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Impact and Process Evaluation of 2014 (PY7) Ameren Illinois Company Retro-Commissioning Program

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1. Executive Summary

This report presents the results of Opinion Dynamics' evaluation of the Ameren Illinois Company (AIC) Commercial and Industrial (C&I) Retro-Commissioning (RCx) Program during its seventh program year (PY7). The Retro-Commissioning Program is one of three in AIC's C&I portfolio, which also includes the Custom and the Standard programs. PY7 ran from June 1, 2014, through May 31, 2015.

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 pre-approved 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 50%–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 PY7, AIC planned to garner 8% of portfolio electric energy savings and 3% of portfolio therm savings from this program.

A secondary goal of the Retro-Commissioning Program is the identification of retrofit and capital improvement projects. Through identification and information from the Retro-Commissioning Program, additional projects may 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 PY7 evaluation includes gross impact results plus an evaluation of program processes. Our quantitative impact research included engineering reviews of a stratified random sample of retro-commissioning projects plus on-site inspection and verification of measures.

The process evaluation reviewed program materials and program-tracking data, and interviewed program administrators, service providers, and customers. Additionally, the evaluation team surveyed non-participating customers in an attempt to determine the major barriers to retro-commissioning. According to a collaborative agreement, this evaluation applies the NTGR found through PY4 research to PY7 results. AIC will apply the current NTGR research values in future years, giving AIC opportunity to adapt, as needed.

Below we present the key findings of the PY7 evaluation.

1.1 Impact Results

Table 1 summarizes reported and verified program participation by the different program components. A total of 16 projects were completed in the PY7 program, a decrease from a total of 26 in PY6. Among the 16 projects, there were 15 unique customers with one customer completing two compressed air projects. Two participants saved both electricity and gas — both healthcare facilities. All others were industrial customers saving only electricity. Six 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 PY7, they will be included in program cost-benefit analysis, although there are no projects or impacts associated with these sites in PY7.[1]

[1] The customers may choose to implement study-recommended measures in PY8 or later.

Table 1. PY7 Program Participation Summary

Program Component	Unique Customers	Unique Projects[a]	*Ex Ante* Gross Electric Savings		*Ex Ante* Gross Gas Savings	
			MWh	%	Therms	%
Compressed Air	13	14	7,488	74%	0	0%
Industrial Refrigeration	0	0	0	0%	0	0%
Large Facility	2	2	2,687	26%	226,171	100%
Healthcare	*2*	*2*	*2,687*	*26%*	*226,171*	*100%*
Commercial	*0*	*0*	*0*	*0%*	*0*	*0%*
Grocery	*0*	*0*	*0*	*0%*	*0*	*0%*
Total	**15**	**16**	**10,175**	**100%**	**226,171**	**100%**

[a] This project count reflects all projects with savings in PY7, which does not include seven healthcare studies (six unique customers) that were completed in PY7 and received a stipend.

The evaluation team performed an engineering review of 11 of the 16 projects (including both healthcare projects with gas savings) 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 (84% for MWh savings, 83% for MW savings, and 99% for therm savings).

The evaluation team also applied NTGRs approved by the Illinois Stakeholder Advisory Group (SAG) to the gross savings estimates to calculate program net impacts. Table 2 summarizes PY7 gross and net impacts.

Table 2. PY7 Retro-Commissioning Program Gross and Net Impacts

Savings Category	Ex Ante Gross	Realization Rate	Ex Post Gross	NTGR	Ex Post Net
Energy Savings (MWh)					
Total MWh	10,175	84%	8,543	96%	8,201
Demand Savings (MW)					
Total MW	0.97	83%	0.80	96%	0.77
Gas Savings (Therms)					
Total Therms	226,171	99%	223,292	95%	212,127

1.2 Process Results

The Retro-Commissioning Program's Compressed Air offering is a well-developed and smoothly operating component of the program — program staff referred to it as "vibrant" in our interviews with them. While the potential for compressed air projects are limited — per the program implementation plan, the program has likely reached upwards of 70% of the target market — many of these customers can participate in the program multiple times and we see evidence that this has already begun to happen as the program matures. Participant and RSP satisfaction with the Compressed Air offering is high, and while the program as a whole saw a decrease in projects and savings in PY7 (compared to previous program years), PY7 actually saw more completed Compressed Air projects than PY6.

The other components of the program are not nearly as mature or stable. The Large Facilities (previously Healthcare and Commercial Facilities) offering saw only two completed projects with savings in PY7, both in healthcare facilities. Seven stipend healthcare projects were completed in PY7 that could lead to savings in PY8, but no projects were completed in the commercial or grocery segments.

The Industrial Refrigeration offering saw zero completed projects in PY7, which program staff attribute predominantly to the largest RSP pulling out of the program after PY6. Program staff tell us that they are actively pursuing additional RSPs for this component of the program.

1.3 Recommendations for Program Improvement

Based on our research, we provide the following recommendations for the program:

- **Focus on developing a larger and more engaged RSP cohort for non-Compressed Air offerings.** The Retro-Commissioning Program is driven by its participating RSPs, and its success depends in large part on having an engaged and effective group of RSPs to develop and complete retro-commissioning projects. The Compressed Air offering has several active RSPs, but in PY7 the Large Facility offering had only one active RSP and the Industrial Refrigeration offering had none. While more RSPs were active in previous program years, outside of Compressed Air, the program has never had a robust group of RSPs. Developing this group should be the top priority for program staff – given how program outreach and marketing generally operates, the most effective way to motivate additional participation in the Retro-Commissioning Program will be to bring more RSPs into the fold.

- **Increase program staff marketing effort.** In tandem with the above recommendation, we recommend increasing non-RSP dependent marketing efforts. Information from the program's implementation plan and our process evaluation activities indicate that, while the market penetration of the Retro-Commissioning Program is relatively high, there are still potential projects remaining in the market, especially in non-Compressed Air segments.

  However, the program's reliance on RSPs for marketing means that customers who are not actively reached by participating RSPs are often unlikely to enter the program. While RSPs generally report being satisfied with program marketing support, if the program wishes to develop additional business in market segments where it does not currently have activity, additional outreach from program staff will be essential. We recommend increased marketing activity by program Energy Advisors (which has already likely begun in PY8 according to our program manager interviews) 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.

- **Work to more clearly define and explain the retro-commissioning proposition to customers and RSPs.** Based on results of our participant interviews, non-participant survey, and RSP interviews, the evaluation team feels 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. Clearly defining what retro-commissioning is will aid customer understanding of the program and help to ensure consistency across RSPs.

- **Require RSPs to better document baseline conditions**. This could be aided by encouraging RSPs to use more-transparent 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. 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.

  - If hourly simulations are used to determine ex ante savings, an executable version of the model should be submitted so that the evaluation team can verify that recommended measures constitute the only changes in the model.

- **Improve documentation of post-installation inspections.** Document most measures with data or representational verification (photos, graphs, etc). Clearly annotate which measures the verification is supposed to show. Sometimes one screenshot can verify multiple measures. Some measures are hard to represent in this manner and others may not seem worth the effort. A savings magnitude threshold (gross kWh or % of project savings) might be used to prioritize effort.

  - 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, assumptions of 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.

- **Implement a stronger review regimen through the Implementation Contractor.** Positively confirm operating hours, plant pressures, production pressures and compressor part-load performance.

2. Evaluation Approach

The assessment of AIC's C&I Retro-Commissioning Program in PY7 consisted of an evaluation of program gross and net impacts and a program process assessment. We applied a NTGR approved by the Illinois Stakeholder Advisory Group (SAG) to PY7 program savings. Table 3 summarizes the PY7 evaluation activities conducted for the Retro-Commissioning Program's assessment.

2.1 Research Objectives

The objective of the PY7 Retro-Commissioning Program impact evaluation is to provide estimates of gross and net electric and gas savings associated with the program. The evaluation will answer the following research questions through the PY7 impact evaluation:

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

Key areas of inquiry for the process evaluation are as follows:

1. Effectiveness of Program Design and Implementation
    a. Did the program as implemented change compared to PY6? If so, how, why, and was this an advantageous change?
    b. What implementation challenges occurred in PY7, 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?
2. Program Participation
    a. What were the characteristics of participating and non-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? Were any changes in the mix of customers and projects desirable?
    c. What are the characteristics of participating RSPs? How many RSPs actively participated in the compressed air, commercial building, industrial refrigeration, and health care sectors? How many participated in the new grocery pilot?
3. Service Provider Feedback
    a. Did the effectiveness of the program improve over the past several years? What have been the improvements? What were the barriers to participation? What suggestions do RSPs have for program delivery and implementation?
    b. Were RSPs satisfied with the program?
    c. Is the scope of the program still appropriate for the market?

4. Participant Feedback

    a. Are the retro-commissioning reports sufficiently actionable to realize savings? Did the scope of work provided through the program meet the needs of participants?

    b. Were participants satisfied with the program?

    c. Was the AIC marketing adequate? What can AIC and the implementation contractor do to increase program outreach and penetration?

5. Non-Participant Feedback

    a. Why do eligible customers not participate in the Retro-Commissioning Program? What were the barriers to conducting retro-commissioning studies and implementing recommendations? Did the program adequately address these barriers? What types of changes can be made to reduce barriers to participation?

2.2 Evaluation Tasks

Table 3 summarizes the PY7 evaluation activities for the Retro-Commissioning Program.

Table 3. Retro-Commissioning PY7 Evaluation Methods

Task	PY7 Process	PY7 Impact	Forward Looking	Details
Materials and Data Review	✓	✓		Analysis of program implementation plan and ex ante estimates
Program Staff In-Depth Interviews	✓			Provides insight into program design and processes
RSP Interviews	✓			Interviewed four of five active RSPs as well as one previously active RSP (not active in PY7) in support of program process evaluation
Participant Interviews	✓			Interviewed 10 of 19 unique customers, representing 13 of the 23 completed projects in support of program process evaluation
Non-Participant Survey	✓			Interviewed AIC customers who have not participated in any Business Program offering, as well as AIC customers who have participated in another business Program offering, but not the RCx Program specifically
Engineering Review		✓		Assess engineering savings estimates and methods
On-Site Verification		✓		Verify implementation and key inputs to savings estimates and methods

The following activities informed the PY7 Retro-Commissioning Program evaluation.

2.2.1 Program Staff Interviews

The evaluation team conducted an in-depth interview with the Retro-Commissioning program manager 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 three interviews with other AIC Business Program staff, including overarching program managers, database staff, and marketing staff, who were able to provide limited information and feedback on the Retro-Commissioning Program.

2.2.2 Review of Program Materials and Data

We conducted a review of program materials and tracking data. We reviewed program marketing and implementation plans and extracts from the program tracking database. We received an extract of the program database in April 2015 and again in July 2015 for use in survey sampling, and a finalized version in September 2015 for use in impact analysis.

2.2.3 Participant Interviews

We conducted telephone interviews with Retro-Commissioning Program participants. We conducted a census attempt of all 19 program participants and eventually completed surveys with 10 participants, representing 13 of 23 completed projects and stipends. Additionally, as part of the AIC Custom Program evaluation, we completed an interview with a CLIP (Competitive Large Incentive Project) participant who was also the appropriate contact for a Retro-Commissioning project and was able to provide limited feedback on the Retro-Commissioning Program.

The evaluation team attempted to contact participants at least four times via email or phone, including leaving voicemails, over an extended period of time. In several cases, interview subjects had retired or moved on to new jobs and their replacements could not speak to the program details.

Table 4. Summary of Participant Interviews

Task	Sample Frame	Targeted Completes	Actual Completes
Participant Interviews	19[a]	Census attempt	10[b]

[a] This count includes participants who were involved in a stipend only in PY7.
[b] As noted above, we also spoke to an additional RCx program participant as part of the Custom program evaluation.

2.2.4 Retro-Commissioning Service Provider (RSP) Interviews

The evaluation team conducted telephone interviews with Retro-Commissioning Service Providers (RSPs). We conducted a census attempt of all five active program RSPs and eventually completed interviews with four, responsible for 22 of the 23 completed projects in PY7. Given the limited number of active RSPs, we also attempted to complete interviews with three inactive RSPs who had completed more than one project in the previous program year (PY6). We were able to complete one interview with an inactive RSP.

As with participant interviews, the evaluation team attempted to reach all RSPs at least four times via email or phone, including leaving voicemails, over an extended period of time.

Table 5. Summary of RSP Interviews

Task	Sample Frame	Targeted Completes	Actual Completes
Active RSP Interviews	5	Census attempt	4
Inactive RSP Interviews[a]	3	Census attempt	1

[a] There are a total of 20 inactive RSPs, defined as any service provider who has completed a project through the program since its inception but did not complete a project in PY7. However, we only attempted to contact inactive RSPs who had completed more than one project in PY6. All inactive RSPs we did not attempt to contact have completed a total of four or fewer projects through the RCx program.

2.2.5 Retro-Commissioning Non-Participant Telephone Survey

For the purposes of this evaluation, we were tasked with trying to understand why eligible customers have not participated in the Retro-Commissioning Program. In order to provide information that is representative of all program non-participants, we needed to talk to two different groups of customers:

1. Those customers who had never participated in any element of the Business Program
2. Those customers who had participated in another part of the Business Program (e.g., the Standard or Custom offerings) but have never participated in the Retro-Commissioning Program specifically.

In conjunction with the other evaluations of AIC's business programs, we conducted a non-participant telephone survey with customers who had never participated in any element of the Business Program.

To supplement our results from the Business Program-wide non-participant survey and provide detail on the entirety of the AIC customer base who have never participated in the Retro-Commissioning program, we conducted a separate telephone survey with AIC customers who have never participated in the Retro-Commissioning program, but who have participated in another part of the Business Program.

Detailed information, including sample development information for the Business Program non-participant survey is presented in the Standard Program evaluation report. We describe the sampling effort and survey fielding results for the Retro-Commissioning-specific non-participant survey below, as well as the methodology for weighting the combined survey results.

Sampling for Retro-Commissioning-Specific Non-Participant Telephone Survey

We developed the survey sample for this effort based on participating premises in the AIC program tracking database. Using machine learning and intelligent pattern matching[2], we aggregated the business premises contained in the tracking database into an eligible population at the premise level, and then removed any premises that had previously participated in the AIC Retro-Commissioning program.

[2] For development of this sample, Opinion Dynamics used internally developed programs that identified unique business premises at the business and premise level and matched accounts from the AIC database to the premises based on similarities in business name, phone number, address, and other available criteria for each account. We define a business premise as a unique location-business combination. Given the size of this database, hand-review of every defined premise was not feasible. However, we pulled subsamples of the data to review for errors and refined matching criteria several times to develop the most accurate match.

Table 6. Retro-Commissioning Non-Participant Eligible Population

Size	Population	Percent of Total
Small Customers[a]	9,567	93%
Large Customers[b]	701	7%
Total	**10,268**	**100%**

[a] Premises with rate codes DS-2, DS-3A, GDS-2, and GDS-3.

[b] Premises with rate codes DS-3B, DS-4, GDS-4, GDS-5. If a premise had multiple rate codes, any one rate code being in the "large" group resulted in that premise's categorization as large.

From this population, we selected all large customers and a simple random sample of small customers, de-duped by phone number, and removed accounts with missing contact information to arrive at our sample selected for interviewing.

We used this sampling approach in order to ensure sufficient coverage of large customers, who represent a particular area of interest for AIC due to their increased likelihood of being eligible for retro-commissioning activities through the AIC program. A simple random sampling approach would have resulted in a very high proportion of survey completions with small customers, who are much less likely to be eligible for the RCx program.

We set initial quotas to provide an equal number of small and large completes. Table 7 presents population and completed survey information for the combined general population non-participant and the retro-commissioning non-participant surveys.

Table 7. Completed Combined Non-Participant Survey Points

Type	Size	Customer Type	Population	Initial Quota	Completed Survey
Business Program Non-Participants[a]	Small Customers[c]	Electric-Only	60,549	51	51
		Gas-Only	9,988	9	9
		Combo	43,160	40	40
	Large Customers[c]	Electric-Only	393	34	10
		Gas-Only	235	18	7
		Combo	499	48	12
Business Program Participants not Participating in RCx Program[b]	Small Customers[c]		9,567	50	50
	Large Customers[d]		701	50	35
	Total		**125,092**	**300**	**214**

[a] Data from Business Program-wide non-participant survey.

[b] Data from Retro-Commissioning-specific non-participant survey.

[c] Premises with rate codes DS-2, DS-3A, GDS-2, and GDS-3.

[d] Premises with rate codes DS-3B, DS-4, GDS-4, GDS-5. If a premise had multiple rate codes, any one rate code being in the "large" group resulted in that premise's categorization as large.

Retro-Commissioning Non-Participant Survey Dispositions and Response Rate

We fielded the survey of retro-commissioning non-participants from November 4 to November 12, 2015. Table 8 provides the final survey dispositions.

Table 8. Retro-Commissioning Non-Participant Survey Dispositions

Disposition	N
Completed Interviews (I)	85
Partial Interviews (P)	0
Eligible Non-Interviews	361
Refusal (R)	*103*
Mid-Interview terminate (R)	*5*
Respondent never available (NC)	*252*
Language Problem (NC)	*1*
Not Eligible (e)	91
Duplicate number	*4*
Fax/data line	*4*
Non-working/disconnect	*15*
Wrong number	*7*
Residential number	*7*
No eligible respondent	*53*
Quota filled	*1*
Unknown Eligibility Non-Interview (U)	61
Always busy	*9*
No answer	*52*
Total Respondents in Sample	**598**

The following table provides the response and cooperation rates (Table 9). Appendix B provides information on the methodology used to calculate response rates for telephone surveys.

Table 9. Non-Participant Survey Response and Cooperation Rates

AAPOR Rate	Percentage
Response Rate	17%
Cooperation Rate	44%

The team assessed the potential for non-response bias by comparing survey respondents to those who did not respond to the survey using available data. We found no evidence to suggest that non-respondents differed significantly from respondents (see Section 2.3 for additional information on potential sources of error).

Weighting

The team developed survey weights for the combined general population non-participant and retro-commissioning non-participant surveys and applied them for the process analysis. These weights reflect that we did not survey strata in proportion to their representation in the population, as described above. For each stratum, we estimated a survey weight by dividing the stratum's share of the overall population by its share of survey responses. Table 10 presents the calculated survey weights for the combined general population non-participant and retro-commissioning non-participant surveys.

Table 10. Survey Weights for Combined General Population Non-Participant and Retro-Commissioning Non-Participant Survey

Type	Size	Customer Type	Population		Completes		Weight
			Total	%	Total	%	
Business Program Non-Participants	Small Customers	Electric-Only	60,549	48%	51	24%	2.03
		Gas-Only	9,988	8%	9	4%	1.90
		Combo	43,160	35%	40	19%	1.85
	Large Customers	Electric-Only	393	<1%	10	5%	0.07
		Gas-Only	235	<1%	7	3%	0.06
		Combo	499	<1%	12	6%	0.07
Business Program Participants not Participating in RCx Program	Small Customers		9,567	8%	50	23%	0.33
	Large Customers		701	1%	35	16%	0.03
Total			**125,092**	**100%**	**214**	**100%**	

2.2.6 Impact Analysis

Gross Impact Analysis Approach

The evaluation examined program impacts for a sample of projects to estimate a realization rate of savings between the ex ante gross savings and the verified gross savings. The evaluation targeted 90%/10% (confidence/precision) in our estimate of the realization rate. We discuss sampling methods below. We reviewed project reports, communications, equipment submittals, and calculations included among the project files. We reviewed 11 of 16 projects with electric savings and conducted a census of projects with gas savings.

In addition, the evaluation team went on-site and inspected equipment and measure status at three sites and collected supplemental data, as needed. We selected sites from among those sampled for the impact evaluation.

Impact Sampling

For the impact evaluation, the team sampled projects using the stratified ratio estimation method.[3] This method is based on the anticipated realization rate with a coefficient of variance assumption of 0.40, informed by prior evaluation results. The method involves stratifying the population based on project ex ante electricity

[3] *The California Evaluation Framework*, 2004, pp. 361–371. A full discussion of separate ratio estimation can be found in *Sampling: Design and Analysis*, 2nd Edition, Lohr, 2010, pp. 144–145.

savings to reduce variation in each stratum to achieve 90%/10% (confidence/precision) with a fewer number of sample points than a simple random sample design would require. Due to the wide range of savings estimates, the ratio estimation method tends to create a sample with a near-census of the largest savings customer stratum and a similar sample size from among the other strata. Within each stratum, we selected projects randomly. In our final sample, the expected precision in the MWh estimate is 6.8% at the 90% confidence level. We reviewed 75% of program MWh savings. Table 11 provides detail on the sample.

Table 11. Electric Impact Evaluation Sample

Stratum	Stratum Range (MWh)	Program Population	Population Ex Ante Gross MWh Savings	Sample Size	Sample Ex Ante Gross MWh Savings	On-Site Verification
A	1,170-1,916	3	4,454	3	4,454	1
B	495-881	6	3,936	5	3,420	1
C	151-389	7	1,786	3	560	1
Total			**10,175**		**8,434**	**3**

Both natural gas projects were part of the engineering review including a census of gas savings.

Additionally, the evaluation conducted on-site verification at three participants in the PY7 program, and we called service providers and participants to clarify inputs for several measures, as needed. We selected the on-site verification group as a subset of the impact evaluation sample. On-site visits were chosen based on diversity of installed measures and geographic proximity.[4] The on-site verification could modify the site savings realization rate and further influenced the stratum and overall realization rate in proportion to the project size in those groupings.

Gross Impact Calculation

The evaluation based gross impacts on a review of a stratified random sample of program projects using ratio estimation. Based on prior evaluation results for the program, the sampling protocol used an error ratio of 0.40. The impact review consisted of analyzing data included in reports and verifying or re-estimating savings using engineering algorithms. Among the 11 projects included in the engineering review, we reviewed projects from each of the active markets served by the program. Our review encompassed 75% of program ex ante electricity savings and 100% of ex ante natural gas savings.

[4] For example, one company had seven similar sites participating in Commercial Building Retro-Commissioning, and we selected one of these sites based on distance from other participants selected for on-site verification.

Table 12. PY7 Population and Sample Ex Ante Gross Impacts by Project Type

Program Component	Program Population	Program Ex Ante Gross Impacts		Sample Size[a]	Sampled Ex Ante Gross Impacts	
		MWh	Therms		MWh	Therms
Compressed Air	14	7,488	0	9	5,747	0
Industrial Refrigeration	0	0	0	0	0	0
Large Facility	2	2,687	226,171	2	2,687	226,171
Healthcare	*2*	*2,687*	*226,171*	*2*	*2,687*	*226,171*
Commercial	*0*	*0*	*0*	*0*	*0*	*0*
Grocery	*0*	*0*	*0*	*0*	*0*	*0*
Total	**16**	**10,175**	**226,171**	**11**	**8,434**	**226,171**

[a] Sampling was performed from strata based on project savings, not program component; therefore, component savings realization rates are not valid to report.

Net Impact Analysis Approach

The ex ante NTGRs for the program are the SAG-approved values of 0.96 for electricity and 0.95 for natural gas. Following the NTGR framework, we apply these NTGRs to PY7 savings.

2.3 Sources and Mitigation of Error

Table 13 provides a summary of possible sources of error associated with the data collection conducted for the Retro-Commissioning Program. We discuss each item in detail below.

Table 13. Possible Sources of Error

Research Task	Survey Errors		Non-Survey Errors
	Sampling Errors	Non-Sampling Errors	
Participant Interviews	• No, attempted census	• Measurement errors • Non-response and self-selection bias • Data processing errors • External validity	• N/A
RSP Interviews	• No, attempted census	• Measurement errors • Non-response and self-selection bias • Data processing errors • External validity	• N/A
Non-Participant Survey	• Yes	• Measurement errors • Non-response and self-selection bias • Data processing errors External validity	• N/A
Gross Impact Analysis	• Yes	• N/A	• Analysis errors
Verification Site Visits	• Yes	• N/A	• Data processing errors • Analysis errors
Net Impact Calculations	• N/A	• N/A	• Analysis errors

The evaluation team took a number of steps to mitigate potential sources of error throughout the planning and implementation of the PY7 evaluation.

Survey Errors

- **Sampling Errors**
  - **Non-Participant Survey:** The evaluation team designed the telephone survey sample to provide a results representative of the non-participant population and subcategories of interest. We surveyed 214 customers out of a population of 125,092. For process results, at the 90% confidence level, we achieved a precision of 5.6% assuming a coefficient of variation of 0.50. The actual precision of each survey question depends on the variance of the responses to each question.
  - **Gross Impact Analysis:** The evaluation team designed the gross impact sample to achieve 90% confidence and ±10% relative precision. We stratified projects in our sample to more accurately capture variations within projects of different sizes. We analyzed results from 11 of 16 completed projects. At the 90% confidence level, we achieved a precision of ±4%.
  - **Verification Site Visits:** The evaluation team performed measure verification for three sites from among the gross impact sample. The on-site verification sample was not statistical, but rather was selected to achieve diversity of facility and measure type.
- **Non-Sampling Errors**
  - **Measurement Errors:** The validity and reliability of survey data were addressed through multiple strategies. First, we relied on the evaluation team's experience to create questions that, on their face, appeared to measure the idea or construct that they were intended to measure. We reviewed

the questions to ensure that we did not ask double-barreled questions (i.e., questions that ask about two subjects, but that have only one response) or loaded questions (i.e., questions that are slanted one way or another). We also checked the overall logical flow of the questions to avoid confusing respondents, which would decrease reliability.

All survey instruments were reviewed by key members of the evaluation team and AIC and Illinois Commerce Commission (ICC) staff also had the opportunity to review.

- **Non-Response and Self-Selection Bias**. Because the response rate for the participant and service provider interviews was not perfect, there is the potential for non-response bias. We attempted to mitigate possible bias by contacting each prospective respondent at least four times via email and/or phone to set up appointments. Team members also used data to assess whether evidence of non-response bias exists. For this survey, we compared interview respondents to the population based on business type, number of projects, and project savings. We found no evidence to suggest that non-respondents differed significantly from respondents. Similarly, there is potential for non-response bias in our non-participant survey. We attempted to mitigate possible bias by contacting each prospective respondent in the sample at least eight times at different times of day, as appropriate, until we received a firm refusal or filled our quota.

- **Data Processing Errors:** The team addressed processing errors through quality checks of completed survey data.

- **External Validity.** We addressed external validity (the ability to generalize any findings to the population of interest) through the development of an appropriate research design.

Non-Survey Errors

- **Analysis Errors**

  - **Gross Impact Calculations:** We applied engineering models 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 focused on the assessment of program design and implementation, participant satisfaction and feedback, and awareness of and attitudes toward retro-commissioning among program non-participants. Our results are based on 1) in-depth interviews with program staff; 2) a review of program data; 3) in-depth interviews with program participants; 4) in-depth interviews with program RSPs and 5) two quantitative surveys — which we combined — of program non-participants.

3.1.1 Detailed Program Description

The Retro-Commissioning Program helps 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 pre-approved 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 50%–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.

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

The program is delivered in three core subcomponents, detailed below. Each subcomponent has different specific eligibility requirements.

- **Compressed Air Retro-Commissioning.** The Compressed Air program provides incentives to defray the cost of a retro-commissioning survey 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 program provides incentives to defray the cost of a retro-commissioning survey 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 Facility Retro-Commissioning.** The Retro-Commissioning program also includes a Large Facility component that targets three separate types of facilities: healthcare facilities, large commercial facilities (primarily offices), and grocery stores (newly introduced in PY7). Healthcare facilities in particular represent a major opportunity for energy savings.

Large Facility 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 encourage the RSPs to market the program more aggressively, AIC pays a screening stipend of 5%–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 14 below.

Table 14. Summary of Retro-Commissioning Program Incentives

Project Type	Survey Incentive	Customer Implementation Incentive	Incentive Requirements
Compressed Air	80% of survey cost	• 2¢/kWh saved	• Payback period of zero to one year • Measures must be complete before program incentive is paid
Industrial Refrigeration	50%–80% of survey cost	• 2¢/kWh saved	• Payback period of zero to one year • Measures must be complete before program incentive is paid
Large Facility	70% of survey cost 5%–10% of survey cost as "stipend" to RSP for complex projects	• 2¢/kWh • 40¢/therm	• Payback period of zero to one year • Measures must be complete before program incentive is paid • Measures do not need to be complete for stipend to be paid

In PY7, all completed projects fell under the Compressed Air and Large Facility categories. No projects were completed under the Industrial Refrigeration offering. All Large Facility projects in PY7 were healthcare projects, and no projects were completed in commercial buildings. In PY7, the program also began the process of offering retro-commissioning to grocery stores under the Large Facility offering, similar to the healthcare and commercial buildings component of the program but with relaxed facility size requirements. This component also did not see any completed projects in PY7.

3.1.2 Program Year 7 Participation Summary

Table 15 displays the contributions of each Retro-Commissioning component to the Program's overall PY7 ex ante gross savings.

Table 15. Summary of PY7 Retro-Commissioning Program Components

Program Component	Unique Customers	Unique Projects[a]	Ex Ante Gross Electric Savings		Ex Ante Gross Gas Savings	
			MWh	%	Therms	%
Compressed Air	13	14	7,488	74%	0	0%
Industrial Refrigeration	0	0	0	0%	0	0%
Large Facility	2	2	2,687	26%	226,171	100%
Healthcare	*2*	*2*	*2,687*	*26%*	*226,171*	*100%*
Commercial	*0*	*0*	*0*	*0%*	*0*	*0%*
Grocery	*0*	*0*	*0*	*0%*	*0*	*0%*
Total	**15**	**16**	**10,175**	**100%**	**226,171**	**100%**

[a] This project count reflects all projects with savings in PY7, which does not include seven healthcare studies (six unique customers) that were completed in PY7 and received a stipend.

Program staff have expressed concern about the number of projects being completed through the Retro-Commissioning Program. In PY7, the total number of projects decreased for the second consecutive year, as did program MWh and therm savings.

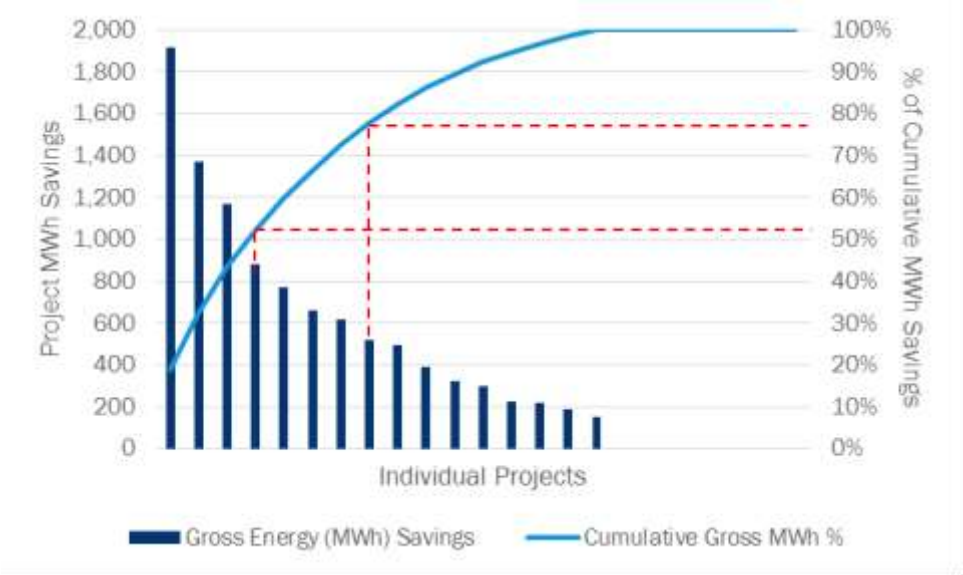
Table 16. Summary of Past Program Participation

Program Year	Projects[a]	Ex Ante Gross MWh Savings	Ex Ante Gross Therm Savings
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

[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.

PY7 project data show that as in past years, program savings are heavily reliant on very few projects. Figure 1 below shows that four projects comprise more than 50% of program electric savings and eight projects comprise more than 75% of electric savings. Gas savings are similarly dependent on a small number of projects; only two projects completed in PY7 had associated gas savings, both Large Facility healthcare projects.

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



One encouraging sign for the program is that seven stipends for healthcare studies were paid in PY7. Our limited number of interviews with participants who completed studies for which a stipend was paid indicate that the customers who completed these studies either have already begun implementation of energy-saving measures at their facilities or plan to in future program years, which will hopefully result in a productive PY8 for the Large Facility offering.

Table 17 summarizes PY7 RSP participation. Five RSPs were active in the program in PY7. One RSP completed all nine Large Facility projects under the program in PY7, all of which were at healthcare facilities. Two of the remaining four were responsible for 12 of the 14 Compressed Air projects.

Table 17. Summary of RSP Participation

RSP	Completed Compressed Air Projects	Completed Large Facility Projects	Healthcare Studies w/ Stipend
RSP-A	0	2	7
RSP-B	7	0	0
RSP-C	5	0	0
RSP-D	1	0	0
RSP-E	1	0	0
Total	**14**	**2**	**7**

3.1.3 Program Design and Implementation

Based on interviews with program staff, implementation of the Retro-Commissioning Program remained relatively consistent with prior years in PY7. AIC did implement some minor changes to the program in PY7, which are described below.

Implementation Changes

Program changes in PY7 included the following:

- The program decreased the level of its additional bonus for customers who complete a Custom project within a year of having completed a retro-commissioning study. In PY6, the program offered a 20% bonus for customers completing a Custom project within 6 months of a retro-commissioning study, and a 10% bonus for customers completing a Custom project between 6 and 12 months after completing a retro-commissioning study. In PY7, these bonuses were reduced to 15% and 5% respectively due to PY7 budget constraints.

- The program combined the healthcare and commercial building subprograms into the Large Facility offering in PY7. Previously, the two subprograms had separate application forms and lists of participating RSPs despite otherwise being identical.

- Finally, as discussed above, the program began the process of developing a grocery store offering in PY7. Although no projects were completed, program staff met with potential program RSPs and also gathered information on potential future participants.

Program Challenges

Program staff were concerned with the fairly low activity level of the program in PY7 and identified several challenges for the program to overcome, which are generally reinforced by the research we conducted. One item noted by Business Program staff was a reduced budget in PY7 – retro-commissioning is inherently more expensive per unit of energy saved for the program as compared to some other portfolio offerings.

Some challenges are market-related. Program staff report a high market penetration for the program among eligible hospitals and facilities with compressed air systems, historically the program's most successful component. The program has now reached a high proportion of eligible facilities, and reaching additional facilities that have not yet participated in the program is proving difficult. Many of the facilities that have been reached will be eligible for a new round of retro-commissioning in coming years, but staff believes that the program is currently in a "lag" phase for healthcare projects where a high percentage of eligible healthcare sites are currently ineligible for the program.

Program staff also report that selling the Large Facility retro-commissioning proposition to commercial buildings can be challenging. Specifically mentioned by staff were several commercial sites that made it into the application phase and then decided to not complete a project (i.e., false starts). For a small program that derives its savings from a small number of completed projects, false starts are challenging to overcome.

A review of past RSP program participation highlights the program challenges mentioned during the program manager interviews. As shown in Table 17, one RSP is the primary driver of the Large Facility and healthcare component of the program while two other RSPs drive nearly all of the Compressed Air projects. Given that the program is highly dependent on RSPs for marketing and development, any variation in RSP activity—particularly the most active ones—can have a dramatic impact on program results. For example, the Industrial Refrigeration component of the program was negatively impacted (and ended up with zero completed projects) in PY7 when the largest previous RSP pulled out of the program. Additionally, program staff report that some past allies were one-time participants – individual customers of the RSP motivated the RSP's participation, and once the customer completed a project, the RSP chose not to actively pursue additional retro-commissioning projects.

Program staff are actively working to build the program in future years – in particular, program staff are actively working to recruit an Industrial Refrigeration RSP for the program to build around in future years.

Marketing and Outreach

According to our program manager and marketing staff interviews, the marketing strategy for the Retro-Commissioning Program is primarily focused around program RSPs. The structure of the program means that it is heavily reliant on RSPs to promote and market the program and to actively pursue customers. Program marketing staff assist in training RSPs and supporting their marketing efforts where possible (for example, providing cobranding materials) but the primary source of outreach is the RSPs.

Program staff indicate that in the course of their regular interactions with AIC customers they work to make them aware of program offerings. Additionally, program staff actively pursue past Retro-Commissioning Program participants to encourage crossover to the Custom Program.

Business Program Energy Advisors are assigned to each of the seven AIC territories. In PY8, the Retro-Commissioning program manager has set a goal of two Retro-Commissioning projects for each of these seven Energy Advisors which will hopefully motivate additional projects in PY8.

3.1.4 Program Marketing Findings

Participant Exposure to Marketing Efforts

Half of the participants that we spoke with reported that their RSP introduced them to the program. The remaining participants either reported direct outreach from AIC that led to a project, or past participation in other AIC programs that led to general awareness of the Retro-Commissioning Program. This finding is consistent with RSP reported information about how they acquire projects and program staff description of the program's marketing efforts.

RSP Marketing Efforts

RSPs were aware that there was marketing collateral (case studies and program fact sheets), but did not generally report using it. RSPs did generally report that being able to co-brand with the AIC program gives their proposals extra credibility. All RSPs reported being generally satisfied with the program's support of their marketing efforts, although RSPs generally reported that business they did through the program was motivated by their outreach rather than that of the program.

Compressed Air RSPs generally had a prior working relationship with participants before conducting a retro-commissioning project for them – often the RSP was the firm that either installed or was contracted to maintain a participant's compressed air system.

3.1.5 Barriers to Participation

Participant Perspective

Most of the 10 participants we interviewed suggest that without the incentives provided through the retro-commissioning program, the cost of conducting retro-commissioning studies would be too high. Further, they indicate that the other companies likely do not participate due to lack of awareness. Participants overwhelmingly suggest that once they become fully aware of the program and its opportunities, the decision to participate is easy. Participants provided no other concrete barriers to participation.

RSP Perspective

RSPs were able to provide a much more nuanced assessment of the barriers to program participation. Multiple RSPs believe that awareness and understanding of retro-commissioning is an issue for the program. One RSP even noted that they believe different RSPs have different understandings of what retro-commissioning truly is, and inconsistent communication from different providers reinforces customer confusion about what energy saving actions should be taken.

Some RSPs also report an initial distrust of what seems to be a "too good to be true" opportunity for customers. RSPs specifically mentioned that the ability to use the AIC name is helpful in allowing them to access to these customers, and that once the details of the program and retro-commissioning are fully discussed, customers are generally extremely receptive to the opportunity to complete a project at little cost.

Non-Participant Perspective

Key findings from our survey of non-participants are twofold: 1) based on self-reported responses, only a small share of the non-participant population (10%) is eligible for retro-commissioning[5], and 2) among those non-participants who are eligible for retro-commissioning, less than two-thirds (60%) are familiar[6] with the general concept. Table 18 provides detailed information from the non-participant survey.

Table 18. Non-Participant Eligibility for and Awareness of RCx

Metric	Small Customers	Large Customers	Overall
% Eligible for RCx (n = 214)	10%	43%	10%
% Familiar with RCx concept (among those eligible for program) (n=49)	59%	82%	60%
% Aware of AIC RCx Program (among those eligible for program) (n=49)	6%	45%	9%

Customer size, as expected, is a clear delineator in eligibility for and awareness of retro-commissioning. Nearly half (43%) of surveyed large non-participants self-report as eligible for retro-commissioning, and over 80% of large customers eligible are familiar with the concept in general.

Less than 10% of non-participants eligible for retro-commissioning are specifically aware of the AIC Retro-Commissioning Program, but close to half of eligible large non-participants are aware of the program.

While we asked detailed questions about the exact barriers to retro-commissioning projects to non-participants who reported eligibility for and awareness of retro-commissioning, the small number of non-participants meeting these criteria resulted in sample sizes for these questions that are insufficient to provide generalizable findings. Anecdotally, some reasons non-participants reported they had not conducted retro-commissioning studies and activities were the associated upfront cost, insufficient payback, and a lack of perceived need.

[5] We asked a number of questions of each respondent to assess their self-reported eligibility for the AIC Retro-Commissioning Program based on PY7 program eligibility requirements, including presence of equipment types and size of facility.

[6] "Very familiar" or "somewhat familiar" on a 4 point scale ranging from "not at all familiar" to "very familiar."

Our non-participant survey findings make it clear that the primary barriers to non-participant participation in the retro-commissioning program are general awareness and understanding of retro-commissioning, as well as specific awareness of the AIC program. These findings align with those from our RSP interviews.

3.1.6 Channeling

A secondary stated goal of the Retro-Commissioning program is identification of retrofit and capital improvement projects. Through identification and information from the Retro-Commissioning Program, additional projects may 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.

Four customers received this additional bonus in PY7 – two completing compressed air projects and two completing other project types. This is a substantial decline from PY6, during which nine RCx-Custom bonuses were issued.

Despite RCx-Custom bonuses being infrequently issued in PY7, our interviews with program participants and RSPs indicate that there is at least some channeling taking place. More than half of interviewed participants say they have either completed or plan to complete an energy efficiency project through AIC programs that they directly link to the retro-commissioning study. Several of the interviewed participants who have not completed or plan to complete a project do state awareness of other AIC programs.

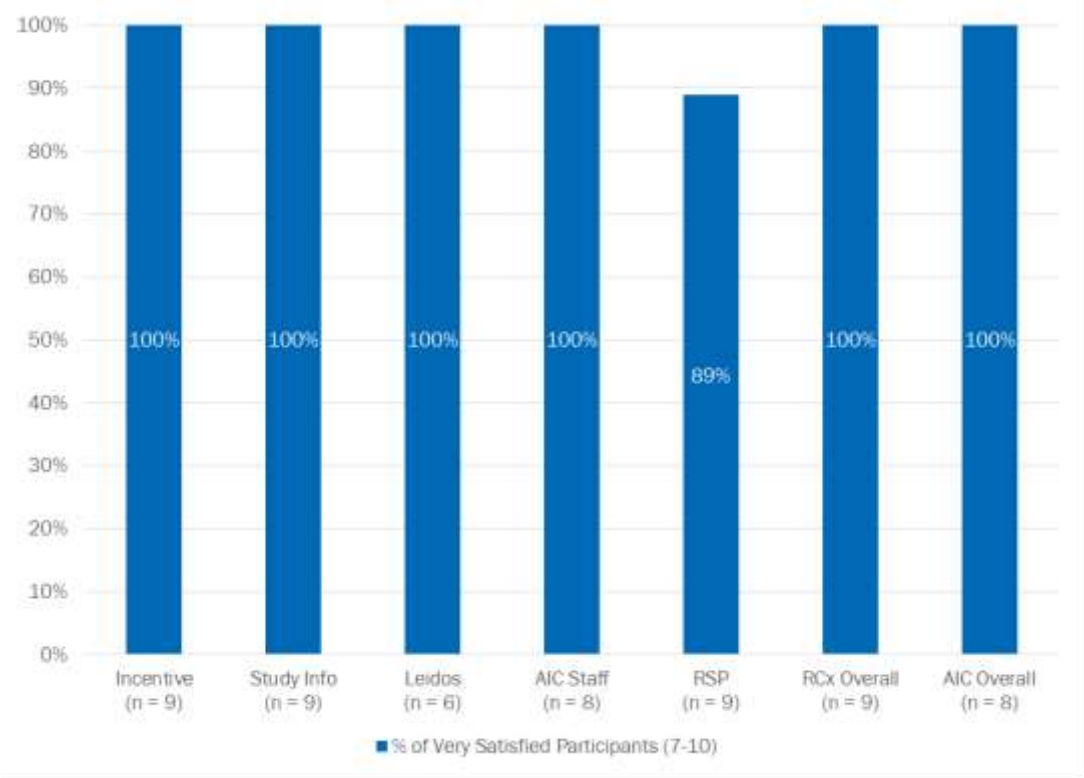
RSPs also indicate that they always actively promote other AIC programs and identify upgrades for most projects. One RSP told us that many times upgrades happen later- a year or more after a retro-commissioning study takes place, while another told us that additional upgrades almost always happen in the first year. One RSP also directly stated that one of their customers was a repeat Retro-Commissioning participant and made additional upgrades during their previous participation in the program, but that no additional opportunities were found during their PY7 participation.

3.1.7 Program Satisfaction

Participant Satisfaction

In general, participants reported a very high level of satisfaction with the Retro-Commissioning Program. Participants were asked to rank aspects of the program on an 11 point satisfaction scale. Nine of the 10 participants we interviewed provided satisfaction ratings, although a number of participants were unfamiliar with Leidos and did not rate them. One interviewee was a PY7 stipend-only participant and did not provide program satisfaction ratings for any aspect of the program.

Figure 2. Participant Satisfaction with Program Components



Nearly every participant we spoke with was very satisfied[7] with every element of the program. The lone exception was one participant who was not fully satisfied with their RSP. While this participant was not entirely dissatisfied with their RSP, they experienced some frustration with the timing of their RSP's work and reported a need to be in constant contact with them to try to move their project along. One other participant did also indicate some slight challenges with their RSP as well, but not to a degree that impacted their satisfaction significantly.

Every participant we spoke with who completed a full retro-commissioning project said that they would participate in the program in the future if they saw the need and would recommend the program to others. Many reported that they had already begun the process of participating in the program at another facility and/or had already recommended the program to others.

RSP Satisfaction

Service providers were also generally satisfied with the program, although slightly less so than participants. RSPs shoulder more of a burden with the program. Some RSPs, including one past RSP that is no longer active in the program, find the technical review process for the program frustrating and/or lacking. In particular, one active RSP believed that the program either does not conduct enough technical review or does not hold RSPs to a high enough standard in the review process. This RSP believed that other RSPs do not do work of sufficient

[7] A rating of seven or greater on scale of zero to 10, where 0 is "very dissatisfied" and 10 is "very satisfied."

quality, and specifically reported conducting retro-commissioning at sites where other RSPs were previously active and achieving greater savings.

RSPs do generally credit the program with generating more work for them, though both the inactive RSP we interviewed and one active RSP believed that at least for some projects the program requirements took more cost and effort to meet than the project would have cost without the program incentives.

3.2 Impact Results

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

Table 19 below 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 sampled projects.

Table 19. PY7 Retro-Commissioning Program Gross Impacts

Savings Category	Ex Ante Gross	Realization Rate	Ex Post Gross
Energy Savings (MWh)	10,175	84%	8,543
Demand Savings (MW)	0.97	83%	0.80
Gas Savings (Therms)	226,171	99%	223,292

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
  - Among all reviewed projects, RSPs calculated air leakage rates assuming 100 PSI plant pressure. In several cases, the reports and data clearly show plant pressure close to 75 PSI which greatly reduces baseline air leakage rates.
  - 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,[8] so reducing airflow due to leak repair does not save the equivalent proportion of energy.
  - All savings from PY7 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 other short-payback measures including, for example: no-loss drains, elimination of inappropriate

[8] 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.

uses, storage, better staging of multiple compressors, and cycling driers. Compressed air retro-commissioning is more than leak repair.

- Large Facilities
  - Ex ante savings are based on hourly computer simulations, but executable simulation files and inputs are not included in the project files. The evaluation needed to generate original calculations to validate ex ante savings. While we found general convergence with ex ante estimates, evaluation estimates could not exactly replicate the RSP analysis with available data. Absence of transparent ex ante calculations introduces potential evaluation risk if we are not able to determine the algorithms and assumptions used.
  - 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.

For ex ante demand savings, most RSPs calculated a simple estimate of kWh divided by annual operating hours in the Amplify 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 sampled projects.

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.

The impact evaluation of the PY7 Retro-Commissioning Program has many findings similar to the PY6 evaluation. This is due partly to the delay between the program year-end and the evaluation that prevents incorporating evaluation recommendations before the subsequent program year kickoff.

3.2.2 Net Impacts

The ex ante NTGRs for the program are the SAG-approved values of 0.96 for electricity and 0.95 for natural gas. Following the NTGR framework, we apply these NTGRs to PY7 savings. Table 20 provides the PY7 net impacts for the retro-commissioning program.

Table 20. PY7 Net Program Impacts

Savings Category	Ex Post Gross	NTGR	Ex Post Net
Energy Savings (MWh)	8,543	96%	8,201
Demand Savings (MW)	0.80	96%	0.77
Gas Savings (Therms)	223,292	95%	212,127

3.3 Conclusions and Recommendations

3.3.1 Impact Recommendations

Key Findings

While realization rates in PY7 are relatively good, there are opportunities to increase the accuracy of the ex ante estimates. As in prior years, ex ante savings calculations were often not included in reports, or simulation inputs did not include validation details. As a result, the accuracy of savings estimates did not have the preferred level of rigor.

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 has continued to perform post-installation inspections in PY7. Documentation for these visits has improved greatly since they began in PY4 but it 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.

Recommendations for Program Improvement

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 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. 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.
  - If hourly simulations are used to determine ex ante savings, an executable version of the model should be submitted so that the evaluation team can verify that recommended measures constitute the only changes in the model.
- **Improve documentation of post-installation inspections.** Document most measures with data or representational verification (photos, graphs, etc.). Clearly annotate which measures the verification is supposed to show. Sometimes one screenshot can verify multiple measures. Some measures are hard to represent in this manner and others may not seem worth the effort. A savings magnitude threshold (gross kWh or % of project savings) might be used to prioritize effort.

  - 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, assumptions of 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.

- **Implement a stronger review regimen through the Implementation Contractor.** Positively confirm operating hours, plant pressures, production pressures and compressor part-load performance.

3.3.2 Process Recommendations

Key Findings

The Retro-Commissioning Program's Compressed Air offering is a well-developed and smoothly operating component of the program – program staff referred to it as "vibrant" in our interviews with them. While the potential for compressed air projects are limited – per the program implementation plan, the program has likely reached upwards of 70% of the target market – many of these customers can participate in the program multiple times and we see evidence that this has already begun to happen as the program matures. Participant and RSP satisfaction with the Compressed Air offering is high, and while the program as a whole saw a decrease in projects and savings in PY7 (compared to previous years), PY7 actually saw more completed Compressed Air projects than PY6.

It is notable that this program functions essentially as a large scale leak survey and repair program. Most ex ante energy savings reported by the Compressed Air offering result from leak repairs. The evaluation team is unable to easily quantify the number of custom projects that have *eventually* resulted from Compressed Air Retro-Commissioning studies, but only two customers received RCx-Custom bonuses for compressed air projects in PY7. While this program implementation strategy is not inherently poor, it is limited, and some Compressed Air RSPs are not producing other energy-saving opportunities beyond leak repair at the sites they service. One interviewed RSP expressed frustration with the quality of work submitted by other Compressed Air RSPs and believed that there are deeper savings available at many of these sites that are not realized.

The other components of the program are not nearly as mature or stable. The Large Facilities (previously Healthcare and Commercial Facilities) offering saw only two completed projects with savings in PY7, both in healthcare facilities. Seven stipend healthcare projects were completed in PY7 that could lead to savings in PY8, but no projects were completed in the commercial or grocery segments.

The Industrial Refrigeration offering saw zero completed projects in PY7, which program staff attribute predominantly to the largest player on the RSP side pulling out of the program after PY6. Program staff tell us that they are actively pursuing additional players for this component of the program.

Recommendations for Program Improvement

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

- **Focus on developing a larger and more engaged RSP cohort for non-Compressed Air offerings.** The Retro-Commissioning Program is driven by its participating RSPs, and its success depends in large part on having an engaged and effective group of RSPs to develop and complete retro-commissioning projects. The Compressed Air offering has several active RSPs, but in PY7 the Large Facility offering had only one active RSP and the Industrial Refrigeration offering had none. While more RSPs were active in previous program years, outside of Compressed Air, the program has never had a robust group of RSPs. Developing this group should be the top priority for program staff – given how program outreach and marketing generally operates, the most effective way to motivate additional participation in the Retro-Commissioning Program will be to bring more RSPs into the fold.

- **Increase program staff marketing effort.** In tandem with the above recommendation, we recommend increasing non-RSP dependent marketing efforts. Information from the program's implementation plan and our process evaluation activities indicate that while the market penetration of the Retro-Commissioning Program is relatively high, there are still potential projects remaining in the market, especially in non-Compressed Air segments.

  However, the program's reliance on RSPs for marketing means that customers who are not actively reached by participating RSPs are often unlikely to enter the program. While RSPs generally report being satisfied with program marketing support, if the program wishes to develop additional business in market segments where it does not currently have activity, additional outreach from program staff will be essential. We recommend increased marketing activity by program Energy Advisors (which has already likely begun in PY8 according to our program manager interviews) 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.

- **Work to more clearly define and explain the retro-commissioning proposition to customers and RSPs.** Based on results of our participant interviews, non-participant survey, and RSP interviews, the evaluation team feels 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. Clearly defining what retro-commissioning is will aid customer understanding of the program and help to ensure consistency across RSPs.

Appendix A. Data Collection Instruments

AIC PY7 RCx
Participant Guide FI

AIC PY7 RCx RSP
Guide FINAL.docx

Appendix B. Survey Response Rate Methodology

Given that survey response rates are calculated and presented for the Core Program participant survey and Business Program non-participant survey, we present here a definition and explanation of how the rate is calculated. The survey response rate is the number of completed interviews divided by the total number of potentially eligible respondents in the sample. We calculated the response rate using the standards and formulas set forth by the American Association for Public Opinion Research (AAPOR).[9] For various reasons, we were unable to determine the eligibility of all sample units through the survey process and so chose to use AAPOR Response Rate 3 (RR3). RR3 includes an estimate of eligibility for these unknown sample units. The formulas used to calculate RR3 are presented below. The definitions of the letters used in the formulas are shown in the Survey Disposition tables in the Retro-Commissioning Non-Participant Telephone Survey section of the report.

$$E = (I + P + R + NC) / (I + R + NC + e)$$

$$RR3 = I / ((I + P + R + NC) + (E*U))$$

We also calculated a cooperation rate, which is the number of completed interviews divided by the total number of eligible sample units actually contacted. In essence, the cooperation rate gives the percentage of participants who completed an interview out of all of the participants with whom we actually spoke. We used AAPOR Cooperation Rate 1 (COOP1), which is calculated as:

$$COOP1 = I / (I + P + R)$$

[9] *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys*, AAPOR, 2011. http://www.aapor.org/AM/Template.cfm?Section=Standard_Definitions2&Template=/CM/ContentDisplay.cfm&ContentID=3156.

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