

The in-person training was supplemented by three webinars with the RSPs. One launched the Commercial Building Incentive Assessment offering in February. A second in March covered the monitoring-based commissioning offering. A third in May with all of the RSPs talked about the results from the survey that ComEd conducted on RSP satisfaction.

Barriers
The program managers and implementer indicated that there are still several barriers affecting program success. These included:

- Coordination with the controls contractors that are brought in to do much of the project work. A number of projects in EPY5/GPY2 were delayed when the controls contractor didn't implement the project correctly. In other cases, lack of equipment availability caused delays. In response to this, Nexant is looking at tweaks in EPY6/GPY3 that may help avoid some of those challenges including having the customer include the control contractors as early as possible in the process.
- Customer implementation funding and staff availability continue to be barriers for the Retro-Commissioning Program. Customers are asked to commit a certain amount of money and time towards implementation, and although Nexant and the RSP are closely involved in the projects, keeping the participant moving and investing continues to be a challenge.

- Staff changes and/or disengagement also continue to cause problems for a smaller percentage of projects. According to the ComEd Program Manager the program loses about 10% of projects to staff changes in an organization (new staffs are not committed to or decide to not follow through with the project) and/or to attrition after the initial phase (companies commit initially and then back out after the planning phase). These losses are costly to the utilities.

Building Operator Certification Training
One program requisite has been the requirement that at least one participant representative attend and complete Level I Building Operator Certification training within 12 months of completing the retro-commissioning project. Feedback from the IC indicated that the BOC training requirement was being better met in EPY5/GPY2, though there is still room for improvement. BOC training attendance is collected in a tracking spreadsheet outside of TrakSmart, Bensight or Frontier.

Monitoring based programs
RSPs indicated that a lot of customers think monitoring-based commissioning is the way things are going in the future. ComEd is piloting an offer that will place them well to take advantage of that in the marketplace as it becomes more common.

5.2 Summary of Nicor Gas – Specific Research

The following four findings comprise the conclusions of supplementary research conducted for Nicor Gas.

(1) There is no evidence that program tools or processes limit gas savings or inhibit estimation of gas savings. Program gas savings overall averaged about 7%, a level similar to electricity savings.
(2) Geography and building stock appear likely to contribute to the perception that Nicor Gas savings levels are low and to the slow ramp up of joint gas and electric projects. Large commercial buildings and most service providers are located in or close to the City of Chicago.
(3) In retro-commissioning projects, the electric savings are the plum because of the higher cost; most gas savings are coincident savings.
(4) Broadening an RCx program to target gas savings as well as electric in a geography with fewer active RSPs takes time as the project development timelines are long.

The overarching conclusion is that there are not major programmatic impediments to recruiting Nicor Gas customers and implementing gas savings that are available.

6. Conclusions and Recommendations

This section summarizes the key impact and process findings and recommendations. In general, the program continues to perform as it did in prior years. A steady flow of projects are generating savings. The program has evolved to capture the diverse customer base in the commercial building market sector. Facilities receiving district energy can participate and smaller buildings that are part of a campus are eligible to participate as well. 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 gas, and analyzing one, while neglecting the other, would be a lost opportunity. The implemented savings is between five and seven percent of participant annual electricity and gas consumption, on average.

Program Savings Goals Attainment

Finding 1. Nicor Gas energy savings fell well-short of goals (1,024,308 therms), though program managers expect GPY3 savings will make up for some of this shortfall due to long implementation lead times for some retro-commissioning measures.[18] The energy savings goals for Peoples Gas and North Shore Gas for the Retro-Commissioning Program were rolled into the Custom goals (Retro-Commissioning goals were revised down from the original plan to 300,000 therms for Peoples Gas, and 10,000 therms for North Shore Gas) due to a low level of activity. No projects were implemented with North Shore Gas customers, so they achieved zero net savings from the program, while verified net savings for the Peoples Gas program were 99 percent of revised planned savings. ComEd energy savings fell just short of their gross energy savings goal of 29,500 MWh savings.[19] ComEd does not have demand savings goals for retro-commissioning.

Recommendation. The EPY6/GPY3 pipeline of projects appears to be a continuation of past performance for all utilities except North Shore Gas[20]. Goals attainment is very dependent on the number of projects processed by the program. EPY5/GPY2 projects involved two more RSPs than EPY4/GPY1 (11 versus 9) but that still leaves more than 50% of participating RSPs without a completed project. Working with the new RSPs to complete projects and enroll future participants should be a priority for meeting future goals.

Gross Realization Rates

Finding 2. A few RSPs are recommending retrofit measures among their retro-commissioning measures that are covered in the Illinois Technical Reference Manual or might be included in future versions of the Manual. These measures include faucet aerators (TRM) and V-Bank filters for ventilation systems.

Recommendation. When measures are covered in the TRM consider using the algorithms there for *ex ante* estimates rather than custom methods for consistency. Consider proposing V-bank filters for deemed savings through the prescriptive program. Base

[18] ICC Quarterly Report 4th Quarter PY2 Final.xls, Nicor Gas, July 16 email.
[19] ComEd PY5 final cost_kWh.pdf, ComEd, October 10, 2013 email from David Nichols.
[20] North Shore Gas has one pipeline participant for GPY3 in a recent tracking review

deemed savings on research from pre- and post-installation measurements through retro-commissioning verification processes.

Demand Savings Estimates

Finding 3. ComEd does not report demand savings for the Retro-Commissioning program; even though, demand savings is tracked in the TrakSmart database and most RSPs estimate demand savings for their clients. The lack of focus on electric demand savings results in inconsistent methods for estimating savings and a low realization rate for demand savings as compared to the tracking system. In many cases demand savings is reliably achieved, and not reporting demand savings can affect the benefit/cost tests for the electric program.

Recommendation. Consider reporting demand savings for measures that generate reliable savings – for example fixing/changing minimum ventilation rates or turning off loads that were running at peak hours. Establishing clear guidelines for the kind of measures that ComEd would qualify for reporting can reduce the burden on RSPs and the implementation contractor for reviewing measures.

Finding 4. The inconsistent demand estimation methods resulted in low realization rates for electric demand savings and can result in misleading economic payback information for participants. Several measures that claimed significant demand savings are effective only during cooler or cold weather (enthalpy economizer controls and water-side free cooling) or diminish in savings potential as outdoor air temperatures rise and affect reset schedules (static pressure, chilled water and discharge air temperature resets).

Recommendation. Consider establishing and enforcing clear methods for estimating demand savings, where it is reliable. A very simple method might be to report the demand savings in the 80-85F temperature bin during daytime hours – similar to the single point estimate for PJM reporting. Reducing the scope for when estimates are required and establishing clear methods will reduce the burden on RSPs to perform the estimates and give participants clear indications when measures will also achieve cost savings from demand reduction.

Service Provider Participation

Finding 5. Eleven RSPs participated in EPY5/GPY2. This is an increase from nine last year, but one RSP submitted almost 40% of projects and the top 4 active RSPs submitted 70% of projects while all others submit three or less. Tracking data show that 15 RSPs have pipeline projects including six that have not completed projects in the past.

Recommendation. Consider focusing marketing and follow-up efforts with new or less active RSPs to help them understand the value proposition for themselves and their customers for participating in the program.

Participant Building Operator Certification Training

Finding 6. One requirement of the program is successful completion of Level I Building Operator Certification training by at least one participant representative within one year of completing the retro-commissioning project. The training is well received, anecdotally, and serves to support savings persistence. Successful tracking of this requirement, however, has only recently been implemented. Data show that thirteen individuals representing eight EPY4/GPY1 participants (of 50) have completed the training. For

EPY5/GPY2 fifteen individuals, representing eleven participants, have completed the training. The one year window for compliance almost ensures this will be a recurring evaluation concern. Program leverage is weak on this requirement as the RSP is paid for the study long before the *participant* must comply.

Recommendation. Consider stronger tools for enforcing this program requirement – such as requiring participants to pay for training tuition prior to program completion. The program might collect the tuition in escrow and pay for the training when the participant enrolls. Compile a list of testimonials from operators who have recently completed the training describing the benefits of training.

Processes.

Finding 7. Program Managers identified coordination with the controls contractors as a barrier to program success. These contractors are brought in to do much of the project work and in some cases, have not implemented projects correctly. Also, program managers identified that customer implementation funding and customer staff availability to participate in the retro-commissioning process continue to be barriers for the program.

Recommendation. Consider closer coordination with controls contractors, either by Nexant or also by utility staff. Closer coordination and more frequent monitoring will ensure that contractors are on track to implement projects successfully. Also, since funding and staff availability continue to be obstacles, the program could consider increasing funding and staffing to meet program goals.

Overall the program is addressing the barriers to retro-commissioning and operational savings in commercial buildings. There are a large number of registered service providers with varying degrees of activity in the service territory. Anecdotal comments suggest that participants are more aware of the program and the benefits of retro-commissioning, in general.

7. Appendix

7.1 Glossary

High Level Concepts

Program Year

- EPY1, EPY2, etc. Electric Program Year where EPY1 is June 1, 2008 through May 31, 2009, EPY2 is June 1, 2009 through May 31, 2010, etc.
- GPY1, GPY2, etc. Gas Program Year where GPY1 is June 1, 2011 through May 31, 2012, GPY2 is June 1, 2012 through May 31, 2013.

There are two main tracks for reporting impact evaluation results, called Verified Savings and Impact Evaluation Research Findings.

Verified Savings composed of

- Verified Gross Energy Savings
- Verified Gross Demand Savings
- Verified Net Energy Savings
- Verified Net Demand Savings

These are savings using deemed savings parameters when available and after evaluation adjustments to those parameters that are subject to retrospective adjustment for the purposes of measuring savings that will be compared to the utility's goals. Parameters that are subject to retrospective adjustment will vary by program but typically will include the quantity of measures installed. In EPY5/GPY2 the Illinois TRM was in effect and was the source of most deemed parameters. Some of ComEd's deemed parameters were defined in its filing with the ICC but the TRM takes precedence when parameters were in both documents.

Application: When a program has deemed parameters then the Verified Savings are to be placed in the body of the report. When it does not (e.g., Business Custom, Retrocommissioning), the evaluated impact results will be the Impact Evaluation Research Findings.

Impact Evaluation Research Findings composed of

- Research Findings Gross Energy Savings
- Research Findings Gross Demand Savings
- Research Findings Net Energy Savings
- Research Findings Net Demand Savings

These are savings reflecting evaluation adjustments to any of the savings parameters (when supported by research) regardless of whether the parameter is deemed for the verified savings analysis. Parameters that are adjusted will vary by program and depend on the specifics of the research that was performed during the evaluation effort.

Application: When a program has deemed parameters then the Impact Evaluation Research Findings are to be placed in an appendix. That Appendix (or group of appendices) should be labeled Impact Evaluation Research Findings and designated as "ER" for short. When a program does not have deemed parameters (e.g., Business Custom, Retrocommissioning), the Research Findings are to be in the body of the report as the only impact findings. (However, impact findings may be summarized in the body of the report and more detailed findings put in an appendix to make the body of the report more concise.)

Program-Level Savings Estimates Terms

N	Term Category	Term to Be Used in Reports‡	Application†	Definition	Otherwise Known As (terms formerly used for this concept)§
1	Gross Savings	Ex-ante gross savings	Verification and Research	Savings as recorded by the program tracking system, unadjusted by realization rates, free ridership, or spillover.	Tracking system gross
2	Gross Savings	Verified gross savings	Verification	Gross program savings after applying adjustments based on evaluation findings for only those items subject to verification review for the Verification Savings analysis	Ex post gross, Evaluation adjusted gross
3	Gross Savings	Verified gross realization rate	Verification	Verified gross / tracking system gross	Realization rate
4	Gross Savings	Research Findings gross savings	Research	Gross program savings after applying adjustments based on all evaluation findings	Evaluation-adjusted ex post gross savings
5	Gross Savings	Research Findings gross realization rate	Research	Research findings gross / ex-ante gross	Realization rate
6	Gross Savings	Evaluation-Adjusted gross savings	Non-Deemed	Gross program savings after applying adjustments based on all evaluation findings	Evaluation-adjusted ex post gross savings
7	Gross Savings	Gross realization rate	Non-Deemed	Evaluation-Adjusted gross / ex-ante gross	Realization rate
1	Net Savings	Net-to-Gross Ratio (NTGR)	Verification and Research	1 – Free Ridership + Spillover	NTG, Attribution
2	Net Savings	Verified net savings	Verification	Verified gross savings times NTGR	Ex post net
3	Net Savings	Research Findings net savings	Research	Research findings gross savings times research NTGR	Ex post net
4	Net Savings	Evaluation Net Savings	Non-Deemed	Evaluation-Adjusted gross savings times NTGR	Ex post net
5	Net Savings	Ex-ante net savings	Verification and Research	Savings as recorded by the program tracking system, after adjusting for realization rates, free ridership, or spillover and any other factors the program may choose to use.	Program-reported net savings

‡ "Energy" and "Demand" may be inserted in the phrase to differentiate between energy (kWh, Therms) and demand (kW) savings.

† **Verification** = Verified Savings; **Research** = Impact Evaluation Research Findings; **Non-Deemed** = impact findings for programs without deemed parameters. We anticipate that any one report will either have the first two terms or the third term, but never all three.

§ Terms in this column are not mutually exclusive and thus can cause confusion. As a result, they should not be used in the reports (unless they appear in the "Terms to be Used in Reports" column).

Individual Values and Subscript Nomenclature

The calculations that compose the larger categories defined above are typically composed of individual parameter values and savings calculation results. Definitions for use in those components, particularly within tables, are as follows:

Deemed Value – a value that has been assumed to be representative of the average condition of an input parameter and documented in the Illinois TRM or ComEd's approved deemed values. Values that are based upon a deemed measure shall use the superscript "D" (e.g., delta watts^{D}, HOU-Residential^{D}).

Non-Deemed Value – a value that has not been assumed to be representative of the average condition of an input parameter and has not been documented in the Illinois TRM or ComEd's approved deemed values. Values that are based upon a non-deemed, researched measure or value shall use the superscript "E" for "evaluated" (e.g., delta watts^{E}, HOU-Residential^{E}).

Default Value – when an input to a prescriptive saving algorithm may take on a range of values, an average value may be provided as well. This value is considered the default input to the algorithm, and should be used when the other alternatives listed for the measure are not applicable. This is designated with the superscript "DV" as in X^{DV} (meaning "Default Value").

Adjusted Value – when a deemed value is available and the utility uses some other value and the evaluation subsequently adjusts this value. This is designated with the superscript "AV" as in X^{AV}

Glossary Incorporated From the TRM

Below is the full Glossary section from the TRM Policy Document as of October 31, 2012[21].

Evaluation: Evaluation is an applied inquiry process for collecting and synthesizing evidence that culminates in conclusions about the state of affairs, accomplishments, value, merit, worth, significance, or quality of a program, product, person, policy, proposal, or plan. Impact evaluation in the energy efficiency arena is an investigation process to determine energy or demand impacts achieved through the program activities, encompassing, but not limited to: *savings verification*, *measure level research*, and *program level research*. Additionally, evaluation may occur outside of the bounds of this TRM structure to assess the design and implementation of the program.

Synonym: **Evaluation, Measurement and Verification (EM&V)**

> **Measure Level Research**: An evaluation process that takes a deeper look into measure level savings achieved through program activities driven by the goal of providing Illinois-specific research to facilitate updating measure specific TRM input values or algorithms. The focus of this process will primarily be driven by measures with high savings within Program Administrator portfolios, measures with high uncertainty in TRM input values or algorithms (typically informed by previous savings verification activities or program level research), or measures where the TRM is lacking Illinois-specific, current or relevant data.
>
> **Program Level Research**: An evaluation process that takes an alternate look into achieved program level savings across multiple measures. This type of research may or may not be

[21] IL-TRM_Policy_Document_10-31-12_Final.docx

specific enough to inform future TRM updates because it is done at the program level rather than measure level. An example of such research would be a program billing analysis.

Savings Verification: An evaluation process that independently verifies program savings achieved through prescriptive measures. This process verifies that the TRM was applied correctly and consistently by the program being investigated, that the measure level inputs to the algorithm were correct, and that the quantity of measures claimed through the program are correct and in place and operating. The results of savings verification may be expressed as a program savings realization rate (verified ex post savings / ex ante savings). Savings verification may also result in recommendations for further evaluation research and/or field (metering) studies to increase the accuracy of the TRM savings estimate going forward.

Measure Type: Measures are categorized into two subcategories: custom and prescriptive.

Custom: Custom measures are not covered by the TRM and a Program Administrator's savings estimates are subject to retrospective evaluation risk (retroactive adjustments to savings based on evaluation findings). Custom measures refer to undefined measures that are site specific and not offered through energy efficiency programs in a prescriptive way with standardized rebates. Custom measures are often processed through a Program Administrator's business custom energy efficiency program. Because any efficiency technology can apply, savings calculations are generally dependent on site-specific conditions.

Prescriptive: The TRM is intended to define all prescriptive measures. Prescriptive measures refer to measures offered through a standard offering within programs. The TRM establishes energy savings algorithm and inputs that are defined within the TRM and may not be changed by the Program Administrator, except as indicated within the TRM. Two main subcategories of prescriptive measures included in the TRM:

Fully Deemed: Measures whose savings are expressed on a per unit basis in the TRM and are not subject to change or choice by the Program Administrator.

Partially Deemed: Measures whose energy savings algorithms are deemed in the TRM, with input values that may be selected to some degree by the Program Administrator, typically based on a customer-specific input.

In addition, a third category is allowed as a deviation from the prescriptive TRM in certain circumstances, as indicated in Section 3.2:

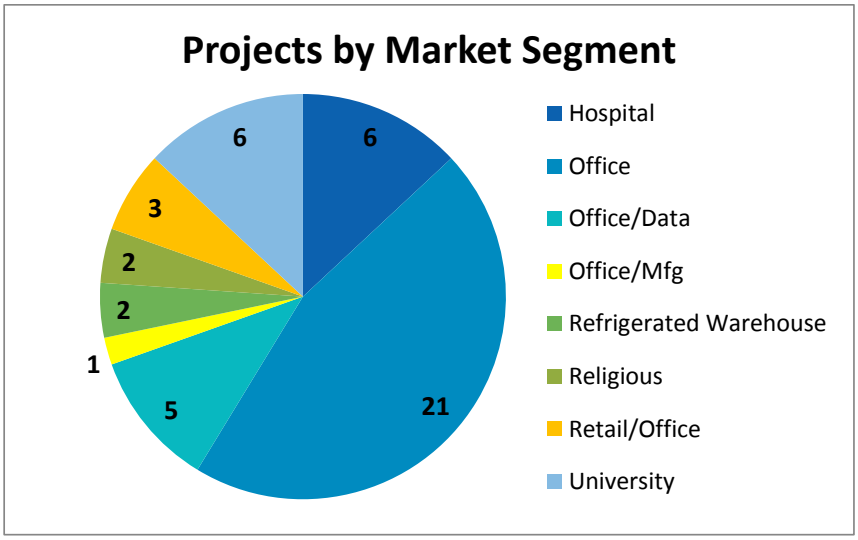
Customized basis: Measures where a prescriptive algorithm exists in the TRM but a Program Administrator chooses to use a customized basis in lieu of the partially or fully deemed inputs. These measures reflect more customized, site-specific calculations (e.g., through a simulation model) to estimate savings, consistent with Section 3.2.

7.2 Detailed Impact Research Findings and Approaches

7.2.1 Gross Impact Results

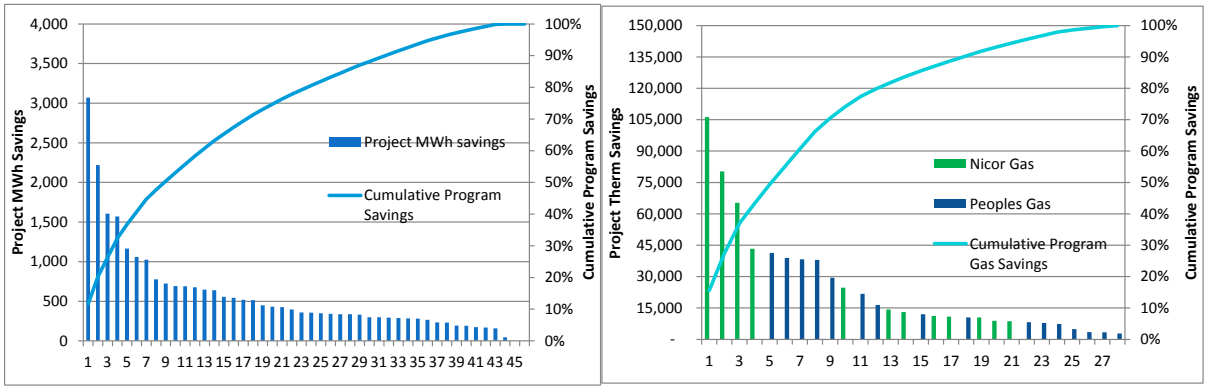
The participants in the EPY5/GPY2 Smart Ideas Retro-Commissioning Program represent a diverse commercial building market sector. While office buildings and their permutations comprise a majority of participants, there is a strong presence of hospitals and universities in the participant pool.

Figure 7-1. Participants by Market Segment



A relatively small number of projects account for a large proportion of savings, thus a stratified sampling protocol is preferred. Nine projects (19%) comprise 50% of electric savings. Four of twelve Nicor Gas projects comprise 75% of utility savings. Likewise, for Peoples Gas seven of sixteen projects comprise 73% of utility savings.

Figure 7-2. Distribution of Program Savings by Project



Navigant categorized measures by affected end-use and measure type to identify patterns. Measure types are optimization (added controls or set point resets/changes), scheduling (turning equipment on and off according to time-of-day criteria), repairs to broken equipment (damper actuators or compressed air leaks) and low-cost retrofits of existing equipment (air nozzles, faucet aerators and

filter media). Figures 7-2 and 7-3 demonstrate that air-side measures generate the bulk of program savings as do optimization measures. These results are consistent with evaluations of this program from prior years.

Figure 7-3. Electric Savings Distribution by Measure

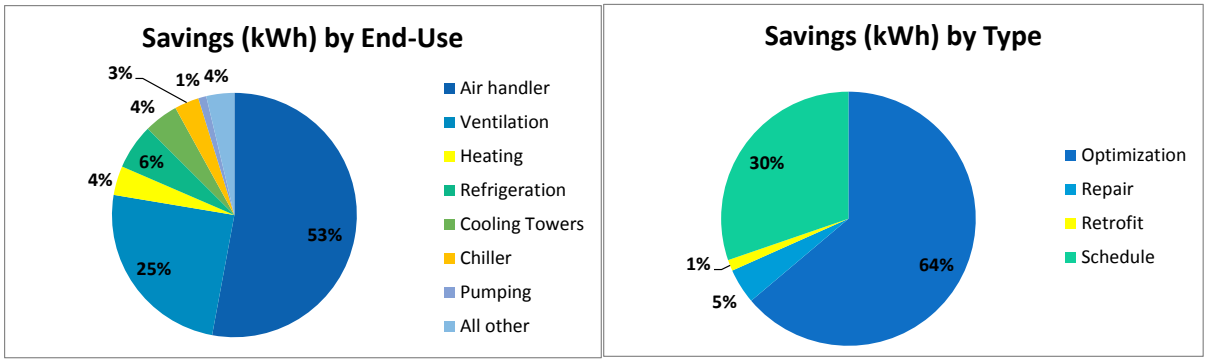
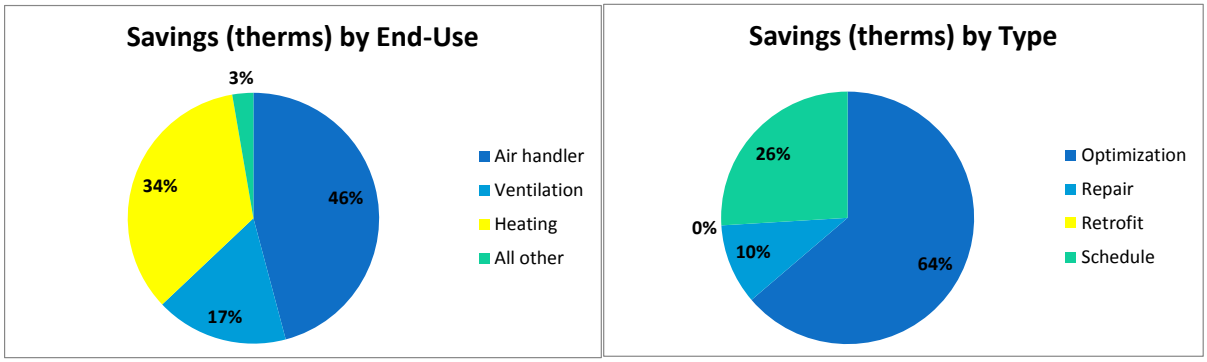


Figure 7-4. Natural Gas Savings Distribution by Measure



Research findings gross realization rates are the result of analysis of individual measures for each project in the impact sample. Table 7-1 details the realization rates by sampled projects.

Realization rates significantly different from 1.0 are due to reasons noted in Section 3.0.

Table 7-1. Project Level Realization Rates

Facility Type	Realization Rates		
	kWh	kW	Therms
Office/Data	94%		144%
Office 1	97%	20%	
Office 2	104%	29%	
Office 3	93%	92%	
Refrigerated Warehouse 1	93%	87%	100%
Refrigerated Warehouse 2	100%	150%	132%
Hospital 1	91%		121%
Office 4	98%	93%	
University 1	98%	103%	157%
Hospital 2	79%	98%	126%
Office 5	82%	100%	
Office 6	102%		117%
Office 7	75%		
Office 8	121%	57%	
Retail/Office 1	88%	100%	67%
Hospital 3	91%	0%	105%
Retail/Office 2	101%	86%	
University 2	110%	98%	117%
Office 9	100%		100%
Office 10	97%	163%	57%
University 3	100%	53%	100%
Office/Mfg.	65%		132%
Office 11	107%	119%	100%
Hospital 4	99%		93%
Office 12	62%	100%	57%
Hospital 5			67%

Source: Evaluation research

7.3 Detailed Process Results

The results of the limited process evaluation are reported in full in section 5.2.

7.4 PJM Data and Findings

ComEd has not claimed PJM demand savings for the Retro-commissioning Program in prior program years.

Retro-Commissioning Program, ComEd Program Year 5

Ex Post Gross Demand (MW) Savings 1.801 MW

Navigant verified *ex post* demand savings with custom calculations for each measure. For many measures implemented through the program savings depends on outdoor air conditions, for example reducing ventilation rates will result in different savings depending on the heat content of the outdoor air used to ventilate the building and the degree to which that air is conditioned. In most cases the savings at 83°F is used for the *ex post* demand savings as this is the average typical temperature (Chicago) during the PJM summer demand hours.

Realization Rate on Demand Savings: 0.64
Precision Estimate on Demand Savings (90% confidence, two-tail): TBD
Standard error for demand: TBD

Peak Demand or Coincident Peak Demand:
Data reported are peak coincident demand. Many retro-commissioning measures have maximum savings at night, for example, turning equipment off when a building is not occupied. Nighttime peak savings is not tracked or reported.

Peak demand is ill-defined in the tracking data for the Retro-Commissioning Program. Indeed some of the tracked demand savings is nighttime or winter demand savings which has been adjusted by evaluation. It does not appear that the implementation contractor or ComEd place high priority on demand savings from this program since savings from this program have not been nominated for PJM in the past.