

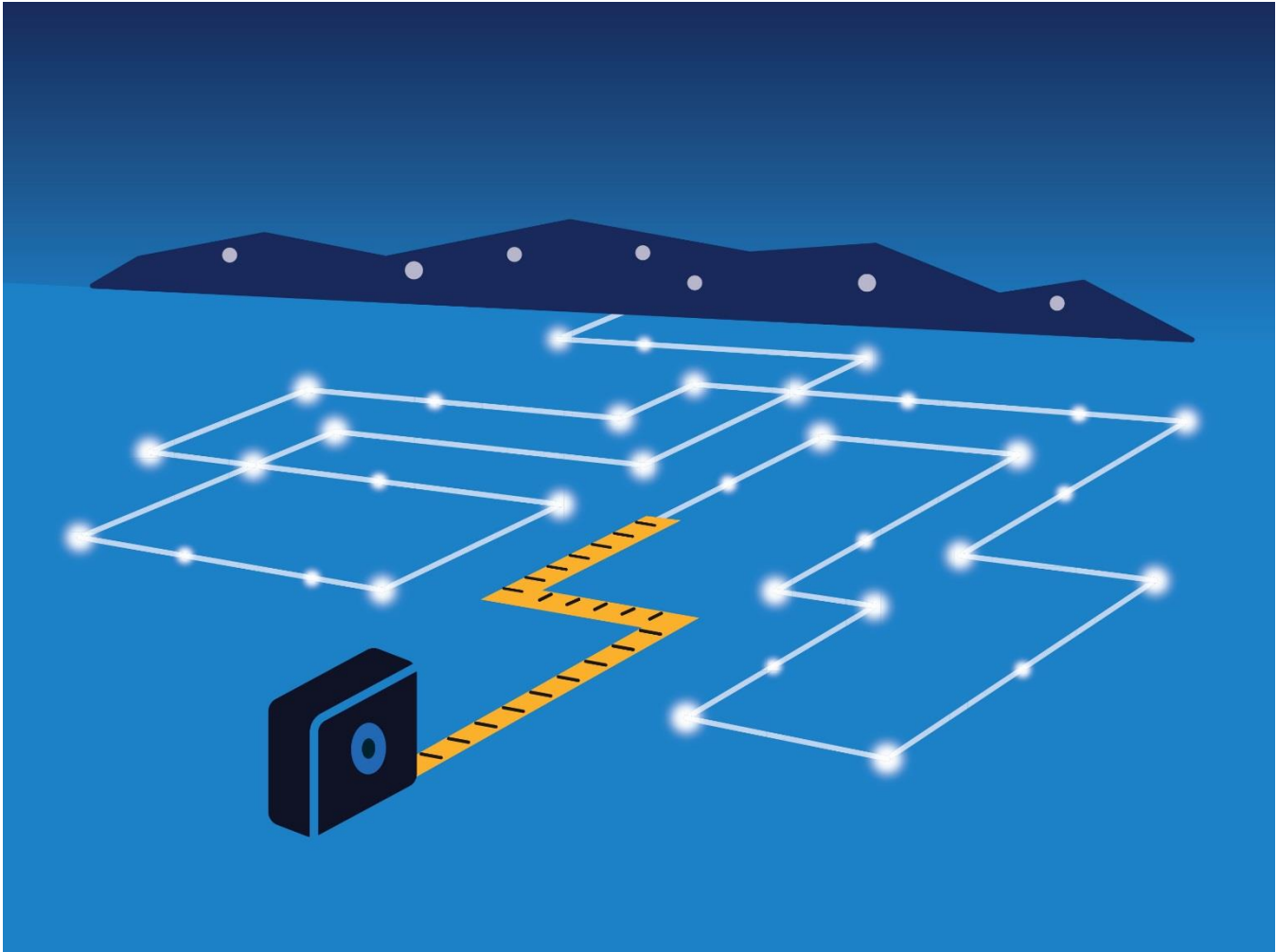


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Impact and Process Evaluation of 2015 (PY8) Ameren Illinois Company Commercial & Industrial Retro-Commissioning Program

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1. Executive Summary

This report presents the results of Opinion Dynamics’s evaluation of the Ameren Illinois Company (AIC) Commercial and Industrial (C&I) Retro-Commissioning Program in Program Year 8 (PY8). The Retro-Commissioning Program is one of three in AIC’s C&I portfolio, which also includes the Custom and the Standard programs. PY8 ran from June 1, 2015 through May 31, 2016.

The Retro-Commissioning Program helps AIC business customers evaluate their existing mechanical equipment, energy management, and industrial compressed air systems to identify no-cost and low-cost efficiency measures to optimize energy systems. Customers contract with preapproved Retro-Commissioning Service Providers (RSPs) to perform an energy survey, resulting in a written report detailing the savings opportunities. Following verified implementation of measures with a payback of less than 12 months, AIC pays an incentive that covers 70%–80% of the energy survey cost, based on the project type. A further implementation incentive is paid to the customer based on the energy saved, and a bonus is paid to the RSP based on timely measure implementation and energy saved.

For PY8, AIC planned to garner 5% of portfolio electric energy savings and 5% of portfolio therm savings from this program. The program had a net electric savings goal of 8,441 MWh and a net gas savings goal of 333,359 therms. The program achieved 9,854 MWh in ex post net electric savings and 413,492 therms in ex post net gas savings, easily meeting both its electric and therm goals in PY8.

A secondary goal of the Retro-Commissioning Program is the identification of retrofit and capital improvement projects that can be channeled to the Standard and Custom incentive programs offered by AIC. AIC offers an additional bonus to customers who complete a Custom project within a year of having completed a retro-commissioning study.

The PY8 evaluation includes gross impact results plus a limited process assessment. Our quantitative impact research included engineering reviews of a census of PY8 retro-commissioning projects plus on-site inspection and verification of measures for a sample of projects.

The process evaluation involved reviewing program materials and program-tracking data and interviewing program managers and two experts experienced with comparable retro-commissioning programs in other jurisdictions.

Below we present the key findings of the PY8 evaluation.

Program Impacts

Table 1 summarizes reported and verified program participation. A total of 19 projects were completed in the PY8 program, a small increase from a total of 16 in PY7. Among the 19 projects, there were 18 unique customers, with one customer completing two healthcare projects. Two projects saved both electricity and gas at a given site — one at a healthcare facility and one at an industrial facility. Two other projects were gas-only. All other projects completed in PY8 were industrial customers saving only electricity. Five customers took steps to begin participation in the program with initial assessments to determine retro-commissioning feasibility, and AIC paid the RSP a small incentive, referred to as a “stipend,” for this task. Since stipend costs occurred in PY8, they will be included in program cost-benefit analysis, although there are no projects or impacts associated with these sites in PY8.¹

¹ The customers may choose to implement study-recommended measures in PY9 or later.

Table 1. PY8 Retro-Commissioning Program Participation Summary

Program Component	Unique Customers	Unique Projects	Ex Ante Gross Electric Savings		Ex Ante Gross Gas Savings	
			MWh	%	Therms	%
Compressed Air	15	15	10,619	87%	0	—
Industrial Refrigeration	0	0	0	—	0	—
Large Facility	3	4	1,520	13%	514,070	100%
<i>Healthcare</i>	2	3	1,032	9%	423,428	82%
<i>Commercial</i>	1	1	488	4%	90,642	18%
Grocery	0	0	0	—	0	—
Total	18	19	12,139	—	514,070	—

The evaluation team performed an engineering desk review of all 19 projects (including both healthcare projects with gas savings), as well as on-site visits for six projects, to obtain gross realization rates for the program savings. The evaluation team modified the program ex ante gross savings for several reasons, although ultimately the gross realization rates were relatively high (88% for MWh savings, 100% for MW savings, and 88% for therm savings).

The evaluation team applied net-to-gross ratios (NTGRs) approved by the Illinois Stakeholder Advisory Group (SAG) to the gross savings estimates to calculate program net impacts. Table 2 summarizes PY8 gross and net impacts.

Table 2. PY8 Retro-Commissioning Program Gross and Net Impacts

	Ex Ante Gross	Realization Rate	Ex Post Gross	NTGR	Ex Post Net
Energy Savings (MWh)					
Total MWh	12,139	0.88	10,714	0.92	9,857
Demand Savings (MW)					
Total MW	1.24	1.00	1.25	0.92	1.15
Energy Savings (Therms)					
Total Therms	514,070	0.88	454,387	0.91	413,492

Key Findings and Recommendations

Based on our research, the evaluation team makes the following impact recommendations for the program:

- **Require RSPs to better document baseline conditions.** This could be aided by encouraging RSPs to use more-transparent and documented calculations, like spreadsheets, and/or by requiring the submission of electronic versions of calculations and simulations to ensure that evaluators understand how the RSPs obtain ex ante results. Calculation inputs should have notes for whether inputs are measured, based on design conditions, or assumed by the RSPs. It would also be useful for the program to require more pre-implementation documentation of as-found conditions to confirm the baselines used in calculations. For example, if the report claims a fan runs continuously, inclusion of a graph or screenshot of a week of operating data or a control schedule would allow for easier baseline verification.
- Consider issuing template calculators for common measures.

- Consider issuing standardized assumptions for key inputs to calculations, if they are not measured. For example, require using 70% of nameplate motor loading if actual loads are not measured.
- **Continue to improve documentation of post-installation inspections.** Though inspection documentation is much improved from prior years, some gaps still exist. Try to document measures with data or representational verification (photos, graphs, etc.). Clearly annotate which measures the verification is supposed to show. Some measures are hard to represent in this manner and some small measures may not merit large effort. A savings magnitude threshold (gross kWh or % of project savings) might be used to prioritize effort.
 - Frequently, the only verification for compressed air leak repairs is a hand-annotated list of leaks. If additional post-installation trend data are available for compressed air projects, they should be included in verification documentation.
- **Correct errors in compressed air savings calculations.** Correcting for inappropriate use of average compressor efficiency rather than marginal efficiency, assuming year-round operation without any down-time, and accurately accounting for plant air pressure in savings estimates will produce more-accurate ex ante savings estimates, resulting in higher realization rates for the program.
- **Encourage implementation of more savings and measures in addition to leak repair.** For example, require implementation of bundled measures that meet a payback threshold — 12 months, for example — in order to receive the study subsidy incentive. All savings from PY8 sampled compressed air projects derive from leak repairs. No other low-cost measures were implemented through the program. While the savings from leak repairs is significant and cost-effective, the RSPs should spend more effort investigating and encouraging implementation of other short-payback measures, including, for example, no-loss drains, elimination of inappropriate uses, storage, better staging of multiple compressors, and cycling driers. Compressed air retro-commissioning is more than leak repair.
- **Implement a stronger review regimen through the implementation contractor.** Positively confirm operating hours, plant pressures, production pressures, and compressor part-load performance.

Based on our interviews with retro-commissioning experts, the evaluation team makes the following process recommendations for program improvement:

- **Consider more clearly delineating the Large Facilities offering from the Compressed Air and Industrial Refrigeration offerings.** In PY7, the evaluation team found that the retro-commissioning proposition is not fully understood by the market and that market actors and customers have an inconsistent understanding of what retro-commissioning is. As a result, the team recommends more clearly defining what retro-commissioning is to aid customer understanding of the program.

One change that could be made to aid in this goal would be to break out the Large Facilities offering more clearly from the other program offerings, as is done in some other jurisdictions. This could be done by simply changing a program name and marketing materials. There is essentially no overlap between customers likely to participate in the Compressed Air and Industrial Refrigeration offerings vs. customers likely to participate in the Large Facilities offering, and the packaging together of these two very different groups of offerings could potentially be causing some confusion in the marketplace.

- **Continue to increase program staff marketing efforts and customer involvement.** Based on our PY7 research, as well as interviews with retro-commissioning experts in PY8, we continue to recommend

increased non-RSP-dependent marketing efforts and engagement for the Retro-Commissioning Program. Information from the program's implementation plan and our process evaluation activities indicate that, while market penetration of the Retro-Commissioning Program is relatively high, there are potential projects remaining in the market, especially in non-Compressed Air segments. Increased involvement by program staff, especially for the Large Facilities offering, could pay dividends. We recommend increased marketing activity by program Energy Advisors and Ameren Key Account Executives, who are the staff likely to have the detailed understanding of customer facilities required to understand if a customer is an ideal candidate for retro-commissioning. These staff are a crucial entry point for future projects into the program.

Additionally, increased involvement by staff could help identify natural breaks when energy-using equipment is shut down at industrial sites and other large facilities that could be an ideal time to conduct retro-commissioning activities.

2. Evaluation Approach

The assessment of Ameren Illinois Company's (AIC) Commercial and Industrial (C&I) Retro-Commissioning Program in Program Year 8 (PY8) consisted of an evaluation of program gross and net impacts and a limited program process assessment.

2.1 Research Objectives

The objective of the PY8 Retro-Commissioning Program evaluation is to provide estimates of gross and net electric and gas savings associated with the program. The PY8 impact evaluation answers the following questions:

1. What were the estimated gross energy and demand impacts from this program?
2. What were the estimated net energy and demand impacts from this program?

In addition, we provide limited insights into program processes and opportunities for improvement where possible. Key areas of inquiry for the process evaluation are as follows:

3. Effectiveness of Program Design and Implementation
 - a. Did the program as implemented change compared to PY7? If so, how and why and was this an advantageous change?
 - b. What implementation challenges occurred in PY8, and how were they overcome?
 - c. What areas could the program improve to create a more effective program for customers and help increase the energy and demand impacts?
4. Program Participation
 - a. What were the characteristics of participating customers? How many projects were completed? By how many different customers? What type of projects?
 - b. Did customer participation meet expectations? If not, how and why is it different from expectations? Are any changes in the mix of customers and projects desirable?

2.2 Evaluation Tasks

The PY8 assessment of the AIC Retro-Commissioning Program included both process and impact analyses. Table 3 summarizes the PY8 evaluation activities conducted for the Retro-Commissioning Program.

Table 3. PY8 Retro-Commissioning Program Evaluation Methods

Activity	PY8 Process	PY8 Impact	Forward Looking	Details
Review of Program Materials and Data	✓	✓		Comprehensive review of program data to assess any changes in program processes or impacts and support evaluation planning, sampling, and reporting
Program and Implementation Staff Interviews	✓			Explore changes made since PY7 and issues in PY8 implementation, and gather information about program marketing and implementation
Expert Interviews	✓			Assess how the challenges faced by AIC's offering compare to challenges faced elsewhere and investigate any other potential changes or additions that could be made to the program
Engineering Desk Reviews		✓		Assess engineering savings estimates and methods
On-Site Verification		✓		Verify implementation and key inputs to savings estimates and methods
Net Impact Analysis		✓		Estimate net impacts using Stakeholder Advisory Group (SAG)-approved net-to-gross ratio (NTGR) values for PY8

The following activities informed the PY8 evaluation of the Retro-Commissioning Program.

2.2.1 Review of Program Materials and Data

We conducted a comprehensive review of all program materials and tracking data, including the program's implementation plan, applications, and extracts from the program-tracking database. We received extracts from the program-tracking database in April 2016 for evaluation planning and survey sampling, and we received updated data in May 2016, July 2016, and finally in August 2016, when the program implementer finalized the PY8 database.

2.2.2 Program and Implementation Staff Interviews

The evaluation team conducted an in-depth interview with the Retro-Commissioning Program's program manager early in 2016 to understand the Retro-Commissioning Program's design and implementation and to discuss evaluation priorities. Additionally, as part of the AIC Standard and Custom program evaluations, the evaluation team conducted two interviews with other AIC Business Program staff, including overarching program managers and marketing staff, who were able to provide limited information and feedback on the Retro-Commissioning Program.

2.2.3 Expert Interviews

The evaluation team conducted interviews with industry experts familiar with retro-commissioning programs in other jurisdictions to assess how the challenges faced by AIC's offering compare to challenges faced

elsewhere, to gather information on best practices from other successful retro-commissioning programs, and to investigate any potential changes or additions that could be made to the program. We conducted two interviews in PY8, speaking with an experienced retro-commissioning program evaluator and a firm experienced in retro-commissioning program evaluation and implementation. Both interviews included discussion of the experts’ experience with retro-commissioning programs in Midwestern states.

2.2.4 Impact Analysis

Gross Impacts

The evaluation examined program impacts to estimate a realization rate of savings between ex ante and verified (ex post) gross savings in two steps. Given the number of completed projects in PY8 (19), the evaluation team first conducted engineering desk reviews for a census of program projects to revise program ex ante savings values.

The engineering desk reviews consisted of a thorough examination of all available project documentation, including project reports, communications, equipment submittals, and calculations, and any other project-specific data that were available to our team. We also spoke to some site contacts to confirm measures and their continued operation and performance.

In addition, the evaluation team went on-site and inspected equipment and measure status for six projects and collected supplemental data, as needed. On-site visits were made to all four large facility sites and two industrial sites for compressed air, representing a sample of electric savings and all gas savings achieved by the program in PY8. We selected the sample for electric on-site verification as a subset of the program participants. Our sample was developed targeting 90/10 precision around electric savings. Table 4 provides detail on ex ante savings covered by our impact review by review method.

Table 4. Impact Evaluation Savings Covered

Review Type	# of Projects	Ex Ante Gross Savings	
		MWh	Therms
Engineering review only	13	8,579,846	0
Engineering review and site visit	6	3,559,607	514,070
Total	19	12,139,453	514,070

For electric savings, we conducted a desk review of all savings but completed on-site verification at only a sample of sites. To extrapolate these results to the population, we compared the savings determined through the site visits (at the project level) to the project-level savings determined for each project via the on-site verification to calculate a savings-weighted realization rate (total site visit-determined gross savings divided by the total desk review-determined gross savings). This sample-based realization rate was then used to adjust savings for the population of PY8 Retro-Commissioning Program projects.

Net Impact Analysis Approach

The ex ante NTGRs for the program are the SAG-approved values of 0.92 for electricity and 0.91 for natural gas. Following the NTGR framework, we apply these NTGRs to PY8 savings.

2.3 Sources and Mitigation of Error

Table 5 provides a summary of possible sources of error associated with data collection conducted for the Retro-Commissioning Program. We discuss each item in detail below.

Table 5. Possible Sources of Error

Research Task	Survey Error		Non-Survey Error
	Sampling Error	Non-Sampling Error	
Engineering Desk Reviews	N/A	N/A	Analysis error
Verification Site Visits (Electric)	Yes	N/A	Data processing errors Analysis error
Verification Site Visits (Gas)	N/A	N/A	Data processing errors Analysis error
Net Impact Calculations	N/A	N/A	Analysis error

The evaluation team took a number of steps to mitigate against potential sources of error throughout the planning and implementation of the PY8 evaluation.

Survey Error

■ Sampling Error

- **Engineering Desk Reviews:** The evaluation team reviewed a census of projects as part of our engineering desk reviews. As such, there was no sampling error associated with the desk reviews.
- **Verification Site Visits:** The evaluation team performed on-site verification for six projects in PY8. The evaluation team designed the verification site visit sample to achieve 10% relative precision at 90% confidence. We achieved a relative precision of 3% around kWh savings. We assessed a census of gas savings via our site visits, and, as such, there is no sampling error associated with our on-site estimates of gas savings.

Non-Survey Error

■ Analysis Error

- **Data Processing Error.** The team addressed processing error by using trained, experienced analysts and engineers to conduct all interviews and site visits and checking the quality and consistency of collected data.
- **Gross Impact Calculations:** We applied engineering models and calculations to the participant data in the project files to calculate gross impacts. To minimize data analysis error, a separate team member reviewed and verified calculation accuracy.
- **Verification Site Visits:** To minimize data collection error, the trained engineers and technicians familiar with the equipment affected by the Retro-Commissioning Program conducted verification visits. To minimize analytical errors, a separate team member reviewed and verified calculation accuracy.

- **Net Impact Calculations:** We applied deemed NTGRs to estimated gross impacts to derive the program's net impacts.

3. Detailed Findings

3.1 Process Findings

The evaluation team's process-related research in PY8 was limited and focused mainly on characterizing PY8 program results and assessing opportunities for improvement. Our results are based on in-depth interviews with program staff, a review of program data, and interviews with experts knowledgeable about comparable retro-commissioning programs in other jurisdictions.

3.1.1 Detailed Program Description and Participation Summary

The C&I Retro-Commissioning Program helps AIC business customers evaluate their existing mechanical equipment, energy management, and industrial compressed air systems to identify no-cost and low-cost efficiency measures to optimize existing energy-using systems.

Over time, deferred maintenance and changing operating directives and practices can lead to inefficient operation of building systems. Retro-commissioning is a process that examines current operations relative to the needs of equipment owners and those served by the equipment and determines opportunities for increasing equipment efficiency through maintenance, system tune-ups, scheduling, and optimization of operations. Most of the identified measures require little, if any, capital funds to implement. Secondary objectives of the program include:

- Channeling participation into other AIC programs to implement cost-effective equipment replacements and retrofits
 - AIC offers an additional bonus to customers who complete a Custom project within a year of having completed a retro-commissioning study
- Developing a network of retro-commissioning service providers (RSPs) that will continue to operate in the AIC service territory

Major market barriers to these energy efficiency opportunities are lack of awareness and the cost of the detailed engineering studies. Furthermore, even with a quality study in-hand, customer apathy can inhibit implementation of recommendations, even if they are no-cost. To overcome these barriers, the program subsidizes RSP studies and publicizes the benefits of retro-commissioning to foster a market for the services, with utility-certified RSPs providing the marketing outreach. AIC incentives pay for 70%–80% of the study cost.

In PY8, the Retro-Commissioning Program had four subcomponents:

- **Compressed Air Retro-Commissioning.** The Compressed Air offering provides incentives to defray the cost of a retro-commissioning study of compressed air equipment, leading to the implementation of low-cost/no-cost energy efficiency measures for existing compressed air systems. Typical measures include leak repair, installation of zero-loss drains, and installation or tune-up of compressed air system controls.
- **Industrial Refrigeration Retro-Commissioning.** The Industrial Refrigeration offering provides incentives to defray the cost of a retro-commissioning study of industrial refrigeration equipment, leading to the implementation of low-cost/no-cost energy efficiency measures for existing industrial refrigeration systems. Typical measures include lowering condensing pressure, raising suction pressure, evaporator fan control, evaporator defrost settings, and compressor sequencing.

- **Large Facilities Retro-Commissioning.** The Large Facilities offering targets two separate types of facilities: healthcare facilities and large commercial facilities (primarily offices). Healthcare facilities represent a major opportunity for energy savings in AIC territory and historically have driven this offering. Typical measures include energy management system (EMS) settings adjustments to optimize the operation of HVAC systems.
- **Grocery Store Retro-Commissioning.** Beginning in PY7, the Retro-Commissioning Program began to offer retro-commissioning to grocery stores under a separate offering. This offering is similar to the Large Facilities offering with relaxed facility size requirements and an increased focus on refrigeration systems. To date, this offering has not had any activity.

Large Facilities retro-commissioning projects go through a screening phase that examines the feasibility of retro-commissioning at the facility. Sites with good savings potential are eligible to apply to the program after AIC reviews the project. RSPs commit resources to this deliverable, which may or may not result in a viable retro-commissioning project. To defray the financial risk to the RSP and to encourage the RSPs to market the program more aggressively, AIC pays a screening stipend of 10% of the retro-commissioning study cost to the RSP for complex projects. This stipend does not require a commitment to implement a project and does not necessarily mean that energy savings will be achieved in future years.

Program incentives vary by type of project, as shown in Table 6 below.

Table 6. Summary of Retro-Commissioning Program Incentives

Project Type	Survey Incentive	Customer Implementation Incentive	Incentive Requirements
Compressed Air	80% of survey cost	<ul style="list-style-type: none"> • 2¢/kWh saved 	<ul style="list-style-type: none"> • Payback period of 0–1 year • Measure must be complete before program incentive is paid
Industrial Refrigeration	70% of survey cost	<ul style="list-style-type: none"> • 2¢/kWh saved 	<ul style="list-style-type: none"> • Payback period of 0–1 year • Measure must be complete before program incentive is paid
Large Facilities	70% of survey cost	<ul style="list-style-type: none"> • 2¢/kWh • 40¢/therm 	<ul style="list-style-type: none"> • Payback period of 0–1 year • Measure must be complete before program incentive is paid • Measures do not need to be complete for stipend to be paid
	10% of survey cost as “stipend” to RSP for complex projects		
Grocery Store	50-70% of survey cost	<ul style="list-style-type: none"> • 2¢/kWh • 40¢/therm 	<ul style="list-style-type: none"> • Payback period of 0–1 year • Measure must be complete before program incentive is paid

In PY8, all completed projects fell under the Compressed Air and Large Facilities categories. No projects were completed under the Industrial Refrigeration or Grocery Store offerings. Three Large Facilities projects in PY8 were healthcare projects, and one project was completed at a manufacturing site.

Table 7 displays the contributions of each component to the Retro-Commissioning Program’s overall PY8 ex ante gross savings.

Table 7. Summary of PY8 Retro-Commissioning Program Components

Program Component	Projects ^a	Ex Ante Gross Savings			
		MWh	%	Therms	%
Compressed Air	15	10,619	87%	0	—
Industrial Refrigeration	0	0	—	0	—
Large Facility	4	1,520	13%	514,070	100%
<i>Healthcare</i>	3	1,032	9%	423,428	82%
<i>Commercial</i>	1	488	4%	90,642	18%
Grocery	0	0	—	0	—
Total	19	12,139	—	514,070	—

^a The project count reflects all projects with savings in PY8, which does not include projects that only received a stipend.

In PY8, the total number of projects completed increased slightly from PY7, but remained below peak program performance in PYs 4–6. Table 8 shows historic program participation.

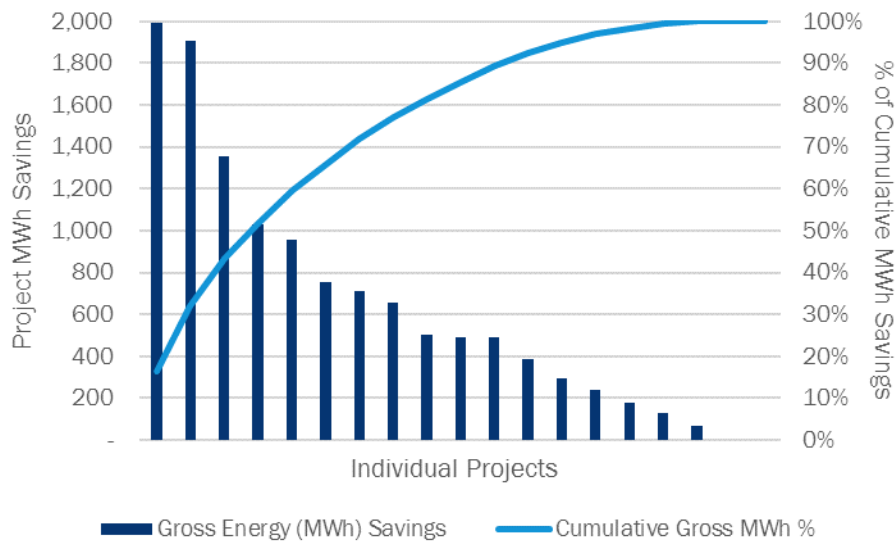
Table 8. Summary of Past Program Participation

Program Year	Projects ^a	Ex Ante Gross Savings	
		MWh	Therms
PY1	1	2,045	0
PY2	17	10,640	0
PY3	21	29,819	0
PY4	25	19,273	412,666
PY5	35	29,257	577,834
PY6	26	12,091	248,851
PY7	16	10,175	226,171
PY8	19	12,193	514,070

^a This project count reflects projects with associated savings. A number of projects listed in the AIC database as paid have no associated savings – the vast majority of which are “stipend” projects.

PY8 project data show that, as in past years, program savings are heavily reliant on very few projects. Figure 1 shows that four projects comprise more than 50% of program electric savings and eight projects comprise more than 75% of program electric savings. Gas savings are similarly dependent on a small number of projects: Only four projects completed in PY8 had associated gas savings, all Large Facilities projects.

Figure 1. Annual Project and Cumulative Program Ex Ante Electric Savings



The evaluation team noted in PY7 that seven stipends were paid for healthcare studies. Our limited number of interviews in PY7 with participants who completed studies for which a stipend was paid indicated that the customers who completed these studies either had already begun implementation of energy-saving measures at their facilities or planned to in future program years. Only three of these stipends from PY7 appear to have yielded savings in PY8. In PY8, five stipends were paid, four for healthcare studies and a fifth for a commercial study.

Table 9 summarizes PY8 RSP participation, which remained relatively unchanged from PY7. Five RSPs were active in the program in PY8. One RSP completed all three healthcare projects under the program in PY8. Two of the remaining four were responsible for 14 of the 15 Compressed Air projects.

Table 9. Summary of PY8 RSP Participation

RSP	Completed Compressed Air Projects	Completed Large Facilities Projects		Completed Stipend-Only Projects	
		Healthcare	Commercial	Healthcare	Commercial
RSP-A	8	0	0	0	0
RSP-B	6	0	0	0	0
RSP-C	1	0	0	0	0
RSP-D	0	0	1	0	1
RSP-E	0	3	0	4	0
Total	15	3	1	4	1

In addition to Retro-Commissioning Program’s primary goal of achieving electric energy and gas savings in PY8, we note that there is verifiable evidence that the program is channeling participation into the C&I Custom program, a secondary goal for the program. Six C&I Custom projects were completed in PY8 and received a bonus incentive for having been completed within a year of a retro-commissioning study at the same site. These six projects totaled 2,460 MWh in ex ante gross electric energy savings.

3.1.2 Program Design and Implementation

Implementation Changes

Based on interviews with program staff, PY8 implementation of the Retro-Commissioning Program remained relatively consistent with prior years. There was one minor change to program implementation in PY8. In the past, program staff reported that some RSPs participating in the Compressed Air offering were occasionally not holding the required implementation plan meeting for projects. In PY8, the program introduced explicit penalties for not holding this meeting, including removal from the official program RSP list, inability to participate in the program symposium event, and inability to receive incentives directly from the program. Since these changes were implemented, program staff have not had issues with RSPs failing to hold implementation plan meetings.

Program Performance and Highlights

In our discussion of the program's performance in PY8, program staff identified a few key items:

- The Retro-Commissioning Program overachieved its goals in PY8. Program staff noted that the program especially overachieved in producing gas savings from the Large Facilities offering relative to their internal goals, which helped the overall C&I portfolio reach its gas goals in PY8.
- Program staff also noted that they paid special attention to the overall cost-effectiveness of the C&I portfolio in PY8, which included trying to increase focus on measures that help achieve savings at the lowest cost and reining in some more-expensive offerings. The Retro-Commissioning Program, in particular gas savings and the Large Facilities offering, tends to be expensive to operate, both because of high-cost savings and because of the high amount of labor on the implementation side required to achieve those savings, and program staff pointed out that they have decreased focus on these offerings.
- Finally, program allies installed metering equipment through the C&I portfolio's Metering & Monitoring offering² at two sites that completed Retro-Commissioning Program projects in PY8. Program staff hope that this dual participation will lead to enhanced retro-commissioning savings by allowing allies to further monitor projects and make future changes if necessary.

3.1.3 Expert Interviews

As specified in the program evaluation plan, the evaluation team conducted interviews with industry experts familiar with retro-commissioning programs in other jurisdictions to assess how the challenges faced by AIC's program compared to challenges faced elsewhere and to investigate any other potential changes or additions that could be made to the program. We conducted two interviews in PY8, speaking with an experienced retro-commissioning program evaluator and a firm experienced in both retro-commissioning program evaluation and implementation. We provided background on AIC's program in advance of these interviews. Both interviews covered the experts' experience with retro-commissioning programs in Midwestern states.

Typical Retro-Commissioning Program Characteristics

The AIC Retro-Commissioning Program's focus on large customers is typical of retro-commissioning offerings in the Midwest. Some offerings (for example, ComEd's Retro-Commissioning Tune-Up program) are targeted

² See the PY8 C&I Custom evaluation report for further discussion of this offering

toward smaller customers and tend to be more prescriptive in nature. The experts we spoke with noted that it is generally harder to succeed with a retro-commissioning offering focused on smaller buildings as the barriers to entry remain high for a relatively small amount of savings.

Healthcare facilities are typically key targets for retro-commissioning programs, like they are for AIC's program. Educational facilities (e.g., college campuses) are also often key targets for retro-commissioning programs, though these facilities are unavailable to AIC's program in some cases due to the Illinois Department of Commerce and Economic Opportunity's (DCEO) coverage of these facilities under its program offerings.

Some jurisdictions use different payback requirements on measures; experts told us up to 2-year paybacks are allowed in some cases, but the 0- to 1-year payback period used by AIC is the typical payback period specified. The experts we spoke with did not believe that there was any reason for AIC to change its current payback requirements.

The experts we spoke with generally did not feel like there were significant new opportunities being missed in the AIC service territory for retro-commissioning (e.g., a new offering covering a different sector). Some program administrators offer "monitoring-based" or "real-time" retro-commissioning programs, which tend to be relatively new; we note that AIC is beginning to take steps in this direction with the implementation of Metering & Monitoring projects at multiple Retro-Commissioning Program project sites in PY8.

Barriers to Success for Retro-Commissioning Program Projects

We discussed the barriers to the success of retro-commissioning programs with the experts we interviewed.

One barrier identified by both experts is the difficulty convincing customers with substantial opportunities for energy savings from retro-commissioning to allow system access (for improvements). In many cases, the customers for whom retro-commissioning activities would be the most beneficial (and yield the greatest energy savings) are healthcare facilities and large industrial customers. These customers typically have mission-critical energy-using equipment and are reluctant to shut the equipment down for improvements; they would rather pay higher energy costs to avoid the inconvenience of shutting a system down. For example, hospitals may not want to shut down operating room HVAC equipment for minor energy savings when it reduces their patient throughput. Large industrial customers may not want to shut down a compressed air system to make changes; they will simply do what they can while the system remains operational.

The experts noted that, in many cases, these customers will conduct scheduled, necessary maintenance on their equipment on yearly or other regular cycles. It may be worth having a Key Account Executive, Energy Advisor, or other AIC representative in contact with customers to attempt to determine when these natural breaks occur and attempt to sync the program's marketing and interventions with customers to those time periods.

Another barrier the experts we spoke with noted was precisely the opposite: Making the retro-commissioning improvements is in some cases so simple (e.g., a settings change taking only a few minutes) that it is difficult to convince a customer and an ally to go through the program process when they can make the change and receive benefits without the program.

Retro-Commissioning Value Proposition

The experts that we spoke with told us that the biggest challenge for retro-commissioning is typically accurately communicating the retro-commissioning value proposition to customers and market actors. Many business customers and market actors simply do not have a clear understanding of what retro-commissioning is and

how it can help them. This finding is consistent with our PY7 research with trade allies and customers, which found that this is a challenge for AIC's program.

One specific item that was identified as a potential confounding factor for AIC's program is the scope of what it covers. What AIC calls "retro-commissioning" is not completely in line with what retro-commissioning programs elsewhere focus on. Typically, retro-commissioning programs are similar to the Large Facilities offering, and the services AIC provides under the Compressed Air and Industrial Refrigeration offerings are provided separately under an "optimization" offering.³

While clearly the optimization offerings can be successful in AIC territory, the experts suggested that the combination of the Large Facilities and other Retro-Commissioning Program offerings could create some confusion in the marketplace for customers about what retro-commissioning is. The experts noted from our past program research that the RSPs who serve each offering tend to be different, and the customers who would participate in each offering tend to be different as well. Additionally, they suggested that the marketing targets for the program should also be different. For the "optimization" offerings (currently covered by Compressed Air and Industrial Refrigeration), a focus on the RSPs was suggested, as many RSPs are firms that have prior relationships with customers to service their equipment. For the Large Facilities offering, RSPs tend to be more specialized firms that primarily provide energy management services and conduct retro-commissioning; as such, they are unlikely to have the deep previous relationships with customers that RSPs in the optimization offerings have, and marketing/information targeted more specifically to the customer is needed to most effectively sell the program. This marketing would be most effectively delivered through Energy Advisors, Key Account Executives, or other staff who have a preexisting relationship with customers and/or knowledge of customer facilities.

Given these factors, it seems that, in some ways, the AIC Retro-Commissioning Program acts (or should be acting) as almost two separate programs, and the combined nomenclature of "retro-commissioning" encompassing both may be confusing to the customers in the marketplace.

3.2 Impact Assessment

The following sections provide gross and net impacts for PY8, as well as gross realization rates. The impact analysis looked at program impact tracking from application acceptance through project savings verification. Ex ante impacts and project documentation were tracked in the Amplify database, which included the data needed to track project milestones and impacts.

3.2.1 Gross Impacts

The evaluation team analyzed the project retro-commissioning and post-inspection reports and re-estimated savings with data in the documentation and our own best estimates. As shown by the relatively high realization rates, in most cases our re-estimations confirmed reported savings with the available data. In some cases, the evaluation team estimated ex post project savings that differed from the ex ante estimates. Reasons for these adjustments include:

- Compressed Air

³ For example, ComEd offers an Industrial Systems Optimization program that covers compressed air, process cooling, and industrial refrigeration.

- Among most reviewed projects, RSPs calculated air leakage rates assuming 100 PSI plant pressure. In several cases, the reports and data clearly show plant pressure significantly lower, which greatly reduces baseline air leakage rates (and the associated savings).
 - RSPs still occasionally estimate savings based on average compressor performance (CFM/kW) as observed during the retro-commissioning inspection, rather than equipment performance at part-load or at marginal reductions in compressed air flow. Using the average performance metric often overestimates savings. Savings are not proportional to reduced airflow for many compressed air systems,⁴ so reducing airflow due to leak repair does not save the equivalent proportion of energy.
- Large Facilities
- Ex ante savings are based mostly on spreadsheet calculations, but in a couple cases the calculations were based on unsubstantiated or undocumented inputs. Though most calculations were adequate, those of a new RSP were lacking rigor and documentation. One RSP used unreasonably high motor loading assumptions in the calculations that inflated ex ante savings. For another project, the chiller efficiency did not agree with manufacturer specifications for the machine.
 - On-site inspection revealed that some settings have changed from those proposed for ex ante estimates. Occasional changes such as these are expected as building and plant operators try to maintain adequate service for occupants and production processes. These changes included set points and schedules.

Table 10 shows the ex ante and ex post gross energy impacts of the program, as well as the realization rates. The ex post impacts are based on our engineering review of the PY8 projects.

Table 10. PY8 Retro-Commissioning Program Gross Impacts

Savings Category	Ex Ante Gross	Realization Rate	Ex Post Gross
Energy Savings (MWh)	12,139	0.88	10,714
Demand Savings (MW)	1.24	1.00	1.25
Gas Savings (Therms)	514,070	0.88	454,387

For ex ante demand savings, most RSPs completing Compressed Air projects calculated a simple estimate of kWh divided by annual operating hours in the upload worksheets. This estimate was inaccurate for many retro-commissioning measures as the peak influence is not the same as this ratio. The evaluation estimated savings for the reviewed projects. For Large Facility projects, most measures did not generate peak demand savings as the measure impacts are primarily in winter or in the evening or night hours (not at the time of system peak).

Overall, the impact evaluation adjusted the program ex ante gross savings for several reasons. Among all reviewed projects, verification adjustments represented isolated cases of miscalculated savings and not systematic problems. Additional documentation with electronic versions of calculations would help ensure reliable savings estimates.

⁴ Constant speed rotary machines consume about 70% of rated power when delivering no compressed air. Constant speed centrifugal machines blow off excess compressed air when delivering less than 70%–80% of design airflow.

3.2.2 Net Impacts

The ex ante NTGRs for the program are the SAG-approved values of 0.92 for electricity and 0.91 for natural gas. Following the NTGR framework, we apply these NTGRs to PY8 savings. Table 11 provides the PY8 net impacts for the Retro-Commissioning Program.

Table 11. PY8 Net Program Impacts

Savings Category	Ex Post Gross	NTGR	Ex Post Net
Energy Savings (MWh)	10,714	92%	9,857
Demand Savings (MW)	1.25	92%	1.15
Gas Savings (Therms)	454,387	91%	413,492

4. Conclusions and Recommendations

While realization rates in PY8 are relatively good, there are opportunities to increase the accuracy of the ex ante estimates. As in prior years, ex ante savings calculations were sometimes not included in reports or calculation inputs did not include validation details.

Compressed air savings calculations still include error types that have been flagged for several evaluation cycles: inappropriate use of average compressor efficiency rather than marginal efficiency, assumptions of year-round operation without any downtime, and failure to accurately account for plant air pressure in savings estimates.

The implementation contractor continued to perform post-installation inspections in PY8. Documentation for these visits has improved greatly since they began in PY4, but still has gaps, especially for HVAC retro-commissioning projects. Photographic, data, or graphical confirmation was included for slightly more than half of the measures. Several measures still lacked positive confirmation or the implementation contractor did not adequately annotate provided confirmation to describe the measures verified by the images.

Many of these opportunities are carryover recommendations from prior years to better document and organize the baseline and post-implementation conditions and estimation methods.

Based on our research, the evaluation team makes the following impact recommendations for the program:

- **Require RSPs to better document baseline conditions.** This could be aided by encouraging RSPs to use more-transparent and documented calculations, like spreadsheets, and/or by requiring the submission of electronic versions of calculations and simulations to ensure that evaluators understand how the RSPs obtain ex ante results. Calculation inputs should have notes for whether inputs are measured, based on design conditions, or assumed by the RSPs. It would also be useful for the program to require more pre-implementation documentation of as-found conditions to confirm the baselines used in calculations. For example, if the report claims a fan runs continuously, inclusion of a graph or screenshot of a week of operating data or a control schedule would allow for easier baseline verification.
 - Consider issuing template calculators for common measures.
 - Consider issuing standardized assumptions for key inputs to calculations, if they are not measured. For example, require using 70% of nameplate motor loading if actual loads are not measured.
- **Continue to improve documentation of post-installation inspections.** Though inspection documentation is much improved from prior years, some gaps still exist. Try to document measures with data or representational verification (photos, graphs, etc.). Clearly annotate which measures the verification is supposed to show. Some measures are hard to represent in this manner and some small measures may not merit large effort. A savings magnitude threshold (gross kWh or % of project savings) might be used to prioritize effort.
 - Frequently, the only verification for compressed air leak repairs is a hand-annotated list of leaks. If additional post-installation trend data are available for compressed air projects, they should be included in verification documentation.
- **Correct errors in compressed air savings calculations.** Correcting for inappropriate use of average compressor efficiency rather than marginal efficiency, assuming year-round operation without any

down-time, and accurately accounting for plant air pressure in savings estimates will produce more-accurate ex ante savings estimates, resulting in higher realization rates for the program.

- **Encourage implementation of more savings and measures in addition to leak repair.** For example, require implementation of bundled measures that meet a payback threshold — 12 months, for example — in order to receive the study subsidy incentive. All savings from PY8 sampled compressed air projects derive from leak repairs. No other low-cost measures were implemented through the program. While the savings from leak repairs is significant and cost-effective, the RSPs should spend more effort investigating and encouraging implementation of other short-payback measures, including, for example, no-loss drains, elimination of inappropriate uses, storage, better staging of multiple compressors, and cycling driers. Compressed air retro-commissioning is more than leak repair.
- **Implement a stronger review regimen through the implementation contractor.** Positively confirm operating hours, plant pressures, production pressures, and compressor part-load performance.

Our limited assessment of program processes in PY8 indicated no major issues with the program as compared to prior years. We provide a few specific process-focused recommendations from our interviews with retro-commissioning experts that we feel could help the program improve in future years.

Based on our interviews with retro-commissioning experts, the evaluation team makes the following process recommendations for program improvement:

- **Consider more clearly delineating the Large Facilities offering from the Compressed Air and Industrial Refrigeration offerings.** In PY7, the evaluation team found that the retro-commissioning proposition is not fully understood by the market and that market actors and customers have an inconsistent understanding of what retro-commissioning is. As a result, the team recommends more clearly defining what retro-commissioning is to aid customer understanding of the program.

One change that could be made to aid in this goal would be to break out the Large Facilities offering more clearly from the other program offerings, as is done in some other jurisdictions. This could be done by simply changing a program name and marketing materials. There is essentially no overlap between customers likely to participate in the Compressed Air and Industrial Refrigeration offerings vs. customers likely to participate in the Large Facilities offering, and the packaging together of these two very different groups of offerings could potentially be causing some confusion in the marketplace.

- **Continue to increase program staff marketing efforts and customer involvement.** Based on our PY7 research, as well as interviews with retro-commissioning experts in PY8, we continue to recommend increased non-RSP-dependent marketing efforts and engagement for the Retro-Commissioning Program. Information from the program's implementation plan and our process evaluation activities indicate that, while market penetration of the Retro-Commissioning Program is relatively high, there are potential projects remaining in the market, especially in non-Compressed Air segments. Increased involvement by program staff, especially for the Large Facilities offering, could pay dividends. We recommend increased marketing activity by program Energy Advisors and Ameren Key Account Executives, who are the staff likely to have the detailed understanding of customer facilities required to understand if a customer is an ideal candidate for retro-commissioning. These staff are a crucial entry point for future projects into the program.

Additionally, increased involvement by staff could help identify natural breaks when energy-using equipment is shut down at industrial sites and other large facilities that could be an ideal time to conduct retro-commissioning activities.

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