RETRO-COMMISSIONING PROGRAM EVALUATION REPORT

INCLUDING: COMPRESSED AIR, COMMERCIAL BUILDINGS, HEALTHCARE, AND LEAK SURVEY AND REPAIR PROGRAM

Final

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1. EXECUTIVE SUMMARY

This report presents results from the evaluation of the fourth program year (June 1, 2011 through May 31, 2012) of the Ameren Illinois Act On Energy Business Retro-Commissioning Program for energy efficiency. The Act On Energy 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, Ameren Illinois pays a survey incentive based on the project type that covers 50% to 80% of the survey cost. A further implementation incentive is paid to the customer based on the energy saved and a bonus is paid to the contractor based on timely measure implementation and energy saved.

In prior program years, the program focused on healthcare customers and compressed air for large industrials. In response to the increasing savings goals, the program implementation plan began outreach to new markets: specifically commercial buildings and industrial refrigeration. It introduced a new and complementary program, Leak Survey and Repair Program, which services customers with smaller compressed air systems. For PY4, Ameren Illinois Company (AIC) planned to garner 8% of the portfolio electric energy savings and 2% of portfolio therm savings from this program.

The evaluation in PY4 focuses on impact results and net-to-gross (NTG) research with process-related work scheduled for PY5. We apply the net-to-gross ratio (NTGR) found through our research retrospectively to PY4. To support the general aspects of the evaluation, we reviewed program materials and program-tracking data and interviewed program administrators and implementation staff. Our quantitative impact and net-to-gross research included engineering reviews of a statistical sample of retro-commissioning projects and net-to-gross interviews with an attempted census of participant customers and a sample of active retro-commissioning service providers.

Impact Results

Table 1 summarizes reported and verified program participation by the different program components. As seen in this table, during PY4, AIC included 31 electric and 5 gas facilities (32 total facilities) as participants and paid them incentives from the Retro-Commissioning Program. One compressed air project's savings depended on a custom incentive project completion that did not occur until shortly after PY5 began. After discussions among AIC staff, the implementation team, ICC staff, and the evaluation team, we chose to drop this site from our PY4 analysis and analyze this participant in PY5. [1]

[1] AIC will count savings for both the custom and retro commissioning projects in PY5 though the incentive cost for the retro-commissioning project is included in PY4 costs.

Table 1. Summary of Program Verification Results

Program Component	Program Participation (N)		Verified Participants (N)		Realization Rate	
	Electric	Natural Gas	Electric	Natural Gas	Electric	Natural Gas
Ammonia Refrigeration Projects	1	0	1	0	100%	NA
Compressed Air Projects	19	0	18	0	95%	NA
Leak Survey and Repair	7	0	7	0	100%	NA
Healthcare Retro Commissioning[a]	3	4	3	4	100%	100%
Commercial Building Retro-Commissioning	1		1		100%	
All Projects	**31**	**5**	**30**	**5**	**97%**	**100%**

[a] One Healthcare project included only natural gas measures since the customer does not receive electricity service from AIC.

The evaluation team performed an engineering review of 15 of the 31 projects (including four of five natural gas sites) to obtain a gross realization rate for the program. The evaluation team performed NTG analysis in PY4 for application to the program retrospectively[2] in PY4. The NTGR, based on participant and RSP self-report data, is 0.95 for both fuels.

We modified the program ex ante gross savings for several reasons, although ultimately, the gross realization rates were relatively high (0.89 electric energy, 0.91 demand, and 0.85 therms). Conversely, the PY4 net-to-gross research revised the NTG ratio upwards; thus, ex post net savings are moderately higher than ex ante net savings. Table 2 summarizes PY4 Net Impacts.

Table 2. PY4 Retro-Commissioning Net Impacts

Program	Ex Ante Net Impacts[a]			Ex Post Net Impacts[b]		
	MW	MWh	Therm	MW	MWh	Therm
Retro-Cx	1,997	16,175	360,693	2,143	17,052.4	361,966
			Net Realization Rate	*1.07*	*1.05*	*1.00*

[a] Ex ante net savings use an NTGR of 0.80 for both fuels, based on "dashboard" spreadsheets.
[b] Ex post net savings use an NTGR of 0.95 for both electric and gas

Process Results

The PY4 evaluation plan for the Retro-Commissioning Program did not call for a formal process evaluation of the program. Process questions will be the focus of the evaluation effort in PY5. Nonetheless, the evaluators noted some process-related observations based on our background research and answers to open-ended questions posed to participants and service providers during the net-to-gross surveys.

[2] Retrospective application of the PY4 net-to-gross ratio estimate is based on the interpretation of the memo: Proposed Framework for Counting Net Savings in Illinois, Optimal Energy, March 12, 2010. AIC assumed NTGR=0.8 for planning purposes not as a result of prior NTGR research.

- Service providers unanimously agreed they liked the program and would continue to participate as RSPs. A sample quote: "This program is great for Illinois businesses."

- Other aspects of program marketing and technical support from the program implementer (SAIC) also received generally positive feedback.

- Respondents offered less positive comments about other program processes. Several service providers noted the cumbersome and shifting processes for participation. One RSP noted that the new program year is announced in May for June 1 launch, but applications were not available until mid-July and revisions continued into September. W-9 requirements were added later and incentives and bonuses seemed to change throughout the program year.

Two key findings from our PY4 effort fall into the process category. Based on our engineering review of the projects:

- Project reports are inconsistent in content and analysis. This can lead to unwarranted reduction of savings if the evaluation team cannot find the most appropriate information.

  - Consider issuing a template report with prescribed sections and elements of data and analysis required for each section. This would encourage more standardization among reports to include critical data and organization that facilitates internal program review and evaluation and may reduce our missing critical information.

- Ex ante savings calculations are often not included in reports or simulation inputs are not detailed. The evaluation effort was greater due to the need to reproduce calculations from scratch to confirm approximate savings estimates. Similar to the inconsistent reports, this may also lead to reduction of savings that could be avoided.

  - Consider encouraging RSPs to use more transparent calculations like spreadsheets or, at a minimum, include electronic input files for simulations when they are used for estimating savings. Require submitting electronic versions of calculations to assure that we understand how the RSPs obtain results. Consider issuing template calculators for common measures to ensure consistent approaches and the use of default parameters among service providers.

2. INTRODUCTION

2.1 PROGRAM DESCRIPTION

The Act On Energy 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 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 a survey incentive based on the project type that covers 50% to 80% of the survey cost. A further implementation incentive is paid to the customer based on the energy saved and a bonus is paid to the contractor based on timely measure implementation and energy saved.

In prior years, the program only served the industrial compressed air and healthcare market segments. These two segments still represent the majority of projects and savings, but the program also has a commercial building component and piloted an ammonia refrigeration system optimization project under the retro-commissioning program. Participation requirements include:

- AIC customer served under applicable rate codes[3]
- Functioning Energy Management and Control system (EMCS) for HVAC equipment automation for commercial buildings and healthcare participants
- Size criteria
  - > 100,000 ft^2 Healthcare and Commercial Building retro-commissioning
  - ≥ 200 horsepower (HP) connected compressor load for Compressed Air retro-commissioning
- Building must be at least five years old for Healthcare and Commercial Building retro-commissioning.

The evaluation team is evaluating the Leak Survey and Repair Program with the Retro-Commissioning Program due to similarities with the compressed air component of the Retro-Commissioning Program. In both cases, compressed air professionals evaluate the industrial compressed air system to find efficiency options. The Leak Survey and Repair Program focuses on systems less than 200 HP and solely targets savings from leak repair. Program incentives are based on system size and the successful leak repair, not energy savings estimates. Program incentives for the other components of the retro-commissioning program vary based on the type of retro-commissioning project.

[3] To be eligible for electric incentives, applicants must be a non-residential electric customer of Ameren Illinois (electric delivery service rates DS-2, DS-3, DS-4, or DS-5) and have a Rider EDR surcharge on their Ameren Illinois bill. To be eligible for gas incentives, applicants must be a non-residential gas customer of Ameren Illinois (gas delivery service rates GDS-2, GDS-3, GDS-4, or GDS-5) and have a Rider GER surcharge on their Ameren Illinois bill.

Table 3. Summary of Retro-Commissioning Incentives

Project Type	Survey Incentive (as percent of survey cost)	Customer Implementation Incentive	Requirement for Implementation Incentive
Compressed Air	80%	➢ 1 cent/kWh (1st 2 GWh saved) ➢ ½ a cent/kwh (from 2-6 GWh saved)	Payback 0-1 year Measures must be complete before survey incentive is paid
Commercial Buildings	50-80%	➢ 1 cent/kWh (1st 2 GWh saved) ➢ ½ a cent/kwh (from 2-6 GWh saved) ➢ 20 cents/therm up to 50,000 therms ➢ 10 cents/therm from 50-150,000	Payback 0-1 year Measures must be complete before survey incentive is paid
Healthcare	50-80%	➢ 1 cent/kWh (1st 2 GWh saved) ➢ ½ a cent/kwh (from 2-6 GWh saved) ➢ 20 cents/therm up to 50,000 therms ➢ 10 cents/therm from 50-150,000	Payback 0-1 year Measures must be complete before survey incentive is paid
Leak Survey and Repair	None	$12 x affected HP (air compressor)	At least one leak per 5 HP must be repaired.

Commercial Building and Healthcare 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 that may or may not result in a viable retro-commissioning project. To defray the financial risk to the RSP and encourage more aggressive marketing of the program, AIC elected to pay a screening stipend of 5-10% of the retro-commissioning study cost to the RSP for complex projects.

A secondary goal of the Retro-Commissioning Program is the identification of retrofit and capital improvement projects that can be channeled to the prescriptive and custom incentives programs offered by AIC.

3. EVALUATION METHODS

This evaluation of the Act On Energy Retro-Commissioning Program reflects the third year of the program[4]. During PY4, 32 facilities were paid incentives for participating in the Retro-Commissioning Program. After discussion between AIC and the evaluation team, one of the participants was moved to PY5 because the retro-commissioning project savings depended on a custom incentive project completion that did not occur until shortly after PY5 began. AIC will count savings for both projects in PY5 though the incentive cost for the retro-commissioning project is included in PY4 costs. We will assess savings for this project in PY5.[5] As noted, the PY4 evaluation focuses on impacts and net-to-gross questions. We will conduct process-related research in PY5.

3.1 DATA SOURCES AND ANALYTICAL METHODS

Even though the PY4 evaluation is focused on impacts, we reviewed many program materials, including the business program marketing plan[6], implementation plan,[7] and other program documents and forms to understand the context surrounding the program. We also interviewed key program staff to obtain program background information.

Table 4. Summary of Evaluation Methods

Task	PY4 Impact	PY4 Process	Forward Looking	Details
Program Staff In-Depth Interviews		✓		Program status & background
Database review	✓			Analysis of ex ante estimates
Participant Survey	✓	✓		Retrospective NTGR & limited program performance
Service Provider Survey	✓	✓		Retrospective NTGR & limited program performance
Engineering review	✓			Key evaluation task including assessing engineering savings estimates and methods.

The database review was used to confirm that key program inputs are being tracked and accurately recorded. The surveys were structured around the net-to-gross questions. The extent of any spillover was also examined via the surveys using a quantitative approach. The impact evaluation involved reviewing the reports and savings estimates from a sample of completed projects to verify that the estimates were based on sound engineering principles.

[4] No projects were completed in the first year of the program.

[5] Project ID 401441 will be assessed in PY5.

[6] *Act On Energy Business Program, Program Year Four (PY4) Marketing Plan*, SAIC, May 27, 2011.

[7] *Act On Energy Business Program, Program Year Four (PY4) Implementation Plan*, SAIC, October 26, 2011.

3.1.1 PROCESS ANALYSIS

The evaluation plan for the Retro-Commissioning program did not call for a formal process evaluation of the program following PY4. Process questions will be the focus of the program in PY5. However, during the course of participant and service provider interviews for net-to-gross research, we gave both participants and service providers the opportunity to volunteer feedback on the program processes. There is no systematic analysis of responses. We included representative and key observations in the process results section

3.1.2 IMPACT ANALYSIS

Gross Impacts

We based gross impacts on a review of a sample of program projects. Our review consisted of analyzing data included in reports and re-estimating savings using engineering algorithms. Among the 15 projects included in the engineering review, we reviewed at least one facility from each program component. We sampled a healthcare gas-only project *in addition to* the random sample frame in order to include the 57% of program gas savings represented by this project.

Table 5. PY4 and Sample Ex Ante Gross Impacts by Project Type

Program Component[8]	Program (N)	Program Ex Ante Impacts		Sample (n)	Sampled Ex Ante Impacts	
		MWh	Therm		MWh	Therm
Compressed Air	18	16,045	0	8	11,340	0
Leak Survey & Repair	7	1,472	0	2	944	0
Healthcare	4	1,082	413,573	3	867	384,551
Commercial Bldg. & Refrigeration	2	1,620	37,293	2	1,620	37,293
Total	**31**	**20,219**	**450,866**	**15**	**14,771**	**459,137**

Net Impacts

PY4 NTG Ratio

The ex ante NTGR for the program is a planning assumption of 0.80[9] for both fuels. Our research performed this year derives an NTG ratio for retrospective application in PY4 and for use in future evaluations until further revised.

Net-to-gross research in PY4 combines results from participant and service provider surveys. Research for both groups uses a self-report method where participants and RSPs answer questions about the influence of the program. The participant survey instrument asks about awareness of the measures identified and participants' inclination to pursue corrective actions for those measures

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

[9] Spreadsheet file: [AIB PY4 Dashboard- Electric- Including Derated], August 2012.

absent the program. The RSP survey instrument asks about the retro-commissioning market prior to and since the program and the likelihood of measure implementation without the program and as a result of the program. The evaluation also explored spillover effects through the participant and service provider surveys.

Free Ridership

The method looks at three elements of free ridership for participants: Program Influence, Timing and Selection, and No Program Score. RSPs can only speak to Program Influence and the No Program elements of free ridership. The Program Influence element looks at the importance of program factors for the decision to undertake retro-commissioning at this time. The Timing and Selection element considers when the participant learned of the program, relative to the decision to retro-commission the facility and the impetus to implement measures. The No Program score is a self-reported estimate of what measures or savings the respondent would have implemented without the program. We weighted the three (or two) elements of free ridership equally for estimates of participant and RSP free ridership, respectively. We subsequently calculated savings-weighted free ridership from individual participant and RSP values to determine overall participant and RSP free ridership. Since program theory would estimate that participants over-estimate free ridership and RSPs under-estimate the factor, we chose to average the participant and RSP estimates for a single program free ridership.

Spillover

We also asked participants and RSPs about the effect the program has on the Illinois retro-commissioning market outside of the program—or spillover. Spillover might include projects at the same facility or a facility under the same ownership or management that implemented energy savings projects as a direct result of the Retro-commissioning Program, without receiving an incentive to do so. For RSPs, spillover consists of additional projects completed and measures implemented, through increased awareness, marketing materials, or staff capacity, as a direct result of the program. Participant and RSP spillover are additive, to the extent the same projects are not the basis of both estimates.

3.2 SAMPLING AND SURVEY COMPLETES

3.2.1 TELEPHONE SURVEYS

The telephone surveys were conducted to achieve statistical significance in results that are better than 10% precision at 90% confidence. To accomplish this, we used all participants and RSPs as our sample frame and attempted to talk with a census. We attempted to contact each participant and RSP at least 3 times to complete the surveys. Table 6 summarizes the survey samples. The nine RSP survey completes included RSPs who completed 28 of the 31 projects recorded for the program.

Table 6. Completed Retro-Commissioning Program Survey Points

Survey Type	Sample Frame		Completes Goal	Completed Surveys	
	Contacts	Projects	Contacts	Contacts	Projects
Participant Survey	30	31	22	14	14
RSP Survey	12	31	11	9	28

3.2.2 Engineering Review Verification

For the impact evaluation, the team sampled projects using the stratified ratio estimation method. This method is based on the anticipated realization rate with an error ratio of 0.40, and we stratified the population based on project ex ante savings to ensure that our 90/10 (confidence/precision) strategy also captures a significant proportion of program savings. The ratio estimation method tends to create a sample with a census of the largest savings customer stratum and a balanced sample between the remaining strata to achieve the desired precision. Within each stratum, we selected projects randomly. In our final sample, the precision is 9.3% at the 90% confidence level. We reviewed 73% of program kWh savings and 94% of program therm savings.

Table 7. Impact Evaluation Samples

Stratum	Program Population	Population kWh savings	Sample Size	Sample kWh Savings
A	3	8,945,502	3	8,945,502
B	6	5,734,394	4	3,185,490
C	22	5,538,757	8	2,639,881
Total	**31**	**20,218,653**	**15**	**14,770,873**

Four of the five natural gas projects were included in the engineering review. These four totaled 421,000 therms out of the program total of 450,000 therms.

We planned no on-site work for the evaluation, though we did call service providers and participants to clarify inputs for several measures.

4. RESULTS AND FINDINGS

4.1 PROGRAM INSIGHTS

As our evaluation team reviewed the various retro-commissioning reports, we needed to be able to understand exactly where the ex ante values created by the RSPs came from to perform our due diligence. Missing or incomplete data can cause misunderstanding on our part, which can open the service providers' analyses to unwarranted changes. However, project reports do not appear to follow standardization. The PY4 review included almost half of the projects (15 of 31). In many, key elements of a comprehensive report are often absent or incomplete. To decrease the possibility of unwarranted changes to the RSP estimates of savings, we suggest the following:

- The RSPs should organize reports so that a reader can easily trace the inputs to savings calculations and savings estimates. Savings calculations should be explicit in the report and all assumptions should be included. We prefer that calculations be included electronically in the project files to make it easier to find differences between the ex ante and ex post values.

- For compressed air projects, evaluation is aided by inclusion of compressor performance curves and performance metrics for each compressor. If generic curves are used, they should still be included and justified.

- For healthcare and commercial building projects, there are many elements where clear presentation aids evaluation: gross conditioned area; annual and monthly energy consumption for all energy sources; the climate data source, detailed operating hours for each piece of equipment addressed in the report; and an equipment list with unit ID, drive power, design flow, and power and control type.

Our findings indicated that the program would benefit from establishing key default parameter inputs when measured data are not available. Defaults would reduce the burden on RSPs in their savings estimates, and those estimates would be more consistent and reliable across service providers. For example, motor loading, motor efficiency, and modifications for fan and pump affinity laws are areas where improper use of these factors can incorrectly affect savings.

Project data show that the program savings are heavily reliant on very few projects. Figure 1 shows that four projects comprise more than 50% of program electric kWh savings and ten projects comprise 75% of electric savings. Gas savings (not shown) is even more skewed with one project accounting for 57% of program savings and the top two projects accounting for 77% of project savings.

Figure 1: Annual and Cumulative Project Electric Savings

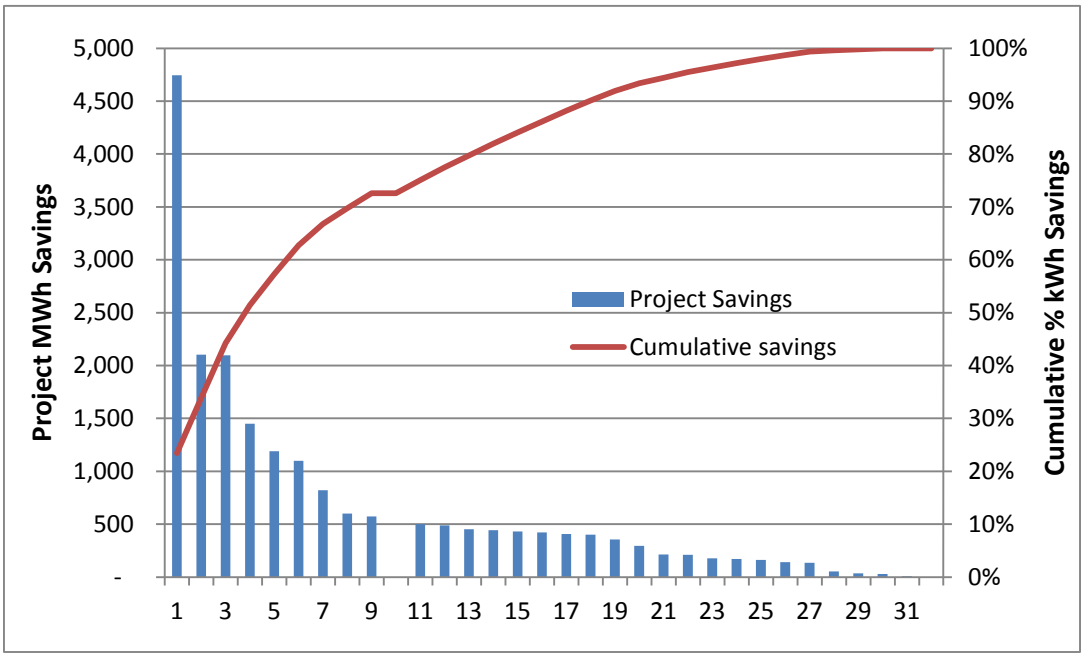
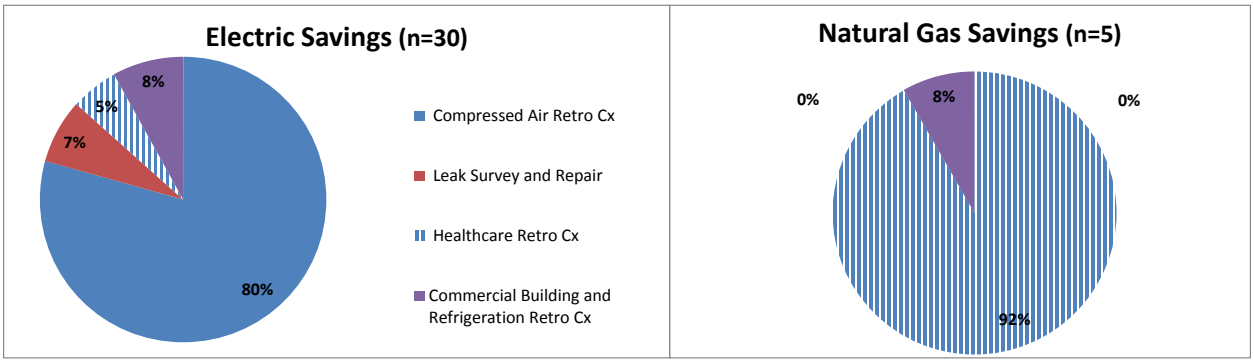


Figure 2 shows that compressed air and leak repair projects account for 87% of electricity savings and healthcare accounts for 92% of gas savings.

Figure 2: Program Savings by Project Type



For implementation purposes, the program database includes all of the key data needed to track project milestones, quality control, and impacts. From the evaluator's perspective, though, it is lacking measure details for each project. It is not possible to follow the progression of measure recommendations to see what measures were implemented and which were dropped, modified, or added. To get those details, the evaluation team had to carefully review each project report that contained unclear measure descriptions, inputs, and savings calculations, which can lead to incorrect determination of ex post savings.

4.2 PROCESS OBSERVATIONS

The evaluation plan for the Retro-Commissioning Program did not call for a formal process evaluation of the program following PY4. Process evaluation questions will be the focus of the evaluation of the PY5 program. However, in the course of the impact evaluation, we asked several open-ended questions about program processes. Participants and service providers responded with a number of valuable process-related observations.

- One project did not appear to meet the eligibility criteria although we kept it in our analysis. The building is too small for the program, according to eligibility criteria, and had only been occupied for less than one year before the retro-commissioning program application was submitted. The evaluator believes many of the measures might have been covered by construction warranty.

- There were several comments about the incentives. From more positive to more negative, these include "The incentive level is good"; "The [implementation] incentive levels are good, but not enough to motivate the customers. Perhaps an early implementation incentive paid to contractors *and* customers would motivate implementation"; and "We spend more time with program paperwork than the incentive value."

- We received positive comments regarding key program staff: "Regional Energy Advisors are very good" and "Support from SAIC is very good." But we also heard that "There can be a communication gap with program administrators about mid-stream changes to the program." The final comment was in the context of perceived shifting application requirements.

- Several service providers noted the cumbersome and shifting processes for participation. One noted that the new program year is announced in May for a June 1 launch, but applications were not available until mid-July and accommodated continued revision into September. W-9 requirements were added later and incentives and bonuses seemed to change through the program year.

- Overall, participants were positive about the program, stating, "We hope the program continues. It is good for Illinois business" and "Retro-commissioning is the right thing to do. It provides the biggest impact for the money."

4.3 IMPACT RESULTS

The impact analysis looked at the program impact tracking from application acceptance through project savings verification. Ex ante impacts and project documentation are tracked in the AIB database. The AIB database includes all of the key data needed to track project milestones, quality control, and impacts.

4.3.1 GROSS IMPACTS

We show the gross impacts for the program in Table 8, based on our engineering review of the projects.

Table 8. PY4 Program Gross Impacts

Gross Impacts	Energy Savings (MWh)	Demand Savings (kW)	Therm Savings
Ex Ante	20,219	2,496	450,866
Ex Post	17,993	2,261	381,925
Gross Realization Rate	0.89	0.91	0.85

The evaluation team analyzed the reports and re-estimated savings with our own best estimates. As shown by the relatively high realization rates, in most cases, our re-estimations confirm reported savings with the available data. In some cases, the evaluation team made adjustments to ex ante estimates to generate ex post project savings. Reasons for adjustments include:

- Commercial and Healthcare projects:
  - Some saving was double-counted when recommendations affected complementary equipment. For example, one project claimed ventilation savings for turning off an air handler and the same project claimed additional ventilation savings for turning off an exhaust fan serving the same zones.
  - Hours of operation were not consistent within the same site analysis. We used consistent hours for our analysis.
  - The evaluation removed savings for a measure that implemented better control of a pump that was not operational during the retro-commissioning inspection. The fact that the pumps failure was not noted prior to the study supports the evaluator's conclusion that the pump was rarely needed in the first place.
  - Demand savings was frequently reported for off-peak operation and the evaluation reduced or eliminated reported peak demand saving.
- Compressed air projects:
  - The ex ante savings included measures that the program had not documented or verified. The evaluation team removed these savings.
  - RSPs frequently estimated savings based on average compressor performance (CFM/kWh) as observed during the retro-commissioning inspection, rather than expected equipment loading. Savings is not proportional to reduced airflow for most compressed air systems[10]; therefore, reducing airflow due to leak repair does not save the proportional amount of energy, yet RSPs calculated it as proportional.

The impact evaluation decreased the program ex ante gross savings for several reasons. Among commercial and healthcare projects, all verification adjustments represented isolated cases of mis-

[10] Constant speed rotary machines consume about 70% of rated power when delivering no compressed air. Constant speed centrifugal machines blow-off compressed air when delivering less than 70-80% of design airflow.

calculated savings and not systematic problems. However, errors among compressed air savings estimates appear to reflect a systematic approach to savings estimates that tended to inflate reported project savings. If AIC had provided the RSPs with specific guidance as suggested above, there might have been a reduction in the systematic errors.

4.3.2 NET IMPACTS

The PY4 research on the NTGR provides the NTGR for PY4 and future program years, until it is researched again. Both participants and RSPs indicated some level of possible free ridership. Most participants had a prior relationship with their RSPs. According to the service providers, about 20% of compressed air participants had completed similar projects. Most cited about 2-4 year intervals between receiving compressed air service. However, the Commercial Building and Healthcare projects did not have a history of prior retro-commissioning efforts.

Compressed air surveys were generally marketed by RSPs prior to the program and they continue to sell the service outside of the program. However, the program and its incentives help marketing and lend credibility to the service. On average, service providers rate the influence of the program 7.9 on a scale of 0 to 10, 10 being extremely influential. Commercial building RSPs rate the program influence 9.5, on a scale of 0 to 10, indicating a greater program influence in these markets.

Participant spillover reported by RSPs appears to be a factor for program NTG. Four RSPs reported performing additional projects in the past program year for customers not participating in the programs. Participant spillover increases the NTGR by 10 percentage points. This moderate level of spillover reflects that *additional* retro-commissioning projects are still few (most service providers were selling similar services previously) and the projects are smaller on average than program projects. RSPs hinted at non-participant spillover with increased awareness of retro-commissioning as a practice, but they could not quantify any non-participant spillover impacts.

We calculated the NTGR for each interview and then savings-weighted participant and RSP NTG values to obtain a program-level NTGR. The results are in Table 9 below. As might be expected, participants felt they might have implemented retro-commissioning measures absent the program and studies. However, service providers with long experience in the market are highly skeptical that they would perform studies and measures implemented without the funded studies and implementation incentives and, by extension, the program. Program Net-of-Free-ridership is the average of the participant and RSP estimates. Spillover rates from both participants and RSPs is additive to the program net-of-free-ridership. Our research found an overall NTGR of 0.95.

Table 9. Net of Free-ridership (1-FR), Spillover, and NTG (1-FR+SO) Estimates

	Participant	RSP	Program
Program effects	0.99	0.89	NA
Timing & Selection	0.70	NA	NA
No-Program Effects	0.71	0.90	NA
Net-of-Free-riders (1-FR)	0.80	0.89	0.85
Spillover	0.00	0.10	0.10
Overall NTGR	0.80	1.00	0.95

As stated previously, we applied the 0.95 NTGR from PY4 research to obtain the net impacts. The ex post NTGR was higher than what AIC had applied for planning purposes.

Table 10. PY4 Net Program Impacts

Program	*Ex Ante* Net Impacts[a]			*Ex Post* Net Impacts		
	MW	MWh	Therm	MW	MWh	Therm
Retro-Cx	1,997	16,175	360,693	2,143	17,052	361,966
			Net Realization Rate	*1.07*	*1.05*	*1.00*

[a] *Ex ante* net savings use a NTGR of 0.80 electric and 0.80 gas, based on "dashboard" spreadsheets.

4.3.3 RECOMMENDATIONS

The evaluation team highlights key findings and recommendations below.

Finding 1: From the evaluators' perspective, the AIB database lacks measure details for each project completed. It is not possible to follow the progression of measure observations to recommendations to implementation to see what measures were added, modified, and implemented or which were dropped. To get those details, the evaluation team had to carefully review each project report that contained unclear measure descriptions, inputs, and savings calculations.

Recommendation 1: Add a table to the database to track each measure related to the project so that the database can be used to track measures implementation and identify common recommended measures or measures that perhaps should be recommended more universally or deemed at a future date. The measure table should link to the project table based on project number and should include savings and status fields for each stage of the project.

Finding 2: A small near-new construction project participated in the program in PY4. It did not meet the size or 5-year occupancy criteria established for the program. Measures implemented might have been covered by construction warrantees. This situation might have led to participant free ridership. Another non-compressed air project consisted of two small buildings that, when combined, do not meet the facility size eligibility criterion.

Recommendation 2: Screen projects for eligibility more effectively to ensure cost-effective participation with high net savings.

Finding 3: Project reports are inconsistent in content and analysis.

Recommendation 3: AIC should consider issuing a template report with required sections and

elements of data and analysis required for each section. This would encourage more standardization among reports to include critical data and organization that facilitates internal program review and evaluation and may reduce our missing critical information. AIC should consider providing default calculation parameters when measurements are not made and the RSP must apply assumptions. The evaluation team suggests the following standardizations:

- Issuing parameters for motor and VFD efficiency, chiller and DX cooling efficiency by vintage, boiler and steam distribution efficiency, motor loading based on application and motor size, and affinity law exponents.
- Establishing a clear priority for measured data used in calculations, followed by equipment-specific performance curves, generic performance curves, and finally program defaults.

Including performance curves in the report or electronically in submitted calculations.

Finding 4: Ex ante savings calculations are often not included in reports or simulation inputs are not detailed. The evaluation effort was greater due to the need to reproduce calculations from scratch to confirm approximate savings estimates.

Recommendation 4: Encourage RSPs to use more transparent calculations like spreadsheets or, at a minimum, include electronic input files for simulations when they are used for estimating savings. Require submitting electronic versions of calculations. Consider issuing template calculators for common measures.

4.4 INPUTS FOR FUTURE PROGRAM PLANNING

This study did not perform any research to inform future program planning.

A. APPENDIX: DATA COLLECTION INSTRUMENTS

Ameren RCx Participant Survey _P

Ameren RCx RSP Guide - PY4.pdf

B. APPENDIX: NTG ALGORITHM

Participant NTGR = 1 – FR + SO

Net-of-Free-ridership (1-FR)

Program influence score (0-10): Maximum of program factors (co-funding, RSP recommendation, program material, AIC account manager recommendation, technical assistance, implementation incentives) Questions N4A through N4F.

Timing and Selection (0-10): Knowledge of program relative to planning or deciding on the study. If both N1 = Before and N2 = Before, then overall program influence score (0 to 10), otherwise 50% x overall program influence score (0 to 10).

No Program Score (0-10): (1-percent of cost paid no program (N8)) x(10 x Percent of savings implemented without the program (N9a)) x (timing of study without program[11] (N9b))

Participant Net of Free-Rider = average (Program Influence, Timing and Selection, No Program Score)/10

Participant Program Net of Free-Rider: savings weighted average of Participant Net of Free-Rider for the sample

Spillover:

Additional projects = if (CH1 b, CH1bb, CH1c or CH1cc) =Y then 1, otherwise 0.

Influence threshold = 1 if program influence rating CH3>7, otherwise 0.

Participant Spillover = Custom estimate if (Additional projects =1 and Influence threshold =1), ask depth questions on measures and savings.

Participant Program Spillover: savings-weighted average of Participant spillover savings/sample savings by Participant

Participant NTGR:

Participant Program Net-of-Free-Rider + Participant Program Spillover

RSP NTGR = 1 – FR + SO

Net-of-Free-ridership (1-FR)

Program influence score (0-10): Maximum of program factors (co-funding, program material, technical assistance, implementation incentives) Questions C1, C2a, C2b).

Timing and Selection (0-10): NA

[11] Linear relationship assuming no free-ridership if estimated timing more than 48 months distant

No Program Score (0-10): (10 x Percent of savings implemented without the program (C3))

RSP Net of Free-Rider = average (Program Influence, No Program Score)/10

RSP Program Net of Free-Rider: savings weighted average of RSP Net of Free-Rider for the sample

Spillover:

Normalized additional projects: Add'l projects completed (D2a) x (Implementation rate (D2d) x relative size(D4)

RSP spillover savings: Normalized additional projects x RSP avg project savings[12]

RSP Program Spillover: savings-weighted average of RSP spillover savings/samples savings by RSP

RSP NTGR:

RSP Program Net-of-Free-Rider + RSP Program Spillover

Overall NTGR

1 – Average (Participant Program FR, RSP Program FR) + (Participant Program Spillover+ RSP Program Spillover)

[12] AIB Program tracking database.