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Impact and Process Evaluation of 2013 (PY6) Ameren Illinois Company Retro-Commissioning Program

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1. Executive Summary

This report presents results from the evaluation of the sixth program year (PY6, June 1, 2013–May 31, 2014) of the Ameren Illinois Company (AIC) ActOnEnergy Business Retro-Commissioning Program for energy efficiency. The ActOnEnergy 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 a survey incentive that covers 50%–80% of the 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.

Prior to PY4, the program focused on health care customers and compressed air for large industrials. In PY4, AIC expanded outreach to the commercial buildings and industrial refrigeration markets. Relatively few projects were completed in these markets in PY4 and PY5, but in PY6 more than one-third of all projects were commercial or industrial refrigeration. For PY6, AIC planned to garner 1% of the portfolio electric energy savings and less than 1% of the portfolio therm savings from this program.[1]

The PY6 evaluation includes gross impact results plus an evaluation of program processes and forward-looking net-to-gross ratio (NTGR) research. 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. According to collaborative agreement, this evaluation applies the NTGR found through PY4 research to PY6 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 PY6 evaluation.

Impact Results

Table 1 summarizes reported and verified program participation by the different program components. Twenty-six projects were completed in the PY6 program (22 electric and gas projects, and 4 gas-only projects). Among the 26 projects, there were 19 unique customers with two customers representing multiple locations. Three participants saved both electricity and gas—one commercial customer and two health care facilities. One customer took steps to begin participation in the program with initial walk-throughs to determine retro-commissioning feasibility, and AIC paid the RSP a "stipend" for this task. Since stipend costs occurred in PY6, they will be included in program cost-benefit analysis, although there are no projects or impacts associated with this site within PY6.[2]

[1] Planned portfolio-level savings estimates are based on the AIC Plan 2 Filing (September 20, 2011).

[2] The customer may choose to implement study-recommended measures in PY7.

Table 1. PY6 Program Participation

Program Component	Unique Customers*	Unique Projects (N)	Program Participation (N)	
			Electric	Natural Gas
Industrial Refrigeration	2	2	2	0
Commercial Building Retro Cx	1	7	7	1
Compressed Air Retro Cx	10	10	10	0
Health Care Retro Cx	6	7	3	6**
All Projects	**19**	**26**	**22**	**7**

* Two customers submitted multiple projects with the program at different sites.
** Four of the six natural gas health care projects included only gas measures because the customer receives electric service from another distributor.

Source: Amplify database, October 2014.

The evaluation team performed an engineering review of 15 of the 26 projects (including 3 of 7 natural gas sites) 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 (0.88 electric energy and 1.00 gas therms). The evaluation team applied NTGRs to the gross savings estimates to calculate program net impacts. Table 2 summarizes PY6 gross and net impacts.

Table 2. PY6 Retro-Commissioning Program Gross and Net Impacts

Program	Ex Ante Impacts			Ex Post Impacts		
	MWh	MW	Therms	MWh	MW	Therms
Gross Impacts*	12,091	NA	248,851	10,666	NA	248,851
Net Impacts**	11,487	NA	236,408	10,133	NA	236,408
Impact Realization Rate				**0.88**	**NA**	**1.00**

* Gross impacts are based on tracking system data and evaluation research.
** Net savings for both ex ante and ex post impacts use a NTGR of 0.95 for both electric and gas, based on PY4 research.

Process Results

The PY6 evaluation plan for the Retro-Commissioning Program called for a process evaluation of the program with input from program staff, participants, and service providers. The high-level results of the process evaluation show a relatively mature program with well-established processes that generally work well for participants, service providers, and staff. Most interviewed subjects were satisfied with the program and participants would recommend the program to their peers.

However, the evaluation team heard some of the same concerns that service providers have raised previously and identified some continuing issues from the evaluation perspective.

- Several RSPs noted that the review of verified savings had become burdensome and irregular. They reported a high turnover of implementation contractor staff, and the project reviewers were not as consistent as in the past. Different reviewers gave contradictory instructions, which added to the project timeline and cost. One RSP thought that the extra work required by implementation staff exceeded the incentives for the study (i.e., they could provide the study at lower cost to the customer without the program).

  - Consider issuing standard methods and/or template calculators for common measures to ensure consistent approaches by both providers and implementation staff.

  - Consider a collaborative training session with RSPs and project review staff to align verification methods, data, and documentation requirements.

- As in prior years, ex ante savings calculations were frequently not included in reports, or simulation inputs were not detailed. As a result, the evaluation effort was greater due to the need to reproduce calculations from scratch to confirm approximate savings estimates. Including these initial calculations in the project files would ensure that the evaluation team understands all aspects of the project from the perspective of program staff conducting the program's technical review.

  - Consider encouraging RSPs to use more transparent calculations, like spreadsheets, or require electronic input files for simulations when they are used for estimating savings. Require the submission of electronic versions of calculations to ensure that evaluators understand how the RSPs obtain results.

  - Establish default parameters and weather data (TMY3) to use when measured data are not available. AIC, Leidos (the implementing contractor [IC]), and the evaluators should define common default parameters to result in conservative (low-end) savings estimates. RSPs should include measured, site-specific data to supplant these defaults, where possible. This approach will diminish evaluation risk from ex post changes.

- The implementation contractor initiated post-installation inspections in PY4 and continued these in PY6. While the evaluation team applauds these steps to verify implementation, we found that the inspections still lacked sufficient detail and documentation, especially for HVAC retro-commissioning projects.

  - The implementation contractor should document as-found measure parameters with data. If controls are the mode for implementation, screen-captures of the control system should be included in the inspection report. Where possible, post-installation trend logs should also be included and analyzed.

  - The program should standardize demand-savings estimating methods. Savings that affect primarily unoccupied hours do not generally affect peak demand.

  - If additional post-installation trend data are available for compressed air projects, they should be included in verification documentation.

2. Introduction

This report presents the results of the evaluation of the Ameren Illinois Company (AIC) Commercial and Industrial (C&I) Retro-Commissioning Program during its sixth program year (PY6). The Retro-Commissioning Program is one of three in AIC's C&I portfolio, which also includes the Custom and the Standard programs.

To support our evaluation, the evaluators reviewed program documents and interviewed key staff, service providers, and participants. We also conducted an engineering review of more than half of all projects, representing 81% of claimed electric savings, and we conducted site verification with additional data collection at four sites.

2.1 Program Description

Leidos is the implementing contractor (IC) of the program, under contract to AIC. The program helps customers evaluate their existing mechanical equipment, energy management, and industrial compressed air and refrigeration systems to identify no-cost and low-cost efficiency measures and to help 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 that meet a minimum savings goal, AIC pays a survey incentive that covers 50%–80% of the survey cost, based on the project type. AIC pays a further implementation incentive 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.

In prior years, the program served only the industrial compressed air and health care market segments. These two segments still represent the majority of projects and savings, but the program now includes a commercial building component and an industrial refrigeration system optimization component. Participation requirements include:

- AIC customer served under applicable rate codes[3]
- Health Care and Commercial Sites:
  - Functioning Energy Management and Control System (EMCS) for HVAC equipment
  - More than 100,000 square feet
  - Buildings must be at least 5 years old
- Compressed Air Sites:
  - At least 200 horsepower (hp) connected compressor load for compressed air retro-commissioning

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

In addition, program incentives vary by type of project (Table 3).

Table 3. Summary of Retro-Commissioning Program Incentives

Project Type	Survey Incentive (as Percent of Survey Cost)	Customer Implementation Incentive	Requirement for Incentives
Compressed Air	80%	• 2 cents/kWh	Payback 0–1 year Measures must be complete before program incentive is paid
Commercial Buildings, Health Care, and Industrial Refrigeration Projects	50%–80%	• 2 cents/kWh • 40 cents/therm	Payback 0–1 year Measures must be complete before program incentive is paid
	5%–10%	• NA	Screening stipend to RSP for complex projects

Commercial Building and Health Care 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.

2.2 Research Objectives

The objective of the PY6 Retro-Commissioning Program impact evaluation was to estimate the gross and net electric energy and demand, and gas savings associated with the program. We also assessed program changes made in PY6 to improve customer participation. The PY6 impact evaluation sought to answer the following questions:

1. What were the estimated gross energy and demand impacts from this program?
2. What were the estimated net energy and demand impacts from this program?
3. What is the updated NTGR that will be applied be applied in PY8?

The evaluation team also explored process-related research questions that focused on the changes to this mature program made from PY5 to PY6.

1. Was the program effective? Did modifications to the program design achieve their desired effects on participation, impacts, and/or processes?
2. Was the new tracking system effective?
3. How effective was communication among key players in the program?
4. Were there common characteristics among participants or service providers that can be leveraged for the program's benefit? Were capital projects channeled into appropriate programs?
5. Was program RSP training adequate? Could more be done?
6. Was program marketing adequate? What worked and what did not work?
7. What were the significant barriers to participation?
8. Did participants find the studies adequately actionable to generate savings?

9. How else might the program be improved from the perspective of participants and RSPs?

3. Evaluation Methods

The assessment of AIC's Retro-Commissioning Program in PY6 comprised a program process assessment and an evaluation of program impacts. We applied the NTGR of 0.95 from PY4 because the program's implementation and NTGR have remained consistent over the past 3 program years. Table 4 summarizes the PY6 evaluation activities conducted for the Retro-Commissioning Program's assessment.

Table 4. Summary of Evaluation Methods

Task	PY6 Process	PY6 Impact	Forward Looking	Details
Program Staff In-Depth Interviews	✓			Provides insight into program design and processes
RSP Interviews	✓		✓	Processes and NTGR: Interviewed four of nine RSPs
Participant Interviews	✓		✓	Processes and NTGR: Interviews 6 of 19 unique customers, representing 12 of the 26 completed projects
Materials and Data Review		✓		Analysis of ex ante estimates
Engineering Review		✓		Assess engineering savings estimates and methods
On-Site Verification		✓		Verify implementation and key inputs to savings estimates and methods

3.1 Data Collection

The following activities informed the PY6 evaluation of the Retro-Commissioning Program.

3.1.1 Program Staff Interviews

We conducted interviews with implementation team staff to understand the Retro-Commissioning Program's design and implementation and to discuss evaluation priorities. We completed one interview with program staff.

3.1.2 Participant and Service Provider Interviews

We fielded telephone surveys with Retro-Commissioning Program participants and service providers. While we attempted contact with a census of participants and service providers, we completed surveys with six participants, representing 12 of 26 completed projects, and we interviewed four of nine participating service providers.

The evaluation team attempted all data points least four times via email or phone, or when the respondent gave a hard refusal, before concluding the sample point was non-responsive. In several cases, interview subjects were not available, had moved on to new jobs and their replacements could not speak to the program details, or, in rare cases, refused interview requests.

Table 5. Summary of Evaluation Samples

Task	Sample Frame	Targeted Completes	Actual Completes
Program Staff In-Depth Interviews	1	1	1
RSP Interviews	9	9	4
Participant Interviews	19	16	6

3.1.3 Review of Program Materials and Data

We conducted a review of program materials and tracking data. We reviewed program marketing and implementation plans, customer and program ally communications, and extracts from the program-tracking database. We received project data in August 2014, after program implementers had finalized the PY6 projects.

3.1.4 Engineering Impact Review

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. For kWh savings, we reviewed 14 projects and we added an additional project to supplement the analysis of gas savings.

3.1.5 On-Site Verification

For the first time in 3 years, the impact evaluation included on-site verification of projects. The evaluation team inspected equipment and measure status at four sites and collected supplemental data, as needed. We selected sites from among those sampled for the impact evaluation.

3.2 Analytical Methods

3.2.1 Impact Sampling

For the impact evaluation, the team sampled projects using the stratified ratio estimation method. [4] 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 savings to reduce variation in each stratum to achieve 90%/10% (confidence/precision) with a fewer number of sample points 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 kWh estimate is 8.9% at the 90% confidence level. We reviewed 81% of program kWh savings.

[4] *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.

Table 6. Electric Impact Evaluation Samples

Stratum	Stratum Range (kWh)	Program Population	Population MWh Savings	Sample Size	Sample MWh Savings	On-Site Verification
A	1,978,311–1,143,303	5	6,728	4	5,538	1
B	982,358–442,234	6	4,100	5	3,658	2
C	220,978–37,807	11	1,263	5	553	1
Gas-Only	0	4	0	1	0	0
Total		**26**	**12,091**	**15**	**9,749**	**4**

Three of the seven natural gas projects were included in the engineering review. Two projects were selected as part of the kWh-based sample, and the largest of the remaining gas-only projects was selected for evaluation. Thus, a total of 15 projects were reviewed for the evaluation. The three gas projects included 168,991 therms out of the program total of 248,851 therms (68%). The gas savings sample is not a statistical sample.

Additionally, the evaluation conducted on-site verification at four participants in the PY6 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.[5] The on-site visits included compressed air, refrigeration, and commercial retro-commissioning participants.

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.

3.2.2 Gross Impacts

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 15 projects included in the engineering review, we reviewed projects from each of the four markets served by the program. Our review encompassed 81% of program ex ante electricity savings and 68% of ex ante natural gas savings.

Table 7. PY6 Population and Sample Ex Ante Gross Impacts by Project Type

Program Component	Program (N)	Program Ex Ante Impacts		Sample (n)*	Sampled Ex Ante Impacts	
		MWh	Therms		MWh	Therms
Ammonia Refrigeration	2	1,873	0	2	1,873	0
Commercial Building Retro Cx	7	695	1,916	3	210	1,916
Compressed Air Retro Cx	10	8,447	0	8	6,815	0
Health Care Retro Cx	7	1,075	246,935	2	851	167,075
Total	**26**	**12,090**	**248,851**	**15**	**9,749**	**168,991**

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

[5] 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.

3.2.3 Net Impacts

The ex ante NTGR for the program is the PY4-determined value of 0.95 for both electricity and natural gas. Following the NTGR framework, since no further research was completed in PY5 to update the PY4 research, we applied the PY4 NTGR in PY6.

3.2.4 Net-to-Gross Ratio

The evaluation included NTGR research in PY6 that will be applied in PY8. See Appendix B for NTGR details.

3.3 Sources and Mitigation of Error

Table 8 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 8. Possible Sources of Error

Research Task	Survey Errors		Non-Survey Errors
	Sampling Errors	Non-Sampling Errors	
Participant Interview	• No, attempted census	• 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 PY6 evaluation.

Survey Errors

- Sampling Errors
  - **Participant Survey:** Due to the relatively small number of participants, the evaluation team had the goal to contact a census of participants, i.e., there is no sample error. In the final tally, the evaluation surveyed 6 customers out of a population of 19 unique contact names. Three participants had turnover in the contact position, we were unsuccessful in some of our contact attempts, and there were some refusals. 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 15 of 26 completed projects. At the 90% confidence level, we achieved a precision of ±9%.

- **Verification Site Visits:** The evaluation team performed measure verification for four 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 low, 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 all available data at their disposal to assess whether evidence of non-response bias exists. For this survey, we compared survey 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.

  - **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, calculations were reviewed by a separate team member to verify their accuracy.

  - **Verification Site Visits:** To minimize data collection error, the verification visits were conducted by trained engineers and technicians familiar with the equipment affected by the Retro-Commissioning Program. To minimize analytical errors, all calculations were reviewed by a separate team member to verify their accuracy.

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

4. Detailed Findings

4.1 Process Findings

The process evaluation of the Retro-Commissioning Program shows a relatively mature program with well-established processes that generally work well for participants, service providers, and staff. Prior to PY4, the program focused on health care customers and compressed air for large industrials. In PY4, AIC expanded outreach to the commercial buildings and industrial refrigeration markets. Relatively few projects were completed in these markets in PY4 and PY5, but in PY6 more than one-third of all projects were commercial or industrial refrigeration. The PY6 process evaluation focused on changes to the program and on ways to improve program processes.

4.1.1 Program Participation

Program participation and gross savings was significantly less in PY6 than in PY5. For several years, program staff have expressed concern about the size of the retro-commissioning market. Though the program expanded to include commercial buildings and industrial refrigeration, the total number of projects decreased, as did savings. Several large projects in PY5 skew the data for that year.

Table 9. Summary of Program Participation

Program Year	Number of Participants	Ex Ante Gross MWh Savings	Ex Ante Gross Therm Savings
PY4	31	16,175	360,693
PY5	36	29,257	577,834
PY6	26	12,091	248,851

PY6 project data show that the program savings are heavily reliant on very few projects. Figure 1 below shows that five projects comprise more than 50% of program electric kWh savings and eight projects comprise 75% of electric kWh savings. Gas savings (not shown) are similarly dependent on large projects. Two of seven gas projects comprise 67% of program savings.

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

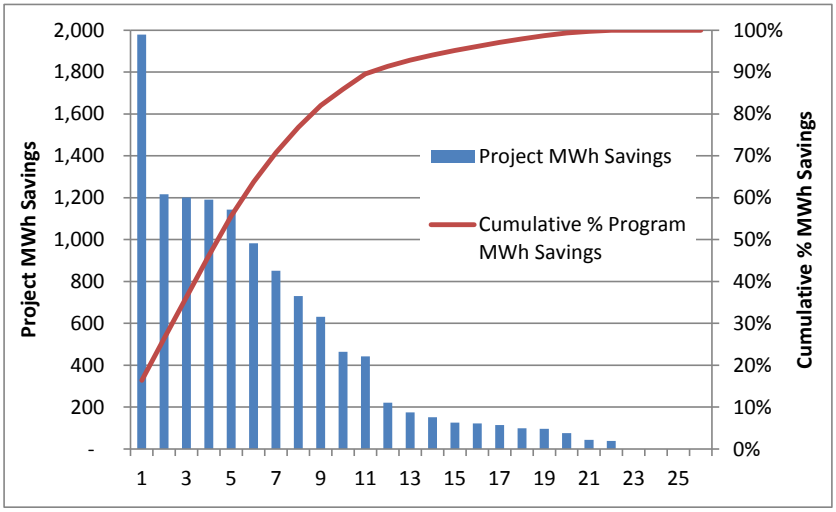
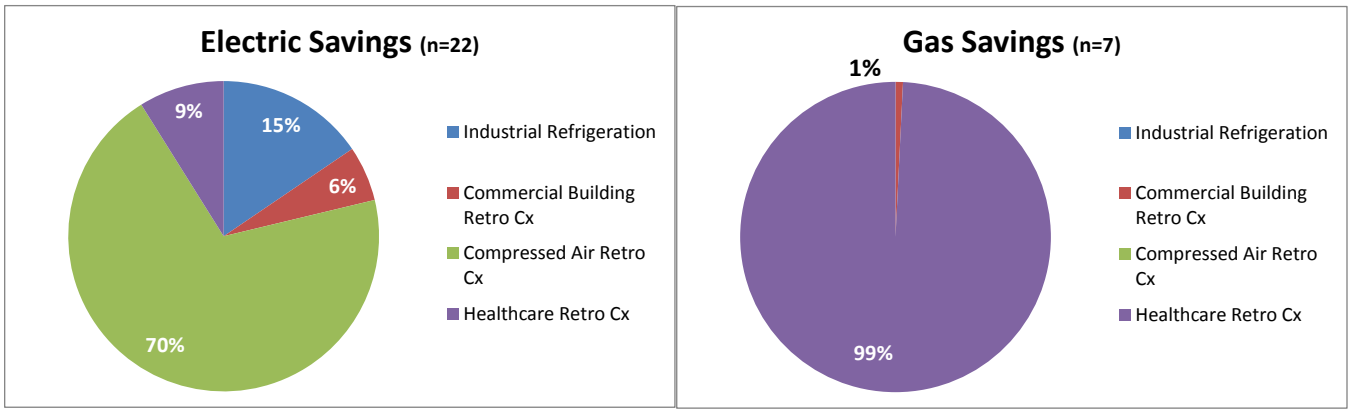


Figure 2 shows that compressed air projects account for 70% of electricity savings and health care accounts for 99% of gas savings.

Figure 2. Program Ex Ante Savings by Project Type



To meet goals in future years, the program will have to continue aggressive marketing to bring in more projects and sustain savings. The commercial building and industrial refrigeration market segments are still relatively under-represented among program participants and may be a source of future projects.

The program is succeeding in surmounting some market barriers. Interviewed subjects reported that the retro-commissioning "value proposition" is more recognized than in the earliest years of the program, as customers become more educated about the retro-commissioning process. Word of mouth among participants is also contributing to increased program awareness. Participants related discussions among their peers, and service providers reported more familiarity with the program. Compressed air participants reported greater initial acceptance of the program, as they knew that the air-leak savings existed, but they used the survey incentive to enable actual follow-through to action.

The program might also consider circling back to participants from early program years, as retro-commissioning measures have limited persistence and some capital projects or upgrades that were not financially attractive in 2009 may be more appealing now.

4.1.2 Communication

Most interview subjects report good communication among Leidos (the IC), RSPs, and participants. Leidos staff participated in customer meeting with RSPs and presented a consistent face for the program. Communication was also a factor during project reviews and processing. Interviewed RSPs reported constructive communication while preparing the program deliverables. One RSP expressed frustration that communication about application status was slow and that the IC channeled all information through the participant, when it was really the RSP driving the process and needing the information.

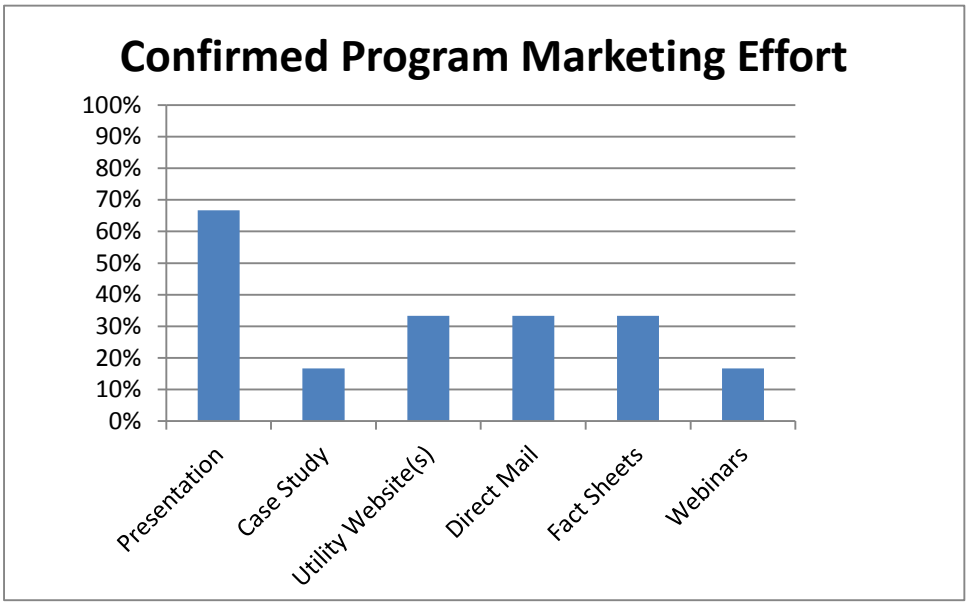
4.1.3 Marketing and Outreach

Program marketing and outreach was complementary between RSPs and Leidos. RSPs were actively marketing the program, though most focused on customers with whom they had a prior business relationship. At the same time, Leidos was active among trade organizations in promoting the program. Half of the survey respondents reported that the RSP introduced them to the program; the other half cite AIC marketing influence. RSPs and participants were generally complimentary about the marketing of the program. Most

customers had heard about the program through presentations or workshops by the IC staff. RSPs credited the implementation staff for their proactive outreach to market the program.

Participants listed email (50%) as the most effective means for reaching similar customers to inform them about programs, like retro-commissioning. Presentations (50%) and case studies (33%) were the most persuasive marketing materials.

Figure 3. Participant-Reported Marketing Efforts



Source: Evaluation research. Respondents allowed multiple responses.

RSPs were aware that there was marketing collateral (case studies and program fact sheets), but not all of them utilized these resources; many of them preferred their own material. The ability to co-brand with AIC was seen as a benefit in the proposal stage. Two interviewed RSPs reported using co-branding material. According to the RSPs, being a "registered" provider with the ActOnEnergy program gives their proposals extra credibility, but co-branding was not mandatory, if the RSP was registered.

4.1.4 RSP Training

AIC and Leidos did not conduct retro-commissioning training for service providers, but instead registered providers that demonstrated competency in the service. Due to the multiple market sectors served by the program, it is difficult to conceive of a single technical training program that would apply equally to, say, compressed air and commercial building-focused service providers. Instead, Leidos hosted an annual program kickoff event to learn about the upcoming year's programs. All RSPs reported attending these events and thought they were useful.

Two RSPs thought that there might be an opportunity to have training with the IC to clarify the expectations for measure verification and final savings estimates. More than half of interviewed RSPs noted mixed expectations for finalizing savings estimates and measure verification that training might clarify. If the program could convey clear expectations for what is required, in terms of post-installation documentation, supplemental data, and savings calculations, there would be less confusion and projects could be finalized more quickly with higher confidence in savings results. This training may need to be specific to different market

segments (refrigeration, industrial compressed air, and commercial/health care), as the measures and verification steps are different for each customer type.

4.1.5 Data Tracking

AIC implemented a new data tracking system for PY6, Amplify. Amplify is a relational database, which includes key data for tracking participation and savings. In parallel with Amplify, the program catalogs communication and electronic versions of key documents for each participant:

- Program application forms
- Contracts and invoices
- Email threads among the IC, customers, and RSPs
- Equipment submittals
- Program survey and inspection reports
- Calculations and database upload forms

The evaluation team found the Amplify data adequate for basic evaluation purposes; however, the table structure required custom report exports from AIC to acquire useful data. The evaluation team would like to have the ability to run ad hoc queries and reports to examine other aspects of the program that might be tracked, such as lead generation and project retention.

The catalogs of project files were also adequate for the evaluation; however, adding a time stamp to file names (or sequential numbers to files as they are cataloged) will clarify which versions of files are final. We would like to see more detailed calculations for savings in electronic format. This will reduce the evaluation effort and help the evaluation team understand the measure intent and context.

4.1.6 Project Channeling

Capital project channeling of participants into the Custom or Standard Program is a secondary goal of the Retro-Commissioning Program. All reviewed retro-commissioning reports included at least one capital measure for the customer to consider. These measures might be new compressors or air dryers, lighting or variable-frequency drives (VFDs), or other major energy using capital. While these prospective projects have been identified, few (one of six interviewed) participants report follow-up to implement these projects. Two interviewed RSPs acknowledged that they could do more to promote these capital projects to their customers. Most retro-commissioning reports did not discuss the magnitude of potential AIC rebates in their discussions. A preliminary estimate of an incentive might entice customers to consider follow-on capital projects.

4.1.7 Market Barriers to Participation

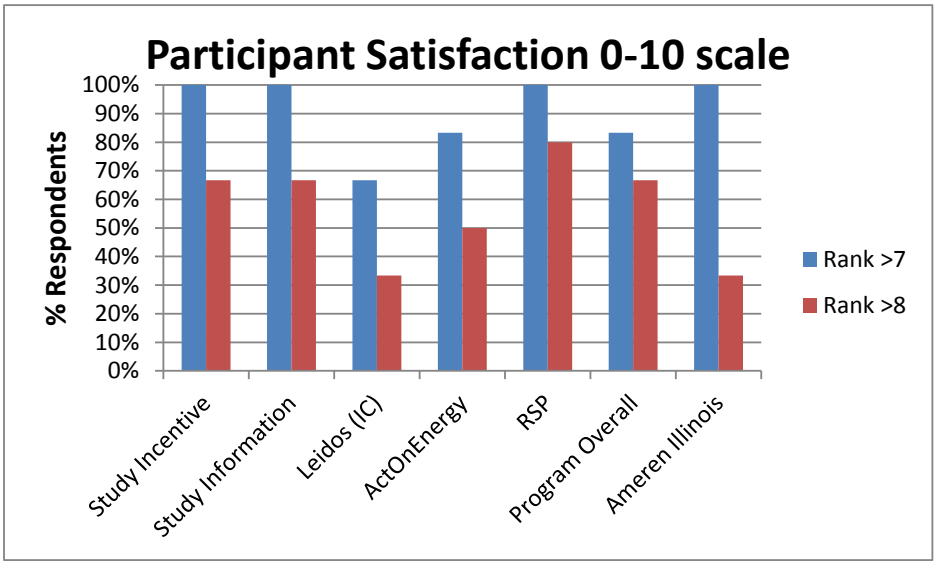
Participants mentioned several market barriers that existed for retro-commissioning. Awareness of the program and the retro-commissioning value proposition were still hurdles; however, these barriers were mentioned by less than half of the interviewees. In PY3, awareness of retro-commissioning was mentioned during more than two-thirds of interviews. The cost of retro-commissioning was the leading barrier for customers. On a scale of 0 to 10, the average score for the importance of the program incentives was 9, indicating that the incentives help motivate customers.

Service provider responses paralleled customer responses to market barrier questions. Service providers attested to more awareness than in early program years, but financial hurdles were the biggest barriers.

4.1.8 Program Satisfaction

In general, participants and service providers ranked the program highly, in terms of satisfaction. Participants were asked to rank aspects of the program from 0 to 10, with 0 = "extremely dissatisfied" and 10 = "extremely satisfied." The incentive, the quality of report content, and RSPs ranked the highest. Only 50% of respondents rated the IC, Leidos. One customer consistently ranked the program and contribution of the RSP and Leidos below 5. This customer's primary complaint stemmed from the comparative value of the program versus the cost added to energy bills to fund programs, in general.

Figure 4. Participant Satisfaction (10 = "extremely satisfied")



Nevertheless, 100% of participants said that they would recommend the program to peers inside and outside of their organization.

Service providers were also generally satisfied with the program. They credited the program with generating more work for them, though one service provider felt that he could deliver equivalent service for lower cost without the program. One felt the application process was too burdensome. This service provider also worked in the Ameren Missouri service territory and thought the application in Missouri was preferable.

4.2 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.

4.2.1 Gross Impacts

Table 10 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 10. PY6 Retro-Commissioning Program Gross Impacts

Savings Category	Ex Ante Gross	Realization Rate	Ex Post Gross
Energy Savings (MWh)	12,091	0.88	10,666
Gas Savings (Therms)	248,851	1.00	248,851

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
  - On-site verification determined that hours of operation were not 8,760 annual hours as used in the ex ante savings estimates.
  - On-site verification revealed that some measures did not persist and it was unclear whether the site would find a solution to re-enable savings.
  - RSPs frequently estimated 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 most compressed air systems,[6] so reducing airflow due to leak repair does not save the proportional amount of energy.
- Industrial Refrigeration
  - An RSP calculation was in the units of hp-hours and never converted to kWh.
  - An RSP calculation for fan power savings was based on compressor loading, which is unaffected by the fans.
  - Combined, these errors were impactful, but not systematic.
- Health Care Retro-Commissioning
  - 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 savings. While we found general convergence with ex ante estimates, evaluation estimates were incomplete in some cases and the effort was time consuming.

We note that demand savings were not included in ex ante reporting and that RSPs frequently did not detail demand savings. The RSPs calculated a simple estimate of kWh divided by annual operating hours in the Amplify upload worksheets, but this value 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, but it is not possible to apply a realization rate to unreported savings for an ex post estimate.

[6] 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.

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 PY6 Retro-Commissioning Program has many findings similar to the PY5 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.

4.2.2 Net Impacts

The NTGR for PY6 is from the PY4 research. Both the ex ante and ex post electric and gas estimates apply the value of 0.95.

Table 11. PY6 Net Program Impacts

Program	Ex Ante Net Impacts		NTGR	Ex Post Net Impacts	
	MWh	Therm		MWh	Therm
Retro-Commissioning	11,487	236,408	0.95	10,133	236,408
Net Realization Rate				**0.88**	**1.00**

See Appendix B for more discussion of the PY6 NTGR research and results.

4.3 Conclusions and Recommendations

4.3.1 Impact Recommendations

While realization rates in PY6 are relatively good, there are opportunities to increase the accuracy of the ex ante estimates. Many of these opportunities are carryover recommendations from PY5 to better document and organize the baseline and post-implementation conditions and estimation methods. Based on the PY6 evaluation effort, the evaluation team makes the following key recommendations.

- **Finding 1:** Project reports are inconsistent in analysis.
  - **Recommendation 1**: AIC should consider minimum reporting and analysis requirements. This would encourage more standardization among reports to include critical data and organization that facilitates internal program review and evaluation, and may reduce the omission of 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:
    - 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.
    - Establishment of a clear priority for measured data used in calculations, followed by equipment-specific performance curves, generic performance curves, and finally program defaults.
    - Requirement of performance curves in the report or electronically in submitted calculations. For compressed air projects, Compressed Air and Gas Institute (CAGI) “Data Sheets” are

usually available from compressor manufacturers for adequate documentation. If generic curves are used, they should still be detailed and justified.

- **Finding 2**: Ex ante savings calculations are sometimes not included in reports, or simulation inputs are not detailed enough to replicate and verify the models. The evaluation effort was greater due to the need to reproduce calculations from scratch to confirm approximate savings estimates.
  - **Recommendation 2**: Encourage RSPs to use more transparent calculations that are auditable and that have defined measured or assumed inputs. Require submitting electronic versions of calculations. Consider issuing template calculators for common measures. Include electronic input files for simulations when they are used for estimating savings. 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.
- **Finding 3**: Post-implementation inspections are good, and evaluators strongly encourage continuing this practice; however, these inspections, as currently executed, are inadequate for verification, especially for the health care and commercial building market segments.
  - **Recommendation 3**: Encourage inclusion of data that confirm implementation in post-implementation inspection reports: screen-captures of control system displays that demonstrate implementation and trend data that show the effects of retro-commissioning changes. Encourage RSPs to continue trend logs used for the studies for use in verification steps.

4.3.2 Process Recommendations

The processes for this program are well established and there are only a few process recommendations.

- **Finding 4**: RSPs would welcome some standardization to reduce the number of review iterations.
  - **Recommendation 4**: Host an engineering training session so that the ICs and RSPs have clear guidelines for the verification requirements: acceptable assumptions or defaults, performance curves, executable simulations, use of trend logs for verification, etc. If verification expectations are clear, RSPs will be able to deliver reports with fewer review iterations.

4.4 Inputs for Future Planning

As part of the PY6 evaluation, we conducted research to update the program's NTGR. We provide the results, as well as additional details in Appendix B.

A. Appendix – Data Collection Instruments

AIC RSP Guide PY63
FINAL 2014-10-27.pc

Ameren PY63
Participant Guide FI

B. Appendix – NTGR Results

NTGR Research Methods

The PY6 NTGR research methods replicated the methods employed for the PY4 research. The evaluators interviewed both participants and RSPs, and the interview subjects self-reported behaviors or opinions that are attributed to motivations for program participation and measure implementation. Where indications of program influences are high, the NTGR is also high.

The NTGR calculated for AIC combines free-ridership (FR) and spillover (SO). The evaluation team included equally weighted participant and service provider NTGR estimates in the final program NTGR:

$$\text{Site NTGR} = \text{NTGR}_{site} = 1 - \text{FR}_{site} + \text{SO}_{site}$$

$$\text{RSP NTGR} = \text{NTGR}_{RSP} = 1 - \text{FR}_{RSP} + \text{SO}_{RSP}$$

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

$$\text{NTGR}_{overall} = \left[\left(\Sigma\ \text{NTGR}_{site} \times \text{kWh}_{site} / \Sigma\ \text{kWh}_{site}\right) + \left(\text{NTGR}_{RSP} \times \text{kWh}_{RSP} / \Sigma\ \text{kWh}_{RSP}\right)\right]/2$$

Free-Ridership

The FR determination is an analysis that combines three attributes investigated during the participant survey, combined with two parallel attributes investigated with the RSP survey[7]:

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

In the attached survey, participant program influence factors are asked in Section N – Decision Influences. Contacts were asked to rate the importance of various program factors between 0 ("not important at all") and 10 ("extremely important"). We asked questions about six program influences. The maximum value from this battery is the site "score" for program influence.

Timing of addressing retro-commissioning measures absent the program are addressed with questions N2 and N4G. Question N2 establishes whether the customer decided to perform retro-commissioning before or after they knew they were eligible for the program. If the customer planned to carry out retro-commissioning *before* they knew about their eligibility for the program, 50% of the 0–10 scale score given to "Overall Program Importance" (N4G) is recorded for this NTGR attribute. If they decided to carry out retro-commissioning *after* they learned of the program, the full value of question N4G is recorded for the timing attribute.

We investigated self-reported actions absent the program to determine the "No-Program" attribute for each site. In questions N9–N10, we asked about actions that would have happened "if the Ameren Retro-

[7] The service provider survey does not address the timing question, since that is solely participant driven.

Commissioning Program were not available." Customers were asked if they would have undertaken the project on their own. If they answered "yes," they were asked the timing in years for undertaking the project. The timing of this independent action was proportionally scaled 0–10 based on the estimated number of months before they would have acted. Longer delays before starting result in a higher "No-Program" score. None of the interviewed participants said that they would have started retro-commissioning within 5 years without the program, thus their score is 10.

The site participant FR score is the average of the three attribute scores, divided by 10 and subtracted from 1.0:

$$FR_{site} = 1 - (\text{program influence} + \text{timing} + \text{no program}) \div 3 \div 10$$

The RSP FR estimate was similar, except that a no-program score is not estimated since it is not relevant for a RSP.

$$FR_{RSP} = 1 - (\text{program influence} + \text{timing}) \div 2$$

Spillover

We investigated participant site SO with questions CH1–CH9 of the participant survey. We asked about additional capital and retro-commissioning measures installed (1) as a result of the program that (2) did not receive additional incentives. No additional measures meeting these criteria were identified. We asked about additional retro-commissioning projects that they were aware of in their company that might have been influenced by the program without receiving incentives. No additional projects were identified, thus SO was 0.0 for all interviewed participants. Had measures or projects been identified, we would have asked the follow-up questions in that section to estimate the extent and size of such projects and proportional savings relative to the participant's project. This indirect approach to estimating savings is not as reliable as direct measure documentation, and, had we concluded that SO was present, the accuracy of such estimates would be contestable.

We investigated RSP SO with similar methods among questions D1–D4 of the RSP survey. One RSP identified one small project performed in the service territory of an electric cooperative. The RSP already had a business relationship with this customer and our contact at the RSP thought the project might have occurred organically without program influence. Thus SO was 0.0 for all interviewed RSPs.

As a result, the evaluation team concludes that participant SO is not a factor for the Retro-Commissioning Program NTGR. However, as described in the PY6 C&I Standard report, there is non-participant spillover within the C&I portfolio (0.01) that should be included in the NTGR for the Retro-Commissioning Program.

Results

The evaluation completed interviews with 6 participants of an attempted census (19). The FR questions established a participant FR rate of 0.00 for three of the projects, and a rate between 0.02 and 0.17 for the others. The weighted average participant FR is 7.7%. Two larger customers ranked the program influence lower, which raised the overall FR score.

RSP estimates of FR are also low: approximately 9.6%. RSPs estimated that most participants would not have performed studies and that they were relatively unaware of savings opportunities, contributing more to FR.[8] Interviewed RSPs thought that the program played a large part in the participant decision-making process.

[8] Participants interviewed accounted for 40% of electric savings.

Without the program's study, RSPs believed that few of the participants would have implemented the retro-commissioning measures on their own.[9] The final PY6 FR ratio is an equally weighted average of savings-weighted participant and RSP FR. Overall FR, equally weighted by participant and service provider, is 0.086. We concluded SO is 0.0, therefore NTGR = 0.91 overall. Table 12 presents the detail for each attribute score that went into calculating the NTGR. Attribute results are not weighted; thus, the overall NTGR values are not the mean of the component scores.

Using the method outlined above, the FR estimate for the Retro-Commissioning Program is 0.09. While the participant and RSP interviews revealed no SO from the program, we include non-participant SO as outlined above and the NTGR is equal to 1 minus the FR score plus SO. As a result, the NTGR for the program is 0.92.

$$NTGR = 1 - FR + SO \qquad NTGR = 1 - 0.086 + 0.01 = 0.924$$

Table 12. NTGR Results Summary

	Program Influence			Timing			No Program			Non-Part SO	Overall NTGR – Weighted
	High	*Low*	*Avg*	*High*	*Low*	*Avg*	*High*	*Low*	*Avg*		
Participant	10	9	9.7	10	10	10	10	7	8.8	0.01	0.93
RSP	10	8	9.1	10	0	7.3	N/A				0.91
									Overall	0.01	0.92

[9] Interviewed RSPs accounted for 58% of electric savings.

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