BizSavers Program Evaluation Report

January 2014 – December 2014

Prepared For:

Ameren Missouri

Prepared by:

ADM Associates, Inc.

Research Into Action

Final Report: May 2015

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1. Executive Summary

This report presents the results of the impact and process evaluations of the BizSavers custom, standard, new construction, and retro-commissioning programs, which occurred during the 2014 calendar year, January through December. The ADM EM&V team consists of ADM Associates, which performed the impact evaluation, and Research into Action, which performed the process evaluation. The primary evaluation activities are as follows:

- Data for the study were collected through review of program materials, on-site inspections, end-use metering, and interviews with Ameren Missouri staff members, Lockheed Martin staff members, and participating customers and contractors.
- Samples for measurement and verification were drawn for all four programs that provide savings estimates at the 90% confidence level. The statistical precision varies by program: ±9.5% for the custom program, ±8.9% for the standard program, ±6.2% for new construction, and ±11.2% for the retro-commissioning program.
- Field technicians conducted on-site visits to collect data for savings impact calculations, to verify measure installation, and to determine measure-operating parameters. Monitoring equipment was installed at a majority of sites to accurately measure the hours of operations of new lighting equipment and motors/VFDs.
- Customer surveys (n=452) provided insight into the participants' decision-making processes, levels of satisfaction with the program, and tendencies to invest in energy efficiency in the future. The results informed the net-to-gross analysis, spillover data collection, as well as a portion of the process evaluation.
- Non-participant surveys (n=280) provided information on program awareness, decision making, and barriers to participation.
- Program staff interviews (n=6) provided insight into the evolving nature of the program. Specifically, program staff answered questions related to program goals, implementation and delivery.
- Surveys were also administered at five Ameren Missouri Trade Ally Training events to assess how well these events deliver program information (n=71).
- A cost effectiveness analysis was conducted to provide program stakeholders and staff with an understanding of how the BizSavers program is performing from a cost perspective at the portfolio, program, and measure level.

Table 1-1 provides a summary of the data collection efforts that are outlined above. The table lists the source of each data element, the outcome, the purpose, and the timeline of each data collection activity.

Table 1-1 Summary of BizSavers EM&V Data Collection Efforts

Data Source	Outcome	Purpose	Period of Data Collection
Impact Analysis			
On site M&V			
Pre- Install Site Visits	6 Visits	Install monitoring equipment to establish project baseline	All Year 2014
Post-Install Site Visits	94 Projects	Verify project energy savings	All Year 2014
Spillover Analysis			
Lockheed Martin Measure Report	145 Projects/ 297 Measures	Identify measures that did not qualify for program incentives, but were installed	January 2015
Participant Survey	452 Responses / 2 with Spillover	Identify customers that said they were "likely to buy or have already bought efficiency equipment because of their experience with the program"	Aug 2014 – Jan 2015
Process Analysis			
Participants			
On-line Survey	452 Responses	Collect data about customer satisfaction, free ridership, and spillover	Aug 2014 – Jan 2015
Participants			
In-Depth Interviews	17 Interviews	Collect data about program experiences; installed equipment; satisfaction with program	Sept-Dec 2014
Near Participants			
In-Depth Interviews	18 Interviews	Investigate the reasons for discontinuation of the application and possibly prevent future lost savings opportunities	Dec 2014 – Jan 2015
Non-participants			
On-line Survey	280 Responses	Collect non-participant data on program awareness, energy decision-making, upgrades to energy-using equipment, barriers to participating in program, and interest in Ameren Missouri programs.	September 2014
Program Staff			
In-Depth Interviews	6 Interviews	Update information on the program's goals, implementation, and delivery for the current program cycle	May, June, Dec 2014
Training Events			
Telephone and On-line Surveys	5 Events /71 Responses	Assess how well these events deliver program information to service providers and customers	May-Oct 2014

Data Source	Outcome	Purpose	Period of Data Collection
Cost Effectiveness Analysis			
Economic and Financial Assumptions	Delivered to MMP	Used to develop the economic model, these assumptions include Ameren Missouri's discount rate, line losses, avoided electric T&D [1]	Jan 2015
2013 Spending Data	Delivered to MMP	Financial data to be used as inputs for the Cost Effectiveness Analysis (program level)	Jan 2015
DSMore Batch Tools	Delivered to MMP	Measure level EUL and incremental costs, to be input into the model	Jan 2015
Aggregation Results	Delivered to ADM	Included the calculations for each cost test	Jan 2015
Write up	Delivered to ADM	A summary document that provides a detailed account of the analysis	Feb 2015

Gross ex post energy savings calculated by ADM do not take into account the impact of free ridership, spillover, or market transformation-related energy savings. In other words, the gross ex post energy savings are the savings verified via on-site data collection, before the net-to-gross ratio is applied. The gross ex ante and ex post energy savings of the BizSavers program during the 2014 calendar year are summarized by program in Table 1-2.

Table 1-2 Summary of kWh Savings for BizSavers Programs

Program Component	*Adjusted Savings Targets 2014*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Savings Realization Rate*	*Ex Post Net kWh Savings*	*Estimated Net to Gross Ratio*	*Percent of Goal Achieved*
Custom	55,500,000	80,379,926	83,161,231	103%	76,493,673	92%	138%
Standard	34,184,000	38,589,848	40,070,742	104%	38,407,774	96%	112%
New Construction	4,174,000	13,170,801	13,399,531	102%	13,373,716	100%	320%
RCx	2,614,000	11,640,860	9,626,043	83%	9,056,403	94%	346%
Total	96,472,000	143,781,436	146,257,547	102%	137,331,565	94%	142%

*Ameren Missouri energy savings targets were adjusted in 2014 to account for opt out customers

[1] These data were provided by Ameren Missouri, and are consistent with DSMore Model – SLX Version 5.0.14, CSG Version 5.0.23., referenced in *Unanimous Stipulation And Agreement Resolving Ameren Missouri's MEEIA Filing* (Case No. Eo-2012-0142).

During this period, the custom program's gross ex post energy savings totaled 83,161,231 kWh, while standard program's gross ex post energy savings totaled 40,070,742 kWh. The gross kWh savings realization rate for the custom program is 103%, while the gross kWh savings realization rate for the standard program is 104%. The new construction program's gross ex post energy savings totaled 13,399,531 kWh, while the retro-commissioning program's gross ex post savings totaled 9,626,043 kWh. The gross kWh savings realization rates for these two programs are 102% and 83%, respectively.

Net savings are equal to gross savings, *minus* free ridership, *plus* participant spillovers, non-participant spillovers, and market effects. ADM uses net program impact analysis to determine what portion of gross energy savings and kWh reductions achieved by participants in the program can be attributed to the effects of the program.

$$\textit{Net Savings} = \textit{Gross Savings} - (\textit{Free-ridership} + (SO_{part} + SO_{non\text{-}partt} + \textit{Market Effects}))$$

During 2014, the custom program's ex post net energy savings totaled 76,493,673 kWh, while the standard program's ex post net energy savings totaled 38,407,774 kWh. The estimated net to gross ratio for the custom program is 92% and the estimated net to gross ratio for the standard program is 96%. The new construction program's ex post net energy savings totaled 13,373,716 kWh, while the retro-commissioning program's ex post net energy savings totaled 9,056,403 kWh. The estimated net to gross ratios of these programs are 100% and 94%, respectively.

The evaluation of net savings presented in this report does not include assessment of market effects. The subject of market effects and the likelihood of their impacts was discussed throughout the program year during weekly group conference calls. However, several challenges to quantifying market effects exist:

- There is a relatively high cost of obtaining reliable snapshots of measure saturation rates in the market over time.
- Methods of attributing market transformation impacts to the program - as distinct from other, naturally occurring market transformation impacts - are not well established.

The evaluation team will collect additional data from trade allies during 2015 to better understand how the BizSavers Program is influencing the equipment types that are being purchased by business sector customers. How and if these impacts will be quantified will be an ongoing discussion during 2015.

Table 1-2 also provides a summary of kWh savings for each BizSavers Program relative to Ameren Missouri's 2014 energy savings goals. Overall, the BizSavers Program portfolio ex post net energy savings (137,331,565 kWh) achieved 142% of its 2014 annual kWh savings goal (96,472,000 kWh). The ex post net kWh energy savings for the custom (76,493,673 kWh) and standard program (38,407,774 kWh) met 138% and

112% of the program 2014 energy savings goals, respectively. The new construction program achieved 320% of its 2014 energy savings goal with 13,373,716 kWh in ex post net energy savings, and the retro-commissioning program achieved 94% of its 2014 energy savings goal with 9,056,403 kWh in ex post net kWh savings.

The gross ex post peak kW reductions during the 2014 calendar year are summarized by program in Table 1-3. The gross ex post peak demand savings totaled 11,854.85 kW for the custom program, and 11,861.27 kW for the standard program. The gross ex post peak kW savings totaled 6,939.51 kW for the new construction program, and 541.59 kW for the retro-commissioning program. The ex post net peak demand savings for the custom program are 10,664.16 kW, while the ex post net peak demand savings for the standard program are 11,394.19 kW. The ex post net peak demand savings for the new construction and retro-commissioning programs totaled 6,680.71 kW and 523.31 kW, respectively. The ex post net peak savings (29,262.37 kW) exceeded the BizSavers 2014 peak demand savings target (21,042 kW).

Table 1-3 Summary of Peak kW Savings for BizSavers Programs

Program Component	*Peak kW Savings Targets: 2014*	*Gross Ex Ante Peak kW Savings*	*Gross Ex Post Peak kW Savings*	*Gross kW Savings Realization Rate*	*Ex Post Net Peak kW Savings*	*Estimated Net to Gross Ratio*[2]
Custom	13,656	12,717.46	11,854.85	93%	10,664.16	90%
Standard	5,747	7,782.21	11,861.27	152%	11,394.19	96%
New Construction	1,116	989.69	6,939.51	701%	6,680.71	96%
RCx	523	479.30	541.59	113%	523.31	97%
Total	21,042	21,968.65	31,197.21	142%	29,262.37	94%

The high gross peak kW realization rates for the New Construction Program and the Standard Program are largely a result the 0 ex ante peak kW estimate for a number of controls measures. There are actually positive peak demand savings associated with these measures. Table 1-4 shows the ex ante savings associated with various New Construction Program measures associated with projects that were sampled for measurement and verification.

[2] The net-to-gross ratio for kWh savings may be different than the net-to-gross ratio for peak kW impacts. This is because the distribution of energy savings across energy consumers is not identical to the distribution of peak kW across energy consumers. A free rider program participant may, for instance, have implemented an exterior lighting project associated with zero peak kW impacts; in that instance, the participant's NTG for kWh savings would be different from the participant's NTG for peak kW impacts.

Table 1-4 kWh Savings of Sampled New Construction Measures with Zero Ex Ante Peak kW Impacts

Measure Name in Tracking Data	*Ex Ante kWh Savings*
Efficiency lighting system	4,936,007
Install Direct Digital Controls	546,338
Built-in to individual fixtures	385,884
Passive Infrared or Ultrasonic	369,779
Daylight sensor lighting control	352,585
Dual Technology Sensors (>150 Watts)	343,598
Control Lighting Circuit > 120 watts	113,399
More Efficient Exterior Lighting	87,196
Control Fixture > 50 and <=200 watts	42,479
Energy Star commercial freezer	3,757
Energy Star ice machine	2,695

The following section summarizes conclusions and recommendations that resulted from the evaluation activities. They are organized to present impact and process findings separately. Below is a list of conclusions that characterize key trends from the impact and cost effectiveness analyses.

- The BizSavers Program has gained momentum in the commercial and industrial sector since 2013. During 2014, all four BizSavers programs exceeded energy savings targets.
- ADM engineers conducted site visits for 94 projects in 2014. The projects for which on-site measurements and verification data were collected account for approximately 29% of custom program gross ex ante kWh savings, 14% of the standard program gross ex ante kWh savings, 71% of new construction program gross ex ante kWh savings, and 67% of retro-commissioning program gross ex ante kWh savings.
- Weekly calls between ADM and Ameren Missouri were an effective strategy for facilitating interim program feedback and mid-year course corrections. ADM relayed evaluation findings to Ameren Missouri to provide staff with an understanding of what was going well and what factors were driving down project savings. ADM brought several issues to the attention of program staff that were specific to trade allies, measure types, and baseline assumptions. The implementation team utilized this real-time feedback, determined the root cause, and were able to respond accordingly.
- Overall, program level realization rates are strong with most averaging close to 100% or greater. Much more variability with realization rates exists at the project

and measure level. Below are three specific findings related to measure level realization rates:

- Within the custom and standard program, lighting controls continue to produce savings uncertainty and in turn, evaluation risk. Modifications to the program application were made to mitigate uncertainties; these modifications are further discussed below.
- ADM applies heating and cooling interaction factors (HCIFs) to all custom and standard lighting projects, which has consistently resulted in a higher than average realization rate for lighting projects. Although the TRM states that the unity value of 1.0 for HCIF is permissible, ADM obtains the heating and cooling system information during site visits for a more accurate HCIF, and includes in all lighting and controls savings calculations.[3]
- Sampled retro-commissioning projects with compressed air measures often had lower than expected realization rates. Although, in all cases, ADM accepted the repaired air leak value for CFM reduction, the ex ante load calculations overestimated the baseline conditions and savings. For example, a trade ally performed pre monitoring at two of their compressed air power plants; one was a retro-commissioning project with a 75/25 split of compressor load. Pressure values at each location were averaged without weighting to provide an estimated single value pressure used in the savings profile. The result was an overestimation of energy savings impacts.
- The estimate of 0 ex ante peak kW savings for a number of controls measures caused the high gross peak kW realization rates for the New Construction Program and the Standard Program. There are actually positive peak demand savings associated with these measures.

- The overall portfolio of BizSavers programs and each individual program is cost effective according to the TRC and UCT tests.
- Several program changes occurred mid-year, two of which have required on-going discussions and attention from the evaluation team.
  - Program application changes were implemented to mitigate the risk of underperforming lighting control measures (occupancy sensors). Lighting controls were segmented into two categories: "fixture-mounted" (installed on and controlling single fixtures) and "controlling lighting circuit" (controlling the lighting on the circuit). The customer also now has to provide the "watts per controlled unit" on the new application, where as previously the customer

[3] See Table 3-11 for a presentation of the heating and cooling interaction factors developed and applied by ADM.

would only select a wattage range. The objective was to allow for more accurate incentive determination and utilization of deemed savings by improving the accuracy of the connected watts value for the sensor category selected.

Projects evaluated in 2014 indicate that the deemed ex ante savings per unit is overestimated for the new control measure, which is based on the Ameren 2012 TRM. For example, the measure "any technology sensors from 50 watts to 120 watts" with an annual unit savings of 387 kWh implies an annual hours of use reduction between 3,225 hours and 7,740 hours, whereas the total hours of use of the weighted building hours is 5,202. Therefore, while the changes are a step in the right direction, the evaluation team believes that the deemed ex ante savings values still overestimate the measure impacts for a subset of lighting control measure types.

- In October of 2014, program guidelines were amended to allow for lighting incentives and savings to be calculated utilizing a T-12 baseline for lighting retrofit projects with T-12 existing fixtures. Prior to the change, the savings and incentives were based on the equivalent wattage of a standard T-8. The program change is in effect for six months, from October 15, 2014 through April 15, 2015. Additionally, project applications that were received, but not committed, prior to October 15th were eligible.

  As a result, the program experienced a significant increase in the number of applications with T-12 to T-8 and T-12 to LED retrofits. From January to the end of September the number of lighting measures that fell under the T-8 guideline totaled 723 In the three-month period (October 15th – December) after the baseline change was made, 127 applications totaling nearly 300 lighting measures were submitted. Additionally, the ex ante kW savings during the enhanced incentive period totaled approximately 1,500 kW, as compared to 833 kW of demand savings from lighting projects completed in January through mid-September. The kWh savings is similar, but the kW values provide a better comparison by omitting the variability in the hours of use between the projects.

- The cost effectiveness analysis provides a list of nineteen Custom Program and Standard Program measures that were associated with a TRC test result of less than one.

Based on the above conclusions, the evaluation team offers the following impact recommendations for consideration in planning future program cycles.

- Continuous program improvement is one of the primary goals of the evaluation. ADM suggests that Ameren Missouri modify the algorithm for calculation of savings of lighting control measures to appropriately account for participant building type, typical energy savings factor associated with control type, and actual controlled wattage.[4] Continued adherence to the TRM deemed values is likely to result in continued high variability of gross realization rates for this measure.

- ADM suggests that program staff apply heating and cooling interaction factors (HCIF) by building type, as defined in the TRM, to more accurately estimate lighting project savings. As project documentation already requires the customer to indicate the building type and space heating fuel source, applying the appropriate HCIF should not require the collection of additional information. For purposes of performing ex post evaluation of lighting project savings, ADM developed HCIFs based on energy simulation of DEER eQUEST prototypical buildings, referencing Ameren Missouri service territory weather data. Those HCIFs are shown in Table 3-11.
- To improve the gross ex ante estimations for compressed air measures, ADM suggests adding retro-commissioning compressed air projects to those that qualify for pre-installation review by both Lockheed Martin and the evaluation team. ADM is willing to review all operating assumptions and savings calculations as provided by the trade ally, in an effort to improve ex ante savings estimations prior to project approval.
- In order to improve peak kW gross realization rates, ADM recommends that the ex ante peak kW estimates for various lighting control measures for which there have been 0 ex ante peak kW savings be appropriately upwardly revised.
- The program has provided incentives for a variety of lighting retrofit ranges, such as T-12 to T-8 retrofits, T-8 to T-5 retrofits, and more recently to even higher efficiency LED lighting. Program staff should consider either continuing only the T-12 to LED measures past April 2015, or providing a relatively higher incentive per kWh saved for T-12 to LED measures. Implementing one of these courses of action, or a similar course of action aimed at increasing the likelihood of participant selection of LEDs instead of T-8 lighting, may reduce the possibility of incentivizing the same facility to step up to T-8/T-5 lighting, then again to LED lighting during following program years.

[4] Please see 4.5.10 Occupancy Sensor Lighting Controls in the *Illinois Statewide Technical Reference Manual* for an example of this methodology (http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Version_4/2-13-15_Final/Updated/Illinois_Statewide_TRM_Effective_060115_Final_02-24-15_Clean.pdf). Note that the specific approach outlined in that document could be employed while using building type-specific operating hours for Ameren Missouri service territory.

The results of the process evaluation research are largely positive. Program participant satisfaction was high across all program facets and the program exceeded its energy savings targets for all four BizSavers programs. This report provides not only the verified energy savings associated with the BizSavers program in 2014, but also an overview of program operations and suggests recommendations to be considered as the program evolves.

Below, conclusions and recommendations are organized according to the five regulatory research questions specified in 4 CSR 240-22.070(8). The conclusions address the first four questions; the fifth question speaks to recommendations.

- **Research Question 1:** What are the primary market imperfections common to target market segment?
- In the context of this process evaluation, we interpret “market imperfection” to mean any structural barriers that prevent Ameren Missouri customers from undertaking energy efficiency upgrades (on their own or through the BizSavers programs). The most commonly reported reason that surveyed nonparticipants gave for not using highly efficient equipment in past or planned upgrades was cost, but only one-quarter of respondents gave that response. Lack of awareness of efficiency options and following contractor recommendations to use standard equipment also were common responses. Evidence that lack of awareness is a barrier comes from the finding that nearly half of the surveyed nonparticipants reported no previous awareness of the BizSavers programs.
- Small facilities constitute a slightly smaller percentage of total program savings than their share of total building area would predict. This was particularly the case for non-lighting savings, which is consistent with the supposition that small facilities are relatively more likely to be occupied by businesses that lease their space (and so might invest in lighting upgrades but not more capital intensive ones). Data from our nonparticipant survey did not provide strong evidence of that small businesses differ much from larger ones in program awareness or past or planned use of energy efficient equipment, but small businesses are less likely than large ones to report having a person or person(s) responsible for energy usage. Small businesses are notoriously difficult to reach.[5,6] Lockheed Martin staff reported a wide range of activities designed to improve the program’s reach into that segment. One strategy that Lockheed has not yet employed is distributing free direct-install measures,

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[5] Mazur-Stommen, S. and Herzer, B. (2014). Unmined Gold. Engaging Small Commercial Customers. Presented at the Bonneville Power Administration-Northwest Energy Efficiency Alliance Efficiency Exchange Conference, Kennewick, Washington, 2014.

[6] Vargas, P. (2015). Blitz! A Community Approach to Savings in Direct Install Commercial and Residential Programs. Presented at the Bonneville Power Administration-Northwest Energy Efficiency Alliance Efficiency Exchange Conference, Portland, Oregon, 2015.

which have been found to be a cost-effective method for achieving savings in the small business segment.[7,8,9]

- **Research Question 2:** Is target market segment appropriately defined, or does it need further subdivision or merging with other segments?
- As was found in the 2013 evaluation, projects were distributed across a range of business types in rough proportion to the distribution of business types in the general population, suggesting that the program is effectively reaching the main segments of the target market. As noted above, small businesses constitute a slightly smaller percentage of total program savings than their share of total building area would predict.
- **Research Question 3:** Do program measures reflect the diversity of end-use needs and available technologies for target segment?
- The range of equipment generally meets the needs of respondents. Equipment is generally delivered with little delay. Participants are largely satisfied with the quality of the installed equipment and the quality of installation. Standard program participants that decided not to pursue the custom option did so primarily because the standard option covers their equipment needs. However, one-third of surveyed participants did not find the range of qualified equipment to be acceptable although none provided details on what might be missing. One possible cause of dissatisfaction may have been a requirement that existed through most of the program year: that lighting upgrades from T-12 to more efficient lamping use T-8 as the baseline case. Program staff reported that the T-8 baseline did not provide adequate incentive for changing T-12s. Late in the year, Lockheed obtained permission to begin using a T-12 baseline, and staff reported positive feedback. The evaluation team will investigate the response to the change in baseline more formally in the 2015 evaluation.
- Retro-commissioning participants are highly satisfied with the services they received, the cost savings, and the performance of the program measures. Interviewed participants tended to focus more on the equipment replacement aspects of their retro-commissioning project than the optimization aspects, which may suggest that the program might review how the optimization aspects are

[7] Fisher, M., Moran, D., and Gogte, S. (2013). Engaging Small Customers: Maximizing the Direct-Install Hook. Presented at the Association of Energy Services Professionals 23rd National Conference, January 2013.

[8] Garland, G. (2013). Successful Tactics for Improving Customer Satisfaction in Small and Unassigned Businesses through Energy Efficiency. Presented at the Association for Energy Services Professionals National Conference, Orlando, FL, 2013.

[9] Mougne, Ti. (2013). The Playbook for Small Business Direct-Install Programs. Presented at the Association for Energy Services Professionals National Conference, Orlando, FL, 2013.

communicated to the participants. The evaluation team will attempt to assess understanding of the equipment optimization goals of retro-commissioning more directly in the 2015 evaluation.

- The ability of the new construction program to meet the diversity of end-use needs and available technologies may be limited by the ability of program staff to become involved before building design takes place. In interviews with 2014 program participants, the evaluation team found that staff became involved in respondents' projects after the building design took place, limiting their influence to lighting measures.
- **Research Question 4:** Are communication and delivery channels/mechanisms appropriate for the target market segment?
- The program implementer, Lockheed Martin, uses a wide range of marketing outreach channels and methods to reach end-use customers and carries out active outreach to service providers (e.g., contractors, vendors, and distributors). Engagement of services providers is important, as they are critical to program communication and delivery and play a key role in shaping upgrade decisions. In 2014, Lockheed added four full-time staff, including an outreach coordinator to coordinate between business development staff and trade allies; provided additional training to staff to improve service; and increased the size of the BizSavers Trade Ally Network by about 50%.
- Lockheed staff reported several additional efforts undertaken in 2014 to improve program awareness and participation. These include rolling out the Distributor Partnership Program (DPP) to raise program awareness, particularly among small businesses, through point-of-purchase information at local distributorships; targeted marketing and outreach to K-12 schools, the hospitality industry, government agencies, commercial kitchens, and IT data centers; implementation of the "Fast Track" standard application, which waives pre-approval for standard projects with incentives below $10,000; and revisions to the look, feel, and functioning of the online application.
- Several evaluation findings speak to the appropriateness of program communication and delivery channels and mechanisms. The participant survey showed that vendors and contractors were the most common source of program awareness, but program staff tended to bring in larger projects and accounted for nearly as much total savings as contractors and vendors. The non-participant survey showed moderate program awareness, driven by BizSavers marketing and information from contractors and associates, but with much room for increased awareness. Further, only about one-third of non-participants were aware of new construction incentives, and awareness was lower for retro-commissioning incentives.

- The 2013 evaluation reported that many participants found application instructions to lack clarity, causing project delay and possible abandonment. Lockheed's revisions to the online application were at least partly in response to this finding. While the current evaluation found that participants were generally satisfied with most aspects of participation, including the application process, the rated ease of using application worksheets and rated ease of finding the online application were lower than reported in the 2013 evaluation. Changes to the application website (including using the single word "Custom" to label an icon linked to the custom/standard application) could possibly be related to these differences, although an analysis of participant survey data to examine that possibility did not provide clear evidence of that (see Section 5.2.5).
- **Research Question 5:** Are there better ways to address market imperfections to increase adoption of each program measure?
- Based on the above conclusions, the evaluation team offers the following process recommendations to improve program effectiveness and increase adoption of program measures.
  - Lockheed Martin should continue to work to clarify application instructions, particularly for the custom program, and ensure that service providers and end-users know whom they can contact to get assistance with applications. Although we did not find evidence that using the word "Custom" for the custom/standard application website icon increased the difficulty of finding applications, we recommend that Lockheed consider relabeling the "Custom" icon to say "Standard and Custom" or provide separate icons for accessing the standard and custom worksheets.
  - Lockheed Martin staff should continue to work to improve program penetration of the small business sector and should consider additional approaches that may include free direct install of low-cost measures to generate immediate cost-effective savings and generate interest in future projects. Staff should also consider conducting additional market research to provide information on specific needs and motives of small business segments.
  - Ameren Missouri and Lockheed Martin should continue to work together to increase awareness of the new construction and retro-commissioning incentives and of the benefits of participation in those programs. In particular, Ameren Missouri and Lockheed Martin should make efforts to ensure that Lockheed business development staff, Ameren Missouri Account Executives and Customer Support Agents, and trade allies promote the new construction program in all discussions with customers, as achieving that program's full potential requires identifying projects before the design phase has begun.

Lockheed and Ameren Missouri should provide their respective staffs with training in basic architecture and design engineering concepts to enable them to be able to discuss energy efficiency with those types of professionals.

- Lockheed Martin staff should review how it presents the retro-commissioning initiative to retro-commissioning service providers (RSPs), other trade allies, and customers to ensure that the information properly communicates the equipment optimization, as opposed to equipment replacement, aspects of retro-commissioning. In particular, Lockheed Martin staff should review with RSPs the information and training they give to participants on optimization.

2. Introduction

This report presents the results of the impact and process evaluations of the BizSavers custom, standard, new construction and retro-commissioning programs. These programs are available to Ameren Missouri's business sector customers. This report presents results for activity during the 2014 calendar year.

2.1. Description of Program

The BizSavers Program was designed to help businesses identify and implement energy saving projects. The four program components evaluated in this report are described as follows:

- Standard incentives, which are payments for the installation or use of specific energy efficient equipment.
- Custom incentives, which are payment for qualifying energy saving measures at a rate of $0.07/kWh for non-lighting measures and $0.06/kWh for lighting measures.
- RCx incentives have two components, an RCx study incentive and an implementation incentive. The study incentive rate is dependent on the project track type and the level of savings associated. The implementation incentive is at a rate of $.07/kWh saved. The total customer incentive is the sum of both the study incentive and the implementation incentive.[10]
- New construction incentives are payments for purchase and installation of energy efficiency measures for new construction projects. Three primary types of incentives exist: whole building performance incentive, standard incentive, and custom incentive. The whole building performance incentive is designed to encourage a holistic approach to energy design and provide a financial incentive for quantifying these design savings and is based on the total savings achieved as shown in Table 2-1 below. The other two incentive types depend on the measure installed and/or its performance, and are paid at a rate comparable to the standard and custom retrofit rates. Note that both whole building performance and custom/standard incentives may be provided for a single project. For instance, it is possible for a new construction project for which only interior lighting accounts for the efficiency improvement relative to baseline to receive custom and/or standard incentives, as well as whole building performance incentives, provided that whole building energy use is reduced by at least 10% relative to baseline.

[10] https://www.ameren.com/sites/aue/UEfficiency/businessenergyefficiency/Documents/BizSavers/RetrocommissioningIncentiveGuidelines.pdf

Table 2-1 New Construction Program Incentives

From Baseline	*Whole Building (Design)*	*Custom (non-lighting)*	*Standard*
10-19% energy savings	$0.02/kWh	$0.07/kWh	See Schedule
20-29% energy savings	$0.03/kWh	$0.07/kWh	See Schedule
30% energy savings	$0.04/kWh	$0.07/kWh	See Schedule

Gross ex ante kWh savings are shown by program in Table 2-2. There were 907 custom projects during the 2014 calendar year with gross ex ante energy savings of 80,379,926 kWh. During the same period, there were 1,202 standard projects with gross ex ante savings of 38,589,848 kWh. There were forty-one new construction projects completed with gross ex ante savings of 13,170,801 kWh, and twenty-two retro-commissioning projects with gross ex ante savings of 11,640,860 kWh.

Table 2-2 Gross Ex Ante kWh Savings for BizSavers Programs

Program	*Number of Projects*	*Gross Ex Ante kWh Savings*	*Gross Ex Ante Peak kW Savings*
Custom	907	80,379,926	12,717.46
Standard	1,202	38,589,848	7,782.21
New Construction	41	13,170,801	989.69
RCx	22	11,640,860	479.30
Total	2,150	143,781,436	21,968.65

2.2. Program Trends in 2014

Figure 2-1 shows the custom program gross ex ante savings by measure start-up month, while Figure 2-2 shows the standard program gross ex ante savings by measure start-up month. The custom program started the year strong with project kWh savings totaling approximately 39.8M kWh in savings. The savings for January are significantly higher due to projects that were initiated in late 2013 and were ultimately finalized in early 2014. Once the surge of activity decreased early in the year, the custom program was averaging approximately 3.5M kWh a month, with spikes of activity in April, July, September, and November.

The standard program also generated significantly more activity in January of 2014 with approximately 6.2M kWh in savings, which is also due to projects that were initiated in late 2013 that carried over to the 2014 program year. After the initial surge of activity, the standard program averaged about 2.9M kWh a month, with an influx of completions in May.

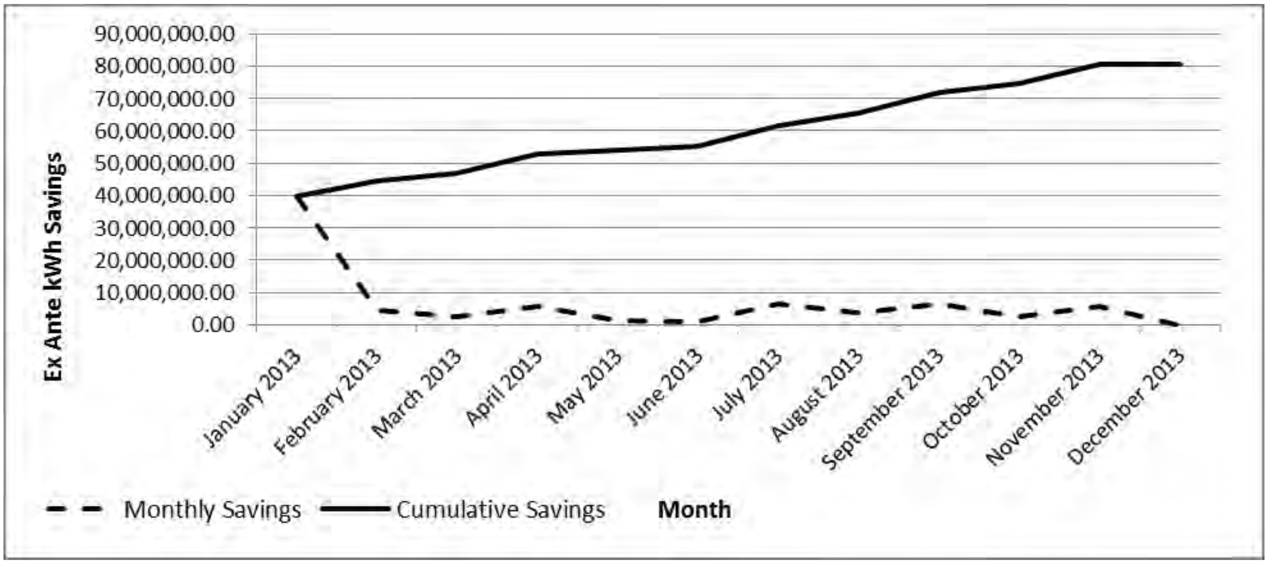


Figure 2-1 Custom Program Gross Ex Ante Savings by Measure Start-up Month

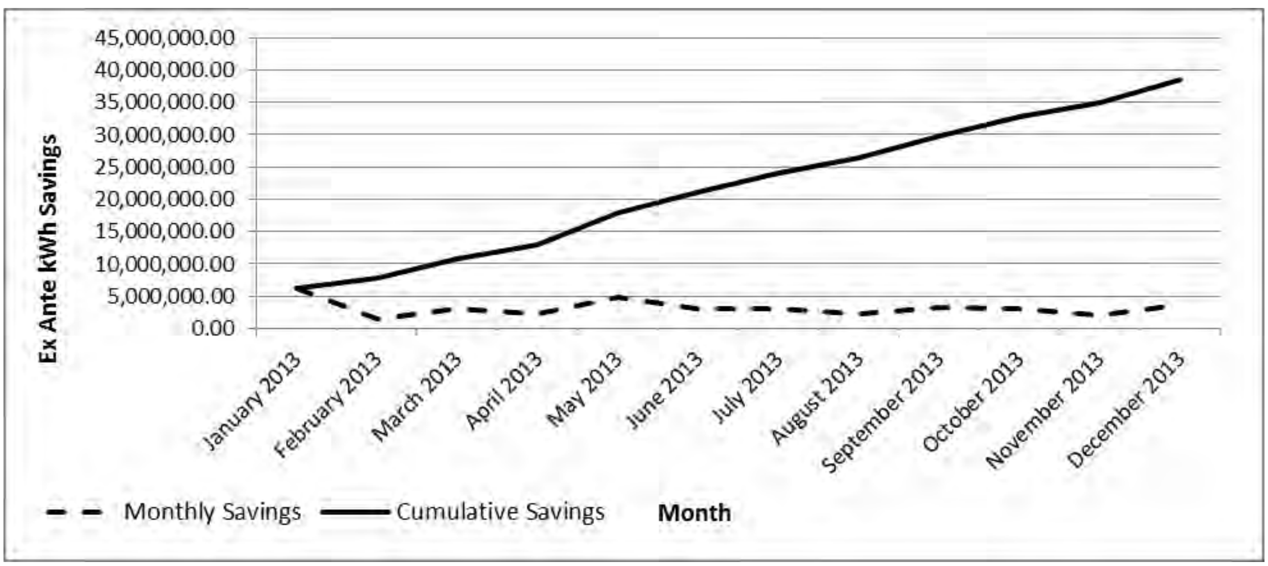


Figure 2-2 Standard Program Gross Ex Ante Savings by Measure Start-up Month

The new construction and retro-commissioning programs also experienced surges of activity during Q1 2014. Seventy-six percent of the 2014 new construction program savings were from projects completed during January, February, March, and April. Similarly, 62% of the 2014 retro-commissioning program savings were from projects completed in January, February, and March. Figure 2-3 and Figure 2-4 below display the program savings by month as well as cumulatively.

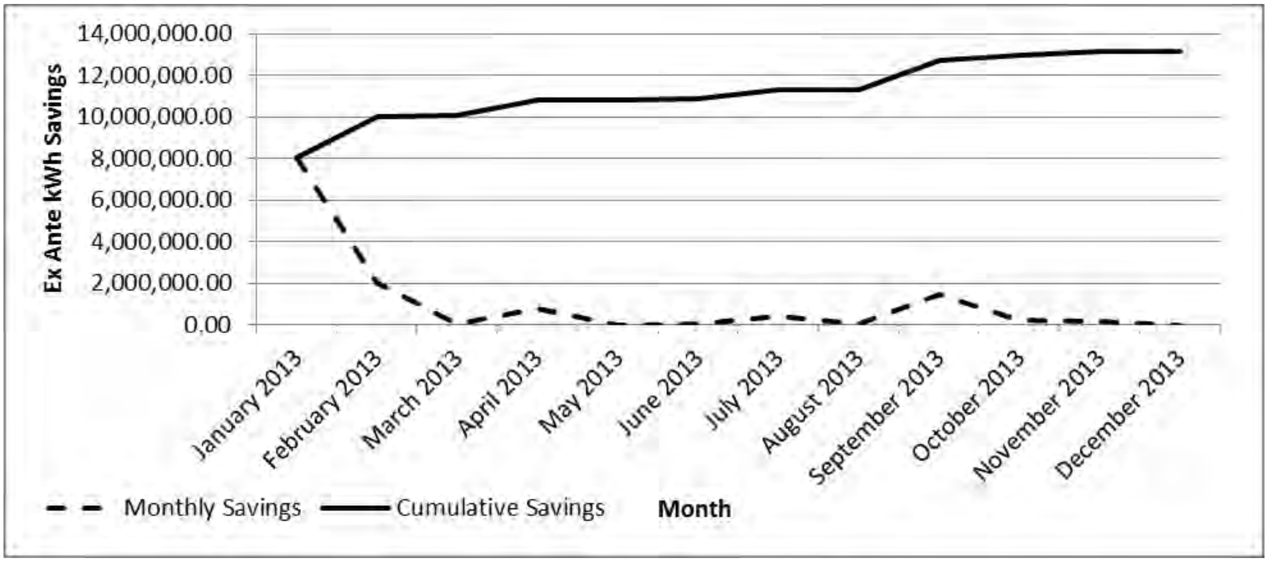


Figure 2-3 New Construction Program Gross Ex Ante Savings by Measure Start-Up Month

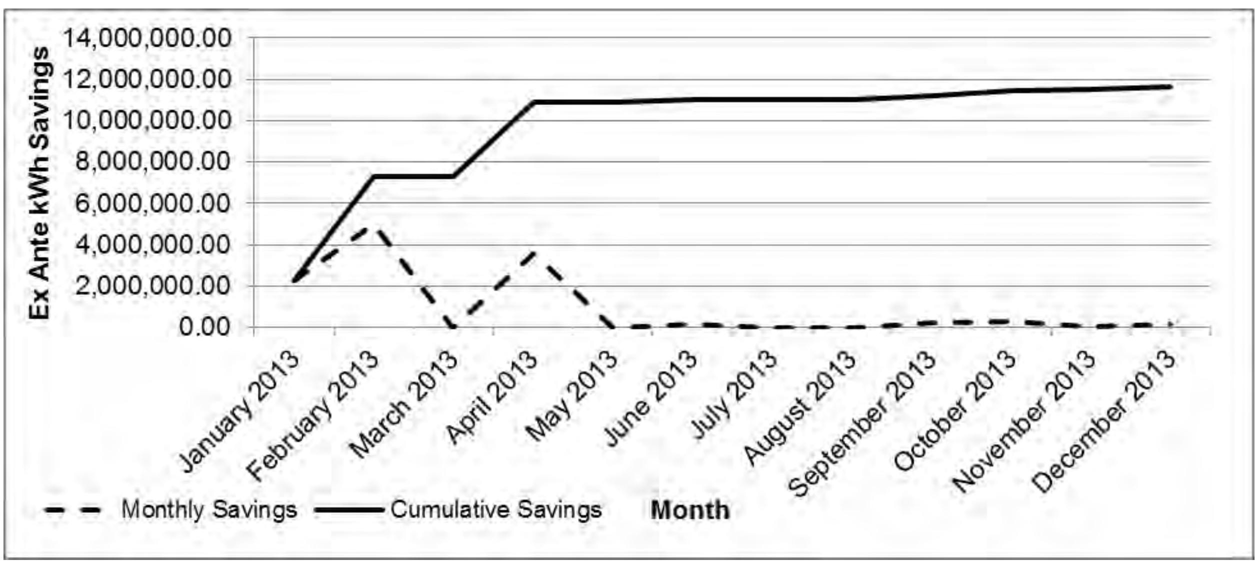


Figure 2-4 Retro-commissioning Program Gross Ex Ante Savings by Measure Start-Up Month

2.3. Overview of Evaluation Approach

The overall objective for the program impact evaluation is to determine the gross and net energy savings, and peak demand (kW) reductions resulting from all program activity during the 2014 calendar year.

The approach for the impact evaluation had the following main features.

- Analysts reviewed available documentation (e.g., audit reports, savings calculation work papers, etc.) from a sample set of projects, giving particular attention to the calculation procedures and evidence of savings estimates.
- Field technicians gathered on-site data for a sample of projects to provide the information needed for estimating annual energy savings and demand reductions. Extra monitoring at some sites, including monitoring of installed equipment, obtained accurate information on the hours of lighting operation, HVAC equipment, and motors/VFDs.
- Gross savings were estimated using proven techniques:
    - Analysts used a lighting evaluation model with system parameters (fixture wattage, operating characteristics, etc.) to analyze ex post energy savings for lighting projects. This lighting evaluation model uses parameters collected on-site or from industry standards.
    - ADM engineers and analysts reviewed and verified the original HVAC measure savings analyses, including the operating and structural parameters. To develop estimates of energy use and savings from the complex custom measures installed, ADM developed building energy simulation models.
    - ADM conducted a survey of program participants to assess customers' decision-making, their likes and dislikes of the program, and factors determining net-to-gross savings ratios for the program.

2.4. Organization of Report

This report on the impact and process evaluation of the program for the period January 2014 through December 2014 is organized as follows:

- Chapter 3 presents and discusses the methods used for and the results obtained from estimating gross savings.
- Chapter 4 presents and discusses the methods used for and results obtained from estimating net savings.
- Chapter 5 presents and discusses the methods used for and results obtained from the process evaluation.
- Chapter 6 presents and discusses the methods used for and results obtained from the cost effectiveness evaluation.
- Chapter 7 presents evaluation conclusions and recommendations.
- Appendix A provides project-level measurement and verification reports for each project for which data were collected on-site.

- Appendix B provides a copy of the program staff interview guide.
- Appendix C presents a copy of the Trade Ally training evaluation form.
- Appendix D presents a copy of the participant online survey.
- Appendix E presents a copy of the non-participant survey.
- Appendix F presents a the critical technical data that were used for the cost effectiveness analysis
- Appendix H presents a glossary of terms

3. Estimation of Gross Ex Post kWh Savings

This chapter explains the estimation of gross ex post kWh savings and gross ex post peak kW savings for year 2014 program participants from measures installed in their facilities. Section 3.1 describes the methodology used for estimating gross ex post kWh savings. Section 3.2 presents the results of the effort to estimate savings for sampled projects from the four programs. Appendix A contains specific methodologies for estimating gross ex post savings and savings estimation results for each sample project.

3.1. Methodology for Estimating Gross Savings

The methodology used for estimating gross ex post kWh savings is described in this section.

3.1.1. Sampling Plan

Program tracking data showed that during the 2014 calendar year, there were 907 custom projects with gross ex ante savings of 80,379,926 kWh annually and 1,202 standard projects during the same period with gross ex ante savings of 38,589,848 kWh annually. There were forty-one new construction projects with gross ex ante annual savings of 13,170,801 kWh, and there were twenty-two retro-commissioning project with gross ex ante annual savings of 11,640,860 kWh. For the 2014 evaluation, stratified sampling was used for all four programs.

Estimation of savings for all four programs is based on a ratio estimation procedure that allows the measured and verified (M&V) sample to have statistical precision requirements to accurately explain the annual gross ex post savings for all completed projects. ADM selected a sample with a sufficient number of projects to estimate the population gross ex post kWh savings with 10% relative precision at the 90% confidence level. The actual relative precision of each program is shown in Table 3-1. The custom program sample is ±9.5%, and the actual relative precision of the standard program sample is ±8.9%. ADM calculated the actual relative precision of the new construction program sample is ±6.2%, while the retro-commissioning precision is ±11.2%.

Table 3-1 Statistical Precision by Program

Program	*Statistical Precision*
Custom	±9.5%,
Standard	±8.9%
New Construction	±6.2%,
Retro-commissioning	±11.2%.

The sample selection includes projects that were completed throughout the 2014 program year. Quarterly samples were drawn from each program so ADM engineers could analyze those projects mid-year and provide feedback to the implementation contractor regarding red flags with measure types or specific trade allies. Partitioning the measurement and verification (M&V) fieldwork in this way allowed for both program staff and the evaluation team to mitigate the risks associated with sampling the projects just once at the end of the year.

Table 3-2 shows the number of custom projects that fell into five energy-saving strata, their gross ex ante kWh savings boundaries, and the number of sample custom projects chosen from the stratum. Table 3-3 shows the number of standard projects that fell into five energy-saving strata, their gross ex ante kWh savings boundaries, and the number of sample standard projects chosen from the stratum. The number of samples within each stratum was selected in order to achieve the desired statistical precision. The percentage of projects selected for inclusion in the sample was greater for strata with higher per project energy savings; this allows for achieving a desired statistical precision with relatively fewer total sample points.

Table 3-2 Population Statistics Used for Sample Design for Custom Program

	Stratum 1	*Stratum 2*	*Stratum 3*	*Stratum 4*	*Stratum 5*	*Totals*
Strata boundaries (kWh)	42,659 <	42,660 - 121,137	121,138 - 262,211	262,212 - 1,055,032	1,055,033 - 8,017,415	
Number of projects	547	206	100	48	6	907
Total kWh savings	8,937,553	15,223,062	17,142,764	22,184,893	16,891,654	80,379,926
Average kWh Savings	16,339	73,898	171,428	462,185	2,815,276	88,622
Standard deviation of kWh savings	10,999	22,152	40,208	205,283	2,586,103	316,300
Coefficient of variation	0.67	0.30	0.23	0.44	0.92	3.57
Final design sample	7	7	9	7	6	36

Table 3-3 Population Statistics Used for Sample Design for Standard Program

	Stratum 1	*Stratum 2*	*Stratum 3*	*Stratum 4*	*Stratum 5*	*Totals*
Strata boundaries (kWh)	19,946 <	19,947 - 58,833	58,834 - 139,249	139,250 - 304,835	304,836 - 837,468	
Number of projects	782	259	108	44	9	1,202
Total kWh savings	6,145,704	9,111,983	9,672,201	8,933,230	4,726,730	38,589,848
Average kWh Savings	7,859	35,181	89,557	203,028	525,192	32,105
Standard deviation of kWh savings	4,977	11,303	23,691	46,783	206,648	63,485
Coefficient of variation	0.63	0.32	0.26	0.23	0.39	1.98
Final design sample	8	9	8	5	7	37

Table 3-4 shows the number of new construction projects that fell into five energy-saving strata, their gross ex ante kWh savings boundaries, and the number of sample custom projects chosen from the stratum. Table 3-5 shows the number of retro-commissioning projects that fell into four energy-saving strata, their gross ex ante kWh savings boundaries, and the number of sample standard projects chosen from the stratum.

Table 3-4 Population Statistics Used for Sample Design for New Construction Program

	Stratum 1	*Stratum 2*	*Stratum 3*	*Stratum 4*	*Stratum 5*	*Totals*
Strata boundaries (kWh)	72,270 <	72,271 - 205,998	205,999 - 275,652	275,653 - 661,518	661,519 - 2,844,387	
Number of projects	15	10	6	6	4	41
Total kWh savings	512,983	1,451,743	1,503,758	3,444,765	6,257,552	13,170,801
Average kWh Savings	34,199	145,174	250,626	574,128	1,564,388	321,239
Standard deviation of kWh savings	23,199	44,300	17,998	72,340	876,757	512,354
Coefficient of variation	0.68	0.31	0.07	0.13	0.56	1.59
Final design sample	2	1	2	4	4	13

Table 3-5 Population Statistics Used for Sample Design for Retro-commissioning Program

	Stratum 1	*Stratum 2*	*Stratum 3*	*Stratum 4*	*Totals*
Strata boundaries (kWh)	220,065 <	220,066 - 415,010	415,011 - 1,807,043	415,011 - 1,807,043	
Number of projects	11	6	4	1	22
Total kWh savings	1,202,529	2,153,125	4,284,479	4,000,727	11,640,860
Average kWh Savings	109,321	358,854	1,071,120	4,000,727	529,130
Standard deviation of kWh savings	68,587	52,067	554,646	-	881,641
Coefficient of variation	0.63	0.15	0.52	-	-
Final design sample	3	1	3	1	8

The sample of custom projects, shown in Table 3-6, account for approximately 29% of the total custom program's gross ex ante kWh savings. The sample of standard projects, shown in Table 3-7, account for approximately 14% of the total standard program's gross ex ante kWh savings.

Table 3-6 Gross Ex Ante Savings for Custom Program Sampled Projects by Stratum

Stratum	*Sample Gross Ex Ante kWh Savings*	*Total Gross Ex Ante kWh Savings*	*Percentage of Gross Ex Ante Savings in Sample*
5	16,891,654	16,891,654	100%
4	3,729,470	22,184,893	17%
3	1,510,752	17,142,764	9%
2	655,113	15,223,062	4%
1	149,054	8,937,553	2%
Total	22,936,043	80,379,926	29%

Table 3-7 Gross Ex Ante Savings for Standard Program Sampled Projects by Stratum

Stratum	*Sample Gross Ex Ante kWh Savings*	*Total Gross Ex Ante kWh Savings*	*Percentage of Gross Ex Ante Savings in Sample*
5	3,248,262	4,726,730	69%
4	1,140,237	8,933,230	13%
3	810,478	9,672,201	8%
2	274,613	9,111,983	3%
1	81,261	6,145,704	1%
Total	5,554,851	38,589,848	14%

The sample of new construction projects, shown in Table 3-8, account for approximately 71% of the total new construction program's gross ex ante kWh savings. The sample of retro-commissioning projects; shown in Table 3-9, account for approximately 67% of total retro-commissioning gross ex ante kWh savings.

Table 3-8 Gross Ex Ante Savings for New Construction Program Sampled Projects by Stratum

Stratum	*Sample Gross Ex Ante kWh Savings*	*Total Gross Ex Ante kWh Savings*	*Percentage of Gross Ex Ante Savings in Sample*
5	6,257,552	6,257,552	100%
4	2,231,522	3,444,765	65%
3	493,018	1,503,758	33%
2	205,998	1,451,743	14%
1	126,999	512,983	25%
Total	9,315,089	13,170,801	71%

Table 3-9 Gross Ex Ante Savings for Retro-commissioning Program Sampled Projects by Stratum

Stratum	*Sample Gross Ex Ante kWh Savings*	*Total Gross Ex Ante kWh Savings*	*Percentage of Gross Ex Ante Savings in Sample*
4	4,000,727	4,000,727	100%
3	3,245,326	4,284,479	76%
2	350,817	2,153,125	16%
1	214,456	1,202,529	18%
Total	7,811,326	11,640,860	67%

3.1.2. Review of Documentation

After the selection of sample projects, ADM obtained project documentation from the tracking database maintained by Ameren Missouri's program implementation contractor. ADM analysts then reviewed this documentation and other program materials that were relevant to the evaluation effort.

The available documentation (e.g., audit reports, savings calculation work papers, etc.) for each incentivized measure was reviewed, with particular attention given to the calculation procedures and documentation for ex ante energy saving estimates. The reviewed documentation for all selected projects included program forms, databases, reports, billing system data, weather data, and any other potentially useful data. Each application was reviewed to determine whether the following types of information had been provided:

- Documentation for the equipment changed, including (1) descriptions, (2) schematics, (3) performance data, and (4) other supporting information
- Documentation for the new equipment installed, including (1) descriptions, (2) schematics, (3) performance data, and (4) other supporting information
- Information about the savings calculation methodology, including (1) what methodology was used, (2) specifications of assumptions and sources for these specifications, and (3) correctness of calculations

If there was uncertainty regarding a project or incomplete project documentation, then ADM staff contacted the implementation contractor to seek further information to ensure the development of an appropriate project-specific M&V plan.

3.1.3. On-Site Data Collection Procedures

Field technicians made on-site visits to collect data used in calculating accurate energy savings effects of the implemented measures. During the site visits of the sampled projects, field technicians collected primary data on the participants' facilities.

When projects were selected for the M&V sample, ADM notified Ameren Missouri in two ways:

1) ADM scheduled measurement and verification activities with Ameren Missouri Key Account Executives (KAE) by providing a list of all desired sites to visit. This list included the company name, the respective KAE for the customer, the site address or other premise identification, as well as the customer representatives' contact information with whom ADM intended to schedule an appointment.
2) ADM provided Ameren Missouri energy efficiency staff with a list of projects for which ADM planned to schedule M&V activities. This list included the company name, the project ID, the site address or other premise identification, and the customer representatives' contact information with whom ADM intended to schedule an appointment.

Typically, customers with KAEs received at least two weeks notification prior to ADM contacted customers to schedule M&V visits. Upon KAE request, ADM coordinated its scheduling and M&V activities with the KAE.

During an on-site visit, the field staff accomplished three major tasks:

- First, they verified the implementation status of all measures for which customers received incentives. They verified that the energy efficiency measures were actually installed, that they were installed correctly, and that they still functioned properly.
- Second, they collected the physical data needed to analyze the ex post energy savings from the installed improvements and measures. Data were collected using a form that was prepared specifically for the project in question after an in-house review of the project file.
- Third, they interviewed the facilities' contact representatives to obtain additional information on the installed system to complement the data collected from other sources.

At some sites, field technicians monitored operating hours of the installed measures. Monitoring occurred where the data would be useful for further refinement and higher accuracy of savings calculations. Monitoring was not necessary for sites where project documentation allowed for sufficiently detailed calculations.

3.1.4. Procedures for Estimating Savings from Measures Installed through the Program

The method ADM employs to determine gross savings impacts depends on the types of measures being analyzed. Categories of measures include the following:

- Lighting;
- HVAC;
- Motors;
- VFDs;
- Compressed-Air;
- Refrigeration; and
- Process Improvements.

ADM uses a specific set of methods to determine gross ex post savings for projects that depend on the type of measure analyzed. The set of methods to determine gross savings for these listed projects are summarized in Table 3-10. Project-specific information on procedures used to estimate savings of sampled projects is contained in Appendix A.

Table 3-10 Typical Methods to Determine Savings for Custom Measures

Type of Measure	*Method to Determine Savings*
Compressed Air Systems	Engineering analysis, with monitored data on load factor and schedule of operation
Lighting	Custom-designed lighting evaluation model, which uses data on wattages before and after installation of measures and hours-of-use data from field monitoring.
HVAC (including packaged units, chillers, cooling towers, controls/EMS)	eQUEST model using DOE-2 as its analytical engine for estimating HVAC loads and calibrated with site-level billing data to establish a benchmark.
Motors and VFDs	Measurements of power and run-time obtained through monitoring
Refrigeration	Simulations with eQUEST engineering analysis model, with monitored data
Process Improvements	Engineering analysis, with monitored data on load factor and schedule of operation

The activities specified in Table 3-10 produced two estimates of gross savings for each sample project: a gross ex ante kWh savings estimate (as reported in the project documentation and program tracking system) and the gross ex post savings estimate developed through the M&V procedures employed by ADM. ADM developed estimates of program-level gross savings by applying a ratio estimation procedure in which achieved savings levels estimated for the sample projects were statistically projected to the program-level gross ex ante savings.

Energy savings realization rates were calculated for each project for which on-site data collection and engineering analysis/building simulations were conducted. Sites with relatively high or low realization rates were analyzed to determine the reasons for the discrepancy between ex ante and ex post energy savings. This information for such sites is included in site-level M&V analyses presented in Appendix A.

The following discussion describes the basic procedures used for estimating savings from various measure types. Project-specific information on savings calculation is contained in Appendix A.

3.1.4.1. Plan for Analyzing Savings from Lighting Measures

Lighting measures examined include retrofits of existing fixtures, lamps and/or ballasts with energy efficient fixtures, lamps and/or ballasts. These types of measures reduce demand, while not affecting operating hours. Any proposed lighting control strategies are examined that might include the addition of energy conserving control technologies such as motion sensors or daylighting controls. These measures typically involve a reduction in hours of operation and/or lower current passing through the fixtures.

Analyzing the savings from such lighting measures requires data for retrofitted fixtures on (1) wattages before and after retrofit and (2) hours of operation before and after the retrofit. Hours of operation are determined from metered data collected after measure installation for a sample of fixtures.

As noted, ADM collects data to determine average operating hours for retrofitted fixtures by using Time-of-Use (TOU) data loggers to monitor a sample of “last points of control” for unique usage areas in the sites where lighting efficiency measures have been installed. Usage areas are areas within a facility that are expected to have comparable average operating hours. For industrial customers, expected usage areas include fabrication areas, clean rooms, office space, hallways/stairways, and storage areas. Typical usage areas are designated in the forms used for data collection.

ADM uses per-fixture baseline demand, retrofit demand, and appropriate post-retrofit operating hours to calculate peak capacity savings and annual energy savings for sampled fixtures of each usage type.

Post-retrofit kWh usage is calculated using the on-off profile and fixture wattages. Fixture demand is calculated by dividing the total kWh usage calculated during Ameren Missouri's peak period of the day by the number of hours in the peak period.

Peak period demand savings are calculated as the difference between peak period baseline demand and post-installation peak period demand of the effected lighting equipment, per the following formula:

Peak Capacity Savings = $kW_{before} - kW_{after}$

The baseline and post-installation average demands are calculated by dividing the total kWh usage during the peak period by the number of hours in the peak period.

ADM calculates annual energy savings for each sampled fixture per the following formula:

Annual Energy Savings = $kWh_{before} - kWh_{after}$

The values for insertion in this formula are determined through the following steps:

- Results from the monitored sample are used to calculate the average operating hours of the metered lights in each costing period for every unique building type/usage area.
- These average operating hours are then applied to the baseline and post-installation average demand for each usage area to calculate the respective energy usage and peak period demand for each usage area.
- The annual baseline energy usage is the sum of the baseline kWh for each costing period for all of the usage areas. The post-retrofit energy usage is calculated similarly. The energy savings are calculated as the difference between baseline and post-installation energy usage.
- Savings from lighting measures in conditioned spaces are factored by the region-specific, building type-specific heating and cooling interaction factors (HCIF) in order to calculate total savings attributable to lighting measures, inclusive of impacts on HVAC operation. ADM developed the factors applied in the analyses based on energy simulation of DEER eQUEST prototypical buildings, referencing Ameren Missouri service territory weather data. The factors are shown below in Table 3-11. Note that the kWh HCIF is calculated as 1 + *HIF* + *CIF*.

Table 3-11 Heating and Cooling Interaction Factors

Building Type	Cooling Type	Heating Type	Cape Girardeau			Jefferson City			Kirksville			St. Louis		
			kWh HIF	kWh CIF	Peak Demand HCIF	kWh HIF	kWh CIF	Peak Demand HCIF	kWh HIF	kWh CIF	Peak Demand HCIF	kWh HIF	kWh CIF	Peak Demand HCIF
Assembly	Packaged Single Zone	Gas	0.00	0.14	1.12	0.00	0.15	1.34	0.00	0.13	1.26	0.00	0.14	1.33
Assembly	Packaged Single Zone	Heat Pump	-0.11	0.14	1.12	-0.11	0.15	1.34	-0.10	0.12	1.23	-0.11	0.14	1.31
Bio Manufacturer	Packaged Single Zone	Gas	0.00	0.10	1.54	0.00	0.11	1.57	0.00	0.10	1.49	0.00	0.11	1.59
Bio Manufacturer	Packaged Single Zone	Heat Pump	-0.05	0.11	1.54	-0.06	0.11	1.58	-0.08	0.10	1.49	-0.06	0.11	1.60
Conditioned Storage	Packaged Single Zone	Gas	0.00	0.09	2.30	0.00	0.10	2.15	0.00	0.08	2.30	0.00	0.10	1.92
Conditioned Storage	Packaged Single Zone	Heat Pump	-0.09	0.10	2.31	-0.10	0.10	2.17	-0.09	0.08	2.30	-0.09	0.10	1.94
Education (Community College)	VAV+Packaged Single Zone	Heat Pump	0.00	0.07	1.48	0.00	0.08	1.43	0.00	0.07	1.43	0.00	0.09	1.42
Education (Community College)	VAV+Packaged Single Zone	Gas	0.00	0.07	1.48	0.00	0.08	1.43	0.00	0.07	1.43	0.00	0.09	1.42
Education (High School)	Fan Coil+Packaged Single Zone	Gas	0.00	0.10	1.18	0.00	0.10	1.14	0.00	0.08	1.16	0.00	0.09	1.23
Education (High School)	Fan Coil+Packaged Single Zone	Heat Pump	-0.03	0.10	1.18	-0.03	0.10	1.14	-0.03	0.08	1.16	-0.03	0.09	1.23
Education (High School)	VAV	Gas	0.00	0.08	1.18	0.00	0.09	1.09	0.00	0.06	1.18	0.00	0.08	1.07
Education (Primary School)	Packaged Single Zone	Gas	0.00	0.09	1.11	0.00	0.09	1.14	0.00	0.08	1.17	0.00	0.09	1.17
Education (Primary School)	Packaged Single Zone	Heat Pump	-0.10	0.09	1.11	-0.11	0.09	1.14	-0.11	0.08	1.16	-0.11	0.09	1.16
Education (Relocatable Classroom)	Packaged Single Zone	Electric Resistance	-0.28	0.11	1.11	-0.30	0.11	1.12	-0.34	0.09	1.13	-0.30	0.11	1.12
Education (Relocatable Classroom)	Packaged Single Zone	Heat Pump	-0.08	0.06	1.09	-0.09	0.06	1.09	-0.09	0.05	1.11	-0.09	0.06	1.10
Education (Relocatable Classroom)	Packaged Single Zone	Gas	0.00	0.09	1.09	0.00	0.09	1.09	0.00	0.07	1.11	0.00	0.08	1.10
Education (University)	VAV	Gas	0.00	0.08	1.41	0.00	0.09	1.38	0.00	0.09	1.61	0.00	0.09	1.36
Hospital	VAV+Packaged Single Zone	Heat Pump	0.00	0.07	1.18	0.00	0.07	1.21	0.00	0.06	1.18	0.00	0.07	1.17
Hospital	VAV+Packaged Single Zone	Gas	0.00	0.07	1.18	0.00	0.07	1.21	0.00	0.06	1.18	0.00	0.07	1.17
Hotel	PVAV+PTHP+PSZ	Heat Pump	-0.01	0.20	1.29	-0.01	0.20	1.38	-0.01	0.16	1.37	-0.01	0.18	1.31
Hotel	VAV+FPFC+PHP	Heat Pump	0.00	0.11	1.23	0.00	0.11	1.21	0.00	0.10	1.36	0.00	0.11	1.43
Hotel	VAV+PTAC+PSZ	Electric Resistance	-0.16	0.20	1.30	-0.19	0.20	1.39	-0.26	0.16	1.38	-0.20	0.19	1.35
Hotel	VAV+PTHP+PSZ	Heat Pump	-0.01	0.20	1.29	-0.01	0.19	1.37	-0.01	0.16	1.36	-0.01	0.18	1.37
Light Manufacturing	Packaged Single Zone	Gas	0.00	0.09	1.52	0.00	0.10	1.49	0.00	0.08	1.48	0.00	0.09	1.46
Light Manufacturing	Packaged Single Zone	Heat Pump	-0.09	0.09	1.53	-0.09	0.10	1.50	-0.08	0.08	1.48	-0.09	0.10	1.46
Motel	Packaged Terminal AC	Electric Resistance	-0.22	0.17	1.43	-0.24	0.16	1.40	-0.29	0.15	1.38	-0.24	0.16	1.44
Motel	Packaged Terminal HP	Heat Pump	-0.04	0.16	1.41	-0.04	0.16	1.39	-0.03	0.14	1.36	-0.04	0.15	1.43
Nursing Home	Fan Coil+Packaged Single Zone	Heat Pump	0.00	0.14	1.52	0.00	0.14	1.34	0.00	0.12	1.38	0.00	0.14	1.35
Nursing Home	VAV	Gas	0.00	0.09	1.54	0.00	0.10	1.47	0.00	0.08	1.53	0.00	0.09	1.44
Nursing Home	Fan Coil+Packaged Single Zone	Gas	0.00	0.14	1.52	0.00	0.14	1.34	0.00	0.12	1.38	0.00	0.14	1.34
Office (Large)	Water Loop Heat Pump	Heat Pump	-0.06	0.24	1.39	-0.07	0.23	1.41	-0.08	0.19	1.40	-0.07	0.22	1.41
Office (Large)	VAV	Gas	0.00	0.10	1.32	0.00	0.09	1.30	0.00	0.08	1.30	0.00	0.09	1.41
Office (Small)	Packaged Single Zone	Gas	0.00	0.10	1.39	0.00	0.11	1.38	0.00	0.09	1.37	0.00	0.11	1.36
Office (Small)	Packaged Single Zone	Heat Pump	-0.09	0.11	1.39	-0.10	0.11	1.38	-0.09	0.09	1.38	-0.09	0.11	1.37
Restaurant (Fast Food)	Packaged Single Zone	Gas	0.00	0.10	1.24	0.00	0.11	1.33	0.00	0.09	1.37	0.00	0.10	1.33
Restaurant (Fast Food)	Packaged Single Zone	Heat Pump	-0.08	0.10	1.25	-0.08	0.11	1.33	-0.08	0.09	1.37	-0.08	0.10	1.34
Restaurant (Full-Service)	Packaged Single Zone	Gas	0.00	0.12	1.21	0.00	0.13	1.36	0.00	0.11	1.40	0.00	0.12	1.35
Restaurant (Full-Service)	Packaged Single Zone	Heat Pump	0.00	0.03	1.29	0.00	0.04	1.28	0.00	0.02	1.36	0.00	0.03	1.09
Retail (Large 3-Story)	VAV	Gas	0.00	0.08	1.35	0.00	0.10	1.36	0.00	0.10	1.33	0.00	0.11	1.34
Retail (Large Single-Story)	Packaged Single Zone	Gas	0.00	0.10	1.26	0.00	0.11	1.28	0.00	0.09	1.32	0.00	0.10	1.29
Retail (Large Single-Story)	Packaged Single Zone	Heat Pump	-0.09	0.10	1.28	-0.10	0.11	1.29	-0.08	0.09	1.31	-0.09	0.10	1.28
Retail (Small)	Packaged Single Zone	Gas	0.00	0.11	1.26	0.00	0.11	1.25	0.00	0.10	1.30	0.00	0.11	1.28
Retail (Small)	Packaged Single Zone	Heat Pump	-0.10	0.11	1.27	-0.10	0.12	1.26	-0.09	0.10	1.30	-0.10	0.11	1.28
Freezer Space (Low Temp)	N/A	N/A	0.00	1.50	1.50	0.00	1.50	1.50	0.00	1.50	1.50	0.00	1.50	1.50
Med. Temp Refrig Space	N/A	N/A	0.00	1.29	1.29	0.00	1.29	1.29	0.00	1.29	1.29	0.00	1.29	1.29
High Temp Refrig. Space	N/A	N/A	0.00	1.18	1.18	0.00	1.18	1.18	0.00	1.18	1.18	0.00	1.18	1.18
Walk-in/In Store Refrigerator	N/A	N/A	0.00	1.40	1.40	0.00	1.40	1.40	0.00	1.40	1.40	0.00	1.40	1.40

3.1.4.2. Plan for Analyzing Savings for Motors

Estimates of the energy savings from use of high efficiency motors on HVAC and non-HVAC applications are derived through an "after-only" analysis. With this method, energy usage is determined only for the high efficiency motor and only after it has been installed. The energy use of the high efficiency motor is determined through the use of nameplate data, one time power measurements, and/or power monitoring equipment. The data collected are then used in estimating what energy use would have been for the motor application if the high efficiency motor had not been installed. In effect, the after-only analysis is a reversal of the usual design calculation used to estimate the savings that would result from installing a high efficiency motor. That is, at the design stage, the question addressed is how would energy use change for an application if an high efficiency motor is installed, whereas the after-only analysis addresses what the level of energy use would have been had the high efficiency motor not been installed.

For the “after only” analysis, it is not possible to use a comparison of direct measurements to determine savings, since measured data are collected only for the high efficiency motor. However, savings attributable to installation of the high efficiency motor can be estimated using information on the efficiencies of the high efficiency motor and on the motor it replaced. In particular, demand and energy savings can be calculated as follows:

$$\textit{Demand Savings} = kW_{peak} \times (Eff_{new} / Eff_{old} - 1)$$

where kW_{peak} is the peak measured power or $kW_{peak} = kW_{break} / Eff_{new}$ and kW_{break} is the break or nameplate motor power.

$$\textit{Energy Savings} = kW_{ave} \times (Eff_{new} /Eff_{old} – 1) \times \textit{Hours Of Use}$$

where kW_{ave} is the average measured power or $kW_{ave} = (kW_{break} / Eff_{new}) * LF$ and kW_{break} is the break or nameplate motor power, and LF is a load factor.

$$\textit{Annual Energy Savings} = kW_{ave} \times (Eff_{new} /Eff_{old} – 1) \times \text{(days of operation per year/ days metered)} \times \text{Annual Adjustment Factor}$$

where kW_{ave} is the average measured power or $kW_{ave} = (kW_{break} / Eff_{new}) * LF$ and kW_{break} is the break or nameplate motor power, and LF is a load factor. Annual Adjustment Factor is 1.0 if the monitoring period is typical for the yearly operation, less than 1 if the monitoring period is expected to be higher use than typical for the rest of the year, and more than 1 if the monitoring period is expected to be lower than typical for the rest of the year.[11]

The information on motor efficiencies needed for the calculation of savings is obtained from different sources.

Data on the efficiencies of high efficiency motors installed under the program should be available from program records.

In some cases, the efficiencies of the replaced motors may also be noted in Ameren Missouri’s program records. Care must be taken using nameplate efficiency ratings of replaced motors, unless the company maintains good documentation of their equipment. If a motor has been rewound it may not operate as originally rated. However, if the efficiencies of the old motors are not directly available, the efficiency values can be imputed by using published data on average efficiency values for motors of given horsepower. If the motor replacement is for normal replacement, the baseline efficiency is established as the efficiency of a new, standard efficiency motor. However,

[11] Current year weather data were compared with the *Typical Meteorological Year* from the National Oceanic & Atmospheric Administration (NOAA)

in cases of early replacement, the efficiency of the old motor is used for the length of the remaining life.[12]

Because motors generally operate at less than full load, some adjustments may be made from the "industry averages" of full load efficiencies. Motor efficiency curves of typical real motors that have the same full load efficiencies are used for determining part load efficiencies.

Like motor efficiency, the power factor varies with motor loading. Motor power factor curves of typical real motors that have the same full load power factor are used for determining part load power factor.

Another factor to consider in demand and energy savings comparisons of motor change out programs is the rotor slip. Full load RPM ratings of motors vary. For centrifugal loads such as fans and pumps, the power supplied is dependent on the speed of the driven equipment. The power is theoretically proportional to the cube of the speed, but in practice acts more like the square of the speed. In general, high efficiency motors have slightly higher full load RPM ratings (lower slip) than standard motors. Where nameplate ratings of full load RPM are available for replaced motors, a de-rating factor can be applied. [13]

The data needed to carry out these plans for determining savings are collected from several sources.

- The first source of data is the information from each project's documentation. This information is expected to include aggregate energy used at a site, disaggregated energy usage data for certain targeted processes (if available), before (actual) and after (projected) data on production, scrap, and other key performance indicators, and final reports (which include process improvement recommendations, analyses, conclusions, performance targets, etc.).
- The second source of data is the energy use data that Ameren Missouri collects for these customers.
- The third source is information collected through on-site inspections of the facilities. ADM staff collect the data during on-site visits using a form that is comprehensive in addressing a facility's characteristics, its modes and schedules of operation, and its electrical and mechanical systems. The form also addresses various energy efficiency measures, including high efficiency lighting (both lamps and ballasts),

[12] Assumptions regarding measure expected useful life were taken from the most recent Database for Energy Efficiency Resources (DEER). See http://www.deeresources.com/.

[13] As an example, take the case where a new motor has a full load RPM rating of 1770 and the old motor had a full load RPM rating of 1760. The derating factor would be:

Derating factor = $(RPM_{old})^2 / (RPM_{new})^2 = 1760^2 / 1770^2 = 0.989$

lighting occupancy sensors, lighting dimmers and controls, air conditioning, high efficiency motors, etc.

- As a fourth source of data, selected end-use equipment are monitored to develop information on operating schedules and power draws.

3.1.4.3. Plan for Analyzing Savings from VFDs

A variable-frequency drive (VFD) is an electronic device that controls the speed of a motor by varying the magnitude of the voltage, current, or frequency of the electric power supplied to the motor. The factors that make a motor load a suitable application for a VFD are (1) variable speed requirements and (2) high annual operating hours. The interplay of these two factors can be summarized by information on the motor's duty cycle, which essentially shows the percentage of time during the year that the motor operates at different speeds. The monitored or trended duty cycle should show substantial variability in speed requirements, with the motor operating at reduced speed a high percentage of the time.

Potential energy savings from the use of VFDs are usually most significant with variable-torque loads, which have been estimated to account for 50% to 60% of total motor energy use in the non-residential sectors. Energy saving VFDs may be found on fans, centrifugal pumps, centrifugal blowers, and other centrifugal loads, most usually where the duty cycle of the process provided a wide range of speeds of operation.

ADM’s approach to determining savings from installation of VFDs involves (1) making one-time measurements of voltage, current, and power factor of the VFD/motor and (2) conducting continuous measurements of amperage over a period of time in order to obtain the data needed to develop VFD load profiles and calculate demand and energy savings. If multiple VFDs are implemented as part of the same project and ADM performs these data collection activities, ADM will typically perform the data collection activities for a sample of similar motors with VFDs that ADM expects will have similar operating characteristics. Where trending data are available, ADM will use that information to supplement any continuous power monitoring performed by ADM. VFDs are generally used in applications where motor loading changes with motor speed. Consequently the true power drawn by a VFD is recorded in order to develop VFD load shapes. One-time measurements of power are made for different percent speed settings. Power and percent speed or frequency (depending on VFD display options) are recorded for as wide a range of speeds as the customer allows the process to be controlled; field staff attempt to obtain readings from 40 to 100% speed in 10 to 15% increments.

3.1.4.4. Plan for Analyzing Savings from Compressed Air Measures

Measures to improve the efficiency of a compressed air system include the reduction of air leaks, the resizing of compressors, installing more efficient compressors, improved controls, and a complete system redesign. Savings from such measures are evaluated through engineering analysis of compressor performance curves, supported by data collected through short-term metering.

ADM field staff obtain nameplate information for the pre-retrofit equipment either from the project file or during the on-site survey. Performance curve data are obtained from manufacturers. Engineering staff then conduct an engineering analysis of the performance characteristics of the pre-retrofit equipment. During the on-site survey, field staff inspect the as-built system equipment, take pressure and load readings, and interview the system operator to identify seasonal variations in load. Potential interactions with other compressors are assessed and it is verified that the incentivized compressor is being operated as intended.

When power monitoring data isn't supplied by the customer or contractor, short-term measurements are performed to reduce the uncertainty in defining the load on the as-built system. These measurements may be taken either with a multi-channel logger, which can record true power for several compressors; with current loggers, which can provide average amperage values; or with motor loggers to record operating hours. The appropriate metering equipment is selected by taking into account variability in load and the cost of conducting the monitoring. ADM used true power monitoring equipment to record compressor load profiles when other, pre-existing monitoring data were not available.

ADM may also use AirMaster+ to calculate the savings due to the energy efficiency measures installed within each compressed air system. The AirMaster+ as-built and baseline compressor types were inputted into the model using data points collected during on-site verification. The as-built model was then calibrated to a typical daily schedule, derived from at least two weeks of trending data. Project energy savings were calculated by subtracting the as-built from the baseline energy consumption.

3.1.4.5. Plan for Analyzing Savings from Refrigeration and Process Improvements

Analysis of savings from refrigeration and process improvements is inherently project-specific. Because of the specificity of processes, analyzing the processes through simulations is generally not feasible. Rather, reliance is made on engineering analysis of the process affected by the improvements. Major factors in ADM's engineering analysis of process savings are operating schedules and load factors. Information on these factors is developed through short-term monitoring of the affected equipment, be it pumps, heaters, compressors, etc. The monitoring is done after the process change, and the data gathered on operating hours and load factors are used in the engineering analysis to define "before" conditions for the analysis of savings.

3.2. Results of Gross Ex Post Savings Estimation

To estimate gross ex post kWh savings and gross peak ex post kW reductions for the four BizSavers programs, data were collected and analyzed for samples of 36 custom projects, 37 standard projects, 13 new construction projects, and 8 retro-commissioning projects. ADM analyzed these projects' data using the methods described in Section 3.1 estimate project energy savings, peak kW reductions, and determine gross kWh savings realization rates for program components. The results of that analysis are reported in this section. Note that detailed, site-level analysis results are presented in Appendix A.

3.2.1. Gross Ex Post kWh Savings

The gross ex post kWh savings for the custom program during the 2014 calendar year are summarized by sampling stratum in Table 3-12. Overall, gross ex post energy savings of 83,161,231 kWh were equal to 103% of the gross ex ante savings. Table 3-13 shows the ex ante and ex post custom program energy savings by sample project.

Table 3-12 Gross Ex Ante and Gross Ex Post Annual kWh Savings for Custom Program by Sample Stratum

Stratum	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Savings Realization Rate*
5	16,891,654	15,431,785	91%
4	22,184,893	22,493,128	101%
3	17,142,764	17,196,028	100%
2	15,223,062	17,457,864	115%
1	8,937,553	10,582,426	118%
Total	80,379,926	83,161,231	103%

Table 3-13 Gross Ex Ante and Gross Ex Post Annual kWh Savings for Custom Program by Project

ID	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Savings Realization Rate
C-1	8,017,415	8,809,083	110%
C-2	2,574,232	972,650	38%
C-3	1,811,093	1,658,024	92%
C-4	1,667,781	1,111,854	67%
C-5	1,565,071	1,677,746	107%
C-6	1,256,062	1,202,428	96%
C-7	1,027,780	1,156,638	113%
C-8	776,477	815,474	105%
C-9	489,351	266,756	55%
C-10	463,805	633,092	136%
C-11	389,272	365,019	94%
C-12	307,679	191,881	62%
C-13	275,106	352,427	128%
C-14	226,648	232,952	103%
C-15	226,633	228,578	101%
C-16	186,848	268,817	144%
C-17	175,480	108,618	62%
C-18	153,958	154,614	100%
C-19	152,387	159,656	105%
C-20	133,811	128,784	96%
C-21	130,145	132,069	101%
C-22	124,842	101,358	81%
C-23	111,239	98,225	88%
C-24	107,180	96,506	90%
C-25	106,419	203,769	191%
C-26	92,146	92,146	100%
C-27	90,145	104,785	116%
C-28	77,786	86,173	111%
C-29	70,198	69,682	99%
C-30	33,901	63,684	188%
C-31	28,672	29,159	102%
C-32	26,411	25,977	98%
C-33	21,786	23,801	109%
C-34	18,151	18,151	100%
C-35	13,376	13,165	98%
C-36	6,757	2,549	38%

ID	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Savings Realization Rate
All Non-Sample Projects[14]	57,443,883	61,504,941	107%
Total	80,379,926	83,161,231	103%

The gross ex post kWh savings for the sampled custom program are presented by measure in Table 3-14.

Table 3-14 Gross Ex Ante and Gross Ex Post Annual kWh Savings for Sampled Custom Program Measures

Measure Name	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Savings Realization Rate
Redesign-Building Redesign	8,017,415	8,809,083	110%
Controls-Direct Digital Controls	5,158,567	3,598,841	70%
Induction-Garage 175 - 250 Watt HID to 40% less	1,667,781	1,111,854	67%
Lighting-Interior-Custom Lighting Power Density (LPD)	1,256,062	1,202,428	96%
LED-LED Redesign	1,070,354	1,201,312	112%
T8-T8 Replacing HID/Fluorescent/Incandescent	839,206	1,078,823	129%
T5-4' T5 Replacing HID	718,381	741,033	103%
Industrial Motor-Industrial Equipment	714,811	654,397	92%
Chiller-Chiller Plant	489,351	266,756	55%
Chiller-Adding VFD Control to Chiller(s)	463,805	633,092	136%
LED-Exterior LED replacing 175W-400W HID	384,463	384,909	100%
System-Compressed Air Optimization	307,679	191,881	62%
LED-High Bay LED replacing 175W-400W HID	226,736	223,661	99%
T8-4' T8 replacing 8' Fluorescent	182,646	114,334	63%
T5-T5 Replacing HID/Incandescent and/or Fluorescent	176,488	185,683	105%
T8-4' T8 replacing 4' Fluorescent	165,903	167,821	101%
T5-400 Watt HID to 4 Lamp T5	152,387	159,656	105%
LED-Exterior LED replacing 1000W HID	144,698	126,872	88%
Pump Motor-Variable Speed Drive on Pump Motor	133,811	128,784	96%
Variable Speed Air Compressor-Replace Fixed Speed Air Compressor with VSD	124,842	101,358	81%
Linear Fluorescent-Linear Fluorescent Lighting Redesign	107,180	96,506	90%
LED-4' LED Tube replacing Fluorescent Fixture	82,135	88,395	108%
LED-LED replacing Incandescent <35 Watts	55,687	87,485	157%
Lighting-LED Replacing 4ft 4-lamp T8	54,386	50,775	93%
Lighting-LED Replacing 8ft 2-lamp T12 F96	52,232	54,809	105%
T5-6 Lamp T5 High Bay high BF	47,805	59,186	124%
Refrigeration-Controls-Head Pressure Controls	32,818	29,950	91%

[14] Note that the realization rate for a program's non-sampled projects may differ from the overall program-level realization rate. Stratum-level realization rates for sampled projects are applied to non-sampled projects within each stratum. Furthermore, the distribution of energy savings across sampling strata for sampled projects differs from the distribution of energy savings across sampling strata for non-sampled projects. Strata have differing shares of total energy savings associated with sampled projects.

LED-LED replacing Incandescent	26,318	19,088	73%
Induction-Induction Replacing HID/Incandescent and/or Fluorescent	21,340	22,984	108%
Lighting-LED Replacing 4ft - 3 lamp T8	19,467	20,427	105%
LED-Linear LED Replacing Incandescent/HID/Fluorescent	12,580	11,342	90%
LED-LED Replacing CFL	9,562	9,164	96%
T8-4' T8 replacing HID	6,938	12,075	174%
LED-2' LED Fixture Replacing Fluorescent	4,187	4,640	111%
T8-High Bay Fluorescent 6LF32T8 Replacing 400W HID	3,512	2,768	79%
Lighting-LED-LED Replacing 8ft - 1 lamp T12 - F96	1,445	797	55%
LED-LED Fixture Replacing HID Fixture <175 Watts	1,025	1,121	109%
Lighting-LED-LED Replacing 2ft - 1 lamp T12 - F20	788	827	105%
Lighting-T8 Replacing 4ft - 4 lamp T12 - F40ES	683	750	110%
CFL-Interior CFL >115 Watts	569	623	109%
Total	22,936,043	21,656,290	94%

The gross kWh savings of the standard program during the 2014 calendar year are summarized by sampling stratum in Table 3-15. Overall, gross ex post kWh savings of 40,070,742 kWh were equal to 104% of the gross ex ante kWh savings.

Table 3-16 shows the ex ante and ex post standard program annual energy savings by sample project.

Table 3-15 Gross Ex Ante and Gross Ex Post Annual kWh Savings for Standard Program by Sample Stratum

Stratum	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Savings Realization Rate*
5	4,726,730	4,132,494	87%
4	8,933,230	9,766,629	109%
3	9,672,201	13,194,959	136%
2	9,111,983	7,907,008	87%
1	6,145,704	5,069,652	82%
Total	38,589,848	40,070,742	104%

Table 3-16 Gross Ex Ante and Gross Ex Post Annual kWh Savings for Standard Program by Project

ID	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Savings Realization Rate
S-1	803,364	578,449	72%
S-2	648,053	582,600	90%
S-3	371,477	405,281	109%
S-4	368,095	105,110	29%
S-5	368,081	403,048	109%
S-6	346,010	383,790	111%
S-7	343,182	381,618	111%
S-8	304,835	233,290	77%
S-9	278,028	255,211	92%
S-10	232,126	153,487	66%
S-11	174,944	533,447	305%
S-12	150,304	71,177	47%
S-13	138,320	263,480	190%
S-14	136,598	62,031	45%
S-15	123,200	406,176	330%
S-16	97,232	64,010	66%
S-17	96,825	114,733	118%
S-18	83,833	90,121	108%
S-19	72,072	38,038	53%
S-20	62,398	67,077	107%
S-21	57,429	17,067	30%
S-22	40,964	40,836	100%
S-23	30,651	30,251	99%
S-24	29,908	35,325	118%
S-25	24,287	24,070	99%
S-26	24,287	24,070	99%
S-27	24,287	24,070	99%
S-28	21,444	21,444	100%
S-29	21,356	21,165	99%
S-30	19,150	14,762	77%
S-31	12,320	4,556	37%
S-32	12,012	15,496	129%
S-33	11,695	5,754	49%
S-34	7,604	8,174	107%
S-35	7,214	7,149	99%
S-36	6,360	5,765	91%
S-37	4,906	5,377	110%
All Non-Sample Projects	33,034,997	34,573,237	105%
Total	38,589,848	40,070,742	104%

The gross ex post kWh savings for the sampled standard program are presented by measure in Table 3-17.

Table 3-17 Gross Ex Ante and Gross Ex Post Annual kWh Savings for Sampled Standard Program Measures

Measure Name	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Savings Realization Rate*
LED-LED replacing Incandescent	3,610,623	3,369,849	93%
Occupancy Sensor-Occupancy Sensor -Passive Infrared or Ultrasonic	807,107	1,265,805	157%
Occupancy Sensor-Occupancy Sensor Single Technology (Field Verified)	765,688	545,765	71%
Dual Technology-Dual Technology Occupancy Sensor - Over 150 watts	172,480	91,124	53%
Fixture Occ Sensor-Fixture occupancy sensor	54,180	44,161	82%
CFL-CFL <30 Watt	36,534	70,150	192%
Controls-Beverage Vending Machine Control	27,982	27,982	100%
LED-LED Case Lighting	25,740	33,568	130%
LED-LED or Electroluminescent Exit Sign	17,257	18,523	107%
LED-LED Exit Sign - 3_0 W_Inc30 base	10,170	10,685	105%
LED-LED Exit Sign - 3_0 W_CF 18 Base	8,935	5,199	58%
Ice Machine-ENERGY STAR Ice Machines 500 to 1000 lbs	8,085	4,982	62%
Lighting-Incandescent to LED-Lamp	7,214	7,149	99%
Controls-Lighted Snack Dispensing Machine	2,208	2,208	100%
LED-LED Exit Sign	648	355	55%
Total	5,554,851	5,497,505	99%

The gross kWh savings of the new construction program during the 2014 calendar year are summarized by sampling stratum in Table 3-18 Table 3-15. Overall, gross ex post kWh savings of 13,399,531 kWh were equal to 102% of the gross ex ante kWh savings. Table 3-19 shows the ex ante and ex post new construction program annual energy savings by sample project.

Table 3-18 Gross Ex Ante and Gross Ex Post Annual kWh Savings for New Construction Program by Sample Stratum

Stratum	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Savings Realization Rate*
5	6,257,552	6,821,392	109%
4	3,444,765	3,848,349	112%
3	1,503,758	850,998	57%
2	1,451,743	1,474,457	102%
1	512,983	404,335	79%
Total	13,170,801	13,399,531	102%

Table 3-19 Gross Ex Ante and Gross Ex Post Annual kWh Savings for New Construction Program by Project

ID	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Savings Realization Rate*
N-1	2,844,387	2,738,499	96%
N-2	1,311,017	1,854,150	141%
N-3	1,246,690	1,176,377	94%
N-4	855,458	1,052,366	123%
N-5	661,518	950,035	144%
N-6	593,008	482,839	81%
N-7	498,998	591,615	119%
N-8	477,998	468,475	98%
N-9	255,705	137,531	54%
N-10	237,313	141,475	60%
N-11	205,998	209,221	102%
N-12	72,270	56,303	78%
N-13	54,729	43,798	80%
All Non-Sample Projects	3,855,712	3,496,847	91%
Total	13,170,801	13,399,531	102%

The gross ex post kWh savings for the sampled new construction program are presented by measure in Table 3-20.

Table 3-20 Gross Ex Ante and Gross Ex Post Annual kWh Savings for Sampled New Construction Program Measures

Measure Name	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Savings Realization Rate
Lighting-New Construction - Lighting	4,936,007	6,139,305	124%
Controls-Garage Carbon Monoxide Controls	761,171	765,171	101%
Controls-Direct Digital Controls	546,338	744,106	136%
New Construction-HVAC Design	391,992	391,992	100%
Fixture Occ Sensor-Fixture occupancy sensor	385,884	76,231	20%
Occupancy Sensor-Occupancy Sensor -Passive Infrared or Ultrasonic	369,779	197,389	53%
Daylight Sensor-Daylight Sensor controls	352,585	341,574	97%
LED-Exterior LED replacing 1000W HID	309,120	308,260	100%
Chiller-Chiller Plant	229,869	175,319	76%
Lghtg Ctls-Occ Sensor Dual Tech-Controlling Circuit >150 Watts	228,038	170,970	75%
Controls-Guest Room Energy Management, Electric Heating	133,890	94,529	71%
Dual Technology-Dual Technology Occupancy Sensor - Over 150 watts	115,560	51,834	45%
Lghtg Ctls-Occ Sensor Single Tech-Controlling Circuit >120 Watts	113,399	80,654	71%
LED-Exterior LED replacing 175W-400W HID	93,960	101,194	108%
New Construction - Lighting-Exterior Lighting	87,196	93,909	108%
IT-Higher Efficiency UPS System	72,270	56,303	78%
IT-ENERGY STAR 5.0 Desktop Computer	62,729	62,729	100%
Lghtg Ctls-Occ Sensor Fixture Mounted-Low Watt Fixture, >50 and <=200 Watts	42,479	9,700	23%
Refrigeration-ENERGY STAR Ice Machine-500 to 1,000 lbs/day	26,950	-	0%
Refrigeration-Strip Curtain	15,174	15,174	100%
Low Flow Aerator-Low Flow Faucet Aerator - Electric water heater	12,528	12,528	100%
VSD Air Compressor-Install VSD Air Compressor for Trim	11,807	3,421	29%
Ice Machine-ENERGY STAR Ice Machines less than 500 lbs	9,912	4,621	47%
Freezer-ENERGY STAR Commercial Solid Door Freezers more than 50ft3	3,757	4,305	115%
Ice Machine-ENERGY STAR Ice Machines 500 to 1000 lbs	2,695	1,466	54%
Total	9,315,089	9,902,684	106%

The gross kWh savings of the retro-commissioning program during the 2014 calendar year are summarized by sampling stratum in Table 3-21. Overall, gross ex post kWh savings of 9,626,043 kWh were equal to 83% of the gross ex ante kWh savings. Table 3-22 shows the ex ante and ex post standard program annual energy savings by sample project.

Table 3-21 Gross Ex Ante and Gross Ex Post Annual kWh Savings for Retro-commissioning Program by Sample Stratum

Stratum	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Savings Realization Rate*
4	4,000,727	3,236,391	81%
3	4,284,479	3,567,435	83%
2	2,153,125	1,886,514	88%
1	1,202,529	935,703	78%
Total	11,640,860	9,626,043	83%

Table 3-22 Gross Ex Ante and Gross Ex Post Annual kWh Savings for Retro-commissioning Program by Project

ID	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Savings Realization Rate*
R-1	4,000,727	3,236,391	81%
R-2	1,807,043	1,281,982	71%
R-3	976,546	929,359	95%
R-4	461,737	490,852	106%
R-5	350,817	307,377	88%
R-6	137,921	108,165	78%
R-7	41,174	21,038	51%
R-8	35,361	37,668	107%
All Non-Sample Projects	3,829,534	3,213,211	84%
Total	11,640,860	9,626,043	83%

The gross ex post kWh savings for the sampled retro-commissioning program are presented by measure in Table 3-23.

Table 3-23 Gross Ex Ante and Gross Ex Post Annual kWh Savings for Sampled Retro-Commissioning Program Measures

Measure Name	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Savings Realization Rate*
Controls-Direct Digital Controls	3,498,138	2,830,117	81%
System-Compressed Air Optimization	1,807,043	1,281,982	71%
HVAC-Controls-HVAC Optimization - Set Point Control	1,193,630	1,073,364	90%
Leak Repair-Compressed Air System Leak Repair	676,193	657,723	97%
Controls-Adding/Updating Controls	350,817	307,377	88%
HVAC-Controls-HVAC Optimization - Waterside	285,505	262,269	92%
Total	7,811,326	6,412,832	82%

Gross ex post kWh savings of the custom and standard programs during the 2014 calendar year are shown by building type in Table 3-24. Among discrete building types, industrial facilities, office buildings, and retail account for the largest percentages of custom program activity: 32.2%, 17.2%, and 13.9%. Lodging facilities account for the largest percentage of standard program activity, 37.2%. Hotels were much more active in the program during 2014 than in 2013. Office facilities account for the largest percentage of new construction program activity, 37%. Health care and industrial facilities account for the largest percentages of retro-commissioning program activity, 42.8% and 41.6% respectively.

Table 3-24 Gross Ex Post kWh Savings for BizSavers Program by Building Type

Building Type	*Program Component*				
	Custom Incentives	*Standard Incentives*	*New Construction Incentives*	*RCx Incentives*	*Total*
Grocery and Convenience	4.3%	2.3%	4.9%	0.0%	3.5%
Lodging	1.6%	37.2%	8.6%	0.0%	11.7%
Warehouse	5.2%	2.4%	10.9%	0.0%	4.6%
Office	17.2%	8.4%	37.0%	1.3%	15.4%
Industrial	32.2%	4.1%	26.0%	41.6%	24.8%
Education	7.8%	5.3%	6.4%	11.3%	7.3%
Entertainment/Recreation	2.2%	7.3%	0.0%	3.1%	3.4%
Healthcare	5.7%	11.8%	0.1%	42.8%	9.8%
Retail	13.9%	11.1%	0.1%	0.0%	10.8%
Faith-Based	1.3%	2.8%	0.7%	0.0%	1.6%
Gas Station	3.5%	0.8%	1.4%	0.0%	2.3%
IT/Data Center	2.5%	0.0%	0.0%	0.0%	1.4%
Food & Beverage Service	0.6%	6.1%	1.9%	0.0%	2.1%
Parking Garage	0.5%	0.1%	2.0%	0.0%	0.5%
Government	1.4%	0.2%	0.0%	0.0%	0.8%
Automotive Services	0.0%	0.1%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

3.2.2. Gross Ex Post Peak kW Savings

The gross ex post peak kW reductions of the custom, standard, new construction, and retro-commissioning programs during the 2014 calendar year are shown in Table 3-25. The gross ex post peak savings are 11,854.85 kW for the custom program, 11,861.27 kW for the standard program, 6,939.51 kW for the new construction program, and 541.59 kW for the retro-commissioning program. The high gross peak kW realization rates for the New Construction Program and the Standard Program are largely a result the 0 ex ante peak kW estimate for a number of controls measures. There are actually positive peak demand savings associated with these measures.

Table 3-25 Gross Ex Ante and Gross Ex Post Peak kW Savings for BizSavers Programs

Program	*Gross Ex Ante Peak kW Savings*	*Gross Ex Post Peak kW Savings*	*Gross kWh Savings Realization Rate*
Custom	12,717.46	11,854.85	93%
Standard	7,782.21	11,861.27	152%
New Construction	989.69	6,939.51	701%
RCx	479.30	541.59	113%
Total	21,968.65	14,664.02	142%

3.2.3. Discussion of Gross Savings Analysis

ADM analysts reviewed project gross kWh savings realization rates and compared them to the gross ex ante kWh savings for each sampled project to better understand if the project size influenced the realization rate. Sample project gross kWh savings realization rates and gross ex ante kWh savings are plotted in Figure 3-1, Figure 3-2,

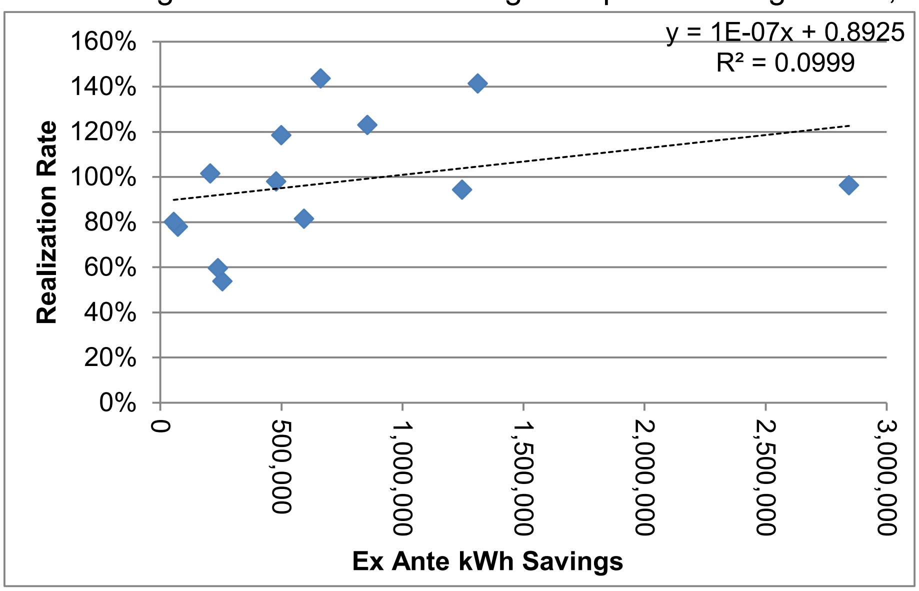


Figure *3-3*, Figure 3-4. There is no strong association between gross kWh savings realization rates and gross ex ante kWh savings.

Therefore, realization rates that were noticeably high or low were due to factors other than the projects' overall gross ex ante kWh savings. In other words, small projects did not have better realization rates than larger ones, or vice versa. Case-by-case examination showed that project-specific factors were more likely to cause gross ex post kWh savings to differ from gross ex ante savings. Project-specific factors include type of measure implemented, building type, facility operating schedule, and other parameters that may affect energy efficiency measure savings.

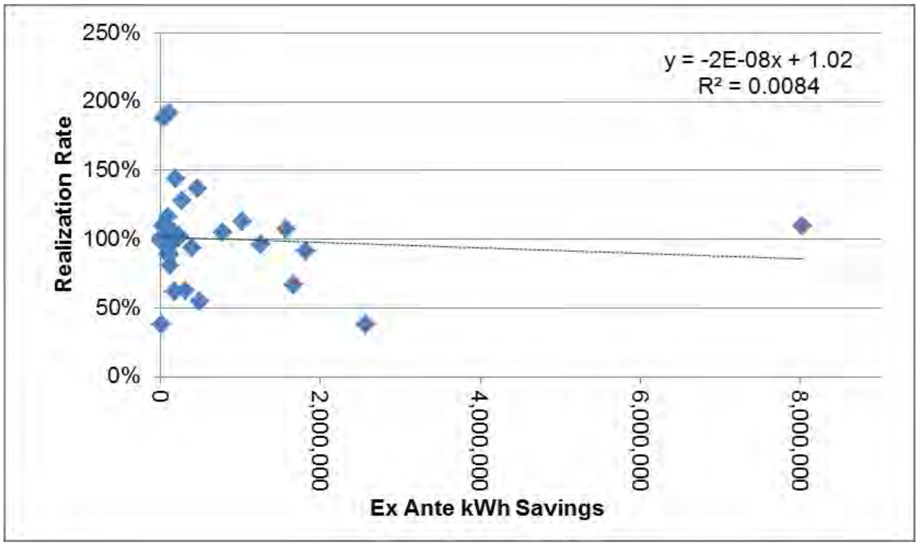


Figure 3-1 Custom Program Sample Project Gross kWh Savings Realization Rate Versus Gross Ex Ante kWh Savings

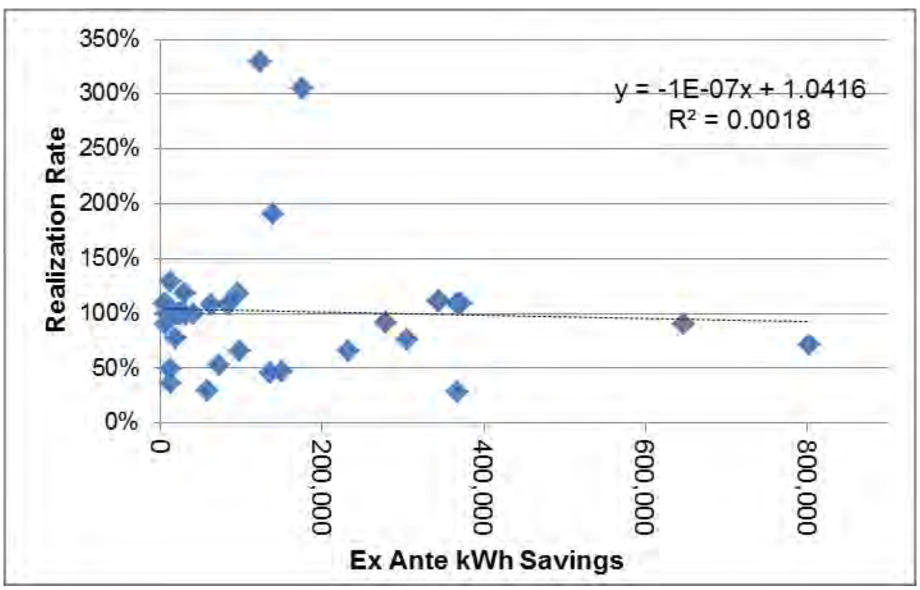


Figure 3-2 Standard Program Sample Project Gross kWh Savings Realization Rate versus Gross Ex Ante kWh Savings

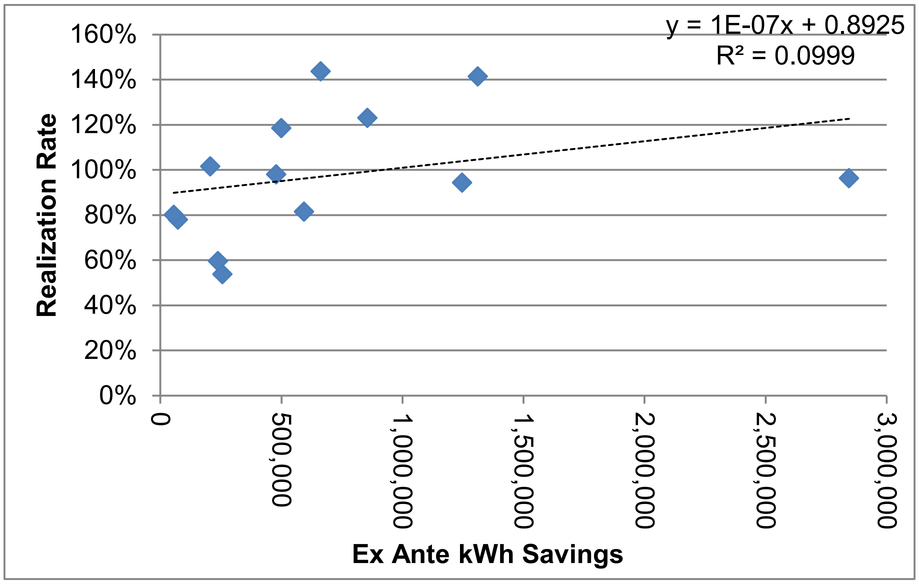


Figure 3-3 New Construction Program Sample Project Gross kWh Savings Realization Rate versus Gross Ex Ante kWh Savings

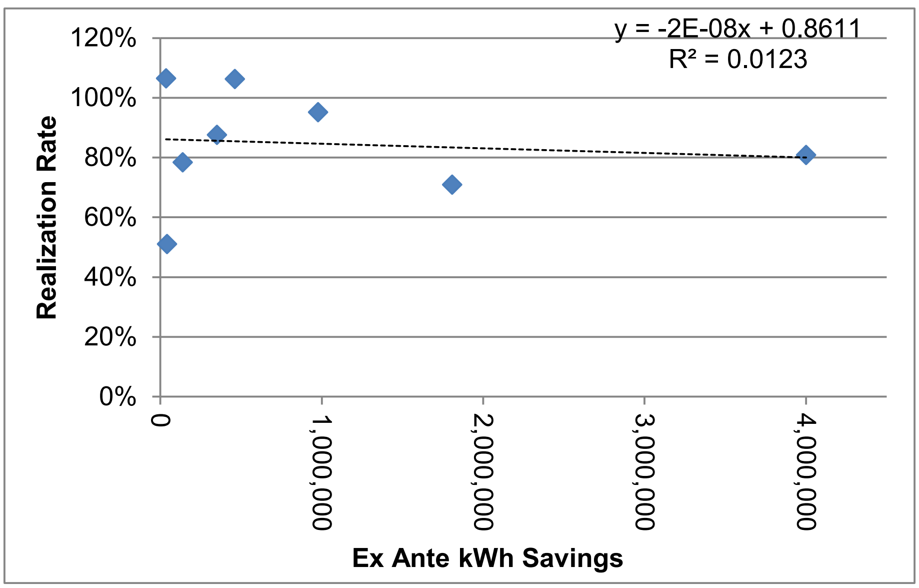


Figure 3-4 Retro-commissioning Program Sample Project Gross kWh Savings Realization Rate versus Gross Ex Ante kWh Savings

4. Estimation of Net Ex Post Savings

This chapter reports the results from estimating the net impacts of the program during calendar year 2014, where net ex post savings represent the portion of gross ex post savings by program participants that can be attributed to the effects of the program. Net savings equal gross savings, *minus* free ridership, *plus* participant spillovers, non-participant spillovers, and market effects.

4.1. Procedures Used to Estimate Net Savings

The procedures used to estimate net savings for all four of the programs are the same. The savings induced by the program are the "net" savings that are attributable to the program.

Free riders are those participants that would have installed the same energy efficiency measures without the program incentives. Net savings may be less than gross savings because of free ridership impacts, which arise to the extent that participants in a program would have adopted energy efficiency measures and achieved the observed energy changes even in the absence of the program. Conversely, net savings may be greater than gross savings due to energy savings spillovers or market transformation impacts attributable to the program. Participants or non-participants may implement energy efficiency measures due to the influence of the program, without receiving program incentives for implemented measures.

A survey of a sample of program participants collected information used for the net-to-gross analysis. Appendix D provides a copy of the survey instrument. Based on review of this information, the preponderance of evidence regarding free ridership inclinations was used to attribute a customer's savings to free ridership.

Several criteria determine which portion of a participant's savings should be attributed to free ridership. The first criterion comes from the response to the question: "Would you have been financially able to install the equipment or measures without the financial incentive from the BizSavers Program?" If a customer answered "No" to this question, a free ridership score of 0 was assigned to the project. That is, if a customer required financial assistance from the program to undertake a project, then that customer was not deemed a free rider.

For decision makers who indicated that they could undertake energy efficiency projects without financial assistance from the program, three additional factors determined what percentage of savings is attributable to free ridership. The three factors are:

- Plans and intentions of the firm to install a measure even without support from the program;
- Influence that the program had on the decision to install a measure; and

- A firm's previous experience with a measure installed under the program.

For each of these factors, rules were applied to develop binary variables indicating whether a participant showed free ridership behavior. Responses to the decision-maker questionnaire helped to develop the rules for the free ridership indicator variables. (A copy of the questionnaire is provided in Appendix D)

The first required step was to determine if a participant stated that his or her intention was to install an energy efficiency measure without the help of the program incentive. The survey respondents' answers to a combination of questions, then a set of rules determined whether a participant's behavior indicated likely free ridership. Two binary variables were constructed to account for customer plans and intentions: one, based on a more restrictive set of criteria that may describe a high likelihood of free ridership, and a second, based on a less restrictive set of criteria that may describe a relatively lower likelihood of free ridership.

The first, more restrictive criteria (Definition 1) indicating customer plans and intentions that likely signify free ridership are as follows:

- The respondent answered "yes" to the following two questions: "Did you have plans to install the measure before participating in the program?" and "Would you have gone ahead with this planned installation of the measure even if you had not participated in the BizSavers Program?"
- The respondent answered "definitely would have installed" to the following question: "If the financial incentive from the BizSavers Program had not been available, how likely is it that you would have installed [Equipment/Measure] anyway?"
- The respondent answered "did not affect timing of purchase and installation" to the following question: "How did the availability of information and financial incentives through the BizSavers Program affect the timing of your purchase and installation of [Equipment/Measure]?"
- The respondent answered "no, the program did not affect level of efficiency that we chose for equipment" in response to the following question: "How did the availability of information and financial incentives through the BizSavers Program affect the level of energy efficiency you chose for [Equipment/Measure]?

The second, less restrictive criteria (Definition 2) indicating customer plans and intentions that likely signify free ridership are as follows:

- The respondent answered "yes" to the following two questions: "Did you have plans to install the measure before participating in the program?" and "Would you have gone ahead with this planned installation of the measure even if you had not participated in the BizSavers Program?"

- Either the respondent answered “definitely would have installed” or “probably would have installed” to the following question: “If the financial incentive from the BizSavers Program had not been available, how likely is it that you would have installed [Equipment/Measure] anyway?”
- Either the respondent answered “did not affect timing of purchase and installation” to the following question: “How did the availability of information and financial incentives through the BizSavers Program affect the timing of your purchase and installation of [Equipment/Measure]?” or the respondent indicated that while program information and financial incentives did affect the timing of equipment purchase and installation, in the absence of the program they would have purchased and installed the equipment within the next two years.
- The respondent answered “no, the program did not affect level of efficiency that we chose for equipment” in response to the following question: “How did the availability of information and financial incentives through the BizSavers Program affect the level of energy efficiency you chose for [Equipment/Measure]?

The second required factor was determining if a customer reported that a recommendation from a program representative or past experience with the program was influential in the decision to install a particular piece of equipment or measure.

This criterion indicates that the program’s influence may lower the likelihood of free ridership when either of the following conditions are true:

- The respondent answered “very important” to the following question: “How important was previous experience with the BizSavers Program in making your decision to install [Equipment/Measure]?
- The respondent answered “yes” to the following question: “Did a representative of the BizSavers Program recommend that you install [Equipment/Measure]?”

The third required factor is determining if a participant in the program indicated that he or she had previously installed an energy efficiency measure similar to one that they installed under the program without an energy efficiency program incentive during the last three years. A participant indicating that he or she had installed a similar measure considered to have a higher likelihood of free ridership.

The criteria indicating that previous experience may signify a higher likelihood of free ridership are as follows:

- The respondent answered “yes” to the following question: “Before participating in the BizSavers Program, had you installed any equipment or measure similar to [Incentivized Equipment/Measure] at your facility?”
- The respondent answered “yes, purchased energy efficient equipment but did not apply for financial incentive.” to the following question: “Has your organization

purchased any energy efficient equipment in the last three years for which you did not apply for a financial incentive through the BizSavers Program?”

The four sets of rules just described were used to construct four different indicator variables that address free ridership behavior. For each customer, a free ridership value was assigned based on the combination of variables. With the four indicator variables, there were 11 applicable combinations for assigning free ridership scores for each respondent, depending on the combination of answers to the questions creating the indicator variables. Table 4-1 shows these values. A free ridership score of 100% indicates total free ridership, and a free ridership score of 0% indicates no free ridership.

ADM recognizes that there are potential survey respondent biases, including social desirability bias, that may impact self-report data. The free ridership assessment methodology employed by ADM is constructed with the intention of mitigating those impacts by asking a *series* of questions in assessing the likelihood of free ridership. Note that although there are four indicator variables used to calculate the free ridership score, the indicator variable values are determined by the answers to a total of 12 questions, with a total of more than 38,000 possible combinations of answers.

Table 4-1 Free Ridership Scores for Combinations of Indicator Variable Responses

Indicator Variables				*Free Ridership Score*
Had Plans and Intentions to Install Measure without BizSavers Program? (Definition 1)	*Had Plans and Intentions to Install Measure without BizSavers Program? (Definition 2)*	*BizSavers Program had influence on Decision to Install Measure?*	*Had Previous Experience with Measure?*	
Y	N/A	Y	Y	100%
Y	N/A	N	N	100%
Y	N/A	N	Y	100%
Y	N/A	Y	N	67%
N	Y	N	Y	67%
N	Y	Y	Y	33%
N	N	N	Y	33%
N	Y	N	N	33%
N	Y	Y	N	0%
N	N	N	N	0%
N	N	Y	N	0%
N	N	Y	Y	0%

4.2. Results of Net Savings Estimation

The procedures described in the preceding section were used to estimate free ridership, spillovers, and net-to-gross ratios for the BizSavers Program for the period January 2014 through December 2014. While Ameren Missouri’s business energy efficiency programs may be categorized as resource acquisition programs, ADM believes that there are market transformation energy impacts associated with the operation the programs. Such impacts are not quantified in this report.[15]

Due to the relatively high cost of obtaining reliable snapshots of measure saturation rates in the market over time, and because the methods of attributing market transformation impacts to the program (as distinct from other, naturally occurring market transformation impacts) are not well established, ADM did not quantify market transformation impacts attributable to the programs as part of this evaluation. During 2015, ADM will explore options for quantification of market transformation impacts that may overcome the obstacles cited above.

4.2.1. Results of Estimation of Free Ridership

The data used to assign free ridership scores were collected through a customer survey of 452 customer decision makers for projects completed during the 2014 calendar year. Individual free ridership rates were estimated for all four programs.

As discussed in Section 4.1, the first criteria in determining a project's proportion of energy savings assigned to free ridership was whether a participant was financially able to undertake the project without financial assistance from the BizSavers Program. If a decision maker respondent answered "No" to the question of "Would you have been financially able to install the equipment or measures without the financial incentive from the BizSavers Program?" a free ridership score of 0 was assigned to the project. That is, if a participant required financial assistance from the program to undertake a project, then that participant was determined not to be a free rider.

Under this criterion, the other free ridership scoring criteria were applied only to projects for participants who answered "Yes" to the question: "Would you have been financially able to install the equipment or measures without the financial incentive from the BizSavers Program?"

Table 4-2 shows the percentage of survey respondents who relayed the following: 1) they had plans and intentions to install the measures without any program incentive (under two alternative definitions as described in the preceding section), 2) that the program influenced their decision to install the measure, or 3) that they previously installed a similar energy efficiency measure without an energy efficiency program

[15] Doe/ee-0829. "Energy Efficiency Program Impact Evaluation Guide." https://www4.eere.energy.gov/seeaction/system/files/documents/emv_ee_program_impact_guide_0.pdf 1 Dec. 2012. Web. 2 Feb. 2015. See page 2-1. According to the SEE Action impact evaluation guide, the primary purpose of resource acquisition programs is to "directly achieve energy and/or demand savings, and possibly avoid emissions, through specific actions," whereas the primary purpose of market transformation programs is to "change the way in which energy efficiency markets operate (e.g., how manufacturers, distributors, retailers, consumers, and others sell and buy energy relate products and services), which tends to result in more indirect energy and demand savings."

incentive during the last three years. Percentages reported are averages weighted by the projects' gross ex post savings.

Table 4-2 Weighted Average Indicator Variable Values

Program Component	*Had Financial Ability*	*Had Plans and Intentions to Install Measure without BizSavers Program (Definition 1)*	*Had Plans and Intentions to Install Measure without BizSavers Program (Definition 2)*	*BizSavers Program had influence on Decision to Install Measure*	*Had Previous Experience with Measure*
Custom	39%	4%	14%	27%	13%
Standard	32%	2%	7%	33%	13%
NC	51%	0%	20%	65%	0%
RCx	24%	0%	0%	19%	17%

Table 4-3 shows percentages of total gross ex post custom program energy savings associated with different combinations of free ridership indicator variable values. Approximately sixty-one percent of the savings are associated with respondents who indicated that they were financially unable to implement the project in the absence of the program incentive.

Table 4-3 Estimated Free-ridership for kWh Savings from Custom Program Projects

Had Plans and Intentions to Install Measure without BizSavers Program? (Definition 1)	*Had Plans and Intentions to Install Measure without BizSavers Program? (Definition 2)*	*BizSavers Program had influence on Decision to Install Measure?*	*Had Previous Experience with Measure?*	*Percentage of Total Expected Gross kWh Savings*	*Free Ridership Score*
Y	Y	N	N	2.93%	100.00%
Y	Y	N	Y	1.63%	100.00%
Y	Y	Y	Y	0.88%	100.00%
Y	Y	Y	N	0.00%	66.67%
N	Y	N	Y	3.10%	66.67%
N	N	N	Y	2.48%	33.33%
N	Y	N	N	6.70%	33.33%
N	Y	Y	Y	0.00%	33.33%
N	N	N	N	11.53%	0.00%
N	N	Y	N	8.68%	0.00%
N	N	Y	Y	0.90%	0.00%
N	Y	Y	N	0.23%	0.00%
Required program incentive to implement measures				60.92%	0%
Total				100.00%	10.57%

Late in the program year, the program administrator obtained permission to begin using a T-12 baseline to calculate ex ante savings and incentive levels for linear fluorescent lighting projects; prior to that time, a T-12 baseline could not be used, reducing the scope of incentives available to retrofit of T-12 lighting. The free ridership rate associated with T12-to-T8 retrofits was very low – approximately 2%. The program intervention was decisive in facilitating the T-12-to-T-8 retrofits.Table 4-4 shows percentages of total gross ex post standard program energy savings associated with different combinations of free ridership indicator variable values. Approximately sixty-eight percent of the savings are associated with respondents who indicated that they were financially unable to implement the project in the absence of the program incentive.

Table 4-4 Estimated Free-ridership for kWh Savings from Standard Program Projects

Had Plans and Intentions to Install Measure without BizSavers Program? (Definition 1)	*Had Plans and Intentions to Install Measure without BizSavers Program? (Definition 2)*	*BizSavers Program had influence on Decision to Install Measure?*	*Had Previous Experience with Measure?*	*Percentage of Total Expected Gross kWh Savings*	*Free Ridership Score*
Y	Y	N	N	1.41%	100.00%
Y	Y	N	Y	0.03%	100.00%
Y	Y	Y	Y	0.00%	100.00%
Y	Y	Y	N	0.16%	66.67%
N	Y	N	Y	0.65%	66.67%
N	N	N	Y	1.82%	33.33%
N	Y	N	N	4.75%	33.33%
N	Y	Y	Y	0.00%	33.33%
N	N	N	N	18.94%	0.00%
N	N	Y	N	3.79%	0.00%
N	N	Y	Y	0.17%	0.00%
N	Y	Y	N	0.06%	0.00%
Required program incentive to implement measures				68.22%	0%
Total				100.00%	4.16%

Table 4-5 shows percentages of total gross ex post new construction program energy savings associated with different combinations of free ridership indicator variable values. Approximately, Forty-nine percent of the savings are associated with respondents who indicated that they were financially unable to implement the project in the absence of the program incentive.

Table 4-5 Estimated Free-ridership for kWh Savings from New Construction Program Projects

Had Plans and Intentions to Install Measure without BizSavers Program? (Definition 1)	*Had Plans and Intentions to Install Measure without BizSavers Program? (Definition 2)*	*BizSavers Program had influence on Decision to Install Measure?*	*Had Previous Experience with Measure?*	*Percentage of Total Expected Gross kWh Savings*	*Free Ridership Score*
Y	Y	N	N	0.00%	100%
Y	Y	N	Y	0.00%	100%
Y	Y	Y	Y	0.00%	100%
Y	Y	Y	N	0.00%	67%
N	Y	N	Y	0.00%	67%
N	N	N	Y	0.00%	33%
N	Y	N	N	2.11%	33%
N	Y	Y	Y	0.00%	33%
N	N	N	N	31.06%	0%
N	N	Y	N	0.14%	0%
N	N	Y	Y	0.00%	0%
N	Y	Y	N	17.80%	0%
Required program incentive to implement measures				48.89%	0%
Total				100.00%	0.70%

Table 4-6 shows percentages of total gross ex post retro-commissioning program energy savings associated with different combinations of free ridership indicator variable values. Seventy-six percent of the savings are associated with respondents who indicated that they were financially unable to implement the project in the absence of the program incentive.

Table 4-6 Estimated Free-ridership for kWh Savings from Retro-commissioning Program Projects

Had Plans and Intentions to Install Measure without BizSavers Program? (Definition 1)	*Had Plans and Intentions to Install Measure without BizSavers Program? (Definition 2)*	*BizSavers Program had influence on Decision to Install Measure?*	*Had Previous Experience with Measure?*	*Percentage of Total Expected Gross kWh Savings*	*Free Ridership Score*
Y	Y	N	N	0.00%	100%
Y	Y	N	Y	0.19%	100%
Y	Y	Y	Y	0.00%	100%
Y	Y	Y	N	0.00%	67%
N	Y	N	Y	0.00%	67%
N	N	N	Y	17.20%	33%
N	Y	N	N	0.00%	33%
N	Y	Y	Y	0.00%	33%
N	N	N	N	4.91%	0%
N	N	Y	N	1.46%	0%
N	N	Y	Y	0.00%	0%
N	Y	Y	N	0.00%	0%
Required program incentive to implement measures				76.24%	0%
Total				100.00%	5.92%

For purposes of adjusting gross savings to account for free ridership, note that gross savings of projects associated with decision makers that were surveyed by ADM are adjusted by that decision makers specific free ridership score (Gross Savings * (1 – Free Ridership Score)). Gross savings of projects associated with decision makers that were *not* surveyed by ADM are adjusted by the program-level free ridership score.

4.2.2. Results of Estimation of Spillovers

During 2014 spillover energy impacts were assessed from multiple sources, program participants, near-participants, and non-participants. Table 4-8 summarizes the results.

4.2.2.1. Program Participants

ADM used two data sources for calculation of program participant spillover; Lockheed Martin measure level spillover report and participant survey data. The measure level spillover report includes all measures that were flagged as an “Installed Spillover Measure.” Generally, the non-incented measures were small components of a broader project comprised of incentivized measures. The spillover ex ante savings estimates were reviewed by ADM, and determined to be reasonable and aligned with ex ante savings estimates for incentivized measures. The savings were calculated as equal to the ex ante savings of the non-incented measure, factored by 1) the project-specific gross realization and 2) the project-specific non-free ridership rate [(Gross Ex Post kWh - Free Ridership Ex Post kWh) / Gross Ex Post kWh].

The second source of participant spillover was the online participant survey. A battery of spillover-related questions was administered to all survey respondents. Thirty-four respondents indicated that they were “likely to buy efficiency equipment because of the experience with the program, or already had purchased energy efficient equipment for which they did not apply for an incentive.” The responses to that question established a pool of participants that *could have* implemented spillover measures. Because implementation of measures outside of program participation could have been either attributable to the program or attributable to non-program factors, it was necessary to collect additional data in order to determine if savings were caused by the program.

In January 2015, ADM performed a follow-up telephone survey with these program participants to assess whether or not program spillovers occurred among this participant segment since administration of the customer survey. ADM attempted to contact all thirty-four of the program participants whose survey responses indicated a likelihood of spillover energy impacts. Of the thirty-four participants that were contacted, two had lighting projects from which spillover energy impacts could be verified. Savings attributed to participant spillover were allocated to the programs in proportion to ex post gross savings.

To ensure the spillover savings were not double counted, ADM cross-checked the survey respondents that indicated a likelihood of spillover with those that were identified by the Lockheed Martin measure report. The two participants from which spillover energy savings were verified did not *also* have spillover measures that were identified in the program tracking system.

4.2.2.2. Program Near-Participants

The evaluation team verified zero near-participant spillover energy savings. The following criteria were used to qualify true program near-participants: data analysts first looked at all projects that were discontinued and then assessed whether those customers had other projects that had been completed. If they had completed other projects through the program then they were not “true” program near-participants. Eleven customers were identified as program near- participants. The evaluation team reached out to all eleven near-participants. Seven of these individuals denied having discontinued projects, and reported that they had a project in process or completed. The other four participants did not install program-qualifying equipment for which spillover energy savings could be verified. See Table 4-7 for tabular presentation of the data noted above.

Table 4-7 Program Near-Participant Spillover Analysis Data

Measure Name in Tracking Data	*Value*
Number of Near-Participants	11
Number of Near-Participants without Discontinued Project	7
Number of Near-Participants Surveyed for Potential Spillovers	4
Near-Participant Spillover (kWh)	-

4.2.2.3. Program Non-Participants

The evaluation team verified zero non-participant spillover energy savings. Non-participants were defined as Ameren Missouri customers with active accounts listed in a customer database provided by Ameren Missouri, who had never submitted a program application. The spillover analysis was facilitated by collection of non-participant data that were also used to better understand the decision making process of customers that have not had experience with the program – section 5.9 presents additional information on the results of the analysis of non-participant survey data. The questions probed at what influences their investments in energy efficiency and the channels from which they receive information regarding energy conservation and utility cost savings.

Non-participants that indicated Ameren Missouri messaging or advertising as being influential to their decision to install energy efficient equipment for which they did not receive an incentive were flagged for potential non-participant spillover. Of the 280 non-participants that were surveyed, eight indicated a likelihood of spillover energy impacts. However, there were no projects for which program-attributable savings could be verified during follow up phone interviews.

4.2.3. Net Ex Post kWh Savings

The net ex post energy savings of the four programs during the 2014 calendar year are summarized by program in Table 4-8. During this period, net ex post energy savings for the custom program totaled 76,493,673kWh, while net ex post savings for the standard program totaled 38,407,774 kWh. The estimated net to gross ratio for the custom program is 92% and 96% for standard. The net ex post energy savings for the new construction program totaled 13,373,716 kWh, while net ex post savings for the retro-commissioning program totaled 9,056,403 kWh. The estimated net to gross ratio for the new construction and retro-commissioning programs are 100% and 94%, respectively.

Table 4-8 Summary of Free Ridership, Spillovers, and Net kWh Savings by Program

Program	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Estimated Free Ridership	Spillovers	Net Ex Post kWh Savings	Estimated Net to Gross Ratio
Custom	80,379,926	83,161,231	8,791,517	2,123,959	76,493,673	92%
Standard	38,589,848	40,070,742	1,668,753	5,784	38,407,774	96%
New Construction	13,170,801	13,399,531	94,439	68,624	13,373,716	100%
RCx	11,640,860	9,626,043	569,640	-	9,056,403	94%
Total	143,781,436	146,257,547	11,124,348	2,198,367	137,331,565	94%

*Total represents the total number of projects in the sample, not the sum of each line item above it

The net ex post energy savings of the custom, standard, new construction and retro-commissioning programs are summarized by measure type in Table 4-9, Table 4-10, Table 4-11, and Table 4-12, respectively.

Table 4-9 Custom Program Net kWh Savings by Measure Type

Measure Type	Units	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Net Ex Post kWh Savings
Compressed Air	2,391	4,676,571	4,642,974	4,263,548
HVAC	3,793	12,130,968	10,610,037	8,676,825
IT	7,205	938,659	956,080	749,835
Lighting Controls	214	42,710	46,469	44,399
Lighting	102,879	54,806,755	58,838,972	53,273,499
Miscellaneous	8	14,160	16,766	14,994
Motors	534	768,156	781,247	734,648
Process	501	674,815	682,875	682,875
Refrigeration	244	660,159	704,126	629,688
VFD	5,317	5,666,973	5,881,685	5,299,402
Total	123,086	80,379,926	83,161,231	74,369,714

**Total represents the total number of projects in the sample, not the sum of each line item above it*

Table 4-10 Standard Program Net kWh Savings by Measure Type

Measure Type	*Units*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Net Ex Post kWh Savings*
Food Service	1	15,170	12,514	12,514
HVAC	3	196	162	162
IT	6,899	2,109,045	1,926,479	1,860,002
Lighting Controls	7,232	4,328,834	4,625,341	4,390,396
Lighting	153,804	31,992,874	33,382,491	32,017,209
Motors	70	38,080	33,044	33,044
Refrigeration	112	96,819	83,427	81,379
VFD	10	8,830	7,284	7,284
Total	168,131	38,589,848	40,070,742	38,401,989

*Total represents the total number of projects in the sample, not the sum of each line item above it

Table 4-11 New Construction Program Net kWh Savings by Measure Type

Measure Type	*Units*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Net Ex Post kWh Savings*
Compressed Air	30	11,807	11,992	11,992
HVAC	1,513	2,496,588	2,430,460	2,421,155
IT	1,251	405,499	418,888	416,362
Lighting Controls	3,037	2,021,124	1,993,296	1,985,668
Lighting	1,978	7,881,739	8,297,870	8,246,895
Motors	99	62,576	35,413	25,356
Refrigeration	381	196,056	152,645	139,028
VFD	36	82,884	46,905	46,575
Water Heat	72	12,528	12,062	12,062
Total	8,397	13,170,801	13,399,531	13,305,092

*Total represents the total number of projects in the sample, not the sum of each line item above it

Table 4-12 Retro-commissioning Program Net kWh Savings by Measure Type

Measure Type	*Units*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Net Ex Post kWh Savings*
Compressed Air	3,787	4,855,992	3,970,084	3,725,842
HVAC	1,869	6,784,118	5,655,376	5,330,013
Process	29	750	584	549
Total	5,685	11,640,860	9,626,043	9,056,403

The shares of net ex post custom program and standard program energy savings accruing to different customer rate classes during the 2013 and 2014 program years are presented in Table 4-13. Compared with 2013, during 2014, rate class 2M customers' share of total savings increased 21% for the custom program and 22% for the standard program. Due to the limited new construction and retro-commissioning program activity during 2013, a year-on-year comparison is unwarranted for those programs.

Table 4-13 Distribution of Program Net kWh Savings by Customer Rate Class

Rate Class	*Standard - 2013*	*Standard - 2014*	*Custom - 2013*	*Custom - 2014*	*New Construction - 2014*	*Retro-Commissioning - 2014*
2M - Small C&I	15%	18%	10%	12%	7%	0%
3M - Medium C&I	62%	58%	53%	47%	88%	24%
4M - Large C&I	15%	16%	27%	22%	5%	73%
11M - Large C&I	8%	7%	10%	19%	0%	3%
Total	100%	100%	100%	100%	100%	100%

ADM used the U.S. Department of Agriculture Economic Research Service (ERS) rural-urban continuum classification framework to categorize program activity in order to provide information on the distribution of savings across areas with varying levels of urbanization.[16] Approximately 75% of the net kWh energy savings of the the BizSavers program portfolio occurred in the St. Louis metropolitan area (area type "1: Metro - Counties in metro areas of 1 million population or more").

Table 4-14 Geographical Distribution of BizSavers Portfolio kWh Savings by Level of Urbanization

Area Type	*Ex Ante kWhSavings*	*Gross kWh Ex Post Savings*	*Net Ex Post kWh Savings*	*Percent of Net Ex Post kWh Savings*
1: Metro - Counties in metro areas of 1 million population or more	108,318,464	110,487,738	102,442,522	74.6%
3: Metro - Counties in metro areas of fewer than 250,000 population	24,883,021	25,356,658	24,721,838	18.0%
4: Nonmetro - Urban population of 20,000 or more, adjacent to a metro area	1,001,958	1,110,328	964,431	0.7%
6: Nonmetro - Urban population of 2,500 to 19,999, adjacent to a metro area	3,940,393	3,973,870	3,650,310	2.7%
7: Nonmetro - Urban population of 2,500 to 19,999, not adjacent to a metro area	3,609,739	3,210,939	3,133,813	2.3%
8: Nonmetro - Completely rural or less than 2,500 urban population, adjacent to a metro area	86,476	74,065	71,041	0.1%
9: Nonmetro - Completely rural or less than 2,500 urban population, not adjacent to a metro area	1,941,385	2,043,948	2,347,611	1.7%
Total	143,781,436	146,257,547	137,331,565	100.0%

[16] See http://tinyurl.com/osfuh6m for ERS data.

4.2.4. Net Ex Post Peak kW Savings

The net ex post peak kW savings of the program during the 2014 calendar year are summarized by program in Table 4-15. The net ex post peak savings for the custom program are 10,664.16 kW, while the net ex post peak savings for the standard program are 11,394.19 kW. The net ex post peak savings for the new construction program are 6,680.71 kW, while the net ex post peak savings for the retro-commissioning program are 523.31 kW. Note that for a particular program, the net to gross ratio for kWh savings may vary from the net to gross ratio for peak kW impacts. This is because the distribution of gross realized kWh savings across decision makers may not be identical to the distribution of gross peak kW impacts across decision makers. For example, a free rider program participant implementing an exterior lighting project with no ex post peak kW impact (the lighting not operating at all during the peak period) would contribute to program-level kWh free ridership and not to program-level peak kW free ridership.

Table 4-15 Summary of Free Ridership, Spillovers, and Net Peak kW Impacts by Program

Program	*Gross Ex Ante Peak kW Savings*	*Gross Ex Post Peak kW Savings*	*Estimated Free Ridership*	*Spillovers*	*Net Ex Post Peak kW Savings*	*Estimated Net to Gross Ratio*
Custom	12,717.46	11,854.85	1,279.79	89.11	10,664.16	90%
Standard	7,782.21	11,861.27	468.56	1.49	11,394.19	96%
New Construction	989.69	6,939.51	259.10	0.30	6,680.71	96%
RCx	479.30	541.59	18.28	-	523.31	97%
Total	21,968.65	31,197.21	2,025.73	91	29,262.37	94%

5. Process Evaluation

This chapter presents the results of the process evaluation of the Ameren Missouri BizSavers Programs during 2014. The purposes of this process evaluation are to assess the effectiveness of Ameren Missouri's 2013-2015 BizSavers Programs in delivering appropriate energy efficiency technologies to the business sector served by Ameren Missouri and to identify ways to improve the BizSavers Programs and inform future program design. The evaluation has been guided by five regulatory research questions specified in 4 CSR 240-22.070(8): to identify the primary market imperfections; to investigate whether the target market segment is appropriately defined, program measures reflect the target market's needs and available technologies, and communication and delivery channels and mechanisms are appropriate; and to investigate whether there are better ways to address market imperfections to increase adoption of program measures.

The remainder of this chapter is organized into nine main sections. The first section presents a summary of evaluation data sources and high-level summaries of process findings by data source. The remaining sections provide details of methods and findings for each data source.

5.1. Summary of Evaluation Sources and Findings

The evaluation team collected or analyzed both qualitative and quantitative data to understand program process and outcomes. Specifically, the team interviewed or surveyed six staff members of Ameren Missouri and its implementation contractor, Lockheed Martin; 469 program participants and near-participants; 280 program non-participants from the Ameren Missouri customer base; and 71 attendees (trade allies, other service providers, and business customers) of program educational events. The team also reviewed program documentation to gain a full understanding of plans (e.g., marketing plan) and processes and analyzed the program database to characterize the population of program participants and review data quality.

The evaluation data collection activities are summarized in Table 5-1. High-level findings follow. In some cases, findings from different sources are grouped as they address common topics.

Table 5-1 Evaluation Data Collection Activities

*Data Source**	*Method*	*Dates*	*Key Research Topics*	*Analytic Techniques*
Program staff (6) Ameren Missouri (2) Lockheed Martin (4)	In-depth interview	May, June, December 2014	Program function; communication; tracking and reporting; quality control	Qualitative, thematic analysis
Program documentation	Document review	January to December 2014	Program function; tracking and reporting; quality control	Qualitative, thematic analysis
Database analysis	Database review	January 2015	Number of projects; project type and details; data quality	Quantitative, univariate and bivariate frequencies
Participants, Standard and Custom programs (452)	Online survey	Though 2014	Program experiences; installed equipment; satisfaction with program	Quantitative, univariate and bivariate frequencies
Participants, New Construction and Retro-commissioning programs (17)	In-depth Interview	September - December 2014	Program experiences; installed equipment; satisfaction with program	Qualitative, thematic analysis
Near-participants, Standard and Custom programs (18)	In-depth Interview	December 2014 to January 2015	Program awareness; reason for program withdrawal; other energy efficiency activities; satisfaction with program	Qualitative, thematic analysis
Non-participants (280)	Telephone survey	September 2014	Program awareness, energy decision-making, upgrades to energy-using equipment, barriers to participating in program, and interest in Ameren Missouri programs	Quantitative, univariate and bivariate frequencies and qualitative, thematic analysis
Event attendees (5 events, 71 attendees)	Online survey	May – October 2014	Event satisfaction; experience with training; Intention to work with BizSavers; firmographics	Quantitative, univariate and bivariate frequencies and qualitative, thematic analysis

* For interviews and surveys, sample sizes are shown in parentheses.

5.1.1. Program Staff and Documentation

Interviews with Ameren Missouri and Lockheed Martin staff, and review of materials provided, documented ongoing efforts to increase program awareness throughout the target market sector and improve services.

Both organizations added staff for the 2014 program year. Ameren Missouri added a new program staff member to deal with program accounting and post-inspections, drafts policies, and the opt-out process. Lockheed Martin added outreach and operations staff and redefined the “trade ally coordinator” position as “outreach coordinator” to help coordinate between business development staff work and trade allies. Lockheed Martin also has provided additional internal and external staff training, and two staff members have completed CEM certification.

Both Ameren Missouri and Lockheed staff report good communication within and between their staffs, and contacts reported that Ameren Missouri Key Account Executives and Customer Support Agents continued to play an important role in educating customers about incentives.

Program staff continue to educate customers about BizSavers programs via a wide range of direct and mass market channels. Staff reported positive feedback on two new efforts to increase small business participation: the “Fast Track” standard application, which waives pre-approval for standard projects with incentives below $10,000, and the Distributor Partnership Program (DPP), which raises program awareness through point-of-purchase information at local distributorships. Lockheed staff also reported continued efforts to target specific customer segments, in 2014 focusing on K-12 schools, the hospitality industry, government agencies, commercial kitchens, and IT data centers.

Lockheed staff reported that they had increased the BizSavers Trade Ally Network (TAN) membership from about 190 members in 2013 to 280 by the end of 2014. Information provided by staff documented a wide range of methods used to keep trade allies informed of program activities.

In response to feedback from the 2013 process evaluation, Lockheed undertook several improvements to program processes, including a redesign of the online application and upgrades to the project tracking system.

Finally, staff reported on the decision to allow T-12 lighting to be used as a baseline for lighting upgrades and provided documentation on their efforts to educate the market about the change and on market feedback indicating acceptance of the change.

5.1.2. Program Database

Program database analysis reveals the characteristics of participants and their completed projects from 2014. Standard and custom projects dominated participation, with about one-fifth more standard than custom projects.

The distribution of participants across building end-use types is consistent with the distribution in the population. The distribution of participants and projects within and outside of the St. Louis metro area mirrors the distribution of businesses.

Small businesses constitute a slightly smaller percentage of total program savings than their share of total building area would predict. However, the proportion of projects completed in smaller buildings (5,000 square feet or less) was nearly double of that from 2013; this suggests that BizSavers is successfully expanding project activity in the small business population.

The program delivered the incentive within 30 days after project installation for more than 99% of Fast Track/Fast Track V2 projects, but the Fast Track V2 path took significantly longer than the original Fast Track template. On average, the program delivered the incentive within the contractually mandated forty-five days for 99% of the Inspection Track projects.

Less than half of participating contractors are members of the Trade Ally Network (TAN), but TAN members were associated with four-fifths of the projects completed in 2014.

5.1.3. Participants

The participant online survey collected data on program awareness, customer decision-making and preferences, experience with program processes and installed equipment, satisfaction with various aspects of the program, and any new construction plans.

Participants were most likely to report a source outside of Ameren Missouri or its program implementer as sources of awareness, project influence, and application assistance. However, program related outreach was associated with a large proportion of project-related savings and should be a continued focus for increasing program awareness.

Fewer than half of standard program participants reported being aware of custom incentives. Those who were aware chose standard because it covered all equipment that was of interest to them.

Participants were moderately proactive in deciding to implement an efficiency upgrade. The evaluation team found that customers who had defined energy savings goals or a person responsible for energy management or who reported multiple energy savings policies (e.g., defined energy savings goals and a policy to purchase energy efficient equipment) were the most proactive.

Participants generally were satisfied with the application process as well as most other aspects of participation, although one-quarter of those with custom projects had to resubmit or provide supporting documentation for their applications. The evaluation team found that participants who reported interacting with program staff were more likely to know where to go for assistance with the application. Additionally, those who had a clear idea of where to go for assistance with the application reported the greatest satisfaction.

Finally, one-third of participants reported considering undertaking a new construction or major building renovation project within the next five years. Approximately half of these participants reported that the new construction project was in the design phase, and about one-third were aware of the new construction program.

5.1.4. Near Participants

Interviews with near participants uncovered little evidence that program rules, staff, or processes were causing customers to discontinue applications. Twenty-six of the thirty-four (76%) customers contacted reported their project was still in process (17), complete (6), or on hold (3), indicating the application was not identified correctly in the tracking system.

5.1.5. Nonparticipants

The telephone survey of 280 commercial and industrial nonparticipants conducted in the third quarter of 2014 asked respondents about awareness of Ameren Missouri's programs and their sources of awareness; efficiency upgrades they completed or planned; barriers to completing efficiency upgrades; interest in Ameren Missouri's new construction and retro-commissioning programs; and how decisions are made about efficiency upgrades.

Slightly more than half of these respondents reported awareness of Ameren Missouri's incentives with most of those being aware of incentives for existing buildings. Smaller percentages were aware of incentives for new construction projects and even fewer were aware of incentives for retro-commissioning.

About half of respondents reported they recently completed an efficiency project or had plans to complete an efficiency project. Lighting and HVAC upgrades were the most commonly cited upgrades and the most commonly cited reason given for making efficiency upgrades was to reduce operations and maintenance expenses.

Of respondents that reported installing standard efficiency equipment rather than energy efficient equipment, almost a third did not know why their firm chose standard equipment. A quarter of these respondents reported that the lower costs associated with standard equipment drove the decision.

Only about a third of non-participants had any goals or policies in place to save energy; conversely, more than half of participant survey responses reported having such goals or policies.

Almost half of non-participant respondents were likely eligible for retro-commissioning incentives and of those about 40% suggested they would apply for retro-commissioning incentives. Of those who were not likely to apply for retro-commissioning incentives, about a quarter said they were concerned with the cost of participation, a second quarter did not know enough about the program, and about one-third said that the program or the energy savings were not worth the trouble. Other respondents either provided miscellaneous reasons or did not provide a reason.

5.1.6. Event Attendees

Interviews with event attendees revealed that attendees were predominately contractors, most of which were members of the Trade Ally Network. Attendees were largely satisfied with the events and found them to be helpful and informative.

5.2. Program Staff Feedback

To gain a full understanding of the program's goals, implementation, and delivery for the current program cycle, evaluation staff interviewed the Ameren Missouri BizSavers Program team and staff from Lockheed Martin, the program implementer. RIA conducted initial interviews with five members of Ameren Missouri's BizSavers management and support staff and ten members of the Lockheed Martin program staff during the first year of the evaluation, and we reported in detail on those interviews in the report for that year's evaluation.[17] Interviews covered respondents' roles and responsibilities; communications; working relations with trade allies, other program partners, and non-allied service providers; marketing and outreach activities; tracking and reporting; and process quality control.

In 2014, the evaluation staff re-interviewed two members of Ameren Missouri's BizSavers management staff (the program manager and the manager of business and community relations) and interviewed the Ameren Missouri Energy Efficiency Program Supervisor for the first time. We also interviewed four members of the Lockheed Martin program staff (the deputy program manager, the marketing manager, the outreach coordinator, and the business development lead). The second set of interviews covered the same set of topics and focused on any changes in the program or lessons learned over the previous year. We conducted the interviews with the Ameren Missouri program manager and the Lockheed marketing manager in May of 2014 and the other interviews in December.

The following subsections summarize information from the interviews conducted in 2014 relating to roles and responsibilities, communication within and between the respective organizations, marketing and outreach, work with trade allies, application processes, data tracking, and measures. Where appropriate, context from the initial interview findings is provided.

[17] *BizSavers Program Evaluation Report: January 2013 – December 2013*, prepared for Ameren Missouri by ADM Associates, Inc. with Research Into Action, Inc., June 2014.

5.2.1. Roles and Responsibilities

Program staff provide oversight and support to Lockheed Martin program implementation staff. Lockheed Martin is responsible for conducting all BizSavers program activities and actively managing the program to meet program goals. The roles of staff in each organization, and their interactions, are described in this section.

5.2.1.1. Ameren Missouri

BizSavers program staff are organized under the Managing Supervisor, Business Energy Efficiency Programs, who reports to the Manager, Energy Efficiency and Demand Response (EERD).[18] The only change of note in the staff organization above the level of the BizSavers program since the previous evaluation report was finalized is that the current Managing Supervisor, Business Energy Efficiency Programs previously headed the renewable energy programs.

At the time of the initial interviews, four program staff had direct reporting lines to the BizSavers managing supervisor: the program manager, responsible for portfolio management activities such as program design and quality control; the retro-commissioning program supervisor; a program specialist serving as acting manager for the new construction program; and a project management supervisor responsible for the tracking system. The program manager directly oversees activities related to the standard and custom programs.

At the time of the May 2014 interviews, two changes had occurred in the BizSavers program staff. First, the retro-commissioning program supervisor is no longer involved with BizSavers; the overall program manager is now directly supervising the retro-commissioning program as well as the standard and custom programs. Second, the program staff had recently added a new member, who has taken over some of the portfolio-level responsibilities of the program manager. Specifically, the new member deals with program accounting and post-inspections, drafts policies, and handles the opt-out process.

Other EEDR staff cover the EM&V, marketing, field, contracts staff, key accounts, and customer service functions.

5.2.1.2. Lockheed Martin

The organization of Lockheed Martin's leadership team for the program remains largely unchanged since the previous year-end report. The program manager directly oversees the deputy manager, who oversees the data analysis and finance functions as well as

[18] These two titles underwent slight changes since the previous report was finalized, but the responsibilities assigned to them have not changed.

the operations staff responsible for the standard, custom, and retro-commissioning programs. The program manager also oversees leads for the new construction program, marketing, business development, and engineering.

Within the above overall framework, Lockheed Martin has implemented some changes to the organization and staffing since the previous report, adding four full-time staff in the process. First, in 2014 Lockheed redefined the previous position of “trade ally coordinator,” who report to the marketing manager, as “outreach coordinator,” reporting to the business development lead. A new person was hired to that redefined position in May of 2014. The outreach coordinator still works largely in recruiting and providing program information to trade allies. The position was placed in the business development group because all business development staff work with trade allies – having the outreach manager report to the business development lead is expected to help with coordination between business development staff work and trade allies.

In addition, in 2014 Lockheed added one full-time outreach field representative to the business development group, added a fourth engineer, and added a member to the operations staff. In 2014, Lockheed also began routing less complex prescriptive applications through trained operations staff for review and approval to free up engineering time.

Figure 5-1 shows all staff members and their reporting relationships. The light blue box illustrates the change from trade ally coordinator to outreach coordinator. The green boxes indicate Lockheed Martin staff that are available as backup to program staff.

Most of Lockheed Martin 2014 staff also worked on the program during the 2013 program year, and half of those worked on the program during the previous cycle or had previous related experience.

In the previous process evaluation, we reported that some staff said they would benefit from additional training on business energy efficiency industry technologies and measures, including obtaining CEA or CEM energy auditor certification. Follow-up information from Lockheed Martin indicates that two business development staff completed CEM training in 2014, with more planned for the coming year. In addition, the program manager reported that all business development staff have undergone considerable internal and external training in 2014 as well as undertaking self-study on non-lighting technologies.

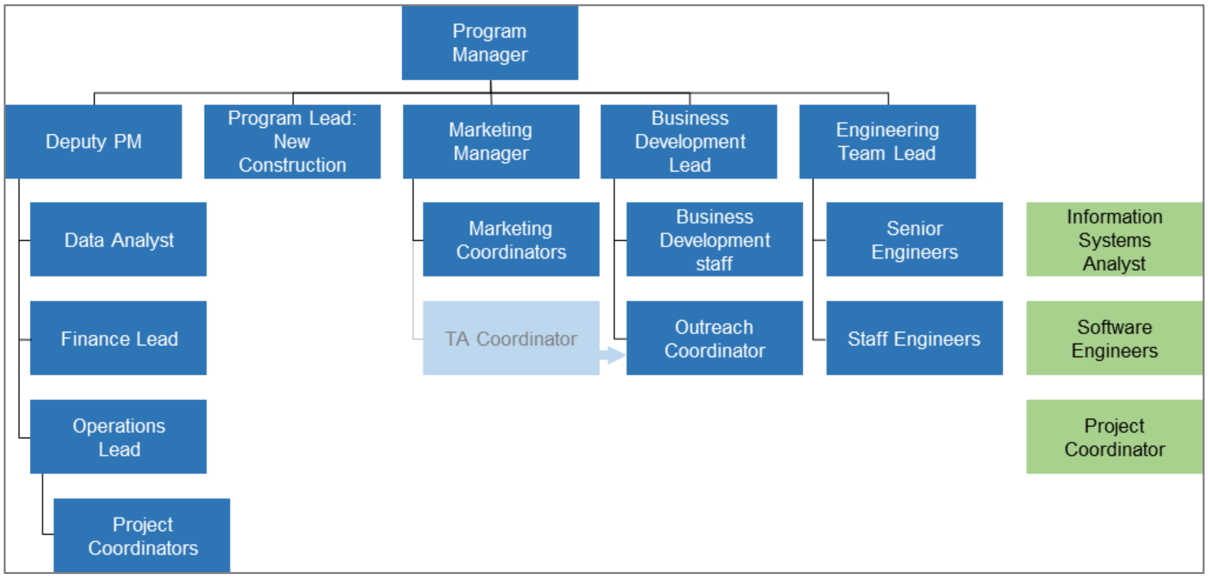


Figure 5-1 Lockheed Martin BizSavers Program Organizational Chart

BizSavers business development representatives, project coordinators, and engineers continue to be organized into "triple teams" to see projects through from initial outreach to payment of incentives. BDs carry out direct outreach in coordination with Lockheed Martin's marketing team, Ameren Missouri KAEs and CSAs, trade groups, and service providers; PCs manage the application process and may conduct pre-inspections for straightforward projects; and engineers review applications, field questions, sign off on incentive offers, and conduct inspections for more complex projects. All triple-team members may have direct contact with Ameren Missouri business customers and service providers.

5.2.2. Program Communication

The staff contacts interviewed for this report commented on communication within and between their respective organizations, including between program staff and the Ameren Missouri KAEs and CSAs. As in the interviews conducted for the previous report, both Ameren Missouri and Lockheed Martin staff report that communication within their respective organizations is good – particularly within the Lockheed Martin staff and the Ameren Missouri program staff. In terms of the latter, contacts described good cross-functional communication supported by effective communication tools. Some specific comments include:

> *"The team does really well in communicating across functions. At the end of the day, there is no activity in the office that doesn't require collaboration with other individuals within a functional area or across areas. A big part of it is the team, the individuals that work there.*
>
> *Transparency is key. [Lockheed's] processes are transparent to Ameren. If we are not achieving an objective, behind schedule, Ameren knows it."*

Lockheed staff also reported “excellent” intra-organizational communication, with the result that, “Everybody is amazingly on the same page.”

Two Lockheed contacts mentioned communication and data tracking tools as supporting effective intra- and inter-organizational communication. One commented that sending links to meeting notes, internal documents, and reference documents stored on SharePoint allows for better tracking of communication between organizations about such documents. Another noted that the “LM Captures” tracking system, which centralizes information that is often captured in real time, enhances communication within Lockheed. A third contact noted that communication with Ameren Missouri would benefit if the latter had more access to the Lockheed database.

Lockheed staff mentioned one specific area in particular in which communication had improved. In the evaluation of the 2013 program year, contacts noted that, while Ameren Missouri’s oversight and review of Lockheed Martin’s marketing and outreach activities usually works well, it can take longer than expected during busy periods. In a follow-up conversation for the 2014 evaluation, program staff reported that the approval process has become more efficient since Ameren Missouri hired a new energy efficiency marketing manager.

5.2.3. Program Marketing and Outreach

During the initial round of interviews, the evaluation team obtained detailed descriptions from program staff on several topics concerning program marketing and outreach. Program staff indicated that a key focus for the 2013 program year was to spread the word that the program was back after a one-year hiatus, and they provided details on the specific marketing and outreach activities employed, their efforts targeting small and mid-sized businesses and businesses outside the St. Louis area, and marketing effectiveness.

In 2014, the evaluation team re-interviewed marketing staff on those and other related topics. During 2014, building awareness with the “ActOnEnergy” and “BizSavers” brand names continued to be a major focus. As detailed below, staff contacts provided updates on marketing and outreach channels and methods and described efforts in 2014 to increase program uptake in specific market segments and to generate more non-lighting savings.

5.2.3.1. Overview of Marketing and Outreach Activities

Program staff continue to use many communication channels to educate customers – directly via in-person, phone, and email direct communications with key targeted customers and trade allies; during public “lunch and learns” and other events held for large customers and trade allies; and more broadly via mass mailings, email blasts, fact sheets, the program website, radio, and newspaper advertising, and webinars.

According to records shared by Lockheed Martin, outreach staff delivered sixty-three group presentations to nearly 9,000 attendees (see Section 5.10 for detail) and sent the BizSavers Solutions monthly e-newsletter to more than 4,000 customers and trade allies in 2014. In addition, Lockheed delivered topic-specific e-mails to “opt in” lists of customers (e-blasts), including:

- Incentives for non-profits (April).
- Introduction to the new online Fast Track application (June and August).
- Announcement of new program rules on T-12 replacement (October).

In addition, Lockheed Martin staff reported that in 2014, they made increased use of social media and media kits to publicize case studies of energy efficiency projects. Lockheed staff would identify projects with significant visibility, such as those done by a prominent area employer. They would then work with the project owner to develop video case studies, using a Lockheed-provided videographer, to share with news media, distribute on YouTube, and use in trade ally presentations. Lockheed staff sent one such video case study to nearly 4,700 customers and trade allies in June of 2014.

Lockheed staff reported two activities that have assisted in efforts to reach large customers through direct outreach. One is the continued coordination with Ameren Missouri Key Account Executives (KAEs), including the new “10 Most Wanted” campaign (see Section 5.2.3.4). The other is the use of Ameren Missouri customer account data to identify single, large organizations that account for multiple, smaller accounts. Examples include business chains and franchises, school districts, and large campus-like organizations, such as airports. In these cases, an individual business outlet, school, or airport building may be a separate Ameren Missouri account, but decisions likely are made or influenced centrally. Lockheed staff reported that building these “customer towers” has enabled Lockheed to get “large usage piles” of customers.

5.2.3.2. Targeting Smaller Customers

Lockheed staff continued to target small and midsized businesses during the 2014 program year. In addition to conducting targeted outreach events, mailings, e-blasts, bill inserts, and social media efforts, Lockheed rolled out two additional efforts targeting small and mid-sized customers.

First, Lockheed introduced a new “Fast Track” user-friendly online application tool for standard incentives, which allows businesses to apply for standard incentives up to $10,000 without pre-approval. The theory is that simplifying the application and waiving the pre-approval requirement for smaller incentives should make incentives more accessible to small customers. One program contact reported that Lockheed has received multiple instances of positive feedback from trade allies on the new tool.

Second, Lockheed rolled out the Distributor Partnership Program (DPP), which it piloted in late 2013. Through DPP, Lockheed is working with six local equipment distributors to try to raise program awareness with smaller business “walk in” customers. Lockheed provides the distributors with marketing collateral and poster boards to display in customer service areas (e.g., counters and shelves) to promote BizSavers as well as envelopes with paper versions of the Fast Track application and the website location for the online application.

According to staff contacts, the purpose of DPP is to raise awareness, not necessarily to drive many point-of-purchase applications. While the program does not track the number of applications that resulted from DPP, staff described the program as “working well” – one cited a particular distributor that was doing a “great job” in bringing in multiple projects.

Lockheed staff also reported that a strategy for reaching smaller customers is to work through trade allies that work with smaller businesses. One contact noted that, at trade ally outreach events, program staff discuss types of measures that would be of interest to businesses of all sizes. Another reported a focus on working with lighting trade allies as a way to reach small businesses, as lighting is the “main measure” for small businesses.

5.2.3.3. Targeting Specific Customer Segments

Lockheed staff also reported continued efforts to target specific customer segments in 2014 focusing on K-12 schools, the hospitality industry, government agencies, commercial kitchens, and IT data centers. One strategy was to identify parts of the Ameren Missouri service territory with a high density of a targeted type for focused outreach efforts. In addition, some of the program’s public events targeted specific segments: one event targeted schools, with fifty attendees; and three targeted the hospitality industry, with a total of sixty-six attendees. Finally, as with efforts targeting smaller businesses, targeting specific segments involves working with trade allies that serve those segments. The contact who identified lighting trade allies as an important channel for reaching smaller businesses also indicated an effort to push those trade allies toward the hospitality market.

Finally, one of the program’s strategies to reach government agencies has been to work with the U.S. Department of Energy’s Federal Energy Management Program (FEMP), which helps federal agencies acquire energy efficiency incentives. The Lockheed Outreach Coordinator writes e-blasts for the FEMP implementer to send to a broadcast list of federal agency contacts (e.g., facility managers and energy managers) within the Ameren Missouri service area.

5.2.3.4. Coordination with Ameren Missouri Account Support Staff

During the evaluation of the 2013 program year, the evaluation team learned that Ameren Missouri KAEs and Customer Support Agents (CSAs) play an important role in the BizSavers program success. They forward monthly BizSavers Solution newsletters, field calls about the program from customers, and use the program as a tool for educating customers about energy efficiency. A new development in 2014 is that energy efficiency metrics have been added to the key performance indicators for the customer operations staff (KAEs and CSAs). These energy efficiency metrics are not tied to individual employees' performance objectives or compensation, however.

The role that KAEs and CSAs play continued to be an important theme in the evaluation of the 2014 program year. Contacts reported that coordination between program staff and Ameren account staff is generally effective, with program staff carrying out active outreach to the KAEs and CSAs and providing monthly reports on interactions with customers, and KAEs and CSAs providing the program with "warm hand-offs." One contact in particular described the KAEs as having been "extremely important and helpful in making the program successful." Illustrating the frequency of communication, another contacted noted that, "A lot of [CSAs and KAEs] have Lockheed Martin staff on speed dial."

Three contacts described regular meetings or webinars that program staff hold with KAEs and CSAs (described as "monthly" by one contact and "occasional" by another). Program staff use these meetings to inform KAEs and CSAs about and solicit feedback on marketing and outreach activities. The program also provides CSAs with customized monthly reports on projects brought into their territory.

Program staff also use the meetings to solicit assistance with high-profile customers. To this end, Lockheed established a "10 most wanted" campaign to identify the ten customers in CSA territories that it most wanted to recruit into the program and to solicit the CSAs' assistance in reaching those customers. In its monthly marketing summary for December of 2014, Lockheed Martin reported that it had "captured" nine of the ten "most wanted" customers.

The program materials that Lockheed has shared with CSAs include presentations targeted at specific subsectors such as hotels and schools. According to the Lockheed marketing manager, one CSA indicated an interest in personally doing a presentation in an outlying area. This may simultaneously illustrate the growing partnership as well as reflect the CSAs' sense of ownership of their territories.

One contact emphasized that coordination is important because customers can be hesitant to talk to a third-party program implementer. Such hesitancy has decreased since the first round of the program as, partly through the efforts of KAEs, Ameren Missouri customers have become more aware of Lockheed's role. However, it is still important for Lockheed to inform KAEs when they are contacting a key account. Lockheed generally does a good job of this, but changes in the key account list (e.g. because a company changes name) sometimes result in a Lockheed staff contacting a customer without realizing it is a key account. A change at Lockheed in who might contact a key account also may result in a breakdown in coordination. Therefore, both parties must continue to work to keep the other informed – KAEs to inform Lockheed of changes in the key accounts list, and Lockheed to inform KAEs when they plan to contact a key account.

5.2.3.5. Market Response

Program staff reported that the program was on track to meet goals. Progress was slow during 2013 following the gap year, but at the time of the staff interview in May 2014, the program had been ahead of monthly goals for committed projects.

5.2.4. Working with Trade Allies and Other Service Providers

For 2014, the evaluation team investigated several specific topics related to the program's work with trade allies and service providers not affiliated with the program: efforts to expand the trade ally network; trade ally communication and training; and the tiered trade ally structure.

5.2.4.1. Expanding the Trade Ally Network (TAN)

In 2014, Lockheed Martin staff worked to expand the BizSavers Trade Ally Network (TAN). Staff reported that they were successful in building the TAN from about 190 members in 2013 to 280 by the end of 2014. Lockheed staff used several strategies to accomplish this:

- Identifying members of trade ally networks run by program administrators bordering Ameren Missouri's service territory and attempting to recruit those that also do business within Ameren Missouri's territory.
- Developing a national trade ally task force comprised of trade ally coordinators in other Lockheed-implemented programs. The task force meets every two weeks to work on how they can achieve greater market penetration. As part of this, they share trade ally information to identify those with national presence for possible recruitment.
- Attending a conference hosted by the Edison Electric Institute, which was attended by national trade allies.

Additionally, Lockheed staff have continued activities pursued in 2013: contacting non-TAN contractors that submit an incentive application and contacting contractors that were TAN members in the previous program cycle who did not re-enroll when the new program cycle began. (As reported in the process evaluation of the 2013 program year, Lockheed required all prior TAN members to re-enroll for the new program cycle, but some did not.)

When asked about barriers to trade ally recruitment, two staff contacts noted that the insurance requirements were sometimes a barrier. One indicated that the smaller trade allies in particular had a challenge meeting insurance requirements, which disproportionately affects rural areas. That contact noted that the program is legally barred from waiving insurance requirements.

5.2.4.2. Communicating and Training

Lockheed staff reported frequent communication with trade allies and non-TAN service providers to provide program updates. Such communication takes part through e-blasts as well as face-to-face meetings at a variety of events. Some examples of e-blasts include the following:

- The monthly *BizSavers Solutions* e-newsletter.
- The trade ally fall newsletter.
- An end-of-year notice of project completions.
- Introduction to the new online Fast Track application (June and August).
- Announcement of new program rules on T-12 replacement (October).

Events include check presentations, orientation and training events, and equipment specific seminars. Lockheed Martin records show the following trade-ally-specific events held in 2014:

- Four trade ally orientations (total of 48 attendees).
- Four equipment-specific seminars (total of 182 attendees).
- Three trade ally refreshers (total of 136 attendees).
- A trade ally awards banquet (140 attendees).

The above events are in addition to some 50 other events open to both trade allies and large customers (see Section 5.10).

Program staff noted that they send monthly program-related information to all contractors that they track in the project database, regardless of TAN membership, and invite them to all events except for the trade ally awards banquet. There is a trade ally newsletter that the program sends four times a year to TAN members only, as they promote it as a benefit of being a member.

Program staff pointed out that in their communication with trade allies about project completions; they provide specific feedback on energy savings. As one noted, it is more effective "to pass that type of message along than 'yeah, it's a good project' kind of message." Similarly, in public presentations, they highlight specific TAs that have had successes and talk about specific projects that have done well. This approach is exemplified in the annual trade ally awards banquet.

A final element of trade ally communication that staff contacts found important was to solicit trade allies' feedback on program changes they would like to see, such as new measures or process improvements. To this end, Lockheed Martin has a place to document such suggestions on its SharePoint site.

5.2.4.3. Trade Ally Tiers

BizSavers continues to maintain a tiered TAN structure. "Platinum" trade allies have completed fifty or more projects or achieved at least five million kWh in savings; "Gold" allies have completed twenty-five to forty-nine projects or saved 1-5 million kWh; and "Silver" allies have fewer than twenty-five projects and less than 1 million kWh savings. Gold ranking comes with expanded co-branded program collateral and program window clings, and Platinum ranking comes with those benefits plus vehicle magnets, sponsored events, and other rewards. When a trade ally achieves a new tier, program staff send them a certificate along with the associated benefits (e.g., window clings). The program also acknowledges Platinum trade allies at the annual awards banquet.

The evaluation team investigated program staff perspectives on whether the tiered structure and the co-branding motivate trade allies. Two staff members worked closely enough with trade allies to have informed views. Both reported they did not think the tiered structure generally provided a high level of motivation. As one put it, they are not "busting to get to the next level, but are happy to get there." One exception noted was a trade ally that sent out a press release upon reaching Platinum status. Neither reported any negative feedback from trade allies.

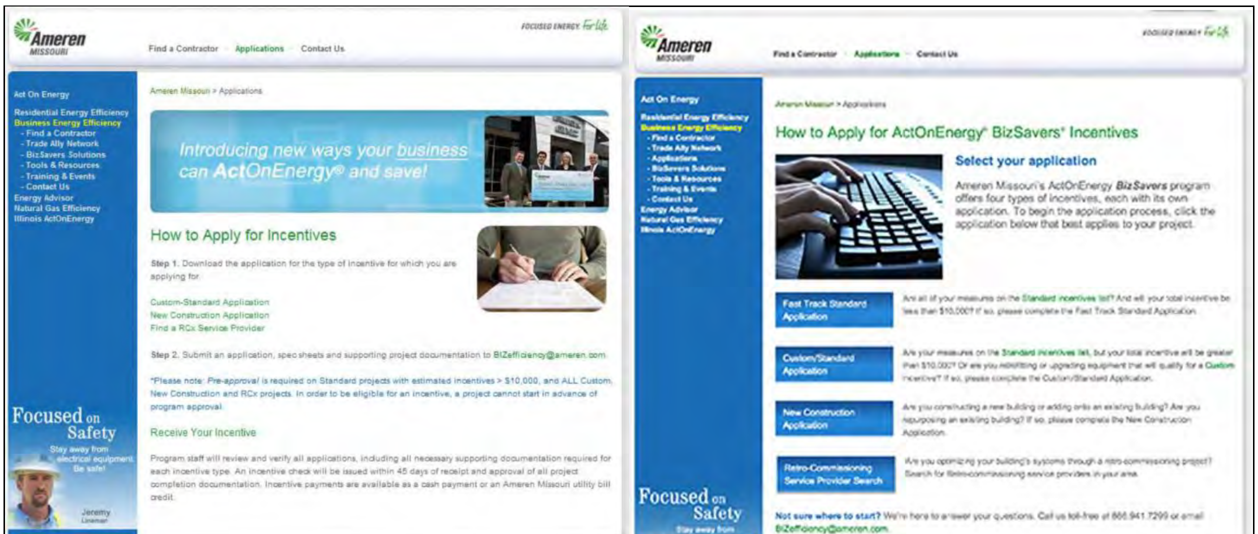
Both staff contacts indicated moderate trade ally interest in co-branding, particularly using the BizSavers logo on websites. One indicated that large trade allies often have corporate guidelines against co-branding.

The evaluation team inquired about any down sides to the tiered system, including whether the program has ever downgraded a trade ally's status. Contacts reported that they will not downgrade a trade ally's status, even if the current year's numbers do not qualify for a status previously achieved. A related concern is that often multiple trade allies will work together on a project – one may sell it while another installs it – but whichever one submitted the paperwork is the one that receive the credit. Program staff are reviewing both of these issues.

5.2.5. Program Application Processes

The process evaluation for the 2013 program year concluded that lack of clarity in application instructions may cause customers to delay or even abandon an efficiency upgrade project. Program staff reported efforts to improve program processes, including the application process. In addition to introducing the Fast Track application for standard incentives up to $10,000 (see Section 5.2.3.2), the program generally improved the online application, adding drop-down menus, data validation, and an overall better layout. The new tool has the look and feel of a website, with multiple "tabs" guiding navigation and is designed to make the input requirements more intuitive. It also carries out many of the calculations, rather than requiring the applicant to perform them.

The program staff also had made a series of revisions to the application webpage itself, beginning in May 2014 (Figure 5-2). The initial revision in May of 2014 introduced large icons (blue rectangles in right part of figure) identifying the application types, with text to the right of the icon describing what each application covers.



September 2013 to April 2014 May 2014 to August 2014

Figure 5-2 BizSavers Website Change in May 2014

Initially, the blue rectangular icons read: Fast Track Standard Application, Custom/Standard Application, New Construction Application, and Retro-Commissioning Service Provider Search. In August 2014, program staff introduced another revision, with separate icons for online and downloadable versions of the Fast Track Standard Application (Figure 5-3). At the same time, the icon for the custom/standard application was changed to read simply "Custom." This version of the application website does not show a separate icon for applying for standard incentives above the $10,000 cap for the Fast Track application. The explanation for the custom application *does* state that that application must be used for projects that combine custom and standard incentives or if the calculated incentive for an all-standard incentive project exceeds $10,000. However, a user focusing on the large print in the icons may miss this detail and become confused. As discussed in Section 5.4.9, below, the evaluation team analyzed participant survey responses to determine whether evidence exists that the website change is associated with any change in ease of finding or using applications.

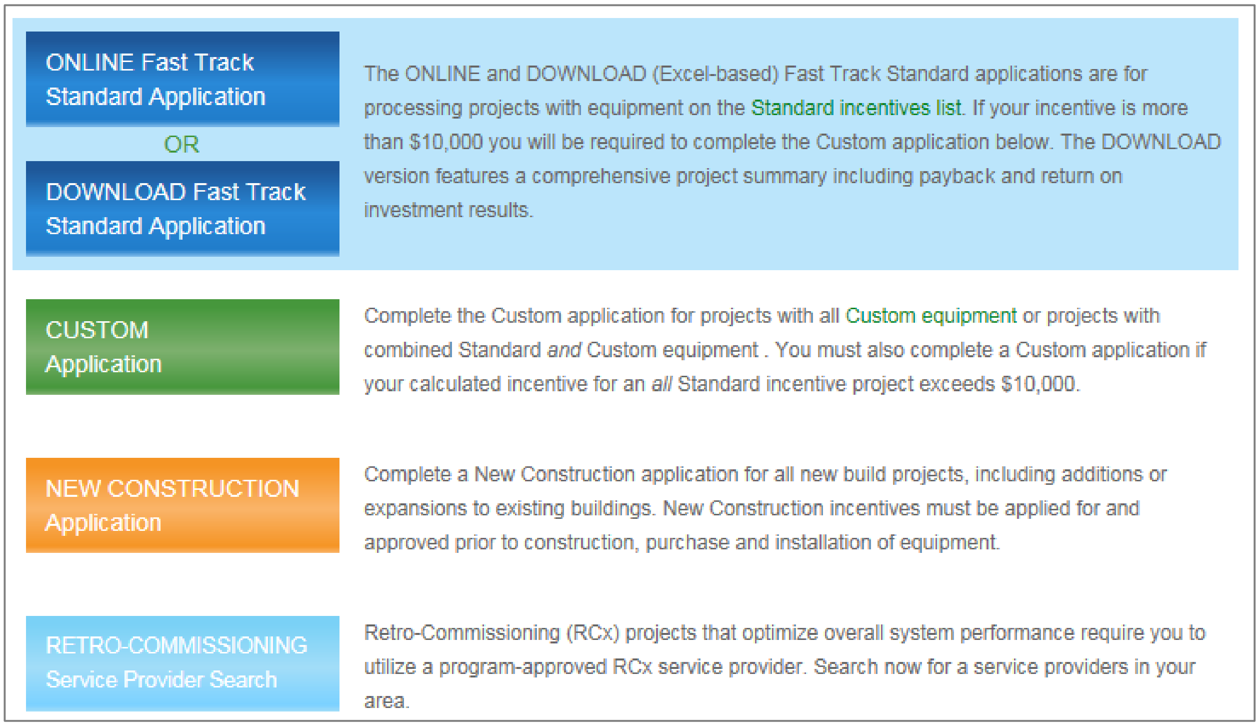


Figure 5-3 Description of Application Types from BizSavers Website

5.2.6. Project Tracking Processes

Staff contacts also reported upgrading the project tracking system (called "LM Captures") to make data easier to find. One upgrade was adding a project grouping functionality. A given participant may do multiple related upgrades under separate applications for various reasons – for example, if planning a large, comprehensive upgrade project over time, breaking it up into multiple smaller projects will allow the participant to receive incentives as discrete stages of the upgrade are completed, rather than having to wait until everything is finished. New construction projects also are often done in this manner, as various building systems have their own timelines. The project grouping functionality allows Lockheed Martin staff to track multiple projects as well as the overall effort. In addition to providing more accurate information as to when a particular effort is finalized, it allows a more accurate assessment of the total energy savings for a large, multi-stage upgrade or construction project.

Staff also reported the establishment of a new standard-only measure identifier. The project tracking database identifies the measure “buckets” that comprise each project – that is, the combinations of what is replaced and what it is replaced with. Previously, all measure buckets (e.g., a T-8 to T-5 replacement) could be used for standard, custom, new construction, and retro-commissioning projects. In September of 2014, Lockheed Martin established a new list of standard measure “buckets” specifically for the standard program with a unique measure identifier.

Program staff also modified the tracking system to generate automatic notifications when the project status changes or a milestone date occurs. When a project hits a certain stage (e.g., when an anticipated project due date occurs), Lockheed Martin generates an email to inform the participant of the change. The email is placed in the assigned project coordinator’s queue. The project coordinator reviews the email and then sends it to the participant. This automated notification system helps project coordinators stay on top of the status of their projects and facilitates prompt notification of the participant when a change or milestone occurs.

A final new feature of the tracking system is the development of an internal office “scoreboard.” The scoreboard consists of a set of charts and graphs on project metrics, populated from a daily output from LM Captures into an Excel file and displayed via a PowerPoint presentation on a television in their office. There are similar dashboards specifically for project coordinators and engineers.

5.2.7. Program Measures

Finally, the evaluation team investigated plans and activities relating to the measures that qualify for program incentives. Three topics emerged.

First, staff contacts reported that they are thinking about adding more non-lighting measures to the standard measures list. These likely would be the most common measures on custom applications. This plan is largely in response to previous evaluation’s finding that non-lighting trade allies reported lower satisfaction with the incentive application. Since non-lighting trade allies are more likely to use the custom application than the standard application, program staff reasoned that providing more standard options to them may improve their satisfaction. The challenge is to establish an incentive that will be cost effective.

On a related note, program staff noted that it takes too long to analyze and approve new measures. One staff member reported that requests from Ameren Missouri to add to or modify Lockheed Martin’s analyses can extend the process to last four to six months, and that improving the “alignment” of the process would speed it up.

Finally, staff reported on the decision to allow T-12 lighting to be used as a baseline for lighting upgrades. In the 2013 program year, a customer that upgraded from T-12s to

LEDs would get incentives based on the energy savings of a T-8 baseline. As a result, customers were leaving T-12s in place or buying new T-12s. The contact reported that allowing a T-12 baseline has induced more T-12 replacements. Despite one staff contact's concern that such midstream changes can seem inconsistent and upset customers, additional information provided by Lockheed staff to the evaluation team document reasonable efforts to educate the market about the change and market feedback indicating acceptance of it.

The evaluation team developed a side-by-side comparison of program activity that was impacted by the T-12 baseline program change (Table 5-2.) The new measure names are listed in the left-hand column, followed by comparison of how many of each measure type appeared in incentive applications, the baseline (T-12 vs. T-8) kW compared under each incentive period compared to the kW demand of the replacement measure, and in the right-column is the sum of the kW demand savings for each measure type.

Table 5-2 T-8 to T-12 Baseline Comparison

Measure Name(T12 Baseline)	*T12base Incentive* Period	*T8base Incentive* Period	*T12base Incentive* Period	*T8base Incentive* Period	*T12base Incentive* Period	*T8base Incentive* Period	*T12base Incentive* Period	*T8base Incentive* Period
Measure Name	*Measures Count*		*kw Avg Baseline*		*kw Average Eff*		*kW Sum*	
102322-Lighting-T8-T8 Replacing T12	0	367		177		88	0.0	81
102349-Lighting-LED-LED Replacing T12	0	4		370		61	0.0	12
102341-Lighting-LED-LED Replacing T12	24	31	146	113	52	49	48	82
102343-Lighting-LED-LED Replacing T12	0	4		221		67	0.0	28
102337-Lighting-LED-LED Replacing T12	34	35	81	68	33	32	24	41
102345-Lighting-LED-LED Replacing T12	12	18	223	165	57	55	25	32
102339-Lighting-LED-LED Replacing T12	52	68	162	113	47	44	111	180
102348-Lighting-LED-LED Replacing T12	0	2		147		41	0.0	1
102340-Lighting-LED-LED Replacing T12	6	3	87	100	33	39	13	1
102334-Lighting-LED-LED Replacing T12	3	2	101	28	37	13	1	0.2
102332-Lighting-LED-LED Replacing T12	0	5		21		10	0	0.3
102315-Lighting-T8-T8 Replacing T12	50	46	86	68	41	47	155	70
102317-Lighting-T8-T8 Replacing T12	65	85	162	112	67	63	832	229
102319-Lighting-T8-T8 Replacing T12	22	40	138	139	90	74	31	70
102314-Lighting-T8-T8 Replacing T12	10	6	49	30	22	25	8	1
102316-Lighting-T8-T8 Replacing T12	20	7	127	85	53	56	255	5
Totals	298	723	1361	1957	533	763	1503	833

As expected, the baseline kW of the measures are higher, as the actual power of the T-12 fixture was allowed, instead of the T-8 baseline. This represents an increase in the allowed base wattage of approximately 34%, using only data with a least a sample size of five for both time periods.

There is an increase in the number of T-12 retrofit applications as of October 2014. A comparison of the measure counts demonstrates the interest in lighting projects that have pre-existing T-12 fixtures. Customers submitted incentives applications for a total of 723 measures from January to October 15, and applied for incentives for 298 measures between October 15 and December 31. These values vary somewhat within the database, depending on the project committal status in late September and early October, as to which level of T-12 was allowed. Overall, the program changes generated more lighting projects with T-12 pre-existing fixtures that would have otherwise been generated had the program change not been implemented.

5.3. Database Analysis

The evaluation team carried out an analysis of the participant database to identify characteristics of participating contractors, participants, and the projects they have done. Another purpose of the analysis is to determine how the project population compares to the broader business population from nationwide data. The analysis results show the following:

- Less than half of participating contractors are members of the Trade Ally Network (TAN), but TAN members did four-fifths of the projects completed in 2014.
- Standard and Custom projects dominated participation, with about one-fifth more Standard than Custom projects.
- The distribution of participants across building end-use types is consistent with the distribution in the population.
- Small businesses constitute a slightly smaller percentage of total program savings than their share of total building area would predict.
- The distribution of participants and project within and outside of the St. Louis metro area mirrors the distribution of businesses.
- The program delivered the incentive within 30 days after project installation for more than 99% of Fast Track/Fast Track V2 projects, but the Fast Track V2 path took significantly longer than the original Fast Track template, on average, to deliver the incentive. The program delivered the incentive within the contractually mandated 45 days for 99% of the Inspection Track projects.

5.3.1. Analysis of Completed Projects

As of the end of Q4 2014, the vast majority of completed projects continued to be in the standard and customer programs, and only 41 new construction and 22 retro-commissioning projects that were completed. The following subsection shows summary data on “All Projects” and “All Participants,” including those in the new construction and retro-commissioning programs, and shows additional detail for custom and standard projects. The subsequent subsection provides additional detail on the completed new construction and retro-commissioning projects.

5.3.1.1. All Projects

The analysis identified 1,110 unique participants with completed BizSavers projects, where the identification of a unique participant was based on the Parent Company field in the program tracking system. Those 1,110 participants collectively had completed 1,912 projects by the end of Q4 2014. While a large majority of participants had a single completed project, those participants with multiple completed projects accounted for more than half (58%) of completed projects (Table 5-3).

Table 5-3 Participants with Single and Multiple Projects

Participant Type	*Participants (n=1,110)*	*Projects (n=1,912)*
Participants with a single project	73%	42%
Participants with multiple projects	27%	58%
Total	100%	100%

Overall, the 2014 BizSavers program outperformed the previous year; the number of completed projects increased by over 50%, the number of participants and total kWh savings was nearly double of that from 2013, and average kWh savings per project and per participant were higher than the previous year (Table 5-4). While participants – on average – completed slightly fewer projects, this difference is largely due to the substantial increase in the number of participants completing projects in 2014.

Table 5-4 Completed Projects - 2013 Compared to 2014

	2013	*2014*
Number of projects	1,218	1,912
Number of participants	589	1,110
Average number of projects per participant	2.1	1.7
Total kWh Savings	74,535,202	143,992,637
Average kWh savings per project	61,195	75,310
Average kWh savings per participant	126,545	129,723

The analysis of projects completed in 2014 assessed the following participant and project characteristics: incentive type, building end-use type, building square footage, annual building kWh usage, and location (by zip code grouping).

Since a participant may have had multiple projects at multiple sites, the participant-level analysis counts some participants more than once in these analyses. Therefore, the percentages of participants across, for example, incentive types or building types sum to greater than 100%.

Completed standard projects were more common than custom projects at both project and participant levels, as shown in Table 5-5. Twenty percent of participants had projects that combined both types of measures, and those types of projects accounted for 14% of all projects.

Table 5-5 Incentive Types of Participants and Completed Projects

Incentive Type	*Participants (n=1,110)*	*Projects (n=1,912)*
Standard (with or without Custom)	67%	63%
Custom (with or without Standard)	54%	47%
Standard only	50%	51%
Custom only	37%	34%
Custom and Standard	20%	14%
New Construction	3%	2%
Retro-commissioning	2%	1%
Total	100%	100%

At both the participant and project levels, the most common building end uses were office and retail (Table 5-6). Together, those two end-use types made up nearly one-third of all projects.

Table 5-6 Building End-Use Types

Building End -Use Type	*Participants (n=1,110)*	*Projects (n=1,912)*
Office	18%	17%
Retail	17%	16%
Lodging	14%	13%
Industrial	11%	9%
Education	6%	7%
Food & Beverage Service	7%	7%
Grocery and Convenience	3%	6%
Faith-Based	7%	6%
Healthcare	3%	5%
Entertainment/Recreation	5%	5%
Warehouse	7%	4%
Gas Station	4%	3%
Other[a]	2%	2%
Total	100%	100%

[*]Other includes automotive services, government, IT/data centers, and parking garages.

Figure 5-4 shows the distribution of 2014 BizSavers non-industrial customers across building end-use types as it compares to the likely distribution of commercial buildings in the broader population. The population data are from the Commercial Buildings Energy Consumption Survey (CBECS), a nationwide survey of commercial buildings conducted by the U.S. Energy Information Administration.[19] This comparison excludes industrial customers, as CBECS addresses only commercial, non-industrial businesses.[20] Overall, the comparison indicates that the distribution of customers across building end-uses matches well with the distribution of buildings in the population.

[19] Source: http://www.eia.gov/consumption/commercial/data/archive/cbecs/cbecs2003/detailed_tables_2003/detailed_tables_2003.html.

[20] Since this comparison excludes industrial customers, the denominator for each "program" percentage is the total number of non-industrial customers. Therefore, the percentages differ somewhat from those shown in Table 5-6.

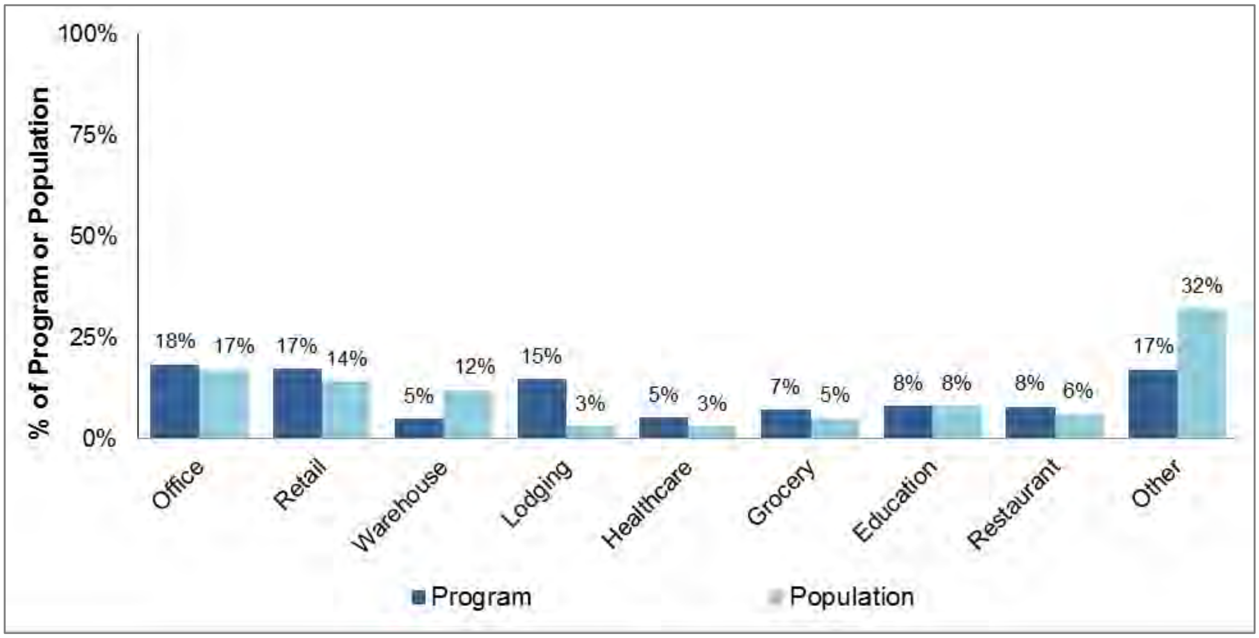


Figure 5-4 Distribution of Participants by Building End-Use Types, Compared to Population Data[a]

[a] The population data are from the Commercial Buildings Energy Consumption Survey (CBECS). The “Industrial” end-use type is not shown as that type is not included in CBECS.

Both participants and projects were fairly evenly distributed across a range of building sizes up to about 500,000 square feet, with relatively few participants or projects represented in buildings larger than that (Table-5-7). The proportion of projects completed in smaller buildings (5,000 square feet or less) was nearly double of that than 2013, suggesting that BizSavers is successfully expanding project activity in the small business population.

*Table-5-7 Building Square Footage**

Building Square Footage	*Participants (n=617)*	*Projects (n=1,135)*
Up to 5,000	10%	14%
5,001 to 10,000	6%	8%
10,001 to 25,000	10%	13%
25,001 to 50,000	10%	14%
50,001 to 100,000	10%	19%
100,001 to 500,000	13%	25%
500,001 to 1M	2%	5%
Greater than 1M	1%	2%
Total	100%	100%

*Square footage data is missing for 41% of completed projects in the Ameren Project Database.

The evaluation team examined the distribution of non-industrial 2014 BizSavers projects across building size as it compares to the distribution of commercial buildings (CBECS data only). In particular, analysts examined the distribution of BizSavers projects and savings across building size as it compares to the distribution of total commercial square footage in the population. This comparison provides an indication of whether the number of projects or savings *per square foot of building space* differs for different building size tiers.

Small facilities account for a about the same percentage of projects, but a lower percentage of overall savings, than would be expected from their share of total commercial building square footage (Table 5-8). The evaluation team hypothesized that small facilities are relatively more likely to be occupied by businesses that lease their space. If so, they would be relatively more likely to restrict their upgrades to lighting than to large capital equipment and building shell measures, which normally would be done by the building owner. The table supports this hypothesis, as the small facilities account for a relatively higher percentage of lighting savings than non-lighting savings.

*Table 5-8 Comparison of Building Square Footage to CBECS Data**

Building Square Footage	Percent of Participants with Non-Industrial Projects (n = 518)	Non-Industrial BizSaver Projects (n = 989)				Percent of Total Square Footage (CBECS)
		Percent of Projects	Percent of Savings			
			Total Savings	Lighting Savings	Non-Lighting Savings	
1,001 to 5,000	20%	15%	4%	7%	0%	10%
5,001 to 10,000	12%	8%	3%	4%	1%	10%
10,000 to 25,000	20%	13%	8%	9%	7%	18%
25,001 to 50,000	17%	14%	10%	13%	6%	13%
50,001 to 100,000	16%	18%	14%	15%	12%	14%
100,001 to 200,000	12%	12%	20%	14%	27%	14%
200,001 to 500,000	11%	11%	28%	22%	38%	10%
Over 500,000	4%	8%	12%	15%	8%	11%
Total	100%	100%	100%	100%	100%	100%

*Square footage data is missing for 41% of completed projects in the Ameren Project Database.

The findings for building annual kWh usage generally mirrored those for building size (Table-5-9).

*Table-5-9 Building Annual kWh**

Annual kWh Usage	Participants (n=1,024)	Projects (n=1,754)
Up to 50,000	18%	13%
50,001 to 100,000	14%	11%
100,001 to 500,000	34%	30%
500,001 to 1,000,000	11%	10%
1,000,001 to 5,000,000	18%	25%
5,000,001 to 10,000,000	3%	4%
Greater than 10,000,000	4%	8%
Total	100%	100%

*Eight percent of completed projects had either no annual kWh value in the database (3%) or a value of 0 (5%).

About two-fifths of participants and projects were in St. Louis, and about another two-fifths were in the immediate suburban areas (Table 5-10). Thus, St. Louis and its suburbs constituted about 80% of participants and projects. Based on county business patterns data from the U.S. Census Bureau, these areas make up a similar percentage of the business establishments and paid employees of Missouri counties with zip codes within the ranges shown.[21] This suggests that the distribution of participants and project within and outside of the St. Louis metro area mirrors the distribution of businesses.

Table 5-10 Geographical Distribution of Completed Projects

Area	*Participants (n=1,110)*	*Projects (n=1,912)*
St. Louis	43%	42%
St. Louis suburbs	40%	39%
All other areas	24%	19%
Total	100%	100%

Finally, analysts examined the time interval between completion of project installation and delivery of the incentive. Analysts did this separately for Fast Track, Fast Track V2, and Inspection Track projects. Table 5-11 shows that the program delivered the incentive within thirty days after project installation for all Fast Track projects, 99% of Fast Track V2 projects, and 93% of Inspection Track projects. Further analyses demonstrate that the new Fast Track V2 path took significantly longer (five days more on average) to deliver the incentive after completion of project installation than did the original Fast Track project template.[22] The program delivered the incentive within the contractually mandated forty-five days for all but six (1%) Inspection track projects.

[21] http://censtats.census.gov/cbpnaic/cbpnaic.shtml

[22] $p < .001$; Mann-Whitney U Test.

Table 5-11 Time from Project Installation to Incentive Delivery

Time Interval	*Fast Track Projects (n=303)*	*Fast Track V2 Projects (n=632)*	*Inspection Track Projects (n=977)*
7 days or fewer	50%	19%	8%
8 to 15 days	45%	49%	45%
16 to 30 days	6%	31%	40%
31 to 45 days	0%	1%	6%
More than 45 days	0%	0%	1%
Total	100%	100%	100%

5.3.1.2. Standard and Custom Projects

This section repeats the previous section's project-level analyses of building type, square footage, kWh usage, and location, cross-tabulated by custom or standard incentive type.[23]

Completed standard projects were more common than custom projects at both the project level and the participant level, as previously shown in Table 5-5. One-fifth of participants had projects that combined both types of measures, and those types of projects accounted for about one-sixth (14%) of all projects.

For both standard and custom projects, two of the three most common building end uses were office and retail (Table 5-12). However, standard and custom projects each had higher rates of a particular end use, respectively; industrial end uses were more common in custom projects and lodging end uses were common in standard projects.

[23] Projects that included both custom and standard measures were included in both the custom and standard cross-tallies; therefore, the cell and column totals for custom and standard projects sum to more than the cell and column totals for all projects.

Table 5-12 Building End-Use Types by Incentive Type

Building End -Use Type	*Standard (n=1,202)*	*Custom (n=907)*
Lodging	19%	4%
Office	17%	18%
Retail	15%	16%
Food & Beverage Service	10%	2%
Faith-Based	7%	4%
Grocery and Convenience	6%	7%
Entertainment/Recreation	6%	3%
Education	5%	9%
Healthcare	5%	4%
Industrial	3%	16%
Warehouse	3%	8%
Gas Station	3%	7%
Other*	1%	3%
Total	100%	100%

* Other includes automotive services, government, IT/data centers, and parking garages.

Completed standard and custom projects were fairly evenly distributed across a range of building sizes up to about 500,000 square feet, with relatively few projects represented in buildings larger than this (Table 5-13).

*Table 5-13 Building Square Footage by Incentive Type**

Building Square Footage	*Standard (n=598)*	*Custom (n=631)*
Up to 5,000	16%	13%
5,001 to 10,000	9%	8%
10,001 to 25,000	14%	14%
25,001 to 50,000	12%	16%
50,001 to 100,000	20%	18%
100,001 to 500,000	22%	25%
500,001 to 1,000,000	6%	5%
Greater than 1,000,000	2%	2%
Total	100%	100%

*Square footage data are missing for 41% of completed projects in the Ameren Project Database.

The findings for building annual kWh usage generally mirrored those for building size (Table 5-14).

*Table 5-14 Building Annual kWh by Incentive Type**

Annual kWh Usage	*Standard (n=1,113)*	*Custom (n=848)*
Up to 50,000	15%	11%
50,001 to 100,000	12%	11%
100,001 to 500,000	31%	31%
500,001 to 1,000,000	9%	12%
1,000,001 to 5,000,000	24%	22%
5,000,001 to 10,000,000	3%	5%
Greater than 10,000,000	5%	9%
Total	100%	100%

*Eight percent of completed projects had either no annual kWh value in the database (3%) or a value of 0 (5%).

The distribution of projects across zip codes was similar for the standard and custom programs, with St. Louis and its suburbs constituting about four-fifths of projects (Table 5-15). As noted previously, that percentage reflects the percentage of business establishments and of paid employees in the St. Louis metro area.

*Table 5-15 Geographical Distribution of Completed Projects**

Area	*Standard (n=1,202)*	*Custom (n=907)*
St. Louis	44%	39%
St. Louis suburbs	37%	41%
All other areas	19%	20%
Total	100%	100%

5.3.1.3. New Construction and Retro-commissioning Projects

Thirty-one parent companies completed 41 new construction projects by the end of Q4 2014. As seen in Table 5-16, new construction projects completed in 2014 were commonly industrial sites and lodging facilities and tended to be large buildings with high energy usage.

Table 5-16 Building Characteristics of Completed New Construction Projects

Building End-Use Type	*Count*
Lodging	8
Industrial	8
Office	7
Grocery and Convenience	4
Education	3
Warehouse	3
Food & Beverage Service	2
Faith-Based	2
Retail	1
Healthcare	1
Gas Station	1
Parking garage	1
Total	41
Building Square Footage	*Count*
Up to 25,000	14
25,001 to 100,000	16
100,001 to 500,000	10
Unknown	1
Total	41
Annual kWh Usage	*Count*
100,001 to 500,000	4
500,001 to 1,000,000	1
1,000,001 to 5,000,000	6
Unknown	40
Total	41

Twenty-two retro-commissioning projects completed in 2014 were completed by 17 different parent companies, primarily at industrial sites (Table 5-17). Retro-commissioning projects mostly took place in medium-to-large buildings, with the majority taking place in sites with more than 100,000 square feet and greater than 1 million in annual kWh usage.

Table 5-17 Building Characteristics of Completed Retro-commissioning Projects

Building End-Use Type	*Count*
Industrial	13
Office	3
Education	2
Healthcare	2
Entertainment/Recreation	2
Total	22
Building Square Footage	*Count*
Up to 25,000	5
25,001 to 100,000	5
100,001 to more than 1,000,000	12
Total	22
Annual kWh Usage	*Count*
100,001 to 500,000	1
500,001 to 1,000,000	1
1,000,001 to 5,000,000	9
5,000,001 to 10,000,000	5
Greater than 10,000,000	6
Total	22

5.3.2. Analysis of Contractors

The evaluation team analyzed information on all contractors associated with completed 2014 projects in the participant database; specifically, RIA looked at the percentage of contractors that were members of the TAN and of the various TAN tiers and the corresponding energy savings. Table 5-18 shows the breakdown of active contractor firms by Network membership and energy savings for 2014. Members of the BizSavers Trade Ally Network comprised less than half (43%) of contractors in the project tracking database and accounted for the large majority (83%) of savings. Platinum-level trade allies generated the most program savings—over two million kWh on average per trade ally firm for all projects completed in 2014.

Table 5-18 Trade Ally Network Membership and Energy Savings

Trade Ally Network (TAN) Membership	*Count*	*Percent of All Contractor Firms*	kWh Savings[a]	*Percent of Total kWh Savings*	*Average kWh Savings Per Trade Ally Membership Type*
TAN Member	113	43%	118,618,847	83%	1,049,724
Platinum	43	16%	90,278,999	63%	2,099,512
Gold	20	8%	15,297,007	11%	764,850
Silver	48	18%	10,514,519	7%	219,052
Not Tiered	2	1%	2,528,321	2%	1,264,161
Not TAN Member	148	57%	25,040,496	17%	169,193
Total	261	100%	143,659,343	100%	550,419

[a] Data shown are for projects completed during 2014 that have contractors identified with them in the project tracking database. Another 333,294 kWh of savings from ten projects completed in 2014 are not attributable to specific contractor firms.

5.3.3. Database Structural and Data-Entry Issues

We previously reported that the project database did not identify the trade ally for 59% of project records. This problem has since been resolved, as less than 1% of projects completed in 2014 have missing trade ally company information. Other previously reported data integrity issues have also since been resolved.

5.4. Participant Online Survey

Throughout 2014, the evaluation team invited 1,067 2014 program participants to take an online survey and received 452 unique responses, for a response rate of 42%.

The survey collected data on program awareness, customer decision-making and preferences, experience with program processes and installed equipment, satisfaction with various aspects of the program, and any new construction plans. Of the 452 surveyed respondents, nine had completed new construction projects and seven had completed a retro-commissioning project. Appendix D provides the full survey instrument.

5.4.1. Description of Sample

Of the 452 survey respondents, 53% had completed custom projects and 53% had completed standard projects (9% had completed both and were counted in both totals). In addition, nine respondents had completed new construction projects, and seven had completed a retro-commissioning project.

The following sections present combined results for all respondents associated with standard and/or custom projects, except for survey questions that were specific to a particular program. In addition, we investigated whether responses differed for standard-only respondents and those with custom-only projects, and we report any such differences.

5.4.2. Respondent Characteristics

Respondents most commonly reported a title that indicated facilities management or other facilities responsibilities (40%), while most others were the company owner, president, or a top officer or director (31%) or reported some other management or administrative responsibility (26%). The remainder (2%) reported some other title or did not respond.

Respondents represented a variety of building types. As Figure 5-5 shows, the distribution of the survey sample by building use is consistent with the distribution of the participant population, with offices, retail, and industrial facilities the most common.

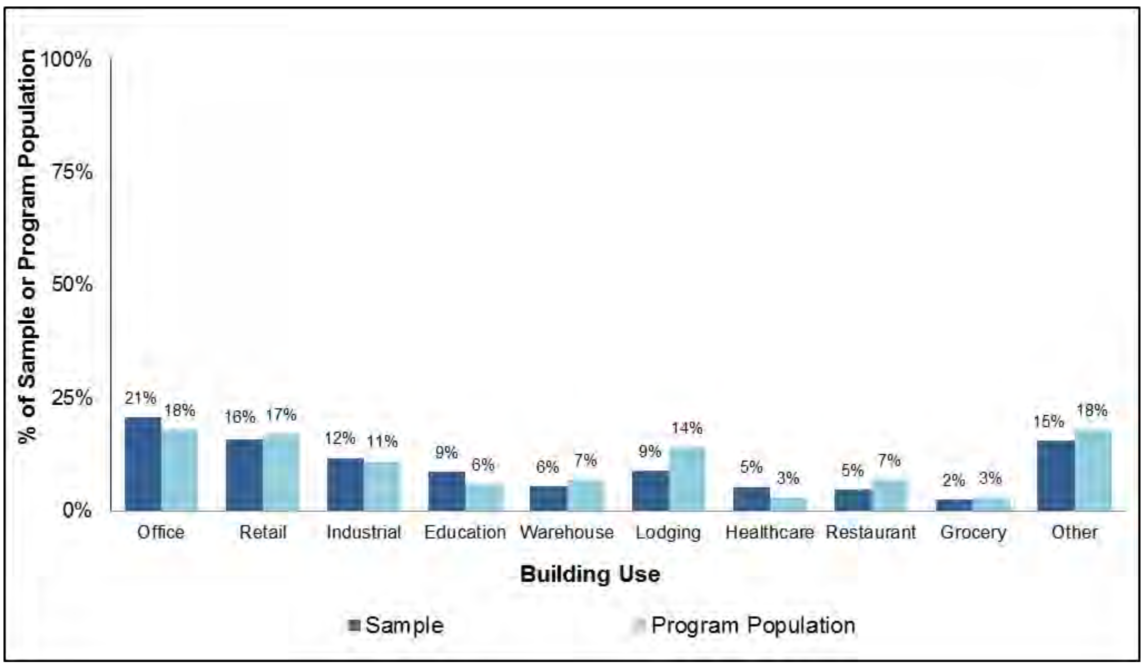


Figure 5-5 Type of Building – Sample Compared to Program Population

The size of the facility where the project occurred varied from less than 5,000 square feet (15% of respondents) to more than 1,000,000 square feet (4% of respondents). About three-quarters (71%) of respondents reported facilities of 100,000 square feet or less. As Figure 5-6 shows, the distribution of survey respondents by building size was similar to the distribution among all program participants.

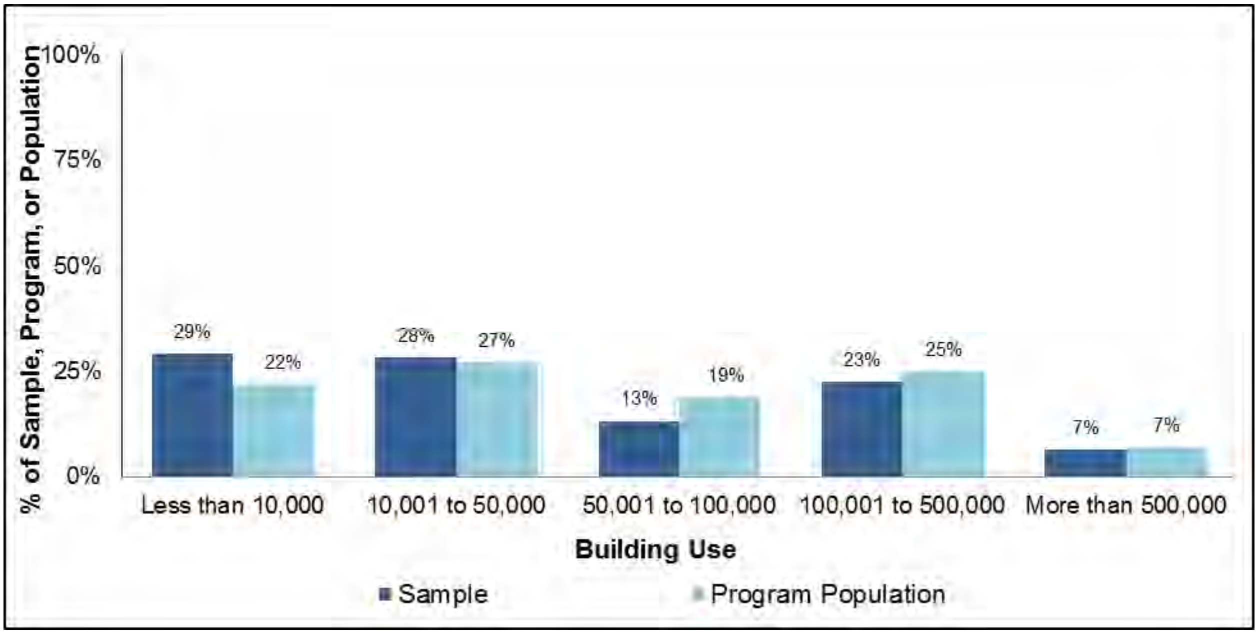


Figure 5-6 Building Size – Sample Compared to Program Population

Among respondents who reported the number of locations within Ameren Missouri territory (65% of the sample), 73% reported five or fewer locations, 19% reported six to twenty-five locations, and 9% reported more than 25 locations.

5.4.3. BizSaver Awareness

Respondents learned about the program through a variety of sources (Table 5-19). Respondents were more likely to report a source outside of Ameren Missouri or its program implementer – primarily an equipment vendor or building contractor – than an Ameren Missouri source. Face-to-face outreach (contact by an Ameren Missouri key account representative, customer account advisor or a program business development representative) reached more program participants than did program mass or direct marketing (including brochures, newsletters, and broadcast ads).

Table 5-19 Sources of Program Awareness (n=452; multiple responses allowed)

Source	Count	Percent
Contractor, vendor, consultant, etc.	293	65%
Program marketing or outreach	168	37%
Program mass or direct marketing	85	19%
Program face-to-face outreach	104	23%
Program website	49	11%
Other program outreach (e.g., “lunch and learns”)	6	1%
Sources other than Ameren or contractor, vendor, or consultant	141	31%
Past program experience	83	18%
Friend, colleague, professional association	67	15%
Do not know	6	1%
No response	1	0%

In addition to examining the percentage of respondents that reported each source of awareness, the research team also examined the percentage of project-related energy savings associated with each source. Figure 5-7 shows that, while awareness from contractor, vendor, or consultants was more common reported than program outreach or other sources of awareness, project-related savings were similar across all three sources. This finding suggests that program related outreach is responsible for a significant proportion of program savings and is an important source program awareness.

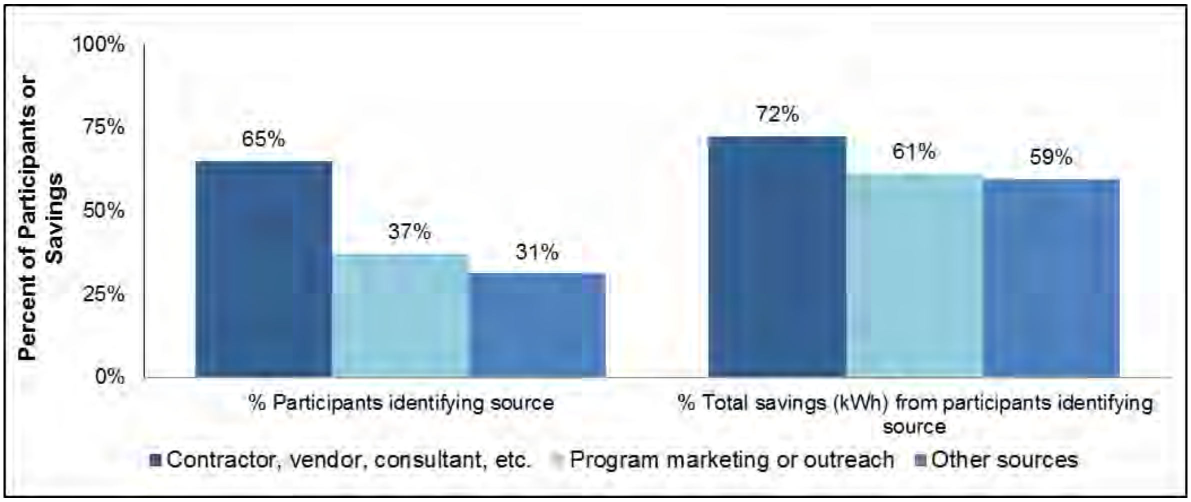


Figure 5-7 Sources of Program Awareness: Participants and Associated Savings Reached by Each Source (n = 452; multiple responses allowed)

5.4.4. Awareness of Custom Incentives and Reasons for Not Seeking Them

The survey asked the 201 respondents with standard-only projects whether they were aware of incentives for custom projects. Fifty-nine respondents (29%) reported they were aware of custom program incentives. Of those fifty-nine respondents, forty (68%) indicated they did not choose the custom program option because the standard program application covered all equipment of interest to them. Six respondents stated that the custom application seemed too complicated. An additional six respondents stated that they were not able to complete custom projects at the time, three of which cited issues related to project costs. Other responses included not wanting to fill out multiple applications (five mentions), measures not qualifying for custom incentives (two mentions), and needing help writing the proposal (one mention).

5.4.5. Proactivity in Saving Energy

The survey investigated the proactivity toward energy efficiency by asking about company policies or practices related to energy management and about the company's role in originating the upgrade project. As explained below, the findings suggest moderate proactivity.

More than half of respondents (56%) reported that their company had one or more energy-related policies, the most common of which was having an employee or employees responsible for energy monitoring or management. Fewer than 20%, however, reported having defined energy-saving goals or an energy efficient equipment purchase policy (Figure 5-8).

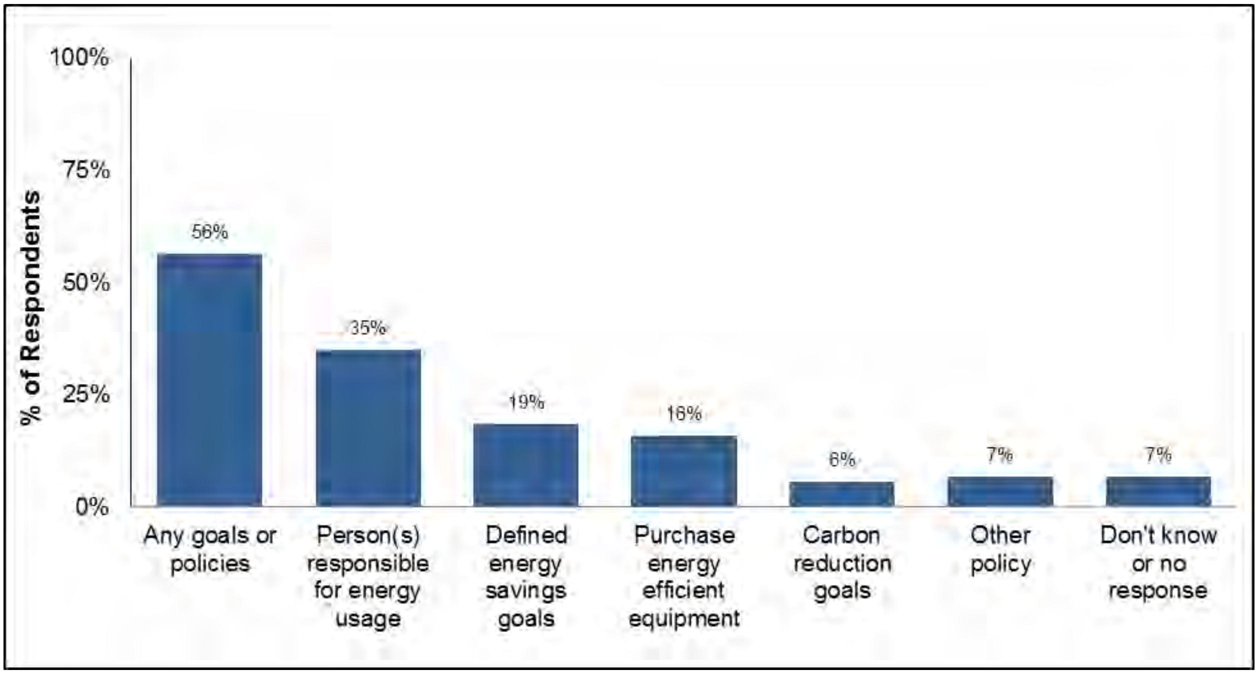


Figure 5-8 Energy Related Policies (n=452)

About two-fifths of respondents reported that a vendor or contractor presented the idea to participate in the program (34%), while slightly fewer reported that the idea originated within their organization (31%) and most others (24%) reported that the idea came up in a discussion with their vendor or contractor (Figure 5-9).

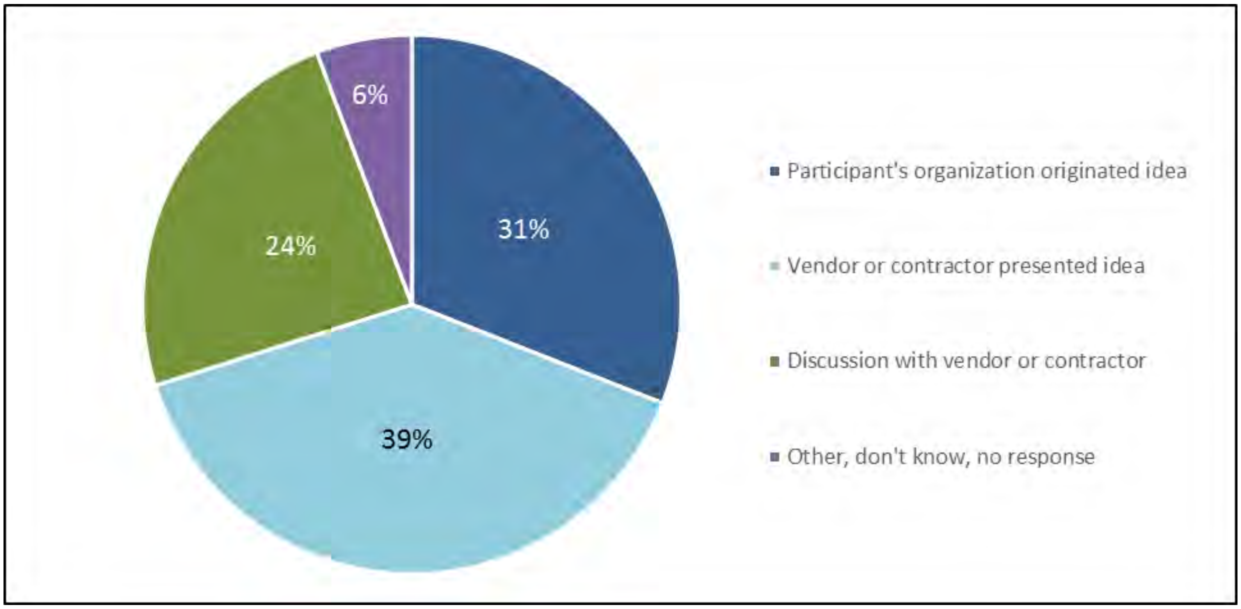


Figure 5-9 Party Initiating Discussion about Program Participation (n=452)

The evaluation team examined whether respondents that reported energy-related policies were more likely also to report that their organizations took the initiative regarding their project. Such a finding would support the view that these are indicators of a proactive approach to saving energy.

We found a relationship for two of the policies and for those who had more than one policy in place. The eighty-four respondents that reported specific energy saving goals and 158 who reported having a person responsible for energy management were more likely than who did not to say that their organization initiated the project idea (41% vs. 29% and 37% vs. 28%, respectively). Additionally, the thirty-nine respondents with two or more policies were more likely than those who had fewer polices in place to say their organization initiated the project idea (49% vs. 29%).

5.4.6. Persons Affecting Customer Decisions

Figure 5-10 shows that vendors and contractors had the greatest reported influence on the decision to install the efficient equipment. More than half said an equipment vendor had either a moderate to large (34%) or critical (28%) influence on the decision, and nearly one-third reported a moderate to large (18%) or critical (13%) influence on the part of a contractor. By contrast, 16% said that either utility staff or a BizSavers program representative had at least a moderate influence.

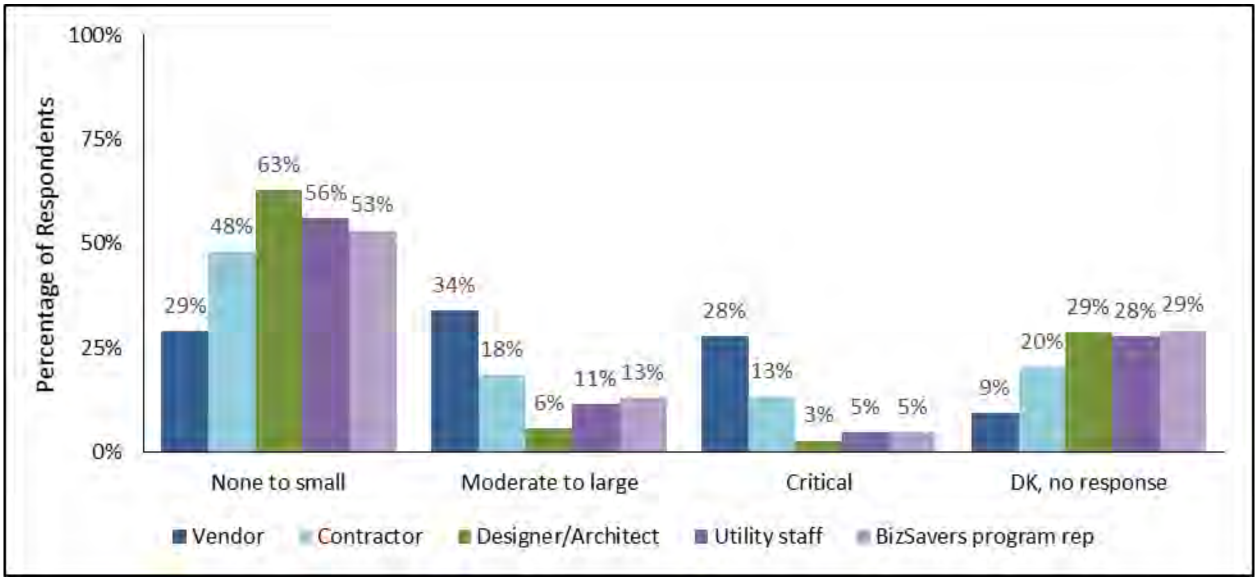


Figure 5-10 Influence of Vendors, Contractors, and Utility Staff on Decision to Install Efficient Equipment (n=439)

The respondents who reported that someone had at least a "moderate" level of influence (n = 340) were asked what that person (or people) did that influenced them. Of the sixty-seven who provided a response, thirty (45%) reported assistance with calculating savings, return on investment, or the incentive level, help with the application paperwork in general, or general assistance with project implementation. An additional twenty-four (36%) respondents indicated the person (or people) provided assistance in the form or "project approval" or "general encouragement and guidance." No more than five respondents reported any other type of assistance, and most types of assistance reported were general (e.g., "responded to questions," "assistance with equipment selection or pricing," "demonstrated equipment").

5.4.7. Customer Experience with the Application

About three-quarters of respondents reported receiving outside help in completing their applications – most commonly, a vendor (Table 5-20). However, nearly the same proportion of applicants also reported that they or a co-worker had a direct role in completing their application for incentives. About half of respondents said both they and some outside party had direct roles.

Table 5-20 Direct Experience with the Application (multiple responses allowed)

Role	*Count*	*Percent*
Any outside help	328	73%
Vendor	214	47%
Contractor	132	29%
Program representative	8	2%
Applicant*	315	70%
Applicant, with outside help	193	43%
Do not know / no response	2	0%
Total	452	100%

*Survey respondent or co-worker.

Of the 315 respondents who reported that they or a co-worker played a direct role in the application, 279 (89%) said they were directly involved. A follow-up survey question asked those 279 respondents about how they completed and submitted the application.

The program provides two versions of the application worksheets that applicants may download and complete: an Excel spreadsheet version and a PDF version. Either may be submitted as an email attachment or by fax or postal mail. More than one quarter (27%) of respondents did not know which application version they completed or did not respond to the question.[24] Of those who knew which version they completed, nearly half (44%) reported the Excel version. Most respondents (74%) reported they submitted their application as an email attachment, with those who reported using the Excel version being more likely to do so than those who used the PDF version.

Of the 251 respondents with custom projects, sixty-eight (27%) reported they had to resubmit or provide additional supporting documentation before their application could be approved. Of those sixty-eight, two-thirds (66%) reported being asked to provide additional supporting documentation, such as invoices. About one-third (32%) stated that the issue was related to how they (or their proxy) had calculated energy savings. Six respondents reported other miscellaneous issues and four said they did not know why they had to resubmit (multiple responses were allowed).

Of the 241 respondents with standard or standard-plus-custom projects, about one in ten (12%) reported the 180-day timeframe limited the types of project they might propose. The remaining respondents said either the timeframe did not impose a limit to their projects (59%) or that they did not know or did not provide a response (29%).

[24] Over two-thirds of those who did not know which version they completed reported having received outside help to complete their application, which may help explain why they were not sure which version they completed.

5.4.8. Equipment

Of 444 respondents who worked directly with a retailer, more than half (58%) reported that they had received their equipment within two weeks of ordering it from a service provider (Figure 5-11).

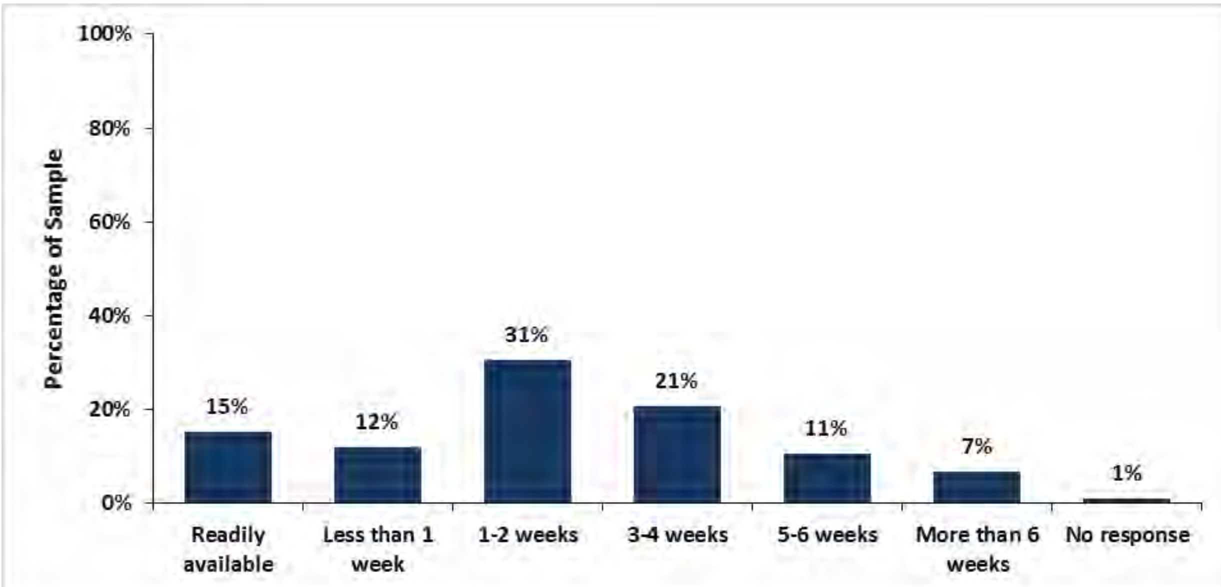


Figure 5-11 Waiting Time to Receive Equipment for Retailer (n=295)

Over two-fifths (42%) of respondents reported that a member of their staff had installed the equipment. Of the others, about one-third (35%) used a contractor they had worked with previously (Figure 5-12).

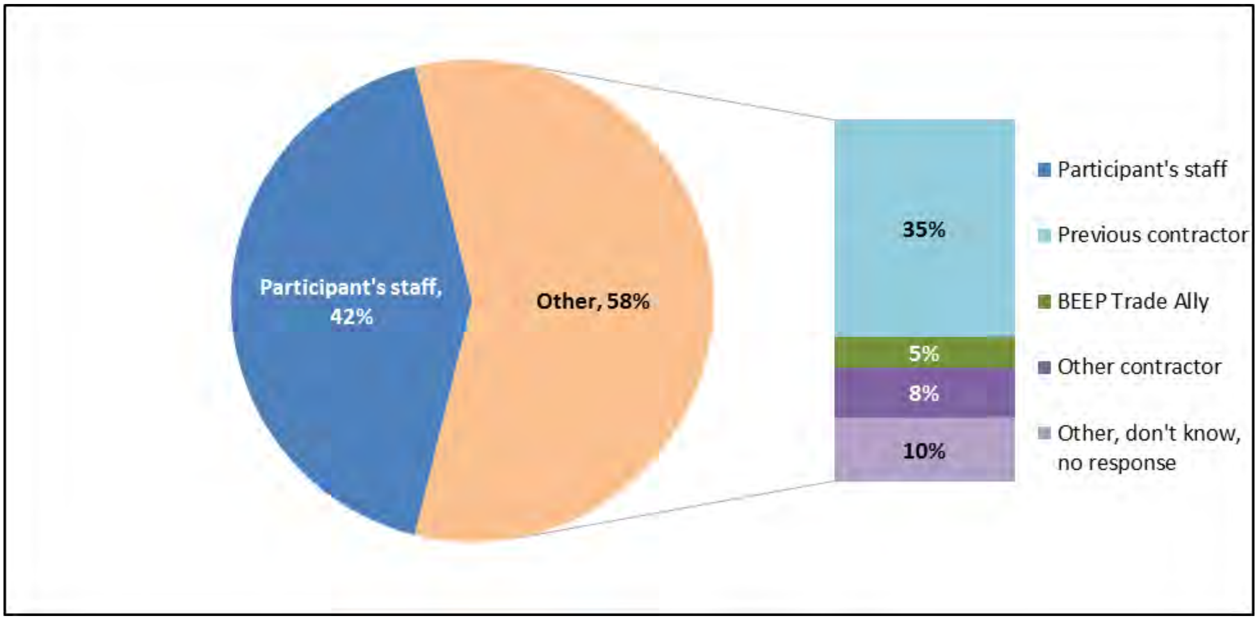


Figure 5-12 Distribution of Who Installed Project (n=451)

5.4.9. Customer Satisfaction with the Program

All respondents rated their satisfaction with the program overall and various aspects of participation.[25] On their overall experience, 81% of participants indicated high satisfaction (Figure 5-13). Satisfaction was greatest with the performance of the installed equipment and the quality of installation – those aspects of participation most directly influenced by the participant's dealings with a contractor or vendor. Satisfaction was lowest regarding the aspects of participation most directly relating to program rules and procedures – the program steps, the incentive turnaround time, and the range of eligible equipment.

[25] Responses were on a 5-point scale from 1 ("not at all satisfied") to 5 ("very satisfied").

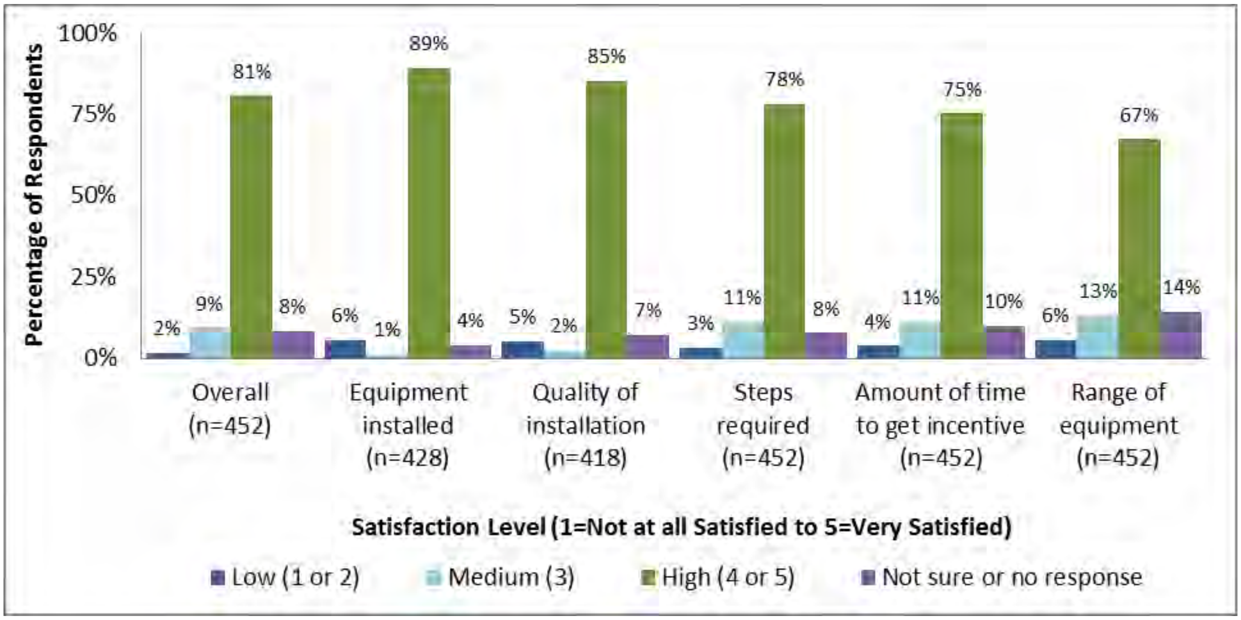


*Figure 5-13 Satisfaction with Participation**

* The percentages shown exclude respondents who indicated the question was "not applicable" (e.g., they did not install any equipment).

To obtain more detail about satisfaction with the application process, the 279 respondents who had a role in completing their application were asked to rate several aspects of their experience with the process, including the clarity of application instructions.[26] As Figure 5-14 shows, respondents gave high ratings on most indices. However, fewer than half of the respondents reported that the application instructions were clear. About two-fifths of respondents did not rate the clarity of application instructions.

[26] Responses were on a 5-point scale. For "clarity of information," the scale endpoints were defined as 1="not at all clear and to 5="completely clear." For all others, the endpoints were 1="completely unacceptable" and 5="completely acceptable."

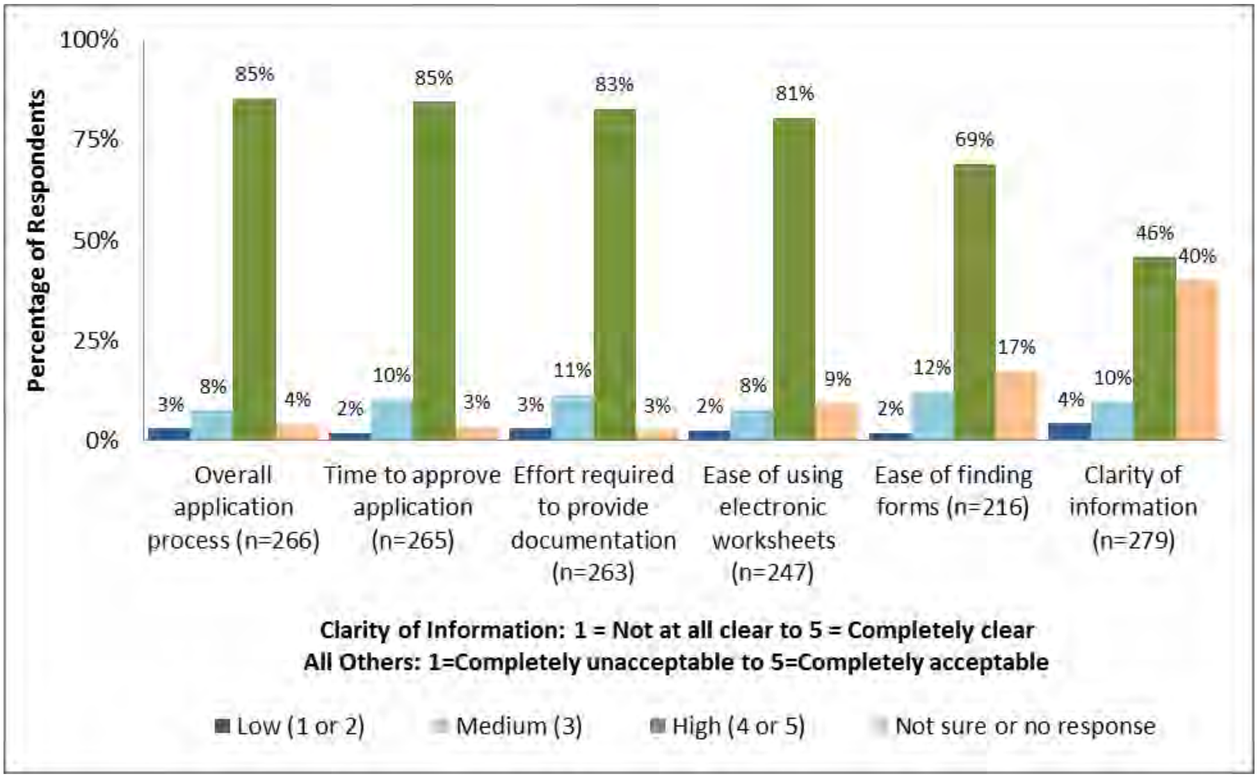


*Figure 5-14 Clarity of Application Instructions and Acceptability of Application Process**

* The percentages shown exclude respondents who indicated the question was "not applicable" (e.g., they did not obtain application forms from the program website, they were not required to provide documentation).

The evaluation team examined whether changes that program staff made in 2014 to the application website and the online application itself (Section 5.2.5) may have influenced the acceptability ratings for the above items. Those changes included: 1) the introduction in, May 2014, of large icons to guide users to the applications; and 2) a change, in August 2014, to the labeling of the icon for the custom/standard application to read "Custom," without referencing the standard application on the icon itself.

The acceptability ratings for two items – the ease of finding forms on the program website and the ease of using electronic worksheets – were lower than in 2013. Acceptability (a "4" or "5" on the five-point scale) decreased from 79% in 2013 to 69% in 2014 for ease of finding forms and from 88% to 81% for ease of using worksheets. However, we found no difference between the acceptability ratings of respondents who completed applications before and since the icon for custom/standard applications was changed to read "Custom." Therefore, it does not appear that the decrease in rated ease of finding forms and using worksheets was related to the latter change, introduced in August 2014.

Moreover, despite the above decreases in acceptability ratings, the percentage of respondents who rated the clarity of information on the application process as high increased from 29% in 2013 to 46% in 2014.[27] Still, program staff may consider reviewing the application revisions to determine whether they may have inadvertently increased the difficulty of use.

Of the 279 respondents who had a role in completing their applications, 230 (82%) said they had a clear sense of whom they could go to for assistance with the application process. Those 230 respondents were more likely than other responses to rate several aspects of the application process as acceptable (Figure 5-15). While it would make sense that those who know where to obtain application assistance would ultimately find the application process more acceptable, we cannot infer a causal relationship with any certainty. However, the fact that knowing where to go for assistance correlates with application acceptability indicates that there is a small group of participants who found the process challenging and did not know where to get help with it. These customers found a way to complete their applications and participate in the program, but their difficulty could prevent repeat participation, and they could represent a larger group of customers that did not go through with the application process.

[27] All three differences were statistically significant at $p \leq .05$ by chi-square.

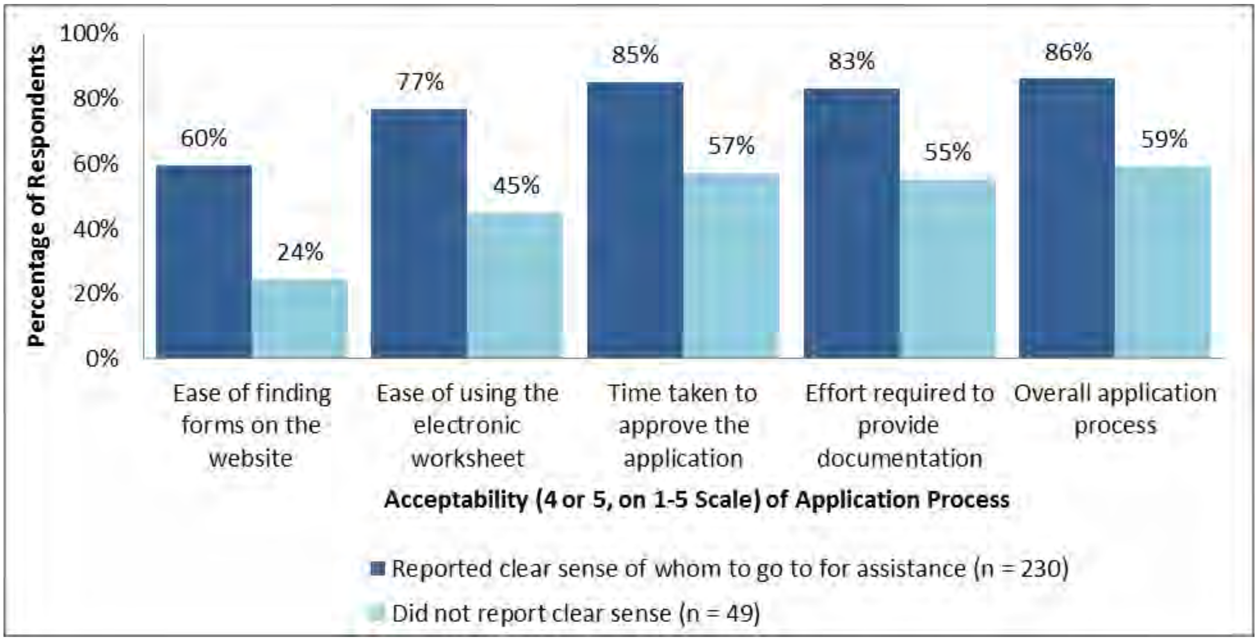


*Figure 5-15 Clarity of Application Instructions and Acceptability of Application Process**

*All differences are statistically significant by *chi-square*, at $p \leq .001$.

When asked whether they had interacted with program staff during the project, 226 of the 452 respondents (50%) reported such interactions; 178 (39%), reported no interactions; and forty-eight (11%) were not sure or did not respond. Of the 226 respondents who interacted with program staff, 203 (90%) rated the program staff as "knowledgeable" or "very knowledgeable," and the majority indicated satisfaction (a rating of 4 or 5 on a 5-point scale) with the amount of time it took program staff to address their questions or concerns (88%) and how thoroughly they addressed them (87%). Those respondents who reported interacting with program staff were significantly more likely to report knowing where to go for help during the application process than those who did not (56% vs. 28%, respectively).

About two-fifths of respondents (161 or 36%) reported that a program representative had inspected the completed project, 138 (31%) reported that no inspection occurred, and 153 (34%) did not know or did not respond. Of the 161 who reported an inspection, about three-quarters indicated high agreement (a 4 or 5 on a 5-point scale) that the inspector had been courteous and efficient (86% for both statements).

When asked how their incentive amount compared to what they had expected to receive, a large majority (78%) of respondents reported that the incentive was at least as much as they had expected (Figure 5-16).

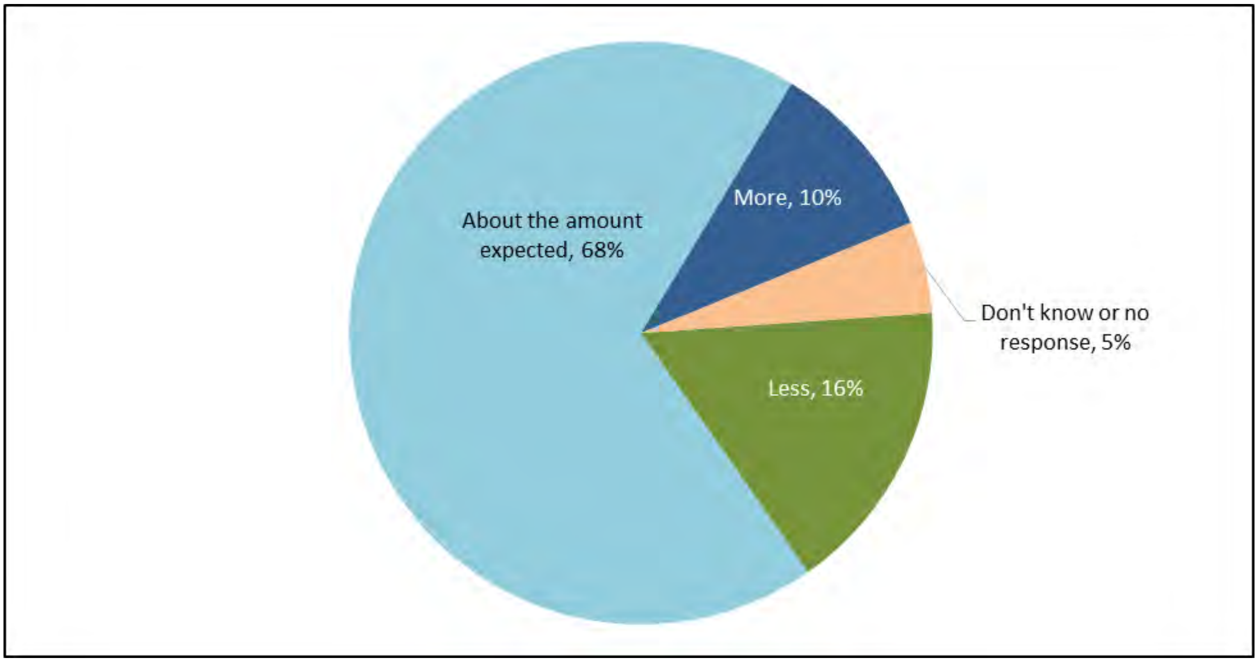


Figure 5-16 How Incentive Compared with Expectations (n=452)

5.4.10. New Construction Plans

One-hundred and forty-six respondents (33% of the total sample) reported considering undertaking a new construction or major building renovation project within the next five years. Of those, more than half (55%) were already in the design phase, and about one-third (28%) were aware of the new construction program. Awareness of the new construction program was the same for those already in the design phase and those not yet in the design phase.

5.5. Retro-Commissioning Participant In-Depth Interviews

During Q3 and Q4, the evaluation team completed in-depth interviews with seven of the nine customers that completed retro-commissioning projects in 2014. The interviews covered the quality of interactions with retro-commissioning service providers (RSPs) and the usefulness of audits; the program's comprehensiveness and focus regarding building types and measures; how well program participation requirements were defined and whether they were reasonable; and experience implementing the recommendations, including whether savings met expectations.

Interviews showed that RSPs play a pivotal role in retro-commissioning projects, from participant recruitment and throughout the project. Participants are generally highly satisfied with the program. The key suggestion for improving program success is to increase program awareness.

5.5.1. Respondent Characteristics

The program provides retro-commissioning incentives for optimizing buildings, compressed air systems, and refrigeration. Respondents tended to be large industrial facilities that averaged a few hundred employees. They completed four compressed air and two building projects. (Table 5-21). None of the projects was refrigeration optimization but as described below, one of the compressed air optimization projects led to a custom refrigeration retrofit.

Table 5-21 Respondent Summary

Building Type	*Retro-commissioning Project Type*	*Square Footage*	*Employees*	*Properties in Ameren Missouri Territory*
Industrial	Compressed air	80,000	135	3
Industrial	Compressed air	200,000	80	2
Industrial	Compressed air	475,000	210	1
Industrial	Compressed air	80,000	200	1
Industrial	Building	100,000	400	12
Non-profit	Building	504,000	400	1
Education	Building	196,00	175	1

5.5.2. Program Awareness and Involvement

All retro-commissioning participants reported some level of experience with Ameren programs in addition to their retro-commissioning program work. Of the seven participants, six did lighting projects, three completed compressed air projects, two completed HVAC upgrades, and one completed a refrigeration project.

When asked about how they became aware of the retro-commissioning program, five explicitly noted their RSP made them aware of the program. The remaining two respondents learned about the program through past project experiences with Ameren Missouri, one of whom mentioned Ameren Missouri's annual information seminar as a source of information (Table 5-22).

Table 5-22 Awareness of Retro-commissioning Program

Building Type	*BizSavers Project Experience*			*Retro-Commissioning Service Provider (RSP)*	*Source of Program Awareness*
	Lighting	*Compres-sed Air*	*Other*		
Industrial	X			Firm A	RSP
Industrial		X	Refrig.[a]	Firm A	RSP
Industrial	X	X		Firm A	RSP
Industrial	X			Firm A	RSP
Industrial	X	X	HVAC	Firm A	BizSavers experience
Non-profit	X			Firm B	BizSavers experience
Education	X		HVAC	Firm C	RSP

This refrigeration project occurred after the retro-commissioning project and took place because the RSP made the respondent aware of the available incentives.

Five of the seven participants – all industrial respondents – identified the same firm as their retro-commissioning Service Provider (RSP),[28] four of whom credited that firm with making them aware of the retro-commissioning program.

The impetus to participate in the retro-commissioning program came from the participant firm's needing or wanting an upgrade and then contacting a contractor and program staff. Participants' projects did not get started as a result of cold calling or being approached by program representatives. Instead, retro-commissioning projects began because the participants had failing equipment. As they researched how to fix or replace the failing equipment, they learned about the retro-commissioning program and available incentives to help them complete the project.

5.5.3. Feedback on Program Processes and the RSP's Role

All respondents reported that they were involved in completing the application, and six of the seven said their RSP was involved as well. Two respondents also said that a program staff person had helped with the application process. Five of the seven respondents reported that the process was relatively straightforward, and all seven rated the clarity of the information on how to complete the application as a 4 or 5 on a 5-

[28] BizSavers list of Approved Retro-commissioning contractors. http://www.ameren.com/-/media/missouri-site/Files/UEfficiency/businessenergyefficiency/BizSavers/Retro-commissioningcontractors2013.pdf (Accessed on 10/20/14). PSI is one of five of the 20 RSPs that specialize in compressed air projects.

point scale.[29] Only one respondent explicitly mentioned any challenge with the process.[30]

Six of the seven respondents reported that the assistance they received from their RSP or a program representative facilitated the process, one of whom explicitly stated that it would have been difficult without his RSP's assistance. For example, one industrial participant receiving compressed air upgrades stated, "We went to [the RSP] for a new compressor and they told us about efficiencies of new compressors and then they told us about Ameren incentives. [The RSP] did all contacts with Ameren. [The RSP] came back with a survey of the system and told us where [the] leaks were. They told us what to buy and came up with incentives and monthly savings."

Another industrial respondent noted that without the RSP's assistance, they likely would not have done the project. This respondent noted the many steps a participant has to go through to participate such as gathering data about their machines, completing applications, and seeking project approval. The RSP's assistance with these steps made the process acceptable.

Two respondents provided specific suggestions on how to improve the application process:

- One suggested that there should be a single program point of contact for RSPs. That respondent stated that his RSP was "dealing with different folks and that could be a little confusing at times."
- One suggested that the application spreadsheet should have a way for the applicant to estimate the impact of implementation costs that came in higher or lower than the study's estimate.

5.5.4. Project Decision Making

We attempted to assess how the participants and their firms determined the scope of their retro-commissioning project, including what role the RSP's recommendations played. We also asked about any assistance the RSP provided to help them maintain the improvements that resulted from the facility optimization, including any training.

Unfortunately, responses provided little insight into these topics. Respondents treated the retro-commissioning project much like a retrofit project, mainly noting that the

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[29] 1 was defined as "not at all clear" and 5 was defined as "completely clear."

[30] One respondent provided feedback on an application process, but we determined after the interview that the respondent was confusing the retro-commissioning project with a new construction project the respondent's company also had done, and the respondent's comments referred to the new construction process

projects arose from their internal decision to undertake capital improvements to reduce energy use. Two respondents did note that they received training, while one stated, “there was no training for them to do for us here.”

5.5.5. Program Satisfaction and Suggestions for Improvement

Respondents generally reported high satisfaction across seven aspects of the program. Respondents rated their satisfaction with eight aspects of the program on a 1-5 scale, where 1 was not at all satisfied and 5 was highly satisfied. Only two satisfaction ratings below 4 were given (Table 5-23).

Table 5-23 Program Satisfaction (n=6)

Building Type	*Number of Respondents Providing Satisfaction Rating (Scale of 1-5)*	
	Medium (3)	*High (4 or 5)*
Steps to go through program	1	5
Range of program measures	0	6
Process complexity	0	6
Quality of interaction with staff	0	6
Documentation requirements	0	6
Audit quality	1	5
Overall program experience	0	6

One respondent did not provide ratings, but generally characterized the process as simple. That respondent reported knowing who to go to for problems and reported no problems reported scheduling inspections.

Additionally, all respondents reported willingness to participate in any future Ameren Missouri program and all noted they received at least the incentive dollars they were anticipating, with two reporting they received more than expected. Only two modest complaints, from two respondents, were recorded about their experience with the program.

- The respondent who represented a non-profit called the quality of his audit “iffy” because “typically a lot of the energy efficiency community is young and they can be spreadsheet jockeys that have not experienced real work applications.” The implication of his comment was the report was too theoretical and not practical.
- One industrial respondent noted there were many steps to go through the program which was a bit overwhelming to him but, as discussed in Section 1.1.3, the role of his RSP made the steps manageable.

When we asked whether there was anything the program could do to keep participants better informed about the program processes, respondents did not identify any problems with this information.

However, five of the seven respondents suggested that, before their RSP brought the retro-commissioning program to their attention, they had been totally unaware of the program despite their past involvement with Ameren Missouri's efficiency programs and they would like to see more outreach about the program. One of these four hypothesized that other companies that could benefit from the retro-commissioning program were likely similarly unaware suggesting missed savings opportunities for Ameren Missouri.

5.5.6. Summary and Conclusions

Participants are highly satisfied with the program, with only minimal exceptions. They received the services they anticipated and all were satisfied with the cost savings and performance of the program measures. Increasing program awareness between C&I customers was the primary suggestion that participants offered.

RSPs play a pivotal role in retro-commissioning projects from getting participants into the program, supporting them throughout the project, and filing all necessary paperwork. The RSP guides the participant through the process, a process that often takes many months to complete. One key compressed air contractor has been instrumental in driving participants to the program and has even supported work outside of their expertise and the Retro-commissioning program. That RSP was the primary source of program information for respondents and, despite not providing refrigeration services, the RSP played an instrumental role in getting one participant to implement a custom refrigeration retrofit project.

It was not clear from the interviews how much value participants placed in the non-capital project aspects of retro-commissioning participation. Participants characterized their retro-commissioning project as less of an optimization project and more as an equipment replacement project. Retro-commissioning is about optimizing systems and identifying low- and no-cost measures for energy savings, but respondents mentioned little about these topics. In future interviews, we will probe more deeply about the low- and no-cost measures.

5.6. New Construction Participant In-Depth Interviews

According to the Ameren database, thirty-seven new construction projects were completed between July 2013 and November 2014. These projects were conducted by 27 unique organizations represented by 25 individuals.[31] During Q3 and Q4, the

[31] In two instances one person represented two company names.

evaluation team completed in-depth interviews with eleven respondents. These eleven respondents represented twelve of the twenty-seven companies that participated in the program. We were unable to reach fourteen of the individuals, representing fifteen companies, despite multiple attempts.

These interviews covered topics such as the participant's specific project, how they became aware of the New Construction program, their experiences with Ameren Missouri, and how they made decisions about the project.

Interviews revealed that participants were generally satisfied with the program. However, contractors were key drivers in project design and program staff became involved in projects after the building design, typically limiting their influence to lighting measures. Findings suggest that the chief opportunity for increased savings would be to get involved earlier in new construction projects.

5.6.1. Respondent Characteristics

The small sample and population did not permit developing a statistically representative sample. However, we compared the respondents company type (*n*=12) to the non-respondent company types (*n*=15) to determine whether there was evidence that the sample deviated from non-sampled participants in some clear way (Figure 5-17). Both respondents and non-respondents represented industrial, office, grocery, and warehouse end-uses. Respondents did not represent food and beverage, gas station, education, or healthcare end-uses. Respondents represented both lodging end-users in the population and the sole retail and faith-based end-users in the population. We did not reach the four largest projects in terms of savings; however, we did interview one of the largest savings projects as part of the retro-commissioning interviews.

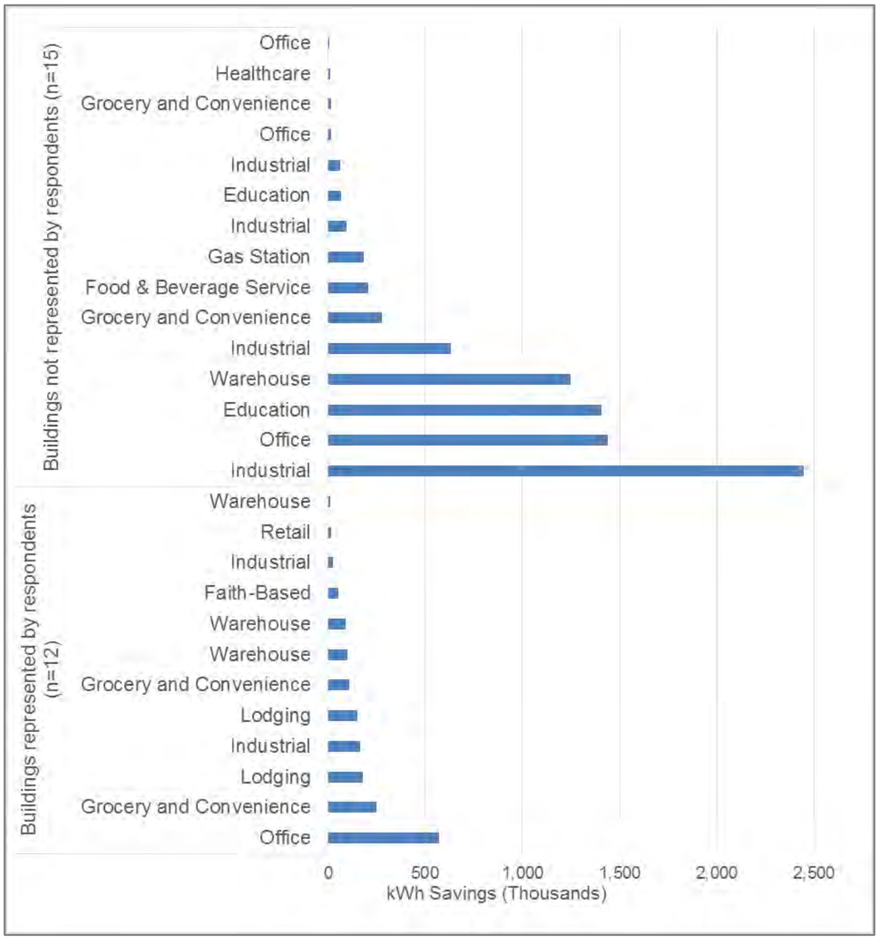

Figure 5-17: Respondent Buildings Compared to Non-Respondent Buildings

Respondents were all owners or staff of the building owners. As Table 5-24 shows, respondents represented a range of business types and building sizes. Nine of the twelve companies reported building new footprint projects, while two were building an addition and one was a major renovation to repurpose the building. All installed lighting, but two respondents noted changes to the building shell and HVAC systems and one of these pursued LEED certification.[32]

[32] The respondent was uncertain of the level of LEED certification being sought.

Table 5-24 Respondent Summary

Respondent Characteristics		**Project Characteristics**				
Building End-Use Type	*Number of Properties in Ameren Missouri Territory*	*Project Type*	*Incentive Path*	*Equipment Type*	*Square Footage**	*Number of On-Site Employees*
Auto repair	1	New footprint	Standard	Lighting	7,560	4
Industrial	1	New footprint	Standard	Lighting	10,800	8
Industrial	3	New footprint	Standard	Lighting	56,000	33
Warehouse	4	New footprint	Standard	Lighting	14,500	0
Warehouse	1	Addition	Standard	Lighting	37,000	70
Office	6	Repurpose/ renovation	Whole bldg.	Lighting, HVAC, Bldg. shell	145,000	700
Grocery	1	New footprint	Standard	Lighting	35,500	80
Grocery	7	New footprint	Standard	Lighting	4,200	27
Lodging (One respondent, two projects)	40	New footprint	Whole Bldg	Lighting, HVAC, Bldg. Shell	51,000	45
		New footprint	Whole Bldg	Lighting, HVAC, Bldg. Shell	15,000	Unk.
Warehouse	1	Addition	Standard	Lighting	35,000	190
Faith-based	1	New footprint	Standard	Lighting	14,400	14

*In most cases, these are as reported by respondent; the exception is the second lodging project, for which the evaluation team used data provided in the project database.

Respondents for the three warehouses reported that lighting was the primary electricity use in the properties. One of the warehouses, a personal storage property, did not have employees on site, supporting the claim that electricity is only for lighting at this location.

5.6.2. Program Awareness and Involvement

Respondents varied in how they became aware of the program. Four reported one of their contractors or distributors alerted them to the program. Three suggested their past experience with Ameren programs triggered their investigating incentive options for their new construction project. The remaining three respondents were first-time Ameren Missouri program participants. Of those, two said they knew of the program from Ameren Missouri sources, one from an Ameren Missouri representative and one from the Ameren Missouri website; and one heard about the program from a colleague.

The degree of involvement in the project and the program varied by customer. Three of the respondents noted that they or their staff completed the lighting installation work and the remaining reported contractors did the installation. The three respondents that reported self-install said that Ameren Missouri was *not* involved in the initial building design phase of their project, while four of the seven that reported contractor installation said that Ameren Missouri *was* involved in the design phase (Table 5-25).

Table 5-25 Degree of Program Involvement

Customer Type	*Source of Program Awareness*	*Installation Completed By*	*Program Staff Involved in Building Design Phase*
Auto repair	Distributor	Property owner	No
Warehouse	Ameren Missouri website	Property owner	No
Industrial	Referral from Local Council of Governments	Property owner	No
Warehouse	Ameren Missouri representative	Contractor	Yes
Industrial	Lighting Contractor	Contractor	No
Office	Past experience	Contractor	Yes
Grocery	Past experience	Contractor	No
Grocery	Past experience	Contractor	Don't know
Lodging	General Contractor	Contractor	Yes
	General Contractor	Contractor	Yes
Warehouse	Electrical Contractor	Contractor	Yes
Faith-based	Member of organization	Contractor	No

Of the six respondents, reporting program staff were not involved in the design phase, in hindsight, two expressed regret that their project had not involved program staff earlier. One respondent admitted that it was a mistake not to have program staff involved in the design phase, as doing so may have prevented a design problem that reduced the project's energy efficiency. This respondent reported that the juxtaposition of the HVAC duct work and the lighting created shadows that required installation of additional lights, which "increased the wattage used and lowered my incentive. This meant I shot myself in the foot…. We did not realize we should have talked to [program staff] in the design process." Similarly, the other respondent regretted she was not able to install skylights in her building, per program staff suggestions, because doing so would have required major changes to the roof design.

The respondent from the faith-based organization reported that his organization became aware of the program because of his professional capacity as a mechanical engineer that works on efficiency projects. This respondent noted that without his role in the project as a volunteer supporting his organization, the organization would not have sought program support.

All respondents noted that program representatives were key players in submitting the application for incentives. While most reported the application was "straightforward" or "great," the respondent from the auto shop (the smallest business in terms of square footage) suggested that without assistance from the program representative, she would have given up on the application, the incentives, and the efficient lighting.

5.6.3. Selection of Incentive Path

The new construction program provides three incentive paths: 1) whole building; 2) standard; and 3) custom. The whole building incentive is based on an energy modeling simulation, while the other two types are based on deemed values or engineered calculations, similar to standard and custom retrofit incentives.

As noted above, two respondents, representing three projects pursued the whole building path and installed multiple measure types, while the remaining interviewees applied for standard lighting incentives. When asked why they selected their respective incentive paths, one whole building respondent reported that his company had a sustainability policy that informed the selection of the whole building approach and the other noted he intended to keep his buildings for a "long time" and saw the whole building approach as a "long-term investment".

Of the other nine respondents, three – the warehouse respondents – reported they selected the standard path because lighting was the only or primary energy use at the properties, and so that was the only path their properties were eligible for. Five other respondents (auto repair, two industrial, and two groceries) indicated that they had been unaware of other incentive paths until their building was already under construction. The respondent representing the faith-based organization noted that they chose lighting because he, as a volunteer helping his organization, did not have time to do whole building energy modeling to pursue incentives beyond lighting. This respondent did suggest that many of the non-lighting measures installed would have likely qualified but without investing the time and effort into a model, he would not know for sure.

Given that we were unable to interview individuals representing the healthcare, food service, education, and gas station end-uses, which together constitute 20% of the new construction individuals (5 of 25), we recognize the risk in over-generalizing from these results. However, the fact that half of the interviewed respondents were aware of only the standard incentive path may point to a need for the program to work to ensure that trade allies and other service providers are better informed about the program's participation options. Furthermore, our one interview with the faith-based representative suggests there are missed savings opportunities with these types of projects because they don't have the resources to be aware of EE opportunities or the resources to apply for the program.

5.6.4. Efficiency Drivers and Expectations

Almost all respondents (10 of 11) reported an external source such as a contractor, distributor, or architect influenced their decisions about which efficiency measures to install, and half reported program staff influenced their decision about efficient measures to install (five reported influence by both a distributor or contractor and a program representative).

As noted above, one warehouse respondent described difficulties arising from not consulting with program staff during the design phase of his project. That respondent also noted that the program's involvement later in the project did not influence his efficiency decisions. Program staff recommended motion detectors, which the respondent decided not to install because he was concerned they would break and not save much energy due to frequent use.

All but one respondent reported that their incentives were at least as much as expected, and those respondents all rated their satisfaction as high (at least 4 on a 1-5 scale, where 1 means "not at all satisfied" and 5 means "very satisfied"). Two respondents, however, did report some reason for dissatisfaction (Table 5-26).

Table 5-26 Project Satisfaction

Customer Type	*Overall Project Satisfaction**	*Incentive, Compared to Expectation*
Auto repair	Satisfied	More than expected
Warehouse	Satisfied	More than expected
Warehouse	Satisfied	About as expected
Office	Satisfied	About as expected
Industrial	Satisfied	About as expected
Industrial	Not Satisfied	Less than expected
Grocery	Satisfied	More than expected
Grocery	Almost Satisfied	About as expected
Lodging	Satisfied	About as expected
	Satisfied	About as expected
Warehouse	Satisfied	About as expected
Faith-based	Satisfied	About as expected

*Satisfied was defined as anyone who scored an average above four across eight 1-5 scale satisfaction questions about the program. All others were deemed not satisfied.

The one respondent who was not satisfied said that his incentives were about half of what he had anticipated. This respondent reported that he relied on his building knowledge and consultation with the program representative in project design. According to this respondent, his distributor's role in the project was limited: "We told the lighting distributor the lumens we wanted and the height of the building and they told us the product to purchase." He cited the program representative as being responsible for this inconsistency and noted he may pursue Ameren incentives in the future, but not with the same representative.

The one respondent who was "almost satisfied" noted satisfaction with program staff and program inspections. He was dissatisfied with the number of steps he had to take to get through the program, the documentation requirements, and the range of equipment eligible for incentives. The areas of dissatisfaction were tempered by the assistance he received from his contractor and program staff.

5.6.5. Summary and Conclusions

Findings suggest that a key opportunity for increased savings is to become involved earlier in new construction projects. The new construction program staff often became involved in respondents' projects after the building design took place, limiting their ability to influence the types of measures that could be installed. Typically, because the buildings were already under construction at the time of program involvement, lighting was the only upgrade that could be implemented. Once program representatives were involved in a project, they influenced the types of equipment that was installed.

One possible way to increase savings is to improve contractors' knowledge about the program and connect knowledgeable contractors with customers. Results suggest that when contractors are more involved in the construction project, program staff become involved earlier thus increasing the odds of doing deeper savings projects.

5.7. Near-Participant In-Depth Interviews

Near-participants are organizations that initiated a BizSavers application but ultimately discontinued it before receiving any incentives. The project database records the reasons for such discontinued applications as change of ownership, lack of interest, lack of funding, or other (unidentified) reasons. The evaluation team contacted and interviewed thirty-four individuals identified as near-participants in the project database. Interviews focused on respondents' experience with the application process and reasons for discontinuing the application to provide possible insights on how to avoid loss of savings from discontinued applications.

5.7.1. Sampling Approach

As the project database shows a start date but no end date for discontinued applications, the sample frame must be defined based on the start date. The evaluation team created the sample frame for the 2013 evaluation from applications created on or before November 11, 2013, so we based the 2014 sample frame on applications created after that date.

A total of 138 customers had begun and later discontinued applications (6% of all customers that started applications). Of those, seventy-seven also had ongoing or completed projects recorded in the database. The evaluation team excluded those from the sample frame, as our previous experience with such customers suggested that in those cases, discontinuation of an application reflected a de-prioritization of that project rather than process issues. The team excluded another three customers as the program implementer had discontinued their applications as ineligible.

The remaining fifty-eight customers had discontinued an application for their own reason and did not have any ongoing or completed projects in the current program cycle. Those fifty-eight customers formed the sample of program near-participants.

5.7.2. Disposition Summary

In Q3 and Q4, we successfully contacted thirty-four of the fifty-eight customers in the frame, for a response rate of 59% (Table 5-27).

Table 5-27 Discontinued Applications Summary

Disposition	*Standard/ Custom*
Number with discontinued applications since November 11, 2013	*138*
Total sample frame	*58*
Attempted	*58*
Not contacted	*24*
Not reached	9
Incorrect number	7
Refusal	2
Duplicate contact	5
Interviewed for special investigation (see Section 5.8)	1
Contacted	*34*
Not discontinued – project in process	18
Not discontinued – project complete	6
Project cancelled or on indefinite hold	10

Of the thirty-four respondents, fifteen were the business owner, four were the president or other officer, seven were a plant, operations, or energy manager, four were a contractor, and four had other roles or did not specify.

5.7.3. Reported Application Status

Of the thirty-four respondents we were able to reach and ask about the status of their applications, twenty-four denied having a discontinued application. Of those, six reported that their projects were completed (three indicating they had received incentives) and seven reported they were installing the measure(s) for which they had applied for incentives. One respondent stated that he was told by his contractor that Ameren Missouri had denied his application; this respondent emphasized that he did not discontinue the project and he was working through his contractor to determine what went wrong with the application. The remaining ten respondents in this group noted their project was delayed for internal reasons but that they did not consider them to be abandoned. Of those ten, three projects were delayed by staffing changes, three by temporary funding issues, and one by inclement weather; one was awaiting corporate approval; one was awaiting a suitable replacement for a lighting product that was no longer available; and one was awaiting completion of another, higher-priority, project at another location.

5.7.4. Reasons for Discontinuing Application

Ten of the thirty-four respondents indicated their projects were cancelled or on hold for an indefinite time period. Only one of those ten reported abandoning the application for some reason related to their experience with the program. This one respondent, a small business owner who owns a restaurant and warehouse, reported backing out of a lighting upgrade project because of a bad program experience reported by an associate, another small business owner. According to this respondent, his associate had invested $700 with a service provider but never received any program services. This respondent chose not to work with the service provider and the program because it seemed like a “scam”.[33]

All other respondents indicated that their applications were discontinued for internal company reasons or (in one case) did not specify a reason other than project discontinuation.

Five respondents cited insufficient funds as the reason for discontinuing the application. Of those five, two were industrial participants who, based on the results of the project study, determined that the return on investment was insufficient to proceed with the project. Another one of the five respondents, a convenience store owner, reported that emergency property repairs prevented participation in the program in the near-term. Another respondent, a product supplier, determined it was too costly to do a conversion from fluorescents to LEDs, and the fifth respondent stated only that he did not have the money to proceed in the short term.

Two firms reported that their projects were cancelled because the firm was relocating or seriously considering relocating. Therefore, it did not make financial sense to invest in a building that was about to be abandoned.

One respondent noted that the project champion left the company and no one else at the company was going to take ownership of the project to push it forward.

[33] After discussing this feedback with Ameren Missouri, the evaluation team undertook a special investigation of other projects associated with the trade ally in question, which we report on in Section 5.8.

5.7.5. Program Experience

Seven respondents provided details of their program experience. Those respondents represented a range of business types, with size ranging from fewer than 10, to 230 employees.

When asked how they came to apply for BizSavers incentives, four reported that a contractor had proposed a project and one stated that an Ameren Missouri representative had approached them, while the other two said that the plan originated within the organization. Two respondents reported that they were involved in the application process, both reporting that the process was sufficiently easy.

We asked respondents to rate their satisfaction with the steps required for participation, the range of qualifying equipment, any interactions with program staff, required documentation, any on-site inspections, the program overall, and Ameren Missouri. The scale was 1 (“not at all satisfied) to 5 (“very satisfied”). In some cases, respondents could not provide a rating (e.g., because they had no interactions with program staff or had no on-site inspection). Otherwise, in only one case did a respondent provide a satisfaction rating lower than 4. In that case, the respondent was not at all satisfied with the range of equipment because of difficulty replacing a lathe.

When asked if they would consider applying for BizSavers incentives in the future, five stated that they would. The other two refrained from responding.

5.7.6. Summary

Interviews with near-participants uncovered little evidence that program rules, staff, or processes were causing customers to discontinue applications. The fact that twenty-four of the thirty-four respondents reported that their project was complete or still in process despite the applications being classified as “discontinued” in the project database suggests an ongoing need to review the status of application. As discussed more fully in Section 5.2.6, Lockheed Martin staff have reported establishing additional procedures to monitor applications in the pipeline.

There is no suggestion that the fact that the apparently incorrect identification of these applications as discontinued will prevent their eventually being completed or have any other adverse effect on program success.

5.8. Special Investigation of a Trade Ally

As described above, one near-participant reported discontinuing the application because he had developed distrust of his contractor based on the experience of an associate that had used the same contractor. This respondent reported that his associated paid the contractor for services that were never delivered.

The evaluators reviewed the project database to identify applications associated with the contractor in question. We determined that 65% of the applications submitted by this contractor, an Ameren Trade Ally,[34] were discontinued; this is the highest percentage of discontinued projects among all contractors that completed at least ten projects. After consulting with Ameren Missouri staff, the evaluation team undertook an investigation of the experiences of all customers associated with that trade ally. The team attempted to interview all customers affiliated with the ally to attempt to determine why so many projects with this ally were discontinued and to assess the experience of those that completed projects with this trade ally.

5.8.1. Characteristics of Trade Ally X's Customers

The evaluators identified eleven customers representing fifteen projects. Of these projects, six were completed in 2014, representing just over 120,000 kWh of savings. The evaluation team was able to complete interviews with four of the eleven customers, representing seven of the fifteen projects associated with the trade ally, and partially completed interviews with three more customers representing three more projects (Table 5-28).

[34] This contractor ceased being a trade ally at some point in 2014.

Table 5-28: Summary of Trade Ally X Customers and Call Disposition

Customer	*Interview Status*	*Building Project Type*	*Project Status*	*Savings kWh*
1	Not reached	Office	Completed	6,312
2	Not reached	Retail	Discontinued	18,288
3	N/A - Ownership change	Restaurant	Completed	24,256
4	Bad number	Restaurant	Discontinued	26,782
		Restaurant	Completed	6,745
5	Partial complete	Retail	Discontinued	74,658
6	Partial complete	Retail	Discontinued	110,885
7	Partial complete	Warehouse	Discontinued	30,204
8	Complete	Grocery	Discontinued	180,788
		Grocery	Completed	41,335
		Grocery	Completed	18,373
9	Complete	Office	Completed	3,080
10	Complete	Office	Discontinued	55,183
11	Complete	Warehouse	Discontinued	27,221
		Restaurant	Discontinued	10,006

5.8.2. Findings

Of the seven full and partial respondents, five did not proceed with any project and two completed at least one project. None reported paying the trade ally in question for an audit and not receiving the promised services, as in the reported experience that sparked this investigation. However, some responses suggested that the trade ally in question, at the least, may have failed to communicate well with the customers, and at worst, may have engaged in less-than-professional practices.

In two cases, it did not appear that the customers were aware that the trade ally had filed an application in their name. One, a small retailer owner, stated he was nearing retirement and was planning to sell the business. Investing in the business did not make sense to him at the time. The other seemed surprised that an application had ever been filed on his behalf because his firm did not have the up-front money to invest in an energy saving project.

Another customer did not suggest any unethical practices, but emphasized that the trade ally in question “wanted to put solar panels in the building and they wanted us to make upgrades all at once through some sort of lease option thing.” That customer opted to do only an exterior lighting project in the short term and to continue with additional upgrades, including the solar panels, "over a few years."

The respondents that completed projects were asked about their satisfaction with their projects. One reported he was generally satisfied with the program, incentives, and his new lights but he did indicate some "sloppy" installation, including visible wires in the bottom of his refrigerated cases and some failing lights. Furthermore, this respondent has been unable to contact the trade ally in questions regarding possible warranties on the malfunctioning lights. This ally "disappeared and we can't get them back." The respondent also reported the ally hired a local electrician to do some project work and this electrician tried to help with his warranty issue but to no avail.

The other respondent reported the trade ally conducted some inspections of the installed lighting but noted that his firm purchased the lights at a local hardware retailer and performed the installation themselves. Beyond receiving this inspection from the trade ally, it was not clear from this respondent what the trade ally had accomplished for the respondent's organization. The trade ally did not even make this respondent aware of the program.

Respondents' experiences with the trade ally in question did not appear to reflect negatively on Ameren Missouri or its programs. We asked the four respondents who completed the full interview to rate their satisfaction with various aspects of program experience, from 1 ("not at all satisfied") to 5 ("very satisfied"); no respondent provided a rating below a 4. Three respondents indicated they would consider applying for BizSavers incentives in the future; the fourth did not provide a response.

5.8.3. Conclusion

Results suggest that the trade ally in question struggled to identify customers likely to proceed with projects and struggled to complete projects in a satisfactory manner. These struggles resulted in at least two unhappy customers that at least partially placed blame upon Ameren Missouri. In December of 2014, the evaluation team alerted Ameren Missouri staff to the problems these two customers experienced, and the latter worked to resolve the issues via direct contact with the customers. In addition, Lockheed Martin has removed the trade ally in question from the BizSavers trade ally network.

5.9. Non-participant Survey

During 2014, the evaluation team completed a survey with 280 Ameren Missouri customers – split approximately equally between commercial and industrial customers – that had not participated in any BizSavers program. Survey topics covered program awareness, energy decision-making, upgrades to energy-using equipment, barriers to participating in program, and interest in Ameren Missouri programs. Results of that survey are provided in this section.

Results indicate moderate program awareness, driven by BizSavers marketing and information from contractors and associates, and an increased interest in energy efficiency, possibly in part through Ameren Missouri's messaging efforts. Results also point to the importance of having defined energy-savings goals and to the key role played by contractors and vendors in equipment-related decisions.

5.9.1. Sample Development

From Ameren Missouri's database of about 174,000 nonresidential customer accounts, the evaluation team identified a population of about 147,000 unique customers. The initial survey goal was to achieve 10% precision at 90% confidence within each of four strata –large and small commercial and large and small industrial.

To guide sample development, we provisionally defined "large" as the largest 20% of customers within each sector based on average daily electric usage. Based on the population sizes, we initially estimated minimum 90/10 sample size requirements of 61 large industrial, 66 small industrial, 67 large commercial, and 67 small commercial customers. These counts summed to 261, which allowed us to exceed the minimum size requirements in one or more strata to achieve the overall total of 280 customers.

Many database records had no contact name, so we drew a stratified sample of about 9,000 records and obtained contact names and phone numbers for those records from a third-party vendor based on address and company name. This provided a sample of 3,612 records with contact information – 1,914 commercial and 1,590 industrial – which we provided to our call center contractor. That sample included all customers that had met the definition of large industrial. After exhausting that sample, the call center had still not achieved the large industrial and large commercial quotas, so we provided the call center with additional sample and instructed the call center to attempt to complete the survey with at least 140 commercial and at least 130 industrial customers.

5.9.2. Sample Disposition and Analysis

The call center completed the survey with 136 industrial customers – eighteen large and 118 small, by our provisional definition – and 144 commercial customers – 74 large and 70 small. Because of the small number of industrial respondents that met our provisional definition of "large," we redefined the size strata for industrial respondents. Small industrial providers are those with less than 100 kWh average daily usage (65) and large industrial customers were those with over 100 kWh of average daily usage (71). These values provide confidence and precision at the 90/10 level (Table 5-29).

Table 5-29 Summary of Sector and Strata (n=280)

Sector and Strata	*Count*
Commercial	144
Small	70
Large	74
Industrial	136
Small	65
Large	71

None of the survey responses differed for industrial and commercial at the $p \leq .05$ level of statistical significance. Therefore, we report all results for the combined sample.

We also examined whether responses differed based on respondent size, based on average daily usage. Although we had dichotomized the sample into large and small strata, we used the continuous usage variable for these analyses to provide greater statistical power. Since the distribution of usage was not normal, we used the nonparametric Mann-Whitney U test. We found some differences, which we report in Section 5.9.9.

5.9.3. Program Awareness

Just over half (56%) of survey respondents reported that they had been aware of Ameren Missouri incentives for energy efficiency purchases and upgrades for new and existing buildings before we surveyed them.

Among those who reported familiarity with Ameren Missouri incentives, 82% were familiar with incentives for existing buildings, but fewer reporting having known about incentives for new construction (57%) or retro-commissioning (42%). Those figures represent 46%, 32%, and 24% of the entire sample, respectively.

Respondents most commonly reported learning about Ameren Missouri incentives through advertisements, contractors or equipment vendors, internet sources, or word of mouth (Table 5-30). The relatively high percentage that cited advertisements as their source of awareness suggests that BizSavers marketing is effective.

Table 5-30 Sources of Awareness (n=158)

Source	*Percent*
Advertisement	31%
Internet source	22%
Contractor or equipment vendor	22%
Word of mouth	20%
Utility or program representative(s)	8%
News coverage	6%
Trade association	5%
Don't know	3%
Industry event	3%
Other	6%

5.9.4. Past and Planned Upgrades to Energy-Using Equipment

The survey asked about both past and planned equipment replacements, including whether past or planned replacements used efficient equipment and planned use of Ameren Missouri incentives for future replacements. Results point to an increased interest in the use of energy efficient equipment.

Just over half (52%) of respondents said they either had replaced equipment in the previous two years or planned to do so in the next two years. Somewhat more reported they had replaced equipment than planned to (41% and 31% of the sample, respectively), but nearly half of them (20% of the sample) reported both past and planned equipment replacements.

Respondents reported similar types of equipment for past and planned replacements. The most common equipment types in both cases were lighting and HVAC, with refrigeration and data/IT equipment a distant third and fourth (Table 5-31).

Table 5-31 Past and Planned Equipment Installations (n=280)

Equipment Type	*Installed New Equipment in Past 2 Years*	*Plan to Install Equipment in the Next 2 Years*	*Either Installed or Plan to Install*
Any equipment	41%	31%	52%
Lighting or lighting controls	13%	13%	21%
HVAC	14%	8%	18%
Refrigeration or freezing	5%	4%	7%
Data center or IT equipment	5%	9%	6%
Water heating	3%	1%	4%
Motors or motor controls	6%	2%	6%
Windows	2%	2%	3%
Cooking (ovens)	1%	2%	3%
Insulation	1%	1%	2%
Other	6%	3%	9%
Don't know	0%	9%	9%
No equipment	59%	69%	48%

The survey assessed past and planned use of efficient equipment in equipment replacements. Overall, 24% (27 of 114) of those who reported past replacements said that the new equipment was energy efficient ("exceeded energy efficiency codes and standards"), while 42% of those who reported planned replacement said the new equipment would be efficient. This comparison is somewhat problematic, however, as some of the respondents who reported past replacements also reported planned ones, but some did not, and some of those who reported planned replacements also reported past ones, but some did not. Therefore, we analyzed results separately for three groups: those who reported only past replacements, those who reported only planned ones, and those who reported both. The results are shown in Table 5-32.

Table 5-32 Use of Efficient Equipment in Past and Planned Equipment Installations

Group	*n*	*Replaced equipment was efficient*	*Replaced equipment will be efficient*
Have replaced equipment, but do not plan to	57	28%	n/a
Plan to replace equipment, but have not done so	31	n/a	35%
Have replaced equipment and plan to do so	57	19%	46%

The difference between those with only past or planned replacements was within the error bounds. However, among those who reported both past and planned replacements, the percentage reporting plans to use efficient equipment (46%) was much higher than the percentage who reported they had used efficient equipment in the past (19%). Subsequent analyses (not shown here) indicate that this difference is not attributable to differences in the types of equipment identified for past or planned replacements among this group.

One possible explanation for why the reported percentage of efficient equipment is higher for planned than past replacements is that this reflects a “social desirability” effect induced by the survey’s focus on energy efficiency. Such an effect may have a greater influence on reported plans, which are not yet concrete, and therefore possibly more subject to distortion, than on reports of past behavior. Another possible explanation is that is reflects a growing understanding of the value of energy efficiency in the market.

5.9.5. Influences on Equipment Upgrade Decisions

The survey also examined influences on decisions regarding equipment upgrades. Results underscore the importance of reducing operations and maintenance (O&M) costs as well as non-energy benefits, with a growing importance of “green” or energy efficiency awareness, and also point to the important role that contractors and vendors play.

We asked both the respondents who reported installing efficient equipment and those who reported plans to install efficient equipment how much influence various factors had on the decision to install that equipment. In both cases, the primary influence by far was reducing O&M costs (Table 5-33). However, non-energy benefits, such as increasing productivity and comfort, also influenced decisions.

Table 5-33 Influences on Installation of Efficient Equipment

Influencing Factor	*Influence Level (Scale is 1=No Influence to 5=Great Influence)*			
	Low (1 or 2)	*Medium (3)*	*High (4 or 5)*	*Don't know*
Past Equipment Replacements (*n* = 27)[35]				
Reducing O&M costs	7%	15%	78%	0%
Increasing productivity	37%	11%	48%	4%
Increasing comfort	26%	37%	37%	0%
Achieving a "green" image	56%	22%	22%	0%
Ameren Missouri EE-related messaging	85%	4%	11%	0%
Planned Equipment Replacements (*n* = 37)				
Reducing O&M costs	5%	3%	92%	0%
Increasing productivity	22%	22%	57%	0%
Increasing comfort	35%	16%	49%	0%
Achieving a "green" image	35%	19%	46%	0%
Ameren Missouri EE-related messaging	35%	24%	38%	3%

Interestingly, respondents reported much greater influence of two factors – Ameren Missouri energy-efficiency-related messaging and desire to achieve a "green" company image – on planned efficient replacements than past ones. This possibly supports the above hypothesis that greater planned-than-past use of efficient equipment reflects an actual change of attitude about energy efficiency.

To understand possible leverage points for motivating customers to participate in efficiency projects, we asked respondents that recently completed or have plans to complete an upgrade how much effect various market actors have on their decisions regarding building equipment. Contractors and vendors were reported to have the most effect on equipment decisions and designers and utility staff had the least influence (Table 5-34).

[35] We took each respondent's maximum influence rating across all past equipment replacements as there weren't enough cases to examine separately by equipment type.

Table 5-34 Amount of Effect Market Actors Have on Equipment Decisions (n = 145)

Market Actor	*No input*	*No effect or a small effect*	*Moderate to critical effect*
Contractor	26%	26%	46%
Retailer	22%	37%	41%
Designer or architect	52%	19%	26%
Utility representative	49%	29%	19%

The responses from these non-participants are comparable to participants' reports of how much effect these various market actors had on their decision to do the project for which they received Ameren Missouri incentives (see Section 5.4.6).

We investigated whether the influence of these market actors differed for large and small businesses. Respondents that reported large properties (those over the median square footage of 12,500) were more likely to report that designers and architects had a moderate to critical effect on their equipment upgrades than smaller property respondents (30% vs. 8%). We found no other differences based on property size or sector.

5.9.6. Barriers to Energy Efficiency and Program Participation

To investigate barriers to achieving energy efficiency through participation in the BizSavers program, where applicable, we asked respondents why they did not select efficient equipment for past or planned upgrades and why they would not apply for Ameren Missouri incentives. Responses reinforce the need for effective marketing and outreach, including information on the cost-effectiveness of efficiency upgrades to businesses, and applicant support. Taken together, they underscore the need for a well-trained trade ally network.

Of all respondents that reported past or planned equipment replacements, 107 stated that the equipment they used *did not* exceed efficiency codes and standards. We asked those respondents about their rationale for selecting standard equipment over efficient equipment. The most common response was that they did not know why their organization did not use efficient equipment. Among those who cited a reason, the most common reasons were cost issues (lack of capital or incentives are too low) and equipment-related issues, the chief of which was lack of awareness of higher efficiency options (Table 5-35).

Table 5-35 Reasons for Using Standard Instead of Efficient Equipment (n=107)

Reasons	*Percent*
Cost issues	25%
Lack of capital / high cost	22%
Incentives are too low	3%
Not aware of higher efficiency options / none available	12%
Followed contractor recommendations	8%
Energy efficiency is not a priority	5%
Not aware of Ameren Missouri incentives	4%
Too much time or trouble to apply for incentives	4%
Other	12%
Not applicable – decisions made by prop or energy management firm	5%
Don't know	32%

The 37 respondents who reported planned equipment replacements were asked to rate their likelihood of applying for Ameren Missouri incentives for planned equipment replacements. Three out of five (62%) reported a high likelihood that they would do so.[36] We asked the remaining fourteen respondents what might keep their company from applying. The most common response, given by five of the fourteen respondents, was lack of awareness or knowledge of what is available or covered. Three respondents each said they would not apply because of the time or trouble involved and because incentives would not offset the added cost. No more than one respondent indicated any other reason.

5.9.7. Policies and Decision-Making

To shed light on decision-making about energy concerns, the survey asked respondents about the types of energy-related policies and practices in place at their organization and asked what the longest payback period is that their organization would consider for capital improvement projects.

Respondents were much less likely to report energy-related policies and practices – particularly, having a person responsible for energy usage, but also having defined energy savings goals – than were program participants (compare Figure 5-18 with Figure 5-8 in Section 5.4.5, above).

[36] Likelihood was rated on a 1-5 scale, where 1 was defined as "not at all likely" and 5 was defined as "very likely." Any response of 4 or 5 was counted as "high" likelihood.

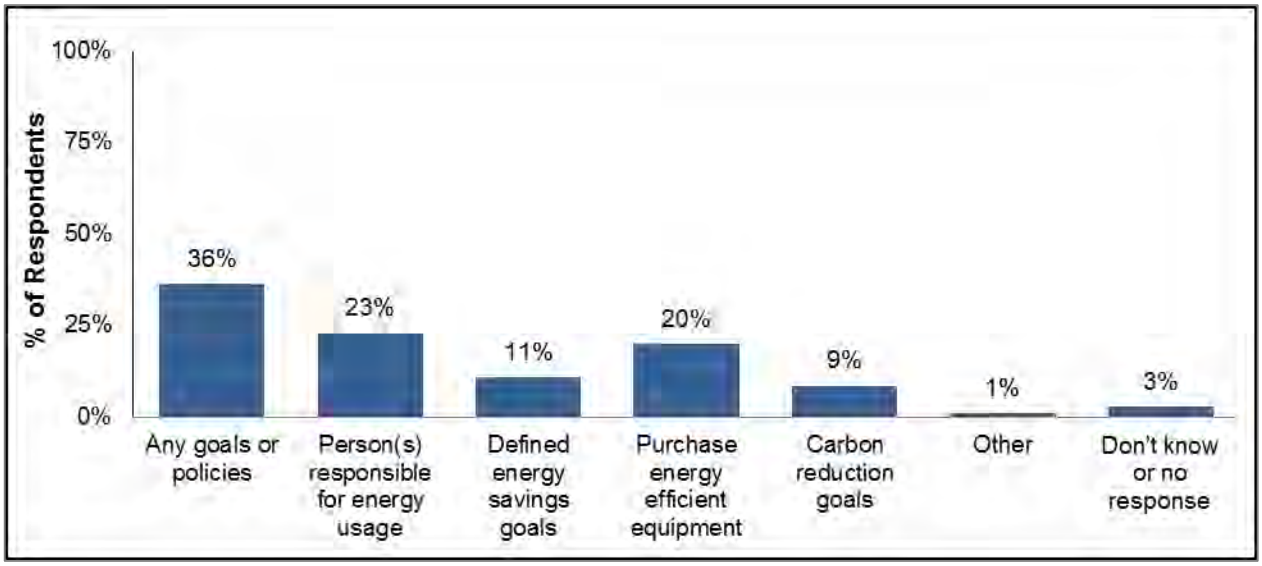

Figure 5-18 Non-Participant Energy Related Policies (n=280)

Analyses of the participant survey revealed that having defined energy savings goals was related to greater proactivity in making decisions about efficiency upgrades (see Section 5.4.5). We examined whether that might be the case for non-participants as well. We found that the percentage of non-participants who reported the use of efficient equipment in past equipment replacements was higher among those who reported defined energy savings goals (34%) than among those who did not report defined energy savings goals (20%). However, we did not observe a similar relationship regarding planned upgrades.

Respondents reported a range of maximum payback periods for equipment capital improvement projects (Table 5-36). About two-fifths (39%) reported their organization would consider paybacks of more than two years and another 10% said that it would depend on the equipment installed. The distribution of responses was not related to whether or not respondents reported defined energy savings goals.

Table 5-36 Maximum Payback Period for Equipment Upgrades

Maximum Payback Period	Percent
1 year or less	11%
More than 1, up to 2 years	7%
More than 2, up to 5 years	26%
More than 5 years	13%
It depends on the equipment installed	10%
No specific payback period	12%
Don’t know	21%

5.9.8. Interest in Ameren Missouri

To gauge the potential for growth of the retro-commissioning and new construction programs, we asked respondents about their eligibility characteristics and interest in seeking incentives for these types of projects.

5.9.8.1. Retro-commissioning

Survey results revealed that close to half (*n*=132) of all respondents indicated they were likely eligible for retro-commissioning incentives because they either had a facility with more than 100,000 square feet (*n*=41), had high-electricity-use equipment (*n* = 113), and/or used an Energy Management System (*n*=24). Of the 132, about 43% reported they were likely[37] to apply for retro-commissioning incentives. It is likely that the number that indicated eligibility based on high-electricity-use equipment overstates the actual number that would be eligible by that criterion, as the survey did not define “high-electricity-use.” Of the 113 reporting high-electricity-use equipment, 29% used less than the median average daily usage (kWh) of 114 kWh. This suggests that the actual number of customers eligible for RCx incentives is less than 132.

A total of 90 respondents indicated they were not “very likely” (5 on the 5-point scale) to apply for incentives; these respondents were asked why they chose this response. A quarter reported they did not know enough about the retro-commissioning program, and another quarter reported that despite the incentives, they were concerned about the cost of participating. Nearly one-third of respondents said the program was too much time or trouble or the energy savings were not worth the trouble (Table 5-37).

[37] Recorded scores of 4 or 5 on a scale where 1 was “not at all likely” and 5 was “very likely.”

Table 5-37 Reasons not to Apply for Retro-commissioning Incentives (n=90)

Reasons	*Count*	*%*
Don’t know enough about retro-commissioning	22	25%
Cost of participating	22	25%
Too much time or trouble	20	22%
Energy savings not worth the trouble	9	10%
Incentives are too low	5	6%
Not applicable – energy decisions made by someone else	4	4%
Prefers not to deal with utility	1	1%
Other	3	3%
Don’t know	11	12%

5.9.8.2. New Construction

About 20% of respondents (*n*=58) reported their business would undertake a new construction project within five years. Of those, more than one-third (*n*=22) stated that they were in the design phase of a current project. When asked how likely they would be to apply for incentives, about 40% reported they were likely[38] to seek incentives for their new construction project.

A total of 41 respondents indicated they were not “very likely” (5 on the 5-point scale) to apply for incentives; these respondents were asked why they chose this response. More than half the respondents reported someone else with their firm would make decisions about new construction projects and could not provide a reason. Of those that were decision makers, the largest percentage of respondents reported that applying for incentives was too much time or trouble (Table 5-38).

[38] Recorded scores of 4 or 5 on a scale where 1 was “not at all likely” and 5 was “very likely.”

Table 5-38 Reasons not to Apply for New Construction Incentives (n=41)

Reasons	*Count*	*Percent*
Not applicable – energy decisions made by someone else	24	58%
Too much time or trouble	8	20%
Don't know	6	15%
Cost	3	7%
Incentives are too low	2	5%
Will use standard equipment	1	3%

5.9.9. Differences between Large and Small Respondents

We found respondent size, as indicated by average daily usage, to be related to the responses on two items. Specifically, greater size was associated with greater a greater likelihood of having a person managing energy use and a policy to purchase energy efficient equipment. To illustrate the differences, we divided the sample into those versus lower two-thirds of the usage distribution. While 31% of the large business respondents had a person responsible for energy use, 18% of the small respondents reported such someone with that responsibility. Similarly, 25% of the large respondents reported a policy to purchase energy efficient equipment, compared to 17% of the small ones. We found no other differences related to size.

5.10. Event Survey

Ameren Missouri periodically holds informational training events for business owners and managers, as well as the contractors that serve the nonresidential sector.[39] The events covered such topics as energy efficiency upgrade concepts and BizSavers incentives. The evaluation team surveyed attendees of five of these events, asking respondents about their experience at the event and what other topics they would like to see at future BizSavers events.

The evaluators sent all attendees email invitations to take a short web-based survey. To increase response rates, the evaluators called non-responders from two of the events and invited them to complete the survey over the phone. Table 5-39 exhibits the number of survey respondents from each event. Due to small sample sizes and similarity in topics presented, all analyses aggregate the samples together.

[39] One event – the September event – was intended for trade allies only.

Table 5-39 Event Sample Sizes (n=71)

Event Month	*Count*
May	15
June	11
July	8
September	4
October	33
Total	71

As the following section demonstrates, attendees highly regarded these training events. Attendees reported high satisfaction with the events, found the content informative and the format appropriate, and subsequently were encouraged to participate in the BizSavers program in the future.

5.10.1. Respondent Characteristics

Respondents were primarily contractors, most of whom were members of the Ameren Missouri Trade Ally Network (Table 5-40). The sample collected is relatively representative of the attendees; attendee sign-in lists reveal that the great majority of attendees at these events were contractors.

Table 5-40 Event Survey Respondent Characteristics (n=71)

Respondent Type	*Count*
Contractor	59
TAN membership	
TAN member	47
Non-TAN member	6
TAN status unknown	6
Firm type	
Distributor	17
Electrical contractor	7
Food service contractor/restaurant supply	6
Energy auditor/modeler	5
Manufacturer's representative	4
Mechanical contractor	3
Sales engineering	3
Lighting specialist	3
Energy Service Company	2
Manufacturer	2
Other*	7
Business Customer**	12
Lodging	3
Government	3
Full service restaurant	2
Fast food restaurant	2
Retail	1
University	1
Total	71

* Other includes unique instances of the following: general contractor, engineering, financial services, HVAC distributor, refrigeration services, retro-commissioning agent, and consulting firm

** One respondent reported being both a contractor and a hotel owner, specifically: "owner, contractor, architect, engineer, end user customer." This respondent was recorded solely as a lodging respondent in the table above (and was not included in the contractor counts).

The events appear to be reaching a varied mix of past and current participants, and those that have yet to complete a BizSavers project. About one-half (51%) of the respondents said they had already completed a project through the program, more than one-third (37%) had not completed a BizSavers project yet, about one-tenth (11%) were unsure, and one respondent did not answer that question.

5.10.2. Event Satisfaction

Overall, attendees were satisfied with the events. All but five respondents reported that the event met or exceeded their expectations, with about two-fifths (41%) reporting that it somewhat exceeded or far exceeded expectations. Additionally, nearly all respondents rated the event as either good (30%), very good (45%), or excellent (20%).

Further demonstrating high levels of satisfaction with the event, attendees largely reported the training event they attended was the appropriate length, provided relevant examples and clearly presented information and was conveniently timed and placed (Figure 5-19). While attendees were generally satisfied with the helpfulness of the supporting materials and the comprehensiveness of the event, these two areas received the fewest “strongly agree” ratings. This suggests that these two areas have potential room for improvement.

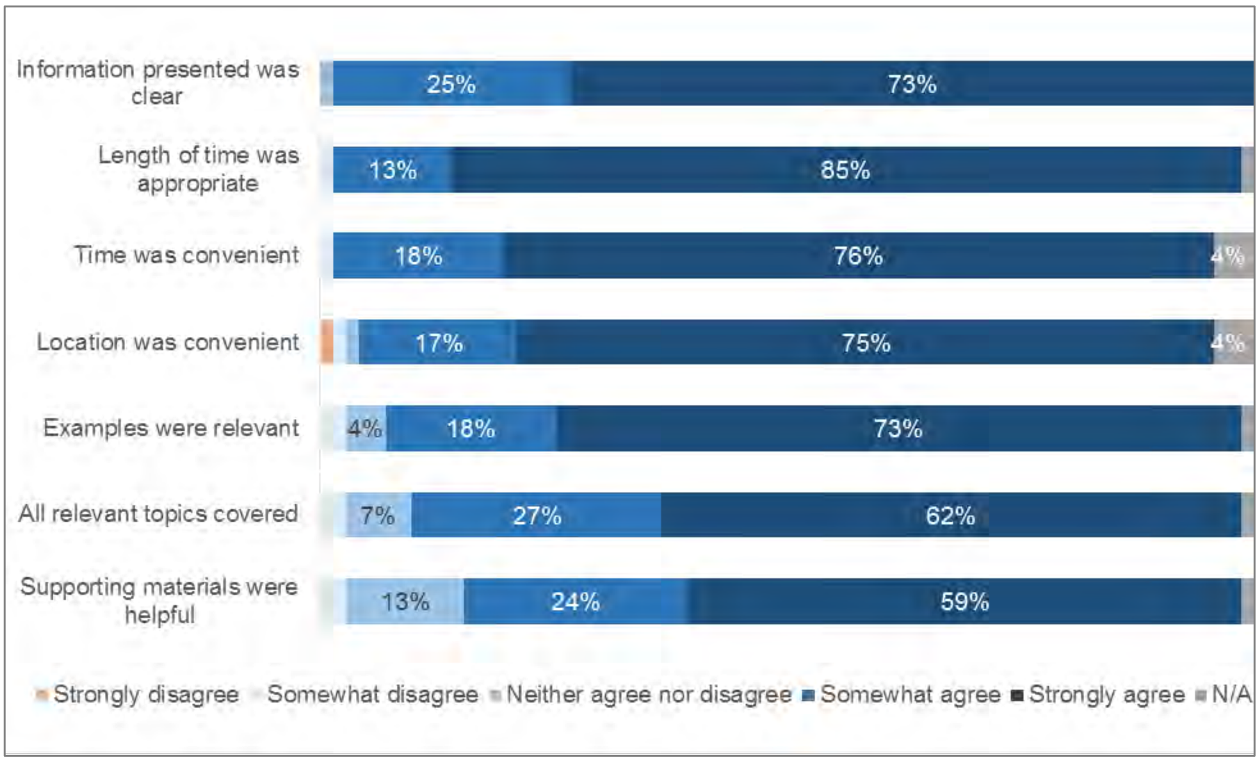

Figure 5-19 Satisfaction with Specific Event Elements (n=71)

Most attendees reported that the event they attended provided high quality information on a variety of topics (Figure 5-20). Respondents were most pleased with the information presented on BizSavers incentives.

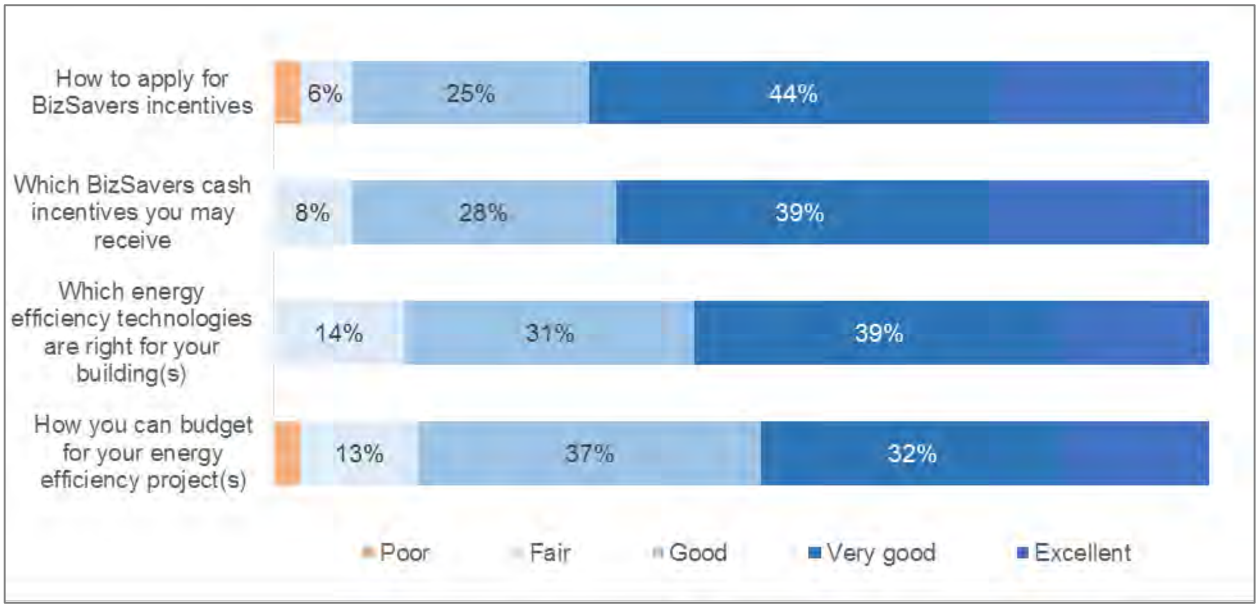

Figure 5-20 Rated Quality of Information Provided at Event (n=71)

The training event proved to be successful in cultivating and retaining participating parties, as all but five respondents indicated that the event encouraged them to work with the BizSavers program in the future (four said they were "not sure" and one said "no"). When asked what might prevent them from working with BizSavers in the future, only six mentioned any potential obstacles to participation. One restaurant employee cited "no financial support"; one TAN member referenced engineering review time and the incentive levels for newer technologies like LEDs; one TAN member said "the program is difficult to manage" and suggested free ridership may be high; one TAN member indicated that lighting training was needed; one TAN member said "lower incentives" would constitute a barrier; and another TAN member offered an indecipherable response: "Work with an Ameren trade ally".

When asked to provide any other comments about the event, most respondents (20 of the 32 who offered a comment) provided further laudatory comments, two of whom specifically praised the "hotel industry expert's case study" that was presented by an employee of said hotel at the May event. Conversely, some critical comments included: two attendees said the event needed more information on completing the "application process"; two attendees said they had trouble seeing the presentation; one attendee expressed frustration with the presenters reading from slides; one attendee said the scheduled time for the July event was incorrect; and a fast food restaurant owner mentioned that the May event was not very appropriate for restaurant owners as it "really pertained more to hotels".

5.10.3. Suggestions for Future Training Events

When asked what topics they would like covered in future BizSavers events, respondents most commonly indicated they would like to see more events focused on specific sectors, but no more than four respondents, or about 6% of the total, mentioned any particular sector (Table 5-41). Six respondents mentioned specific measures they would like to see covered at future events: two each mentioned HVAC, VFDs, kitchen appliances and refrigeration, and lighting and one each mentioned controls and thermostats.

Table 5-41 Suggested Topics for Future BizSavers Events (multiple selections allowed; n=71)

Suggested Topic	*Count*
Specific sectors	8
Food service	4
IT/data centers	2
Other sectors	3
Specific measures	6
More “how to” on application process	3
Savings calculations	3
Renewables	2
Other	7
No suggestions/don’t know	7
No response offered	39

6. Cost Effectiveness Evaluation

This chapter presents the results of the cost effectiveness evaluation of the Ameren Missouri BizSavers Program.

For each program and the BizSavers portfolio as a whole, the following cost effectiveness tests were performed: Total Resource Cost (TRC) test, Utility Cost Test (UCT), Societal Cost Test (SCT) and Participant Cost Test (PCT), and Ratepayer Impact Measure test (RIM), as defined by the California Standard Practice Manual[40]. This analysis was completed by Morgan Marketing Partners (MMP) utilizing DSMore software, referencing the same cost benefit analysis model utilized by Ameren Missouri for program development. Developed and licensed by Integral Analytics based in Cincinnati Ohio, the DSMore cost-effectiveness modeling tool takes hourly prices and hourly energy savings from the specific measures/technologies being used in the Ameren Missouri programs, and then correlates both prices and savings to weather. The software references over 30 years of historic weather variability to appropriately model weather variances. In turn, this allows the model to account for low probability, high impact weather events and apply appropriate value to them. Thus, a more accurate view of the value of the efficiency measure can be captured in comparison to other alternative supply options. Additional information on the data sources, test formulas, inputs, and methodology can be found in Appendix F: Cost Effectiveness - Critical Technical Data.

Table 6-1 shows the resulting cost benefit scores for each program and for the overall portfolio. Any score above one signifies cost effectiveness. Table 6-1 also includes the cost of conserved energy (CCE) by program, which describes the costs of acquiring the lifetime benefits of program energy savings. In addition, the present values of the UCT net lifetime benefits (net avoided costs minus program costs) are provided.

[40] California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects, October 2001

Table 6-1 Results of Cost Effectiveness Evaluation (expressed in 2013 dollars)

Variable	*Portfolio*	*Custom*	*Standard*	*New Construction*	*RCx*
UCT	7.24	8.16	6.98	6.69	4.18
TRC	2.67	2.56	3.34	1.73	4.17
RIM	.86	0.89	0.81	0.87	0.88
PCT	3.34	3.00	4.90	2.08	8.74
SCT	3.23	3.11	4.09	2.10	4.82
CCE - $/kWh	$.01	$0.01	$0.01	$0.01	$0.02
UCT Net Lifetime Benefits	$93,669,928	$55,152,500	$24,034,160	$9,096,053	$5,387,214
TRC Net Lifetime Benefits	$67,912,061	$38,346,256	$19,657,563	$4,522,258	$5,385,984

All programs pass the UCT and TRC tests.

The DSMore analysis was conducted at the individual measure level, which allows for an analysis by measure for all components of the program. Table 6-2 and

Table 6-3 and 6-4 provide measures that are underperforming or marginally performing with regards to their TRC values. Measures that had TRC values of 1 or less were included in the following tables as measures to monitor.

Table 6-2 Custom Measures to Monitor

BizSavers Custom Program				
Measure Name	*End Use*	*TRC*	*Efficient*	*Baseline*
104110-CFL-CFL <30 Watt	Lighting BUS	0.35	Compact fluorescent lamp less than 30W	Incandescent lamp
105210-Metal Halide-Ceramic Metal Halide (20-100W), Replacing Incandescent	Lighting BUS	0.90	Ceramic metal halide display lighting 20-100W	Incandescent display lighting
209010-VRV-Variable Refrigerant Volume System	HVAC BUS	0.91	Variable Refrigerant Volume Flow System	Standard Efficiency HVAC System

Table 6-3 Standard Measures to Monitor

BizSavers Standard Program				
Measure Name	*End Use*	*TRC*	*Efficient*	*Baseline*
203180-HVAC-DX-Packaged or Split System	Cooling BUS	0.22	14 SEER	13 SEER
104110-CFL-CFL <30 Watt	Lighting BUS	0.62	Compact fluorescent lamp less than 30W	Incandescent lamp
521030-Refrigerator-Open Refrigeration Case to Closed Refrigeration Case	Refrigeration BUS	0.31	Closed Refrigeration Case	Open Refrigeration Case
551010-ENERGY STAR PC (1)-Commercial Computer Networks	OFFICE BUS	0.02	ENERGY STAR 5.0 Desktop Computer	Desktop computer meeting ENERGY STAR 3.0 with a standard efficiency power supply
555010-Desktop Virtualization/Thin Client (2)-Commercial Computer Networks	OFFICE BUS	0.19	Hardware and/or software replacing desktop PC	Desktop computer meeting ENERGY STAR 3.0
999152-IT-ENERGY STAR 5.0 Desktop Computer	Lighting BUS	0.07	ENERGY STAR 5.0 Desktop Computer	Desktop computer meeting ENERGY STAR 3.0 with a standard efficiency power supply

Table 6-4 New Construction Measures to Monitor

BizSavers New Construction Program				
Measure Name	*End Use*	*TRC*	*Efficient*	*Baseline*
Guest Room Energy Management, Electric Heating	HVAC BUS	0.70	Guest Room with motion control on HVAC	Guest Room without motion control on HVAC
999125-Refrigeration-Night Covers	Refrigeration BUS	0.72	Night Cover	Cooler cases with no covers or replacing worn out covers
103510-LED-LED Case Lighting	Lighting BUS	0.87	LED Case lighting	Fluorescent case lighting
414110-Elevator-Elevator Motor Controls	Motors BUS	.30	More Efficient Elevator Motor Controls	More Efficient Elevator Motor Controls
513040-VSD Air Compressor-Install VSD Air Compressor for Trim	Air Comp BUS	.67	Install VSD Air Compressor for Trim	No Trim Capability
209010-VRV-Variable Refrigerant Volume System	HVAC BUS	.41	Variable Refrigerant Volume Flow System	Standard Efficiency HVAC System
527020-Refrigeration-Strip Curtain for Walk-in Refrigeration	Refrigeration BUS	.75	Install Strip Curtain	No Strip Curtain
557010-IT-Higher Efficiency UPS System	OFFICE BUS	.43	Higher Efficiency UPS System	Standard Efficiency UPS System
555010-Desktop Virtualization/Thin Client (2)-Commercial Computer Networks	OFFICE BUS	0.41	Hardware and/or software replacing desktop PC	Desktop computer meeting ENERGY STAR 3.0
999152-IT-ENERGY STAR 5.0 Desktop Computer	Lighting BUS	0.05	ENERGY STAR 5.0 Desktop Computer	Desktop computer meeting ENERGY STAR 3.0 with a standard efficiency power supply

These measures should be monitored carefully when planning for future years. Some of the severely underperforming measures could be removed from the program, and the funds re-allocated to better performing measures. This should be part of the annual review process when allocating funds and approving measures within each program. Other measures may be close to falling below a TRC of 1, and updates to the baselines or incremental costs could easily drop those measures into the non-cost effective range.

7. Conclusions and Recommendations

The following section summarizes conclusions and recommendations that resulted from the evaluation activities. They are organized to present impact and process findings separately. Below is a list of conclusions that characterize key trends from the impact and cost effectiveness analyses.

- The BizSavers Program has gained momentum in the commercial and industrial sector since 2013. During 2014, all four BizSavers programs exceeded energy savings targets.
- ADM engineers conducted site visits for 94 projects in 2014. The projects for which on-site measurements and verification data were collected account for approximately 29% of custom program gross ex ante kWh savings, 14% of the standard program gross ex ante kWh savings, 71% of new construction program gross ex ante kWh savings, and 67% of retro-commissioning program gross ex ante kWh savings.
- Weekly calls between ADM and Ameren Missouri were an effective strategy for facilitating interim program feedback and mid-year course corrections. ADM relayed evaluation findings to Ameren Missouri to provide staff with an understanding of what was going well and what factors were driving down project savings. ADM brought several issues to the attention of program staff that were specific to trade allies, measure types, and baseline assumptions. The implementation team utilized this real-time feedback, determined the root cause, and were able to respond accordingly.
- Overall, program level realization rates are strong with most averaging close to 100% or greater. Much more variability with realization rates exists at the project and measure level. Below are three specific findings related to measure level realization rates:
    - Within the custom and standard program, lighting controls continue to produce savings uncertainty and in turn, evaluation risk. Modifications to the program application were made to mitigate uncertainties; these modifications are further discussed below.
    - ADM applies heating and cooling interaction factors (HCIFs) to all custom and standard lighting projects, which has consistently resulted in a higher than average realization rate for lighting projects. Although the TRM states that the unity value of 1.0 for HCIF is permissible, ADM obtains the heating and cooling system information during site visits for a more accurate HCIF, and includes in all lighting and controls savings calculations,

  - Sampled retro-commissioning projects with compressed air measures often had lower than expected realization rates. Although, in all cases, ADM accepted the repaired air leak value for CFM reduction, the ex ante load calculations overestimated the baseline conditions and savings. For example, a trade ally performed pre monitoring at two of their compressed air power plants; one was a retro-commissioning project with a 75/25 split of compressor load. Pressure values at each location were averaged without weighting to provide an estimated single value pressure used in the savings profile. The result was an overestimation of energy savings impacts.
  - The estimate of 0 ex ante peak kW savings for a number of controls measures caused the high gross peak kW realization rates for the New Construction Program and the Standard Program. There are actually positive peak demand savings associated with these measures.
- Several program changes occurred mid-year, two of which have required on-going discussions and attention from the evaluation team.
  - Program application changes were implemented to mitigate the risk of underperforming lighting control measures (occupancy sensors). Lighting controls were segmented into two categories: "fixture-mounted" (installed on and controlling single fixtures) and "controlling lighting circuit" (controlling the lighting on the circuit). The customer also now has to provide the "watts per controlled unit" on the new application, where as previously the customer would only select a wattage range. The objective was to allow for more accurate incentive determination and utilization of deemed savings by improving the accuracy of the connected watts value for the sensor category selected.

    Projects evaluated in 2014 indicate that the deemed ex ante savings per unit is overestimated for the new control measure, which is based on the Ameren 2012 TRM. For example, the measure "any technology sensors from 50 watts to 120 watts” with an annual unit savings of 387 kWh implies an annual hours of use reduction between 3,225 hours and 7,740 hours, whereas the total hours of use of the weighted building hours is 5,202. Therefore, while the changes are a step in the right direction, the evaluation team believes that the deemed ex ante savings values still overestimate the measure impacts for a subset of lighting control measure types.
  - In October of 2014, program guidelines were amended to allow for lighting incentives and savings to be calculated utilizing a T-12 baseline for lighting retrofit projects with T-12 existing fixtures. Prior to the change, the savings and incentives were based on the equivalent wattage of a standard T-8. The program change is in effect for six months, from October 15, 2014 through

April 15, 2015. Additionally, project applications that were received, but not committed, prior to October 15th were eligible.

As a result, the program experienced a significant increase in the number of applications with T-12 to T-8 and T-12 to LED retrofits. From January to the end of September the number of lighting measures that fell under the T-8 guideline totaled 723 In the three-month period (October 15th – December) after the baseline change was made, 127 applications totaling nearly 300 lighting measures were submitted. Additionally, the ex ante kW savings during the enhanced incentive period totaled approximately 1,500 kW, as compared to 833 kW of demand savings from lighting projects completed in January through mid-September. The kWh savings is similar, but the kW values provide a better comparison by omitting the variability in the hours of use between the projects.

- The overall portfolio of BizSavers programs and each individual program is cost effective according to the TRC and UCT tests.

Based on the above conclusions, the evaluation team offers the following impact recommendations for consideration in planning future program cycles.

- Continuous program improvement is one of the primary goals of the evaluation. ADM suggests that Ameren Missouri modify the algorithm for calculation of savings of lighting control measures to appropriately account for participant building type, typical energy savings factor associated with control type, and actual controlled wattage.[41] Continued adherence to the TRM deemed values is likely to result in continued high variability of gross realization rates for this measure.
- ADM suggests that program staff apply heating and cooling interaction factors (HCIF) by building type, as defined in the TRM, to more accurately estimate lighting project savings. As project documentation already requires the customer to indicate the building type and space heating fuel source, applying the appropriate HCIF should not require the collection of additional information. For purposes of performing ex post evaluation of lighting project savings, ADM developed HCIFs based on energy simulation of DEER eQUEST prototypical buildings, referencing Ameren Missouri service territory weather data. Those HCIFs are shown in Table 3-11.

[41] Please see 4.5.10 Occupancy Sensor Lighting Controls in the *Illinois Statewide Technical Reference Manual* for an example of this methodology (http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Version_4/2-13-15_Final/Updated/Illinois_Statewide_TRM_Effective_060115_Final_02-24-15_Clean.pdf). Note that the specific approach outlined in that document could be employed while using building type-specific operating hours for Ameren Missouri service territory.

- To improve the gross ex ante estimations for compressed air measures, ADM suggests adding retro-commissioning compressed air projects to those that qualify for pre-installation review by both Lockheed Martin and the evaluation team. ADM is willing to review all operating assumptions and savings calculations as provided by the trade ally, in an effort to improve ex ante savings estimations prior to project approval.
- In order to improve peak kW gross realization rates, ADM recommends that the ex ante peak kW estimates for various lighting control measures for which there have been 0 ex ante peak kW savings be appropriately upwardly revised.
- The program has provided incentives for a variety of lighting retrofit ranges, such as T-12 to T-8 retrofits, T-8 to T-5 retrofits, and more recently to even higher efficiency LED lighting. Program staff should consider either continuing only the T-12 to LED measures past April 2015, or providing a relatively higher incentive per kWh saved for T-12 to LED measures. Implementing one of these courses of action, or a similar course of action aimed at increasing the likelihood of participant selection of LEDs instead of T-8 lighting, may reduce the possibility of incentivizing the same facility to step up to T-8/T-5 lighting, then again to LED lighting during following program years.

The results of the process evaluation research are largely positive. Program participant satisfaction was high across all program facets and the program exceeded its energy savings targets for all four BizSavers programs. This report provides not only the verified energy savings associated with the BizSavers program in 2014, but also an overview of program operations and suggests recommendations to be considered as the program evolves.

Below, conclusions and recommendations are organized according to the five regulatory research questions specified in 4 CSR 240-22.070(8). The conclusions address the first four questions; the fifth question speaks to recommendations.

- **Research Question 1:** What are the primary market imperfections common to target market segment?
- In the context of this process evaluation, we interpret ”market imperfection” to mean any structural barriers that prevent Ameren Missouri customers from participating in the BizSavers programs. The current evaluation results suggest that the primary barrier continues to be lack of up-front capital (which is common to most energy efficiency programs). The lack of capital issue disproportionately affects small businesses, which constitute a slightly smaller percentage of total program savings than their share of total building area would predict. Small businesses are notoriously difficult to reach, and Lockheed Martin staff reported a wide range of activities designed to improve the program’s reach into that segment. One strategy

that Lockheed has not yet employed is distributing free direct-install measures, which have been found to be a cost-effective method for achieving savings in the small business segment.[42,43,44,45]

- **Research Question 2:** Is target market segment appropriately defined, or does it need further subdivision or merging with other segments?
- As was found in the 2013 evaluation, projects were distributed across a range of business types in rough proportion to the distribution of business types in the general population, suggesting that the program is effectively reaching the main segments of the target market. As noted above, small businesses constitute a slightly smaller percentage of total program savings than their share of total building area would predict.
- **Research Question 3:** Do program measures reflect the diversity of end-use needs and available technologies for target segment?
- The range of equipment generally meets the needs of respondents. Equipment is generally delivered with little delay. Participants are largely satisfied with the quality of the installed equipment and the quality of installation. Standard program participants that decided not to pursue the custom option did so primarily because the standard option covers their equipment needs. However, one-third of surveyed participants did not find the range of qualified equipment to be acceptable although none provided details on what might be missing. One possible cause of dissatisfaction may have been a requirement that existed through most of the program year: that lighting upgrades from T-12 to more efficient lamping use T-8 as the baseline case. Program staff reported that the T-8 baseline did not provide adequate incentive for changing T-12s. Late in the year, Lockheed obtained permission to begin using a T-12 baseline, and staff reported positive feedback. The evaluation team will investigate the response to the change in baseline more formally in the 2015 evaluation.
- Retro-commissioning participants are highly satisfied with the services they received, the cost savings, and the performance of the program measures.

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[42] Fisher, M., Moran, D., and Gogte, S. (2013). Engaging Small Customers: Maximizing the Direct-Install Hook. Presented at the Association of Energy Services Professionals 23rd National Conference, January 2013.

[43] Mazur-Stommen, S. and Herzer, B. (2014). Unmined Gold. Engaging Small Commercial Customers. Presented at the Bonneville Power Administration-Northwest Energy Efficiency Alliance Efficiency Exchange Conference, Kennewick, Washington, 2014.

[44] Garland, G. (2013). Successful Tactics for Improving Customer Satisfaction in Small and Unassigned Businesses through Energy Efficiency. Presented at the Association for Energy Services Professionals National Conference, Orlando, FL, 2013.

[45] Mougne, Ti. (2013). The Playbook for Small Business Direct-Install Programs. Presented at the Association for Energy Services Professionals National Conference, Orlando, FL, 2013.

Interviewed participants tended to focus more on the equipment replacement aspects of their retro-commissioning project than the optimization aspects, which may suggest that the program might review how the optimization aspects are communicated to the participants. The evaluation team will attempt to assess understanding of the equipment optimization goals of retro-commissioning more directly in the 2015 evaluation.

- The ability of the new construction program to meet the diversity of end-use needs and available technologies may be limited by the ability of program staff to become involved before building design takes place. In interviews with 2014 program participants, the evaluation team found that staff became involved in respondents' projects after the building design took place, limiting their influence to lighting measures.
- **Research Question 4:** Are communication and delivery channels/mechanisms appropriate for the target market segment?
- The program implementer, Lockheed Martin, uses a wide range of marketing outreach channels and methods to reach end-use customers and carries out active outreach to service providers (e.g., contractors, vendors, and distributors). Engagement of services providers is important, as they are critical to program communication and delivery and play a key role in shaping upgrade decisions. In 2014, Lockheed added four full-time staff, including an outreach coordinator to coordinate between business development staff and trade allies; provided additional training to staff to improve service; and increased the size of the BizSavers Trade Ally Network by about 50%.
- Lockheed staff reported several additional efforts undertaken in 2014 to improve program awareness and participation. These include rolling out the Distributor Partnership Program (DPP) to raise program awareness, particularly among small businesses, through point-of-purchase information at local distributorships; targeted marketing and outreach to K-12 schools, the hospitality industry, government agencies, commercial kitchens, and IT data centers; implementation of the "Fast Track" standard application, which waives pre-approval for standard projects with incentives below $10,000; and revisions to the look, feel, and functioning of the online application.
- Several evaluation findings speak to the appropriateness of program communication and delivery channels and mechanisms. The non-participant survey showed moderate program awareness, driven by BizSavers marketing and information from contractors and associates. The participant survey showed that vendors and contractors were the most common source of program awareness, but program staff tended to bring in larger projects and accounted for nearly as much total savings as contractors and vendors. Only about one-third of non-participants were aware of

new construction incentives, and awareness was lower for retro-commissioning incentives.

- The 2013 evaluation reported that many participants found application instructions to lack clarity, causing project delay and possible abandonment. Lockheed's revisions to the online application were at least partly in response to this finding. While the current evaluation found that participants were generally satisfied with most aspects of participation, including the application process, the rated ease of using application worksheets and rated ease of finding the online application were lower than reported in the 2013 evaluation. One possible source of confusion for applicants is that the online application provides a single icon, labeled "Custom," to access both the custom and standard application worksheets (see Section 5.2.5).
- **Research Question 5:** Are there better ways to address market imperfections to increase adoption of each program measure?
- Based on the above conclusions, the evaluation team offers the following process recommendations to improve program effectiveness and increase adoption of program measures.
    - Lockheed Martin should continue to work to clarify application instructions, particularly for the custom program, and ensure that service providers and end-users know whom they can contact to get assistance with applications. Lockheed should consider relabeling the "Custom" icon on the online application to say "Standard and Custom" or provide separate icons for accessing the standard and custom worksheets.
    - Lockheed Martin staff should continue to work to improve program penetration of the small business sector and should consider additional approaches that may include free direct install of low-cost measures to generate immediate cost-effective savings and generate interest in future projects. Staff should also consider conducting additional market research to provide information on specific needs and motives of small business segments.
    - Ameren Missouri and Lockheed Martin should continue to work together to increase awareness of the new construction and retro-commissioning incentives and of the benefits of participation in those programs. In particular, Ameren Missouri and Lockheed Martin should make efforts to ensure that Account Executives, Customer Support Agents, and trade allies promote the new construction program in all discussions with customers, as achieving that program's full potential requires identifying projects before the design phase has begun.

Appendix A: Project-Level Analyses

This appendix contains project-level analyses for the impact evaluation of the program.

Site C-2

Executive Summary

Project C-2 received custom incentives from Ameren Missouri for retrofitting existing HVAC controls to DDC and installing (2) new chillers. The realization rate for this project is 38%.

Project Description

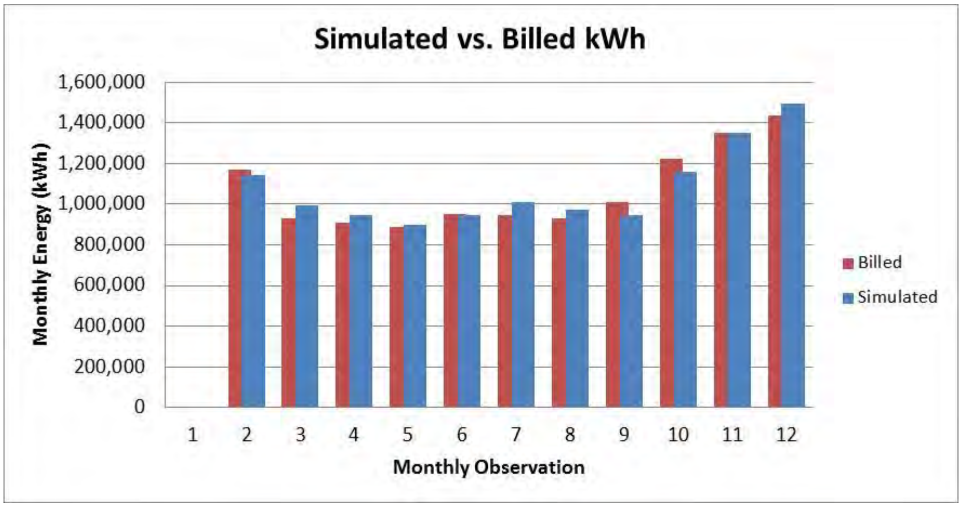
The customer retrofitted existing pneumatic HVAC controls with DDC controls and installed (2) new chillers. The new DDC controls enabled several energy efficiency measures to be implemented including: schedule changes, dynamic VFD controls, supply air reset, increased economizer set points, and chilled water reset. The new chillers replaced the existing chillers that were less efficient.

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation and verified changes in the BMS system.

Energy savings for the HVAC controls and chiller replacements were calculated using eQUEST modeling of the facility. ADM compiled a model of the baseline facility based upon ex ante model information and data collected during the M&V site visit. Upon the completion of the initial model, a custom weather file was created using 2012 NOAA weather data for the St. Louis area. Using this weather file and billing data for the facility, ADM was able to ensure that the model's energy load shape matched that of the bills. The results of this calibration effort can be seen below:

2012 Weather Data Monthly kWh Calibration



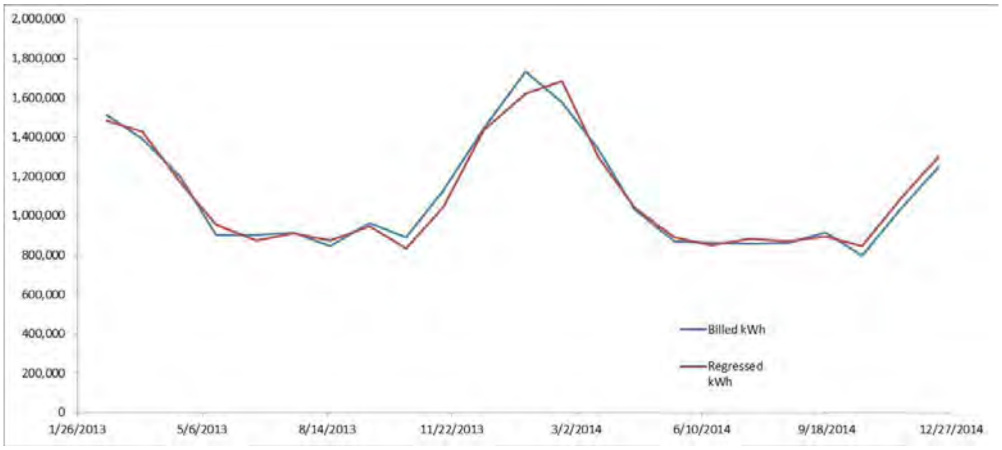
Upon completion of the calibration for the baseline eQUEST model, an as-built model was created in which the new controls and chiller efficiencies were implemented. Once the baseline model was completed, the baseline and as-built models were run using TMY3 weather data for the region. The typical year annual savings is the difference between the two models' annual consumption and can be seen below:

As-Built Vs. Baseline Annual Energy Consumption

End-Use	Baseline kWh	As-Built kWh	Annual kWh Savings
Lighting	1,992,124	1,992,124	0
Miscellaneous Equipment	3,221,182	3,221,182	0
Heating	3,874,428	3,166,732	707,696
Cooling	1,465,129	1,274,474	190,654
Heat Rejection	226,243	210,642	15,601
Pumps	538,942	541,308	-2,367
Fans	2,434,063	2,372,997	61,066
Domestic Hot Water	0	0	0
Total	**13,752,110**	**12,779,460**	**972,650**

ADM also triangulated the modeled savings using a whole facility billing regression. St. Louis weather data for 2013 and 2014 were used to obtain cooling and heating degree days (CDD and HDD). The results of the regression can be seen below:

Billed vs. Regressed Monthly Energy Consumption



The coefficients from the regression were used in conjunction with CDD and HDD from TMY weather data. The regression savings were found to be about 30% less than the modeled savings; however, the modeled savings fall within a 90% confidence interval.

CDD HDD Model

$$Monthly\ kWh = 371\ CDD\ \times 1{,}016\ HDD\ \times -31 CDD/Post\ \times -109\ HDD/Post\ + 588{,}987$$

The table shown below presents the ex ante and ex post energy savings for the HVAC measures performed under the project:

HVAC Savings Calculations

Measure	Gross Ex-ante kWh Savings	Gross Ex-post kWh Savings	Gross kWh Savings Realization Rate
HVAC	2,574,232	972,650	38%
Total		972,650	38%

Ex ante savings were based on a Trane Trace model developed by the participant's contractor.

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex-post Peak kW Reduction
		Gross Ex-ante kWh Savings	Gross Ex-post kWh Savings	Gross Realization Rate	
HVAC	Custom	2,574,232	972,650	38%	44
Total		2,574,232	972,650	38%	44

The project-level realization rate is 38%. The low realization rate is due to the controls currently only being implemented in half of the buildings' twelve floors. The ex post eQuest model only applied the HVAC controls for half of the floors per project documentation and M&V site visit. The ex ante analysis applied the controls to all of the floors. Another smaller difference is due to the ex post analysis using calibrated simulation as the ex ante analysis was not calibrated to billing data. The calibration accounts for actual building operations, occupancies, and efficiencies. The ex post peak kW reduction is also low because it coincides with the kWh savings results.

Site R-5 & C-20

Executive Summary

R-5 & C-20 received incentives from Ameren Missouri for repairing compressed air leaks and installing a new variable speed (VSD) compressor to act as a trim for the compressed air system. The combined realization rate for these projects is 90%.

Project Description

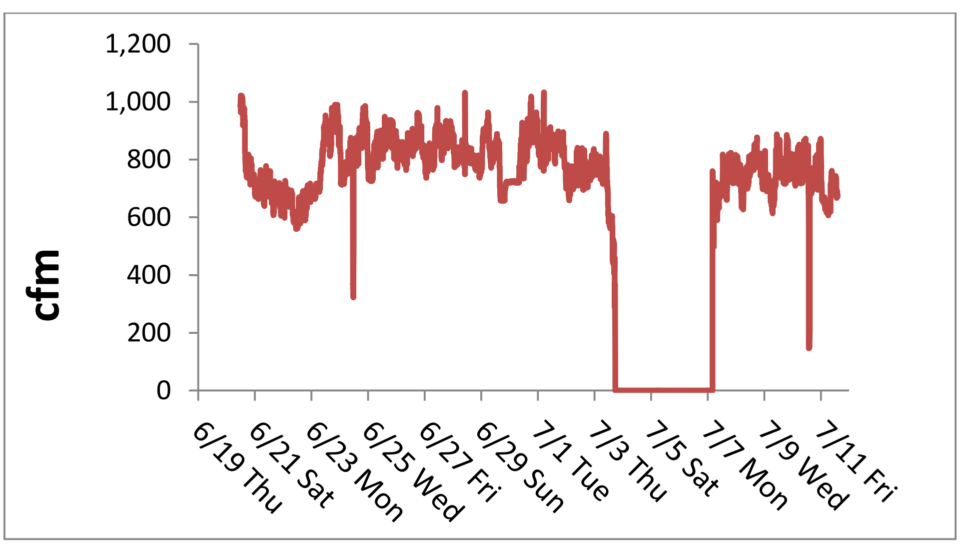
The customer repaired compressed air leaks and installed a new (181) hp Gardner Denver VS135 VSD compressor. The existing system utilized one (150) hp and one (75) hp fixed speed compressor. The advantage of the VSD is it allows the compressor to run at more efficient part loads when the demand is less than the max of the compressor. The (75) hp fixed speed compressor is now the base compressor and the VSD compressor is the trim. (207) CFM of air leaks were also repaired.

Measurement and Verification Effort

ADM visited the facility and confirmed the various components of the compressed air project. During the M&V visit, it was confirmed that the new compressor was installed and leaks were repaired.

ADM used power monitoring to calculate an average daily operating profile for each day of the week for the new VSD compressor and the existing (75) hp fixed speed compressor. Manufacturer's performance curves were used to calculate the as-built air demand profile based upon the kW profile from power monitoring. The results of this extrapolation can be seen in the following graph:

As-Built Compressed Air System CFM Output



Assuming the CFM profile is the same in the baseline and as-built conditions, compressor performance curves were used to calculate the baseline compressors usage. The pre and post weekly profiles were then extrapolated to a year and energy savings were calculated by subtracting the post consumption from the pre.

Energy savings for the repaired air leaks were calculated by adding 207 CFM to the baseline compressor demand profiles. The same calculation methodology for the compressor savings was used to calculate leak savings.

Results

Verified Gross Savings/Realization Rates

Measure Category	Incentive	Gross kWh Savings			Gross Ex Post Peak kW Reduction
		Ex Ante	Ex Post	Realization Rate	
Compressed Air Leaks	R-5	350,817	307,377	88%	18.36
VSD Compressor	C-20	133,811	128,784	96%	15.98
Total		484,628	436,161	90%	34.34

The combined realization rate for these projects is 90%. The realization rate for the RCx compressed air leaks repair project is 88%. The realization rate for the custom VSD Compressor project is 96%.

The differences in savings can be attributed to the utilized operating profiles, and the assumed hours of operation. ADM analysis was informed through the use of post power monitoring equipment which recorded compressor kW at five minute intervals. The ex ante calculations relied on pre-installation air flow data at fifteen second intervals. Upon reviewing the air flow data, it was determined that the monitoring was most likely done after the receiver. The flow after a receiver and resultant pressure drop, does not directly correlate to the flow produced by the compressed air system; therefore, the data should not be used solely to create operating profiles. The ex ante also assumed 8760 hours of operation. ADM determined the facility does not operate at full capacity during holidays.

Site C-9

Executive Summary

Project C-9 received custom incentives from Ameren Missouri for retrofitting the facility's original chilled water system with new high performance chillers and the conversion to a variable primary only chilled water system. The realization rate for this project is 55%.

Project Description

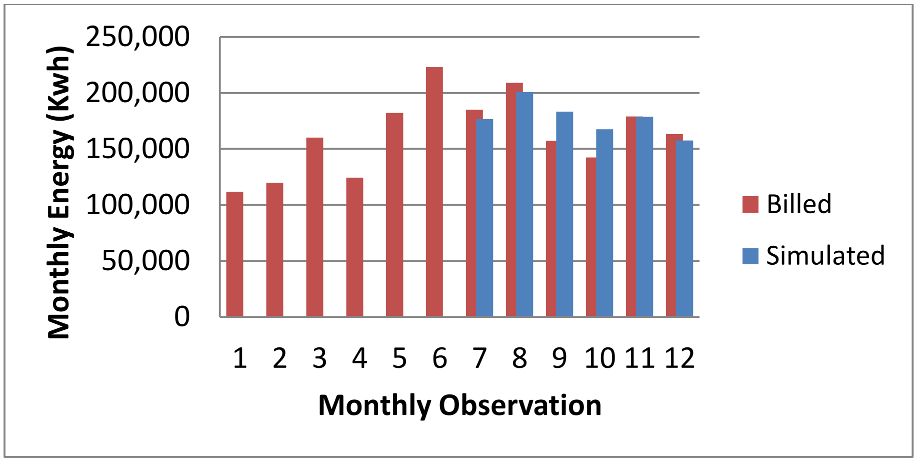
As part of a facility retrofit, the original Carrier 30HR160 reciprocating chillers were replaced with high efficiency SMARDT WA046 chillers. The SMARDT chillers utilize a centrifugal Turbocor compressor that is able to operate much more efficient than standard compressors at part load. The facility also converted from a primary/secondary constant flow chilled water system to a variable primary only chilled water system. A primary only variable chilled water system is advantageous as the required pump power is much lower compared to a standard primary/secondary system. The new primary pumps were also equipped with VFDs, thus adding additional energy savings.

Measurement and Verification Effort

During the M&V visit, ADM staff verified the installation of the equipment and interviewed site contacts about the typical operation of the facility. ADM collected details on the supporting HVAC equipment as well as interfaced with the facility's BMS to gather operational setpoints for the air and water side systems.

Energy savings for the conversion to the primary only variable chilled water system and the installation of the new chillers was determined through the construction of a site specific eQUEST model. Upon the completion of the initial as-built model, a custom weather file was created using 2014 NOAA weather data for the St. Louis area. Using this weather file and billing data for the facility, ADM was able to ensure that the model's energy load shape matched that of the bills. The results of this calibration effort can be seen below:

2014 Monthly kWh Calibration



It should be noted that ADM did not calibrate the model to the January through June bills, as the facility was not fully occupied until June 2014. The January through June bills were left in the chart to illustrate that facility was indeed in the process of being fully occupied.

Upon completion of the calibration for the as-built eQUEST model, a baseline model was created in which all the high efficiency chillers and primary only variable chilled water system were removed, and replaced with the original chillers and primary/secondary chilled water system. The baseline and as-built models were then run using TMY3 weather data for the region. The typical year annual savings is the difference between the two models' annual consumption and can be seen below:

As-Built Vs. Baseline Annual Energy Consumption

End-Use	*Baseline kWh*	*As-Built kWh*	*Annual kWh Savings*
Lighting	*750,450*	*750,450*	*0*
Miscellaneous Equipment	*686,370*	*686,370*	*0*
Heating	*0*	*0*	*0*
Cooling	*381,358*	*214,041*	*167,317*
Heat Rejection	*13,046*	*11,766*	*1,280*
Pumps	*244,017*	*102,889*	*141,118*
Fans	*310,223*	*353,182*	*-42,959*
Domestic Hot Water	*0*	*0*	*0*
Exterior Lighting	38,738	38,738	0
Total	**2,424,200**	**2,157,444**	**266,756**

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
HVAC	Custom	489,351	266,756	55%	153.29
Total		489,351	266,756	55%	153.29

The project-level realization rate is 55%. The ex ante analysis utilized a Trane Trace simulation to calculate their savings. However, due to the model being compiled before billing data was available for the fully occupied building, they were unable to accurately calibrate the model. ADM was not supplied the Trane Trace modeling outputs. However, from the ADM created eQUEST model, it can be concluded that the ex ante analysis overestimated the internal loads of the fully occupied building.

Site N-6

Executive Summary

Project N-6 received New Construction incentives from Ameren Missouri for installing lighting and occupancy sensors in new construction. The customer also received incentives for exceeding building code HVAC measures. The realization rate for this project is 81%.

Project Description

The customer installed the following fixtures:

- (20) 4' 2LT8 fixtures
- (18) linear fluorescent fixtures
- (23) 2' 2LT8 fixtures
- (41) LED track light - 3 lamps fixtures
- (118) CFL fixtures
- (58) LED track light - 4 lamps fixtures
- (158) CFL fixtures
- (154) 4' 1LT8 fixtures
- (98) linear fluorescent fixtures
- (2) LED down light fixtures
- (5) 4' 4LT8 fixtures
- (57) parking garage fixtures
- (268) Fixture mounted Occupancy Sensors
- (17) Infrared Occupancy Sensors
- (6) Infrared Occupancy Sensors

The facility was also built to include above code improvements including:

- High Efficiency Water-Cooled Chillers
- Key-Card HVAC Controls

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings. The reduction of lighting operating hours associated with occupancy sensors is determined by multiplying the baseline hours by a Power Adjustment Factor of 0.7 (adapted from ASHRAE 90.1-2007).

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

Lighting occupancy sensor energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times W \times N \times \left(t_{base} - t_{as-built} \right) / 1000 \right]$$

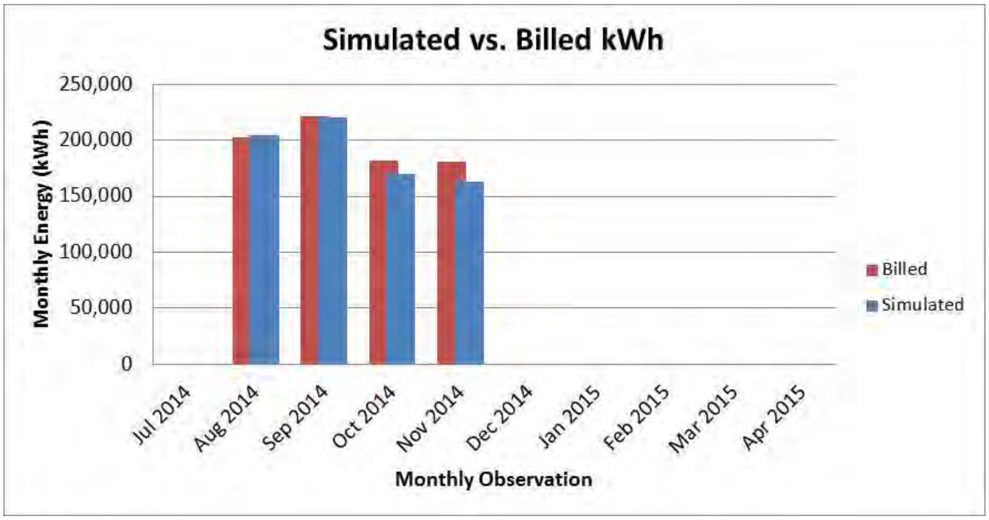
Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of occupancy sensors*
W	= *Wattage controlled by each occupancy sensor*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

Above code energy savings for the measures were calculated using eQUEST modeling of the facility. ADM compiled a model of the as-built facility based upon data collected during the M&V site visit. Upon the completion of the initial model, a custom weather file was created using 2014 NOAA weather data for the St. Louis area. Using this weather file and billing data for the facility[46], ADM was able to ensure that the model's energy load shape matched that of the bills. The results of this calibration effort can be seen below:

[46] All of the billing data for the four new construction campus housing projects were calibrated together.

2014 Monthly kWh Calibration



Upon completion of the calibration for the as-built eQUEST model, a baseline model was created in which all the above-code measures were removed, and replaced with minimum standards as detailed by ASHRAE 90.1-2007. Once the baseline model was completed, the baseline and as-built models were run using TMY3 weather data for the region. The typical year annual savings is the difference between the two models' annual consumption and can be seen below:

As-Built Vs. Baseline Annual Energy Consumption

End-Use	*Baseline kWh*	*As-Built kWh*	*Annual kWh Savings*
Lighting	*954,466*	*954,466*	*0*
Miscellaneous Equipment	*339,395*	*339,395*	*0*
Heating	*10,642*	*9,795*	*848*
Cooling	*774,703*	*489,285*	*285,418*
Heat Rejection	*0*	*8,979*	*-8,979*
Pumps	*126,106*	*191,429*	*-65,323*
Fans	*65,432*	*58,318*	*7,113*
Domestic Hot Water	*0*	*0*	*0*
Total	**2,270,745**	**2,051,667**	**219,077**

The tables shown below present ex ante and ex post energy savings for the lighting retrofit and above code HVAC measures performed under the project.

Lighting Retrofit Savings Calculations

Measure	*Quantity (Fixtures)*		*Wattage*		*Hours*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
	Old	*New*	*Old*	*New*					
4' 2LT8	20	20	121	59	3,000	3,697	3,853	1.04	104%
linear fluorescent	18	18	241	118	3,000	6,654	6,935	1.04	104%
2' 2LT8	23	23	53	26	3,000	1,874	1,952	1.04	104%
LED track light - 3 lamps	41	41	117	57	3,000	7,322	7,630	1.04	104%
CFL	118	118	59	29	3,000	10,721	11,172	1.04	104%
LED track light - 4 lamps	58	58	147	72	3,000	13,083	13,634	1.04	104%
CFL	158	158	127	62	3,000	30,691	31,983	1.04	104%
4' 1LT8	154	154	61	30	3,000	14,474	15,084	1.04	104%
linear fluorescent	98	98	31	15	3,000	4,605	4,799	1.04	104%
LED down light	2	2	53	26	3,000	163	170	1.04	104%
4' 4LT8	5	5	241	118	3,000	1,848	1,926	1.04	104%
parking garage	57	57	373	154	8,760	109,307	109,307	1.00	100%
Total						204,437	208,442		102%

The table shown below presents ex ante and ex post energy savings for the lighting controls installed under the project.

Lighting Controls Savings Calculations

Measure	*Quantity*	*Controlled Wattage*	*Hours*		*Ex Ante kWh Savings*	*Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
			Old	*New*				
Controls	268	103	3,000	2,100	106,396	25,986	1.04	24%
Controls	17	393	3,000	2,100	10,477	6,265	1.04	60%
Controls	6	1,463	8,760	6,132	4,622	23,069	1.00	499%
Total					121,495	55,320		46%

HVAC Savings Calculations

Measure	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Savings Realization Rate
Chillers	229,869	175,319	76%
HVAC Controls	37,207	43,758	118%
Total	267,076	219,077	82%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	New Construction	204,437	208,442	102%	47.11
Lighting Controls	New Construction	121,495	55,320	46%	13.90
HVAC Controls	New Construction	37,207	43,758	118%	11.00
Chillers	New Construction	229,869	175,319	76%	122.00
Total		593,008	432,839	81%	194.00

The project-level realization rate is 81%. For the lighting retrofit, the realization rate is high because the ex post savings analysis included an HCIF for multifamily in St. Louis (1.04), while the ex ante savings estimate did not account for HVAC interactive effects. The lighting controls have a low realization rate because the ex ante savings estimation for two measures (397 kWh and 616 kWh per sensor) is greater than the ex post savings analysis (97 kWh and 369 kWh per sensor). The third occupancy sensor has a high realization rate mainly due to the fixtures being densely populated per quantity of sensor.

The HVAC controls realization rate is higher due to the ex post analysis using a calibrated simulation. The ex ante analysis was done before construction, so it could not be calibrated to billing data. The calibration accounted for actual building operations and efficiencies. The high efficiency water-cooled chillers realization rate is lower because the ex ante analysis doesn’t appear to account for the extra pump power that is required to cool the chillers.

Site N-10

Executive Summary

Project N-10 received New Construction incentives from Ameren Missouri for installing lighting, occupancy sensors, and key-card HVAC controls in new construction. The realization rate for this project is 60%.

Project Description

The customer installed the following:

- (16) 4' 2LT8 fixtures
- (16) linear fluorescent fixtures
- (22) 2' 2LT8 fixtures
- (37) 3L LED Track Halogen fixtures
- (114) CFL fixtures
- (50) 4L LED Track Halogen fixtures
- (139) CFL fixtures
- (86) linear fluorescent fixtures
- (101) 4' 1LT8 fixtures
- (4) LED Panel fixtures
- (251) Fixture mounted Occupancy Sensors
- (18) Infrared Occupancy Sensors
- (2) Infrared Occupancy Sensors
- Key-Card HVAC Controls

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings. The reduction of lighting operating hours associated with occupancy sensors is determined by multiplying the baseline hours by a Power Adjustment Factor of 0.7 (adapted from ASHRAE 90.1-2007).

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$ = *Annual energy savings*

N = *Number of fixtures*

W	= *Wattage of each fixture*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

Lighting occupancy sensor energy savings are calculated as:

$$kWh_{savings} = \sum_{Area}\left[HCIF \times W \times N \times \left(t_{base} - t_{as-built}\right)/1000\right]$$

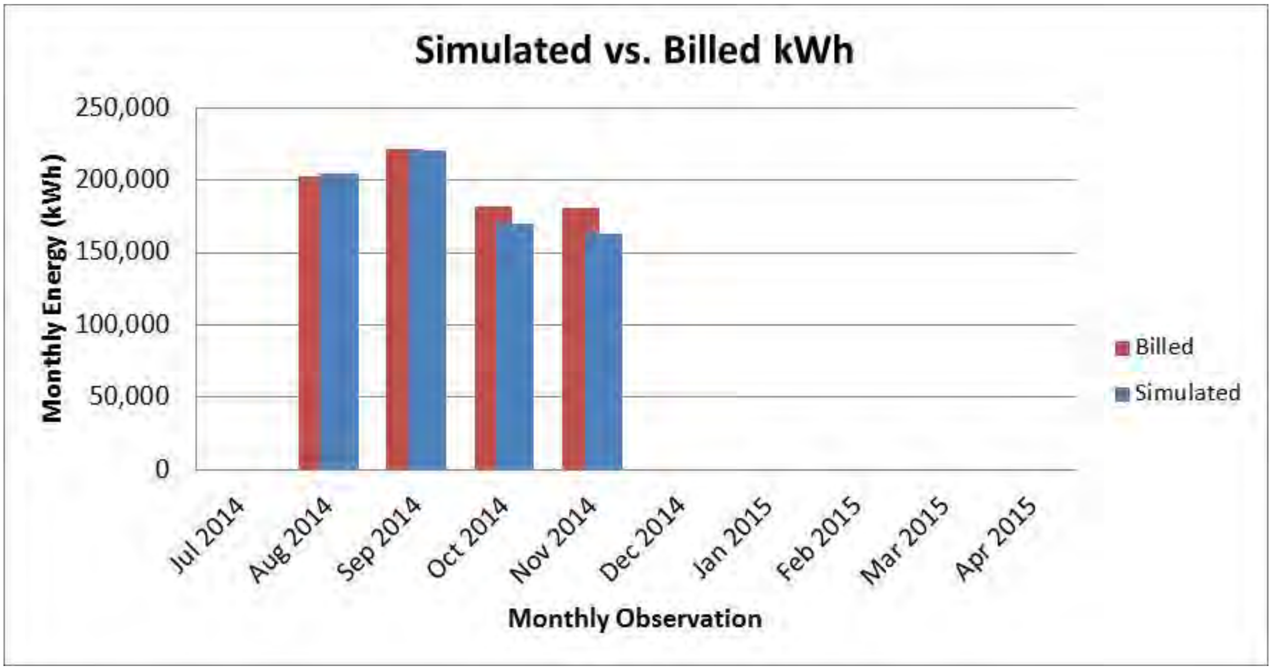
Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of occupancy sensors*
W	= *Wattage controlled by each occupancy sensor*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

Energy savings for the key-card HVAC measure were calculated using eQUEST modeling of the facility. ADM compiled a model of the as-built facility based upon data collected during the M&V site visit. Upon the completion of the initial model, a custom weather file was created using 2014 NOAA weather data for the St. Louis area. Using this weather file and billing data for the facility[47], ADM was able to ensure that the model's energy load shape matched that of the bills. The results of this calibration effort can be seen below:

[47] All of the billing data for the four new construction campus housing projects were calibrated together.

2014 Monthly kWh Calibration



Upon completion of the calibration for the as-built eQUEST model, a baseline model was created in which all the above-code measures were removed, and replaced with minimum standards as detailed by ASHRAE 90.1-2007. Once the baseline model was completed, the baseline and as-built models were run using TMY3 weather data for the region. The typical year annual savings is the difference between the two models' annual consumption and can be seen below:

As-Built Vs. Baseline Annual Energy Consumption

End-Use	*Baseline kWh*	*As-Built kWh*	*Annual kWh Savings*
Lighting	*954,466*	*954,466*	*0*
Miscellaneous Equipment	*339,395*	*339,395*	*0*
Heating	*10,458*	*9,817*	*641*
Cooling	*761,279*	*743,125*	*18,154*
Heat Rejection	*0*	*0*	*0*
Pumps	*126,222*	*125,559*	*663*
Fans	*62,091*	*54,625*	*7,467*
Domestic Hot Water	*0*	*0*	*0*
Total	**2,253,912**	**2,226,987**	**26,925**

The tables shown below present ex ante and ex post energy savings for the lighting retrofit and above code HVAC measures performed under the project.

Lighting Retrofit Savings Calculations

Measure	*Quantity (Fixtures)*		*Wattage*		*Hours*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
	Old	*New*	*Old*	*New*					
4’ 2LT8	16	16	124	59	3,000	3,121	3,246	1.04	104%
Linear Fluorescent	16	16	248	118	3,000	6,243	6,493	1.04	104%
2’ 2LT8	22	22	55	26	3,000	1,891	1,967	1.04	104%
3L LED Track Halogen	37	37	120	57	3,000	6,973	7,253	1.04	104%
CFL	114	114	61	29	3,000	10,931	11,370	1.04	104%
4L LED Track Halogen	50	50	151	72	3,000	11,903	12,381	1.04	104%
CFL	139	139	130	62	3,000	28,495	29,638	1.04	104%
Linear Fluorescent	86	86	32	15	3,000	4,265	4,436	1.04	104%
4’ 1LT8	101	101	63	30	3,000	10,019	10,420	1.04	104%
LED Panel	4	4	40	19	3,000	251	261	1.04	104%
Total						84,093	87,465		104%

Lighting Controls Savings Calculations

Measure	Quantity	Controlled Wattage	Hours		Ex Ante kWh Savings	Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
			Old	New				
Controls	251	99	3,000	2,100	99,647	23,145	1.04	23%
Controls	18	194	3,000	2,100	11,093	3,277	1.04	30%
Controls	2	354	3,000	2,100	1,541	663	1.04	43%
Total					112,281	27,084		24%

HVAC Savings Calculations

Measure	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Savings Realization Rate
HVAC Controls	40,939	26,925	66%
Total	40,939	26,925	66%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	New Construction	84,093	87,465	104%	30.55
Lighting Controls	New Construction	112,281	27,084	24%	9.46
HVAC Controls	New Construction	40,939	26,925	66%	11.01
Total		237,313	141,475	60%	51.02

The project-level realization rate is 60%. For the lighting retrofit, the realization rate is high because the ex post savings analysis included an HCIF for gas heated multifamily in St. Louis (1.04), while the ex ante savings estimate did not account for HVAC interactive effects. For the lighting controls the realization rate is low because the ex ante estimate (397 kWh, 616 kWh, and 770 kWh per sensor) was greater than the ex post savings analysis (92 kWh, 182 kWh, and 331 kWh per sensor).

For the HVAC controls the realization rate is low likely to the ex post using calibrated simulation. The documentation behind the results of the ex ante approximations is lacking; therefore, a more detailed comparison cannot be made.

Site N-13

Executive Summary

Project N-13 received New Construction incentives from Ameren Missouri for installing lighting and occupancy sensors in their building which included retail. The realization rate for this project is 80%.

Project Description

The customer installed the following:

- (8) 4' 2LT8 fixtures
- (7) linear fluorescent fixtures
- (13) CFL fixtures
- (10) 3L LED Track Halogen fixtures
- (32) CFL fixtures
- (12) 4L LED Track Halogen fixtures
- (34) CFL fixtures
- (23) linear fluorescent fixtures
- (25) 4' 1LT8 fixtures
- (4) LED down light fixtures
- (5) exterior lighting fixtures
- (65) Fixture mounted Occupancy Sensors
- (8) Infrared Occupancy Sensors

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings. The reduction of lighting operating hours associated with occupancy sensors is determined by multiplying the baseline hours by a Power Adjustment Factor of 0.7 (adapted from ASHRAE 90.1-2007).

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$ = *Annual energy savings*

N = *Number of fixtures*

W = *Wattage of each fixture*

t = *Lighting operating hours*

HCIF = *HVAC interaction factor*

Lighting occupancy sensor energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times W \times N \times \left(t_{base} - t_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$ = *Annual energy savings*

N = *Number of occupancy sensors*

W = *Wattage controlled by each occupancy sensor*

t = *Lighting operating hours*

HCIF = *HVAC interaction factor*

The tables shown below present ex ante and ex post energy savings for the lighting installation performed under the project.

Lighting Retrofit Savings Calculations

Measure	*Quantity (Fixtures)*		*Wattage*		*Hours*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
	Old	*New*	*Old*	*New*					
4' 2LT8	8	8	124	59	4,179	1,556	2,232	1.06	143%
linear fluorescent	7	7	248	118	4,179	2,724	3,905	1.06	143%
CFL	13	13	55	26	4,179	1,114	1,598	1.06	143%
3L LED Track Halogen	10	10	120	57	4,179	1,879	2,695	1.06	143%
CFL	32	32	61	29	4,179	3,060	4,388	1.06	143%
4L LED Track Halogen	12	12	151	72	4,179	2,849	4,085	1.06	143%
CFL	34	34	130	62	4,179	6,951	9,967	1.06	143%
linear fluorescent	23	23	31	15	4,179	1,138	1,631	1.06	143%
4' 1LT8	25	25	63	30	4,179	2,473	3,546	1.06	143%
LED down light	4	4	40	19	4,179	251	359	1.06	143%

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
Total						23,994	34,406		143%

The table shown below presents ex ante and ex post energy savings for the lighting controls installed under the project.

Lighting Controls Savings Calculations

Measure	Quantity	Controlled Wattage	Hours		Ex Ante kWh Savings	Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
			Old	New				
Controls	65	92	3,000	2,100	25,805	7,716	1.06	30%
Controls	8	162	3,000	2,100	4,930	1,675	1.06	34%
Total					30,735	9,391		31%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	New Construction	23,994	34,406	143%	11.83
Lighting Controls	New Construction	30,735	9,391	31%	3.57
		54,729	43,798	80%	15.40

The project-level realization rate is 80%. For the lighting retrofit, the realization rate is high because the ex post savings analysis included an HCIF for gas heated multifamily and retail in St. Louis (1.06), while the ex ante savings estimate did not account for HVAC interactive effects. The ex post included hours for the retail portion which had to be estimated since no data was available. The realization rate for the lighting controls is low because the ex ante savings estimate (397 kWh and 616 kWh per sensor) was greater than the ex post savings analysis calculation (119 kWh and 209 kWh per sensor).

Site N-9

Executive Summary

Project N-9 received New Construction incentives from Ameren Missouri for installing lighting, occupancy sensors, and Key-Card HVAC controls for new construction. The realization rate for this project is 54%.

Project Description

The customer retrofitted the following fixtures:

- (13) 4' 2LT8 fixtures
- (14) linear fluorescent fixtures
- (34) 2' 2LT8 fixtures
- (4) 2' 2LT8 fixtures
- (3) CFL fixtures
- (38) 3L LED Track Halogen fixtures
- (93) CFL fixtures
- (46) 4L LED Track Halogen fixtures
- (123) CFL fixtures
- (91) linear fluorescent fixtures
- (138) 4' 1LT8 fixtures
- (6) CFL twin tube fixtures
- (251) Fixture Mounted Occupancy Sensors
- (16) Infrared Occupancy Sensors
- (5) Infrared Occupancy Sensors
- Key-Card HVAC Controls

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings. The reduction of lighting operating hours associated with occupancy sensors is determined by multiplying the baseline hours by a Power Adjustment Factor of 0.7 (adapted from ASHRAE 90.1-2007).

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area}\left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built}\right)/1000\right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

Lighting occupancy sensor energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times W \times N \times \left(t_{base} - t_{as-built} \right) / 1000 \right]$$

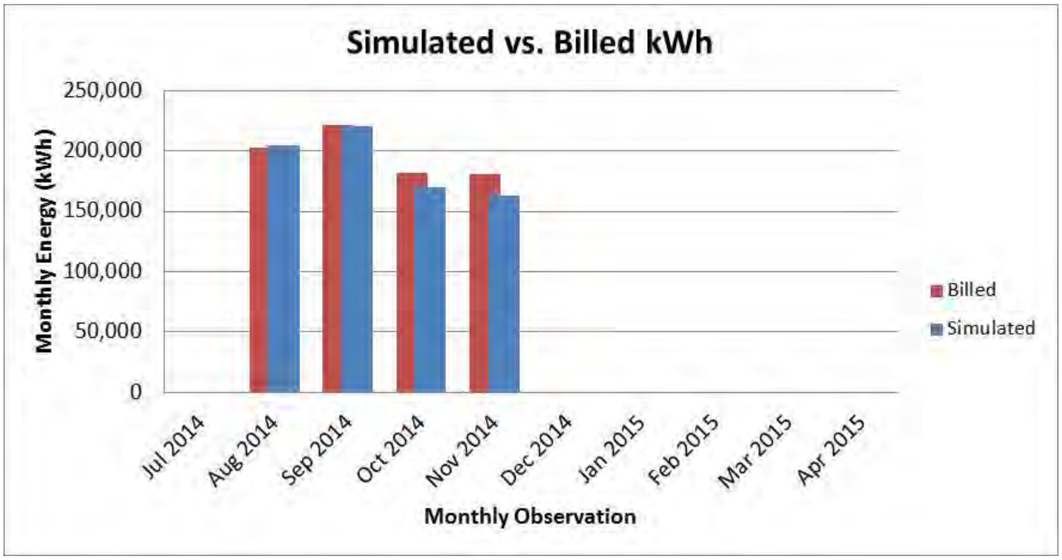
Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of occupancy sensors*
W	= *Wattage controlled by each occupancy sensor*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

Energy savings for the key-card HVAC measure were calculated using eQUEST modeling of the facility. ADM compiled a model of the as-built facility based upon data collected during the M&V site visit. Upon the completion of the initial model, a custom weather file was created using 2014 NOAA weather data for the St. Louis area. Using this weather file and billing data for the facility[48], ADM was able to ensure that the model's energy load shape matched that of the bills. The results of this calibration effort can be seen below:

[48] All of the billing data for the four new construction campus housing projects were calibrated together.

2014 Monthly kWh Calibration



Upon completion of the calibration for the as-built eQUEST model, a baseline model was created in which all the above-code measures were removed, and replaced with minimum standards as detailed by ASHRAE 90.1-2007. Once the baseline model was completed, the baseline and as-built models were run using TMY3 weather data for the region. The typical year annual savings is the difference between the two models' annual consumption and can be seen below:

As-Built Vs. Baseline Annual Energy Consumption

End-Use	*Baseline kWh*	*As-Built kWh*	*Annual kWh Savings*
Lighting	*954,466*	*954,466*	*0*
Miscellaneous Equipment	*339,395*	*339,395*	*0*
Heating	*10,340*	*9,817*	*523*
Cooling	*759,498*	*743,125*	*16,373*
Heat Rejection	*0*	*0*	*0*
Pumps	*125,953*	*125,559*	*394*
Fans	*61,181*	*54,625*	*6,557*
Domestic Hot Water	*0*	*0*	*0*
Total	**2,250,833**	**2,226,987**	**23,846**

The tables shown below present ex ante and ex post energy savings for the lighting retrofit and controls and above code HVAC measures performed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
4' 2LT8	13	13	127	59	3,000	2,658	2,770	1.04	104%
linear fluorescent	14	14	254	118	3,000	5,725	5,966	1.04	104%
2' 2LT8	34	34	56	26	3,000	3,064	3,193	1.04	104%
2' 2LT8	4	4	69	32	3,000	444	462	1.04	104%
CFL	3	3	60	28	3,000	291	303	1.04	104%
3L LED Track Halogen	38	38	123	57	3,000	7,506	7,822	1.04	104%
CFL	93	93	63	29	3,000	9,347	9,740	1.04	104%
4L LED Track Halogen	46	46	155	72	3,000	11,478	11,961	1.04	104%
CFL	123	123	134	62	3,000	26,428	27,541	1.04	104%
linear fluorescent	91	91	32	15	3,000	4,730	4,930	1.04	104%
4' 1LT8	138	138	65	30	3,000	14,347	14,952	1.04	104%
CFL twin tube	6	6	60	28	3,000	582	607	1.04	104%
Total						86,601	90,247		104%

Lighting Controls Savings Calculations

Measure	Quantity	Controlled Wattage	Hours		Ex Ante kWh Savings	Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
			Old	New				
Controls	251	59.54	3,000	2,100	99,647	14,016	1.04	14%
Controls	16	476.63	3,000	2,100	9,861	7,152	1.04	73%
Controls	5	483.80	3,000	2,100	3,852	2,269	1.04	59%
Total					113,360	23,437		21%

HVAC Savings Calculations

Measure	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Savings Realization Rate
HVAC	55,744	23,846	43%
Total	55,744	23,846	43%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
HVAC	Custom	55,744	23,846	43%	9.00
Lighting Retrofit	New Construction	86,601	90,247	104%	31.52
Lighting Controls	New Construction	113,360	23,437	21%	8.19
Total		255,705	137,530	54%	48.71

The project-level realization rate is 54%. For the lighting retrofit, the realization rate is high because the ex post savings analysis included an HCIF for gas heated multifamily in St. Louis (1.04), while the ex ante savings estimate did not account for HVAC interactive effects. The realization rate for the lighting controls is low because the ex ante savings estimate (397 kWh, 616 kWh, and 770 kWh per sensor) is greater than the ex post savings analysis calculation (56 kWh, 447 kWh, and 454 kWh per sensor).

The realization rate for the HVAC controls is low likely because the ex post analysis used calibrated simulation. The documentation behind the results of the ex ante approximations is lacking; therefore, a more detailed comparison cannot be made.

Site R-6

Executive Summary

Project R-6 received incentives from Ameren Missouri for repairing air leaks to reduce compressed air demand. The realization rate for the air leak repair project is 78%.

Project Description

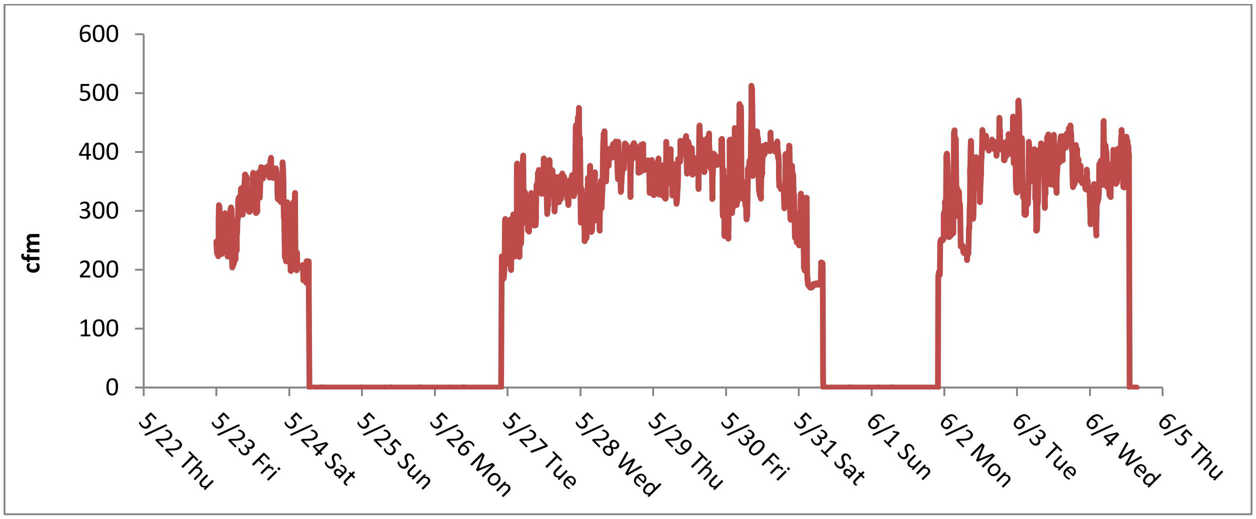
The customer repaired (75) CFM of compressed air leaks. The existing system utilized two (75) hp and one (20) hp fixed speed compressors. They also installed a VSD air compressor, incentivized in an additional project. The advantage of the VSD is it allows the compressor to run at more efficient part loads when the demand is less than the max of the compressor.

Measurement and Verification Effort

ADM visited the facility and confirmed the various components of the compressed air project. During the M&V visit, it was confirmed that the new compressor was installed and leaks were repaired.

ADM used power monitoring to calculate an average daily operating profile for each day of the week for the new compressor. Manufacturer's performance curves were used to calculate the as-built air demand profile based upon the kW profile from power monitoring. The results of this extrapolation can be seen in the following graph:

As-Built Compressor CFM Output



Assuming the CFM profile is the same in the baseline and as-built conditions, compressor performance curves were used to calculate the baseline compressors usage. The pre and post weekly profiles were then extrapolated to a year and energy savings were calculated by subtracting the post consumption from the pre. Energy usage from the new dryer was subtracted from compressor energy savings to find the gross annual kWh savings for the custom project.

Energy savings for the repaired air leaks were calculated by adding 75 CFM to the as-built compressor demand profiles. The same calculation methodology for the compressor savings was used to calculate leak savings.

Results

Verified Gross Savings/Realization Rates

Measure Category	*Incentive*	*Gross kWh Savings*			*Gross Ex Post Peak kW Reduction*
		Ex Ante	*Ex Post*	*Realization Rate*	
Compressed Air Leaks	Retro-commissioning	137,921	108,165	78%	15.19
Total		137,921	108,165	78%	15.19

The realization rate for this project is 78%. The differences in savings can be attributed to the ex ante utilized operating profiles, and the assumed hours of operation. ADM analysis was informed through the use of power monitoring equipment which recorded compressor kW at five minute intervals. This equipment was installed after the VSD compressor was installed and leaks were repaired. The ex ante calculations relied on extrapolated pre-installation, fifteen second interval data.

Site R-7 and C-12

Executive Summary

Project R-7 and C-12 received incentives from Ameren Missouri for repairing compressed air leaks and for installing a new turn valve air compressor with flow controller to replace two existing throttle inlet control air compressors. The combined realization rate for these projects is 61%. The RCx leak repair project had a 51% realization rate while the compressor replacement and new flow controller had a realization rate of 62%.

Project Description

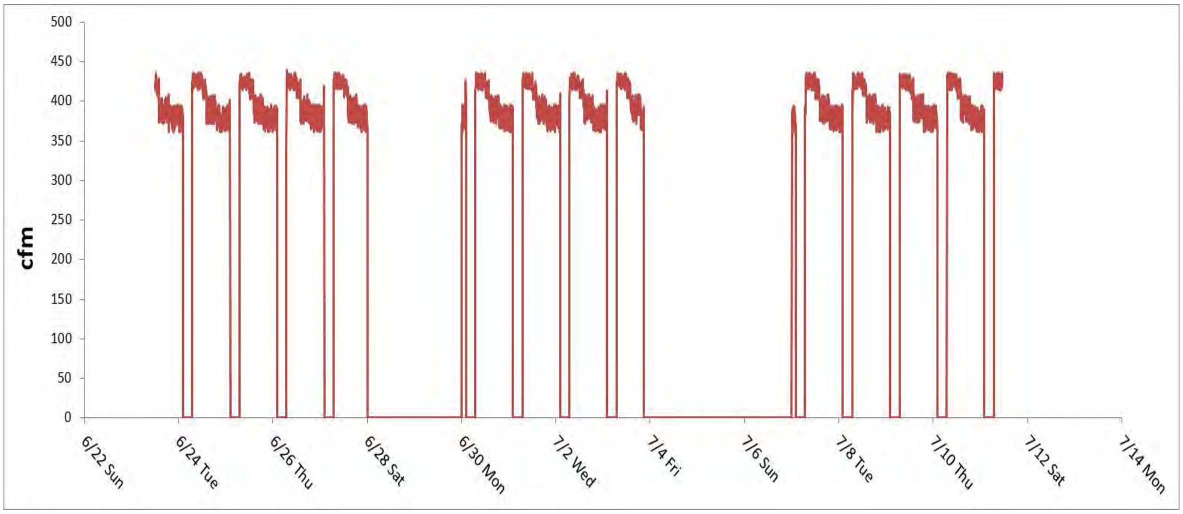
The customer repaired 64 CFM of compressed air leaks. The act of reducing air leaks in the facility produces energy savings, as the loading on the compressors is reduced. The new air compressor along with load reduction and new flow controller enabled the facility to turn off their two 320 CFM compressors.

Measurement and Verification Effort

ADM visited the facility, and it was confirmed that the leaks were repaired. This was accomplished through interviews with site contacts along with the review of the facility's repair logs.

ADM performed power monitoring to calculate an average daily operating profile for each day of the week for the new air compressor. Manufacturer's performance curves were used to calculate the as-built air demand profile based upon the kW profile from power monitoring. The results of this monitored period are in the following graph:

Compressed Air CFM Output



Results

Verified Gross Savings/Realization Rates

Measure Category	*Incentive*	*Gross kWh Savings*			*Gross Ex Post Peak kW Reduction*
		Ex Ante	*Ex Post*	*Realization Rate*	
Compressed Air Leaks	RCx - 6957	41,174	21,038	51%	4.18
Turn Valve Compressor	Custom - 7572	307,679	191,881	62%	34.18
Total	7529	348,853	212,919	61%	38.35

The combined realization rate for these projects is 61% with 51% for the RCx leak repair and 62% for the new air compressor. The ex ante savings for the RCx leak repair was calculated from trade ally monitoring data that only included intervals when the compressor was actually running, which then applied this load profile to 7,508 annual operating hours. This method over-estimated the savings, primarily during weekends and the period between the afternoon shift and day shift.

The ex ante savings for the custom project involving the new air compressor and flow controller, also applied the intervals without load to create a single profile that was applied to 7,508 annual operating hours. The data from the ex ante monitoring as well as the ex post monitoring data, indicated the annual hours approximately 1,000 hours lower.

Additionally, the ex ante air flow profile was measured at a single location under the baseline condition of the north and south air compressors running. Air leaks between the far air compressor and the measurement device created measurement error, under estimating the plant air consumption. The ex post load profile based on monitored power data and manufacturer data, indicated average morning loads of 415 CFM measured from a single air compressor source, compared to the ex ante total measurement from two compressors of approximately 320 CFM. Adjusted for the repaired leaks, this 320 CFM was expected to be 256 CFM.

Site C-28, S-31

Executive Summary

Project C-28, S-31 received custom and standard incentives from Ameren Missouri for retrofitting lighting in the interior of its facility and installing occupancy sensors. The realization rate for this project is 101%.

Project Description

The customer retrofitted the following fixtures:

- (4) MH fixtures with (4) 4' 6LT8 fixtures in the blue room area
- (6) 4' 4LT12 fixtures with (6) 4' 2LT8 fixtures in the shipping / plant office
- (2) 8' 2LT12 fixtures with (2) 8' 2LT8 fixtures in the warehouse break room
- (45) 4' 4LT12 fixtures with (45) 4' 2LT8 fixtures in the machine shop
- (13) 4' 4LT12 fixtures with (13) 4' 2LT8 fixtures in the task lighting area
- (8) 4' 4LT12 fixtures with (4) 4' 2LT8 fixtures in the task lighting area
- (103) 4' 4LT12 fixtures with (103) 4' 2LT8 fixtures in the maintenance office
- (35) 4' 4LT12 fixtures with (35) 4' 2LT8 fixtures in the maintenance office
- (6) HPS fixtures with (6) Induction fixtures in the parking lot area
- (11) MH fixtures with (11) Induction fixtures on the exterior of the facility
- (38) 4' 4LT12 fixtures with (38) 4' 2LT8 fixtures in the lab area
- Installation of Occupancy Sensors

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and placed eight photo-sensor loggers at the site (from 3/11/14 to 3/27/14) to monitor lighting operation. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$ = *Annual energy savings*

N = *Number of fixtures*

W = *Wattage of each fixture*

t = *Lighting operating hours*

HCIF = *HVAC interaction factor*

Lighting occupancy sensor energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times W \times N \times \left(t_{base} - t_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$ = *Annual energy savings*

N = *Number of occupancy sensors*

W = *Wattage controlled by each occupancy sensor*

t = *Lighting operating hours*

HCIF = *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit installed under the project.

Lighting Retrofit Savings Calculations

Measure	*Quantity (Fixtures)*		*Wattage*		*Hours*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
	Old	*New*	*Old*	*New*					
MH to 4' 6LT8	4	4	461	217	2,592	3,512	2,768	1.09	79%
4' 4LT12 to 4' 2LT8	6	6	112	54	2,592	1,252	987	1.09	79%
8' 2LT12 to 8' 2LT8	2	2	110	54	2,592	403	318	1.09	79%
4' 4LT12 to 4' 2LT8	45	45	112	54	3,452	9,391	9,856	1.09	105%
4' 4LT12 to 4' 2LT8	13	13	112	54	6,398	2,713	5,277	1.09	195%
4' 4LT12 to 4' 2LT8	8	4	112	54	6,398	2,447	4,759	1.09	194%
4' 4LT12 to 4' 2LT8	103	103	112	54	2,924	21,494	19,128	1.09	89%
4' 4LT12 to 4' 2LT8	35	35	112	54	2,924	7,304	6,500	1.09	89%
HPS to Induction	6	6	469	150	4,308	7,656	8,246	1.00	108%
MH to Induction	11	11	461	150	4,308	13,684	14,738	1.00	108%
4' 4LT12 to 4' 2LT8	38	38	112	54	5,639	7,930	13,597	1.09	171%
Total						77,786	86,173		111%

The table shown below presents ex ante and ex post energy savings for the lighting controls installed under the project.

Lighting Controls Savings Calculations

Measure	Quantity	Controlled Wattage	Hours		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
			Old	New				
Controls	20	414	2,924	2,422		4,556	1.09	
Total					12,320.00	4,556		37%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Custom	77,786	86,173	111%	20.04
Lighting Controls	Standard	12,320	4,556	37%	0.32
Total		90,106	90,729	101%	20.78

The project-level realization rate is 101%. The realization rate is high mainly because the lighting hours of operation verified during the site visit (ranging from 2,592 to 6,398), not accounting for the effect of lighting controls, are less than those used to perform the ex ante savings estimation (ranging from 3,598 to 4,000). For the lighting controls installation, the ex ante savings estimation assumes a greater impact on lighting hours than was measured and verified on site.

Site C-1, S-1

Executive Summary

Project C-1, S-1 received standard and custom incentives from Ameren Missouri for retrofitting lighting in the interior of their facility and installing occupancy sensors. The realization rate for this project is 106%.

Project Description

The customer retrofitted and installed the following fixtures:

- (2) Incandescent lamps with (2) CFL lamps
- (1) 4' 2LT8 fixture with (1) LED fixture
- (5) MH fixtures with (5) LED fixtures
- (62) MH fixtures with (62) LED fixtures
- (2) 8' 2LT8 fixtures with (2) LED fixtures
- (2) 8' 2LT8HO fixtures with (9) LED fixtures
- (9) MH fixtures with (12) LED fixtures
- Installation of (4) LED fixtures
- (3) 4' 3LT8 fixtures with (3) LED fixtures
- (30) 4' 3LT8 fixtures with (30) LED fixtures
- (80) 8' 2LT8 fixtures with (112) LED fixtures
- (72) 4' 4LT8 fixtures with (72) LED fixtures
- (423) 4' 4LT8 fixtures with (423) LED fixtures
- (2) 8' 2LT8 fixtures with (2) LED fixtures
- (2) 8' 2LT8 fixtures with (2) LED fixtures
- (37) MH fixtures with (28) LED fixtures
- (4) MH fixtures with (12) LED fixtures
- (927) MH fixtures with (1173) LED fixtures
- (8) MH fixtures with (8) LED fixtures
- (21) 4' 2LT8 fixtures with (21) LED fixtures
- (7) MH fixtures with (7) LED fixtures
- (14) MH fixtures with (14) LED fixtures
- (96) 4' 3LT8 fixtures with (96) LED fixtures
- (13) 8' 2LT8 fixtures with (13) LED fixtures
- Removal of (7) 8’ 2LT8 fixtures
- (320) 4' 4LT8 fixtures with (320) LED fixtures
- (72) 4' 4LT8 fixtures with (72) LED fixtures
- (6) 4' 4LT8 fixtures with (6) LED fixtures
- Removal of (7) 4' 4LT8HO fixtures
- (3) Incandescent fixtures with (3) LED fixtures

- (17) 8' 2LT8HO fixtures with (17) LED fixtures
- (2) 4' 3LT5HO fixtures with (2) LED fixtures
- (7) 8' 2LT8HO fixtures with (7) LED fixtures
- (20) 8' 2LT8HO fixtures with (20) LED fixtures
- (10) MH fixtures with (10) LED fixtures
- Removal of (1) MH fixture
- (2) Quartz MH fixtures with (2) LED fixtures
- (4) Quartz MH fixtures with (4) LED fixtures
- Removal of (11) MH fixtures
- Installation on 95 Occupancy Sensors
- Installation of 1243 Infrared Occupancy Sensors

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. ADM placed monitoring equipment in the factory floor areas to determine the baseline hours of use. These data were used to calculate energy savings. The reduction of lighting operating hours associated with occupancy sensors is determined by multiplying the baseline hours by a Power Adjustment Factor of 0.7 (adapted from ASHRAE 90.1-2007).

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area}\left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built}\right)/1000\right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
$HCIF$	= *HVAC interaction factor*

Lighting occupancy sensor energy savings are calculated as:

$$kWh_{savings} = \sum_{Area}\left[HCIF \times W \times N \times \left(t_{base} - t_{as-built}\right)/1000\right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of occupancy sensors*

W	*= Wattage controlled by each occupancy sensor*
t	*= Lighting operating hours*
HCIF	*= HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	*Quantity (Fixtures)*		*Wattage*		*Hours*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
	Old	*New*	*Old*	*New*					
Incandescent to CFL	2	2	75	23	8,760	911	1,000	1.10	110%
4' 2LT8 to LED	1	1	58	44	3,336	44	51	1.10	117%
MH to LED	5	5	90	117	8,760	(1,183)	(1,298)	1.10	110%
MH to LED	62	62	110	117	8,760	(3,802)	(4,174)	1.10	110%
8' 2LT8 to LED	2	2	220	117	8,760	1,805	1,981	1.10	110%
8' 2LT8HO to LED	2	9	234	117	8,760	(5,125)	(5,627)	1.10	110%
MH to LED	9	12	1,080	117	8,760	72,848	79,987	1.10	110%
Installation of LED	-	4	-	117	8,760	(4,100)	(4,501)	1.10	110%
4' 3LT8 to LED	3	3	88	55	8,760	867	952	1.10	110%
4' 3LT8 to LED	30	30	88	55	3,336	3,089	3,626	1.10	117%
8' 2LT8 to LED	80	112	110	132	8,760	(52,420)	(57,557)	1.10	110%
4' 4LT8 to LED	72	72	112	55	8,760	35,951	39,474	1.10	110%
4' 4LT8 to LED	423	423	112	55	3,336	75,226	88,317	1.10	117%
8' 2LT8 to LED	2	2	110	145	8,760	(613)	(673)	1.10	110%
8' 2LT8 to LED	2	2	110	264	8,760	(2,698)	(2,962)	1.10	110%
MH to LED	37	28	458	132	8,760	116,070	127,445	1.10	110%
MH to LED	4	12	458	145	8,760	806	885	1.10	110%
MH to LED	927	1,173	1,080	132	8,760	7,413,798	8,140,350	1.10	110%
MH to LED	8	8	1,080	145	8,760	65,525	71,946	1.10	110%
4' 2LT8 to LED	21	21	58	44	3,120	917	1,007	1.10	110%
MH to LED	7	7	62	55	3,120	153	168	1.10	110%
MH to LED	14	14	62	55	8,760	858	943	1.10	110%
4' 3LT8 to LED	96	96	88	55	3,120	9,884	10,854	1.10	110%
8' 2LT8 to LED	13	13	110	117	8,760	(797)	(875)	1.10	110%
Removal of 8; 2LT8	7	-	110	-	8,760	6,745	7,406	1.10	110%

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
4' 4LT8 to LED	320	320	112	55	3,120	56,909	62,490	1.10	110%
4' 4LT8 to LED	72	72	112	55	8,760	35,951	39,474	1.10	110%
4' 4LT8 to LED	6	6	112	110	8,760	105	115	1.10	110%
Removal of 4' 4LT8HO	7	-	123	-	8,760	7,542	8,282	1.10	110%
Incandescent to LED	3	3	150	23	8,760	3,338	3,665	1.10	110%
8' 2LT8HO to LED	17	17	160	110	8,760	7,446	8,176	1.10	110%
4' 3LT5HO to LED	2	2	179	110	8,760	1,209	1,327	1.10	110%
8' 2LT8HO to LED	7	7	220	110	8,760	6,745	7,406	1.10	110%
8' 2LT8HO to LED	20	20	220	165	8,760	9,636	10,580	1.10	110%
MH to LED	10	10	295	42	8,760	22,163	24,335	1.10	110%
Removal of MH	1	-	458	-	8,760	4,012	4,405	1.10	110%
Quartz MH to LED	2	2	500	21	8,760	8,392	9,215	1.10	110%
Quartz MH to LED	4	4	500	42	8,760	16,048	17,621	1.10	110%
Removal of MH	11	-	1,080	-	8,760	104,069	114,268	1.10	110%
Total						8,018,326	8,810,084		110%

The table shown below presents ex ante and ex post energy savings for the lighting controls installed under the project.

Lighting Controls Savings Calculations

Measure	Quantity	Controlled Wattage	Hours		Ex Ante kWh Savings	Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
			Old	New				
Controls	95	116	8,706	6,093	36,765	31,683	1.10	86%
Controls	1,243	174	7,567	5,263	765,688	545,765	1.10	71%
Total					802,453.00	577,449		72%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Custom	8,017,415	8,809,083	110%	1,393.39
Lighting Retrofit	Standard	911	1,000	110%	0.16
Lighting Controls	Standard	802,453	577,449	72%	96.53
Total		8,820,779	9,387,532	106%	1,490.07

The project-level realization rate is 106%. For the lighting retrofit, the realization rate is high mainly because the ex post savings analysis included an HCIF for gas-heated light manufacturing in central Missouri (1.10), while the ex ante savings estimate did not account for HVAC interactive effects. For the lighting controls, the ex ante savings estimation assumes a greater impact on lighting hours than was measured and verified during the M&V site visit.

Site C-23, S-16

Executive Summary

Project C-23, S-16 received standard and custom incentives from Ameren Missouri for retrofitting the lighting in the interior and exterior of their facility and also for installing occupancy sensors. The realization rate for this project is 78%.

Project Description

The customer retrofitted the following fixtures:

- (100) 4' 4LT12 fixtures with (100) 4' 2LT8 fixtures
- (30) Incandescent lamps with (30) LED lamps
- (48) 4' 2LT12 fixtures with (48) 4' 2LT8 fixtures
- (50) Exit Sign fixtures with (50) LED Exit Signs
- (55) Incandescent lamps with (55) LED lamps
- (18) 4' 4LT12 fixtures with (18) 4' 2LT8 fixtures
- (73) CFL lamps with (73) LED lamps
- (26) Incandescent lamps with (26) LED lamps
- (6) Incandescent lamps with (6) LED lamps
- (30) 8' 2LT12 fixtures with (30) 8' 4LT8 fixtures
- (100) Incandescent lamps with (100) LED lamps
- (200) Incandescent lamps with (200) LED lamps
- (6) MV fixtures with (6) LED-Wall Pack fixtures
- (108) 4' 2LT12 fixtures with (108) 4' 2LT8 fixtures
- (35) Incandescent lamps with (35) LED lamps
- (42) 4’ 2L12 fixtures with (42) 4’ 2LT8 fixtures
- Installation of 94 Occupancy Sensors

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and placed six photo-sensor loggers at the site (from 06/06/14 to 07/06/14) to monitor lighting operation. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$ = *Annual energy savings*

N = *Number of fixtures*

W = *Wattage of each fixture*

t = *Lighting operating hours*

$HCIF$ = *HVAC interaction factor*

Lighting occupancy sensor energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times W \times N \times \left(t_{base} - t_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$ = *Annual energy savings*

N = *Number of occupancy sensors*

W = *Wattage controlled by each occupancy sensor*

t = *Lighting operating hours*

$HCIF$ = *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
4' 4LT12 to 4' 2LT8	100	100	112	54	7,046	50,808	43,808	1.07	86%
Incandescent to LED	30	30	45	11	8,760	8,935	9,579	1.07	107%
4' 2LT12 to 4' 2LT8	48	48	62	54	8,760	3,364	3,606	1.07	107%
Exit Sign to Exit Sign	50	50	40	3	8,760	16,206	17,373	1.07	107%
Incandescent to LED	55	55	60	11	8,760	23,608	25,308	1.07	107%
4' 4LT12 to 4' 2LT8	18	18	112	54	8,760	9,145	9,804	1.07	107%
CFL to LED	73	73	35	12	2,513	5,147	4,272	0.99	83%
Incandescent to LED	26	26	25	5	7,215	4,669	4,123	1.07	88%
Incandescent to LED	6	6	90	20	4,308	1,680	1,809	1.00	108%
8' 2LT12 to 8' 4LT8	30	30	110	95	7,046	3,942	3,399	1.07	86%
Incandescent to LED	100	100	15	2	8,760	11,388	12,208	1.07	107%
Incandescent to LED	200	200	3	1	485	3,504	208	1.07	6%
MV to LED-WallPack	6	6	450	85	4,308	8,760	9,434	1.00	108%
4' 2LT12 to 4' 2LT8	108	108	62	54	7,046	7,569	6,526	1.07	86%
Incandescent to LED	35	35	45	11	2,850	10,424	3,361	0.99	32%
4' 2LT12 to 4' 2LT8	42	42	62	54	2,513	2,943	837	0.99	28%
Total						172,093	155,655		90%

The table shown below presents ex ante and ex post energy savings for the lighting controls installed under the project.

Lighting Controls Savings Calculations

Measure	Quantity	Controlled Wattage	Hours		Ex Ante kWh Savings	Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
			Old	New				
Controls	94	33	2,513	376	36,378	6,580	0.99	18%
Total					36,378.00	6,580		18%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Standard	60,854	57,430	94%	7.20
Lighting Retrofit	Custom	111,239	98,225	88%	12.61
Lighting Controls	Standard	36,378	6,580	18%	1.14
Total		208,471	162,235	78%	20.95

The project-level gross kWh savings rate is 78%. The realization rate for the standard lighting incentive is slightly low because the ex post hours of operation verified during the M&V site visit for one measure (2,850) were fewer than the lighting hours of operation used to perform ex ante savings (8,760). The realization rate for the custom lighting incentive was also low because several measures had ex post hours of operation verified during the M&V site visit (485 – 7,215) that were fewer than the lighting hours of operation used to perform ex ante savings (8,760). For the standard lighting controls, the ex post savings is low due to each control being installed on a single fixture where the controlled wattage was low. The ex ante savings estimation assumes a greater impact on lighting hours (36,376) than was measured and verified during the M&V site visit (6,580).

Site C-13

Executive Summary

Project C-13 received custom incentives from Ameren Missouri for installation of Direct Digital Controls (DDC) on the HVAC system serving their building. The realization rate for this project is 128%.

Project Description

Originally tenants had unlimited control of space temperature set points as the pneumatic controls offered no global control of the HVAC system. In order to reduce building HVAC energy consumption, the customer replaced aging pneumatic controls with a new DDC system. The installed DDC system allows for global control of the buildings seven package roof top units which have a combined tonnage of 395. The installation of the DDC system allowed for the following control strategies to be implemented:

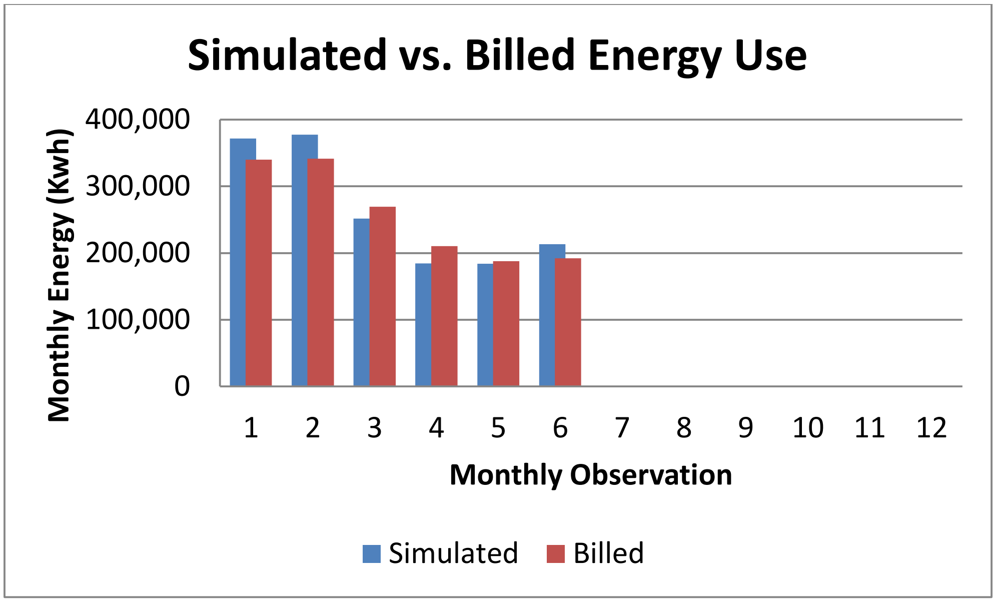
- Reduced the range of control for temperature set points by tenants,
- Global time clock for HVAC hours of operation,
- Cooling and Heating setbacks for unoccupied hours, and
- Eliminate baseboard heating during periods of cooling.

Measurement and Verification Effort

ADM visited the facility and confirmed the installation of the DDC system. During the M&V visit, site specific construction details were collected to inform eQUEST simulation. These details included typical building construction, window construction, floor layout, HVAC zoning, HVAC equipment nameplates, and building space utilization. ADM also interviewed facility staff to determine HVAC sequence of operation, temperature set points, and typical hours of operation.

The ex post electrical savings were calculated using a calibrated eQUEST (ver. 3-64) computer simulation model, which was compiled based upon the fore mentioned collected details. The simulation was first built using the as-built DDC system control strategy. The model was then calibrated using billing data and 2014 weather data for the area. The results of the calibration effort are shown below:

eQUEST As-Built Calibration



The baseline model was created by removing the control strategies offered by the installed DDC system. The baseline controls used in the simulation were determined through interviews with site contacts. Parametric runs were used to make the appropriate changes within the model, in which the model was run using TMY3 weather. The annual savings is the difference between the annual consumption of the baseline and as-built eQUEST model, which can be seen in the following table:

Annual kWh Energy Savings

End Use	Baseline	As-Built	Savings
Lighting	609,863	609,863	0
Misc. Equipment	429,760	429,760	0
Heating	1,261,921	983,576	278,345
Cooling	563,529	525,782	37,747
Heat Rejection	0	0	0
Pumps	1,129	1,138	-9
Fans	368,511	332,233	36,318
DHW	48,973	48,947	26
Exterior	2,213	2,213	0
Total	3,285,940	2,933,513	352,427

Results

Verified Gross Savings/Realization Rates

Measure Category	Gross kWh Savings			Gross Ex Post Peak kW Reduction
	Ex Ante	Ex Post	Realization Rate	
DDC	275,106	352,427	128%	-5.58
Total	275,106	352,427	128%	-5.58

The high realization rate can be attributed to the ex post analysis having post retrofit billing data available for simulation calibration purposes. Using both pre and post billing data to inform the individual parametric runs of the eQUEST model showed that the facility is saving slightly more energy than ex ante models originally anticipated.

Site C-15

Executive Summary

Project C-15 received incentives from Ameren Missouri for installation of Direct Digital Controls (DDC) on the HVAC system serving their building. The combined realization rate for these projects is 101%.

Project Description

Originally tenants had unlimited control of space temperature set points as the pneumatic controls offered no global control of the HVAC system. In order to reduce building HVAC energy consumption, the customer replaced aging pneumatic controls with a new DDC system. The installed DDC system allows for global control of the buildings four package roof top units which have a combined tonnage of 255. The installation of the DDC system allowed for the following control strategies to be implemented:

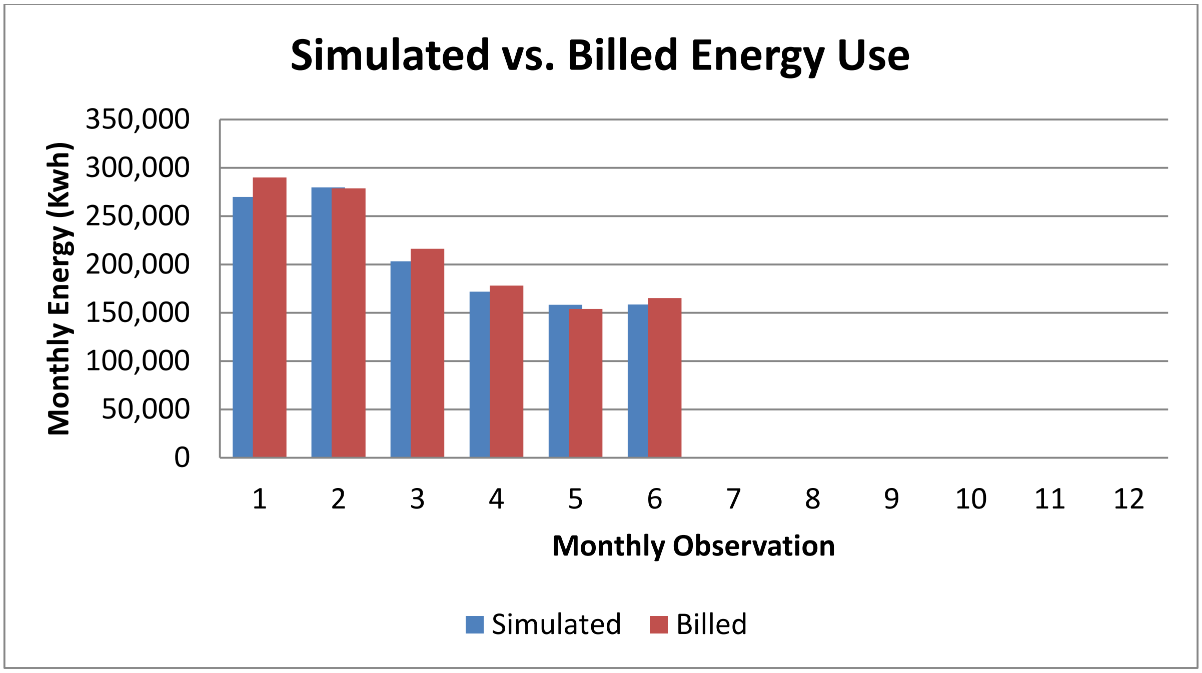
- Reduced the range of control for temperature set points by tenants,
- Global time clock for HVAC hours of operation,
- Cooling and Heating setbacks for unoccupied hours, and
- Eliminate baseboard heating during periods of cooling.

Measurement and Verification Effort

ADM visited the facility and confirmed the installation of the DDC system. During the M&V visit, site specific construction details were collected to inform eQUEST simulation. These details included typical building construction, window construction, floor layout, HVAC zoning, HVAC equipment nameplates, and building space utilization. ADM also interviewed facility staff to determine HVAC sequence of operation, temperature set points, and typical hours of operation.

The ex post electrical savings were calculated using a calibrated eQUEST (ver. 3-64) computer simulation model, which was compiled based upon the fore mention collected details. The simulation was first built using the as-built DDC system control strategy. The model was then calibrated using billing data and 2014 weather data for the area. The results of the calibration effort are shown below:

eQUEST As-Built Calibration



The baseline model was created by removing the control strategies offered by the installed DDC system. The baseline controls used in the simulation were determined through interviews with site contacts. Parametric runs were used to make the appropriate changes within the model, in which the model was run using TMY3 weather. The annual savings is the difference between the annual consumption of the baseline and as-built eQUEST model, which can be seen in the following table:

Annual kWh Energy Savings

End Use	*Baseline*	*As-Built*	*Savings*
Lighting	482,684	482,684	0
Misc. Equipment	362,416	362,416	0
Heating	1,116,480	963,755	152,725
Cooling	514,721	447,183	67,538
Heat Rejection	0	0	0
Pumps	701	701	0
Fans	82,832	74,551	8,281
DHW	32,691	32,655	36
Exterior	15,946	15,946	0
Total	2,608,471	2,379,893	228,578

Results

Verified Gross Savings/Realization Rates

Measure Category	Gross kWh Savings			Gross Ex Post Peak kW Reduction
	Ex Ante	Ex Post	Realization Rate	
DDC	226,633	228,578	101%	5.71
Total	226,633	228,578	101%	5.71

The calibrated ex post model results substantiated the ex ante uncalibrated model savings.

Site C-3

Executive Summary

Project C-3 received custom incentives from Ameren Missouri for extensive HVAC upgrades including multiple variable frequency drive (VFD) motor upgrades, damper hardware and control upgrades, faulty equipment and wiring upgrades. The combined realization rate for these projects is 91%.

Project Description

C-3 is a manufacturing facility. It is approximately 600,000 ft^2 and operates 24/7, 365 days of the year. In May of 2014, several air handlers were identified for updating the controls to allow "free cooling" which uses outside air during cool weather conditions to provided cooling to the facility. Several pumps and fans were also retrofitted with variable frequency drives (VFDs) along with new controls being programmed into the EMS. Those systems identified and upgraded are as followed:

- AHU-1 Replace EA, RA, & OA damper systems and positioners,
- AHU-2 Replace EA, RA, & OA damper systems and positioners,
- AHU-3 Replace EA, RA, & OA damper systems and positioners,
- AHU-4 Replace OA damper system and positioner,
- AHU-6 Replace EA, RA, & OA damper systems and positioners,
- AHU-7 Replace EA, & RA damper systems and positioners,
- AHU-8 Replace EA, & RA damper systems and positioners,
- AHU-10 Add EA, RA, & Ex dampers and add to Metasys,
- AHU-11 Replace EA, RA, & OA damper systems and positioners,
- Old Ac-12 Add electric EA damper, gravity relief, replace RA damper, and connect to Metasys,
- AHU-12 Replace RA, & OA damper systems and positioners,
- 40 Hp VFD on condenser water pump P-5,
- 30 Hp VFD on chilled water pump P-7,
- 50 Hp VFD on chilled water pump CWP-3,
- 25 Hp VFD on condenser water pump P-4,
- 20 Hp VFD on chilled water pump P-6,
- 2 - 20 Hp VFDs on cooling tower fans,
- 15 Hp VFD on chiller room pump P1,
- 30 Hp VFD on hair care pump,
- 20 Hp VFD on hot water pump P-1,
- 50 Hp VFD on hot water pump P-11,
- 15 Hp VFD on hot water pump P-12,
- 20 Hp VFD on hot water pump P-10, and

- 30 Hp VFD on hot water pump P-9.

In addition to the chilled and hot water lock-outs, the secondary chilled water pumps were all programmed to be off when not needed. Also, heating supply air temperatures, cooling air supply temperatures, chilled water temperatures, and hot water supply temperatures were programmed to be automatically reset according to plant demand requirements or outside air temperature.

Measurement and Verification Effort

ADM visited the facility and confirmed the installation of the VFDs and implementation of the control upgrades. During the M&V visit, site specific details were collected for engineering analysis and simulation. These details included typical building construction, HVAC equipment nameplates, and building space utilization. ADM also interviewed facility staff to determine HVAC sequence of operation, temperature set points, and typical hours of operation. Power consumption from a sample of motors was monitored for three weeks using WattNode equipment, including cooling tower fans and pumps from various locations throughout the facility. In each case, one-time power measurements using a voltage meter was completed to verify the monitoring hardware output.

The ex post electrical savings were calculated using a multiple linear regression of the building power consumption as a function of several independent variables. This is possible because the base non-weather dependent power consumption is relatively constant, and the retrofits were so extensive that the building utility bills were affected. The independent variables used in the regression include heating and cooling degree days, temperature, relative humidity, wind speed, and others. The retrofits were only associated with temperature-dependent power consumption, so the equipment upgrades were effectively isolated. The linear models for the billing data were then applied to Typical Meteorological Year (TMY3) data to create typical power consumption with and without the retrofit. The savings is the difference between the pre and post power calculations.

Results

Verified Gross Savings/Realization Rates

Measure Category	*Gross kWh Savings*			*Gross Ex Post Peak kW Reduction*
	Ex Ante	*Ex Post*	*Realization Rate*	
HVAC Upgrades	1,811,093	1,658,024	92%	189.27
Total	1,811,093	1,658,024	92%	189.27

The savings are slightly lower than originally claimed because more recent billing data was used, which would have been unavailable during ex ante calculations.

Site R-3

Executive Summary

Project R-3 received incentives from Ameren Missouri for performing a retro-commissioning project on the facility's HVAC system. The realization rate for this project is 95%.

Project Description

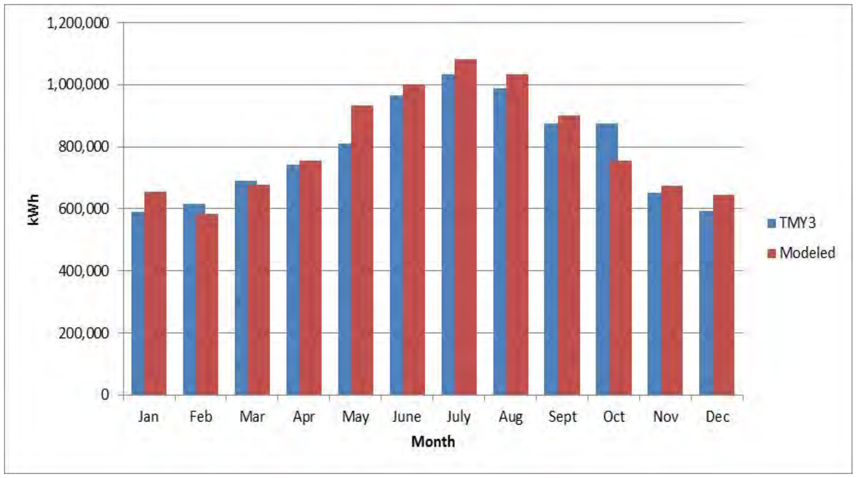
The customer performed a HVAC retro-commissioning project at their southwest campus. The project involved the implementation of time of use scheduling for the HVAC system as the system originally operated 24/7 even though portions of the medical center would be unoccupied. Also performed was pneumatic and DDC control system calibrations as many of the systems sensors were providing inaccurate readings to the BMS and resulting in excess system energy use. The facility also installed VFDs on chilled water pumps and rebalanced the flow of the chilled water system.

Measurement and Verification Effort

During the M&V visit, ADM staff verified the changes to the BMS system. During this time occupancy schedules and other operating setpoints were collected from the BMS.

Energy savings for the retro-commissioning project was calculated through the use of a Trane Trace 700 energy model provided by the project implementer. ADM reviewed the model for inconsistencies and ensured the model representing the baseline medical center was properly calibrated. Minor adjustments were necessary to calibrate the model to provided billing data. The effort of this calibration can be seen below:

Monthly kWh Calibration



Upon the completion of the baseline model, ADM reviewed the Trane Trace alternative models, which represent the retro-commissioning project performed at the medical center. Once the inputs of the alternative models were reviewed the models were run using TMY3 weather for the St. Louis, MO area. The typical year annual savings is the difference between the two models' annual consumption and can be seen below:

As-Built Vs. Baseline Annual Energy Consumption

End-Use	*Baseline kWh*	*As-Built kWh*	*Annual kWh Savings*
Lighting	*1,189,139*	*1,189,139*	*0*
Miscellaneous Equipment	*1,976,071*	*1,976,071*	*0*
Pumps & Fans	*4,482,183*	*3,685,509*	*796,674*
Cooling	*1,985,818*	*1,862,002*	*123,816*
Heating	*61,157*	*52,288*	*8,869*
Total	**9,694,368**	**8,765,009**	**929,359**

The following table presents the annual energy savings by retro-commissioning measure:

Retro-Commissioning Measure Level Savings

Evaluation Measure ID	*Ex Ante*	*Ex Post*	*RR*
MC-1: Pneumatic Control System Enhancements for Occupancy Requirements and Scheduling	3,860	2,248	58%
MC-2 & 6: Pneumatic Control System Calibration	68,642	38,833	57%
MC-3: DDC Control System Enhancements for Occupancy Requirements and Scheduling	96,910	97,268	100%
MC-4: DDC Control System Calibration	521,629	528,741	101%
MC-5 &7: Replace VFDs on Chilled Water Pumps and Rebalance Chilled Water Flow	285,505	262,269	92%
Total	**976,546**	**929,359**	**95%**

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	*Incentive*	*kWh Savings*			*Gross Ex Post Peak kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Retro-Commissioning	RCx	976,546	929,359	95%	85.33
Total		976,546	929,359	95%	85.33

The project-level realization rate is 95%. The low realization rate can be attributed to small changes made in the Trane Trace model provided by the implementer, in order for it to reflect the setpoints and control strategies collected during the post M&V visit. The additional calibration effort undertaken by ADM also had a slight impact on energy saving

Site R-1

Executive Summary

Project R-1 received incentives from Ameren Missouri for performing a retro-commissioning project on the facility's HVAC system. The realization rate for this project is 81%.

Project Description

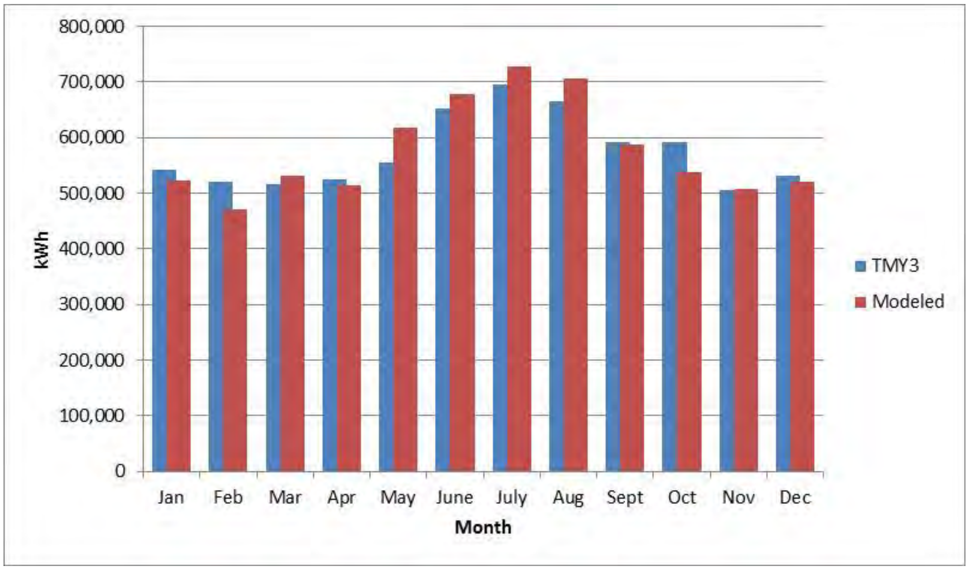
The customer performed a HVAC retro-commissioning project at their southwest campus. The project involved the implementation of time of use scheduling for the HVAC system as the system originally operated 24/7 even though portions of the medical center would be unoccupied. Also performed was pneumatic and DDC control system calibrations as many of the systems sensors were providing inaccurate readings to the BMS and resulting in excess system energy use. The facility also installed a single package terminal air conditioned in a critical zone to allow the original air handler to be shut down during periods of un-occupancy in other zones.

Measurement and Verification Effort

During the M&V visit, ADM staff verified the changes to the BMS system. During this time occupancy schedules and other operating setpoints were collected from the BMS.

Energy savings for the retro-commissioning project was calculated through the use of a Trane Trace 700 energy model provided by the project implementer. ADM reviewed the model for inconsistencies and ensured the model representing the baseline medical center was properly calibrated. Minor adjustments were necessary to calibrate the model to provided billing data. The effort of this calibration can be seen below:

Monthly kWh Calibration



Upon the completion of the baseline model, ADM reviewed the Trane Trace alternative models, which represent the retro-commissioning project performed at the medical center. Once the inputs of the alternative models were reviewed the models were run using TMY3 weather for the St. Louis, MO area. The typical year annual savings is the difference between the two models' annual consumption and can be seen below:

As-Built Vs. Baseline Annual Energy Consumption

End-Use	*Baseline kWh*	*As-Built kWh*	*Annual kWh Savings*
Lighting	*516,912*	*516,912*	*0*
Miscellaneous Equipment	*1,422,826*	*1,422,826*	*0*
Pumps & Fans	*3,794,839*	*964,913*	*2,829,926*
Cooling	*982,330*	*609,240*	*373,090*
Heating	*206,969*	*173,594*	*33,375*
Total	**6,923,876**	**3,687,485**	**3,236,391**

The following table presents the annual energy savings by retro-commissioning measure:

Retro-Commissioning Measure Level Savings

Evaluation Measure ID	*Ex Ante*	*Ex Post*	*RR*
***SW-1**: Control System enhancements for occupancy*	*3,494,278*	*2,827,869*	*81%*
***SW-2**: Pneumatic Control System Calibration*	*278,995*	*119,027*	*43%*
***SW-3**: DDC Control System Calibration*	*143,817*	*205,858*	*143%*
***SW-4**: Critical Zone HVAC Isolation*	*83,637*	*83,637*	*100%*
Total	**4,000,727**	**3,236,391**	**81%**

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	*Incentive*	*kWh Savings*			*Gross Ex Post Peak kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Retro-Commissioning	RCx	4,000,727	3,236,391	81%	77.67
Total		4,000,727	3,236,391	81%	77.67

The project-level realization rate is 81%. The low realization rate is attributed to inconsistencies discovered within the Trane Trace model provided by the implementer. Most significant, was the lighting and miscellaneous equipment power densities varying between the baseline model and the subsequent alternative models. These inconsistencies resulted in the calculation of unrealized energy savings by the implementer.

Site C-24, S-22

Executive Summary

Project C-24, S-22 received custom and standard incentives from Ameren Missouri for retrofitting lighting in the interior of their facility and installing occupancy sensors. The realization rate for this project is 93%.

Project Description

The customer retrofitted the following fixtures:

- (6) 8' 1LT12 fixtures with (6) 4' 2LT8 fixtures
- (9) 4' 4LT12 fixtures with (9) 4' 2LT8 fixtures
- (38) 4' 4LT12 fixtures with (23) 4' 2LT8 fixtures
- (133) 4' 4LT12 fixtures with (117) 4' 2LT8 fixtures
- (2) 4' 2LT12 fixtures with (2) 4' 1LT8 fixtures
- (3) U-tube 2LT12 fixtures with (2) 4' 2LT8 fixtures
- (13) 8' 2LT12 fixtures with (13) 4' 2LT8 fixtures
- (5) 4' 4LT12 fixtures with (5) 4' 2LT8 fixtures
- (6) 4' 1LT12 fixtures with (4) 4' 1LT5 fixtures
- Installation of 2 occupancy sensors
- Installation of 4 occupancy sensors
- Installation of 8 occupancy sensors
- Installation of 39 occupancy sensors
- Installation of 4 occupancy sensors
- Installation of 4 occupancy sensors

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and placed four photo-sensor loggers at the site (from 4/01/14 to 4/15/14) to monitor lighting operation. These data were used to determine the as built hours of use, and then extrapolated to an hourly model of the baseline period based on hourly activity in the usage area.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$ = *Annual energy savings*

N = *Number of fixtures*

W = *Wattage of each fixture*

t = *Lighting operating hours*

HCIF = *HVAC interaction factor*

Lighting occupancy sensor energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times W \times N \times \left(t_{base} - t_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$ = *Annual energy savings*

N = *Number of occupancy sensors*

W = *Wattage controlled by each occupancy sensor*

t = *Lighting operating hours*

HCIF = *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	*Quantity (Fixtures)*		*Wattage*		*Hours*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
	Old	*New*	*Old*	*New*					
8' 1LT12 to 4' 2LT8	6	6	100	54	7,509	2,072	2,072	1.00	100%
4' 4LT12 to 4' 2LT8	9	9	112	54	7,509	3,920	3,920	1.00	100%
4' 4LT12 to 4' 2LT8	38	23	112	54	7,509	22,632	22,633	1.00	100%
4' 4LT12 to 4' 2LT8	133	117	112	54	5,538	64,412	52,116	1.10	81%
4' 2LT12 to 4' 1LT8	2	2	62	28	5,538	511	413	1.10	81%
U-tube 2LT12 to 4' 2LT8	3	2	59	54	5,538	518	419	1.10	81%
8' 2LT12 to 4' 2LT8	13	13	185	54	7,509	12,788	12,788	1.00	100%
4' 4LT12 to 4' 2LT8	5	5	112	54	8,009	2,178	2,416	1.04	111%
4' 1LT12 to 4' 1LT5	6	4	30	54	7,509	(270)	(270)	1.00	100%
Total						107,180	96,506		90%

The table shown below presents ex ante and ex post energy savings for the lighting controls installed under the project.

Lighting Controls Savings Calculations

Measure	Quantity	Controlled Wattage	Hours		Ex Ante kWh Savings	Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
			Old	New				
Controls	2	162	7,509	1,155	1,540	2,059	1.00	134%
Controls	4	122	7,509	3,207	2,464	2,091	1.00	85%
Controls	2	162	7,509	3,207	1,540	1,394	1.00	91%
Controls	29	147.10	5,538	1,816	17,864	17,418	1.10	98%
Controls	10	221.60	5,538	1,816	7,700	9,048	1.10	118%
Controls	4	176	7,509	3,207	3,080	3,020	1.00	98%
Controls	4	94.50	7,509	3,207	3,080	1,626	1.00	53%
Controls	6	162	7,509	3,207	3,696	4,181	1.00	113%
Total					40,964.00	40,836		100%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Custom	107,180	96,506	90%	18.04
Lighting Controls	Standard	40,964	40,836	100%	3.29
Total		148,144	137,342	93%	21.33

The project-level realization rate is 93%. The custom incentive realization rate is low mainly because the ex post lighting hours of operation verified during the M&V site visit for the front offices (5,538) are less than the production areas that were used to perform the ex ante estimate (7,509). In addition, the ex post savings analysis included an HCIF for the front offices (1.10), while the ex ante savings estimate did not account for HVAC interactive effects. For the lighting controls, the ex ante estimate was highly accurate.

Site R-2

Executive Summary

Project R-2 received incentives from Ameren Missouri for repairing compressed air leaks, installing a compressor sequencer, flow controller and replacing heated regenerative dryers with non-cycling refrigeration dryers. The project realization rate is 71%.

Project Description

The customer repaired compressed air leaks in their air compressor power plants, and installed new equipment in their power plant. They removed two regenerative dryers that consume pressurized air, and replaced with two refrigeration dryers. Also, installed were a flow controller and sequencer to achieve savings in pressure reduction.

Measurement and Verification Effort

ADM utilized trade ally provided data from their pre installation monitoring and data from two additional post monitoring periods.

ADM used the as-built monitoring data files and documents to calculate an average daily operating profile for each day and hour of the week for the revised compressed air process. Manufacturer's performance curves were used to calculate the as-built air demand profile based upon the kW profile from power monitoring. The results of this extrapolation can be seen in the following graph:

As-Built Compressor CFM Output

Assuming the CFM profile is the same in the baseline and as-built conditions, compressor performance curves were used to calculate the corresponding baseline compressors usage. The pre and post weekly profiles were then extrapolated to a year and energy savings were calculated by subtracting the post consumption from the baseline period. Energy savings for the repaired air leaks was calculated by adding 151 CFM to the as-built compressor demand profiles, an additional 91 CFM was also added to the consumption profiles to account for purge air used by the baseline dryers. The same calculation methodology for the compressor savings was used to calculate leak savings.

Results

Verified Gross Savings/Realization Rates

Measure Category	*Incentive*	*Gross kWh Savings*			*Gross Ex Post Peak kW Reduction*
		Ex Ante	*Ex Post*	*Realization Rate*	
Compressed Air Leaks	RCx - 7435	1,807,043	1,281,982	71%	144.8
Total		1,807,043	1,281,982	71%	144.8

The realization rate for the RCx project is 71%. There are two major causes of the low realization rate. The first is attributed to the ex ante expected savings from the two refrigerated dryers. They included the reduction in air purge (CFM) in the as-built profile as well as a separate calculation for the dryers based on a given CFM/kW savings value for reducing the purged air.

Also, the ex ante provided new data logging for savings beyond the offered amount that was performed over the Thanksgiving holiday week. The data distribution did not appear normalized to the previously logged air flow profiles.

The ADM methodology creates bins based on the day of the week and hour of the day, with flags in the calculation to handle holidays and weekends, separately from weekday operations. Historical work has indicated that even 7-day a week manufacturing operations, have a unique weekend work schedule.

Site C-10

Executive Summary

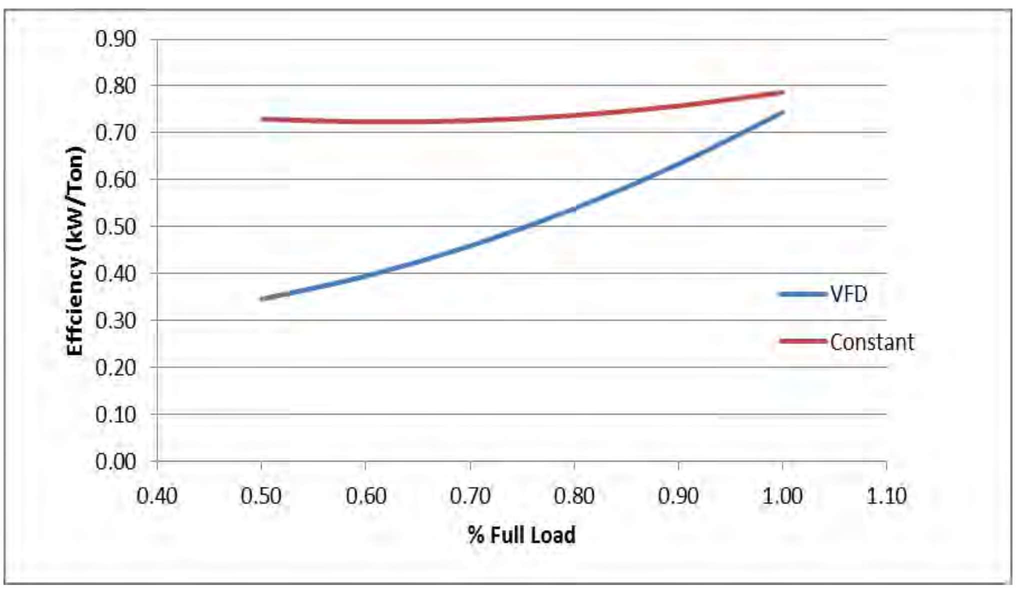
Project C-10 received custom incentives from Ameren Missouri for the installation of VFDs on two pre-existing chillers along with implementation of a condenser water reset control strategy. The realization rate for this project is 136%.

Project Description

C-10s building relies on three 360 ton Trane Centravac chillers to provided cooling to the 19 story office building. Originally all three of the chillers operated at constant speed thus relying on inlet guide vanes to modulate the capacity of the chillers. In order to improve the part load efficiency of chillers, variable frequency drives (VFDs) were installed on two of the three chillers.

The following graph illustrates the differences in chiller efficiency between constant speed and VFD equipped chiller, assuming a constant 85F condenser water temperature:

VFD vs Constant Speed Chiller Efficiency



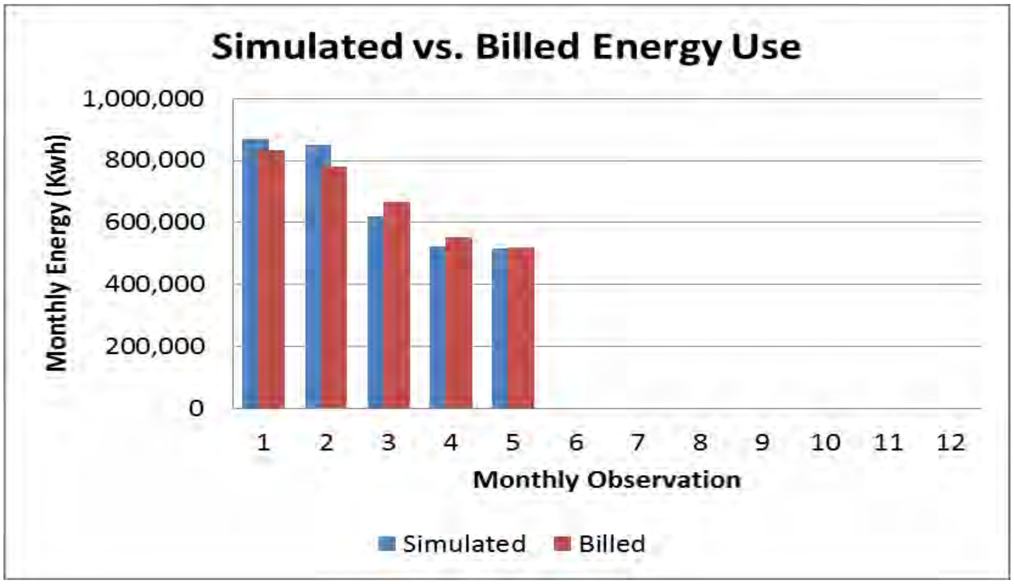
The addition of the VFDs on the chillers also allowed the facility to take advantage of a condenser water reset control strategy that was not originally being used. The benefit of allowing the condenser water to reset based on outside wet bulb temperature is it reduced the overall lift of the chiller therefore increasing chiller efficiency.

Measurement and Verification Effort

ADM visited the facility and confirmed the installation of the VFDs and implementation of the condenser water reset control. During the M&V visit, site specific construction details were collected to inform eQUEST simulation. These details included typical building construction, window construction, floor layout, HVAC zoning, HVAC equipment nameplates, and building space utilization. ADM also interviewed facility staff to determine HVAC sequence of operation, temperature set points, and typical hours of operation.

The ex post electrical savings were calculated using a calibrated eQUEST (ver. 3-64) computer simulation model, which was compiled based upon the fore mention collected details. The simulation was first built using as-built parameters which included two of the three chillers being equipped with VFDs and condenser water reset controls. The model was then calibrated using billing data and 2014 weather data for the area. The results of the calibration effort are shown below:

eQUEST As-Built Calibration



In order to ensure that the chiller operation within the eQUEST model reflected that of the facility, chiller log data was exported from the facility's energy management system. The provided data included; chiller tonnage, kW demand, and condenser/chilled water temperatures. Using the provided data in conjunction with corresponding local weather data obtained from NOAA, a regression was developed allowing for the determination of chiller runtime hours. Using TMY3 weather data it was determined that the two retrofitted chiller should operate approximately 5,815 and 1,725 hours per year, while ADM's eQUEST model resulted in annual runtime hours of 5,695 and 1,721 hours. This suggests that the model accurate reflects the operation of the chillers.

The baseline model was created by removing the condenser water reset control and removing the VFDs from the two chillers. Parametric runs were used to make the appropriate changes within the model, in which the model was run using TMY3 weather. The annual savings is the difference between the annual consumption of the baseline and as-built eQUEST model, which can be seen in the following table:

Annual kWh Energy Savings

End Use	*Baseline*	*As-Built*	*Savings*
Lighting	3,053,558	3,053,558	0
Misc. Equipment	1,215,219	1,215,219	0
Heating	1,668,291	1,668,291	0
Cooling	1,427,011	790,528	636,483
Heat Rejection	50,146	53,537	-3,391
Pumps	315,374	315,374	0
Fans	149,416	149,416	0
DHW	152,328	152,328	0
Exterior	15,946	15,946	0
Total	8,047,285	7,414,193	633,092

Results

Verified Gross Savings/Realization Rates

Measure Category	*Gross kWh Savings*			*Gross Ex Post Peak kW Reduction*
	Ex Ante	*Ex Post*	*Realization Rate*	
Chiller VFDs	463,805	633,092	136%	116.14
Total	463,805	633,092	136%	116.14

The high realization rate can be attributed to the analytical methodology used in the ex ante calculations. Ex-ante savings estimates were determined through the use of a Temperature Bin calculator, which assumed a building cooling load for each temperature bin. ADM believes that the assumed cooling load for each of these bins contributed to the uncertainty of the analysis as there was no provided calculation for these cooling loads.

Site C-16

Executive Summary

Project C-16 received custom incentives from Ameren Missouri for installation of Direct Digital Controls (DDC) on the HVAC system serving their building. The realization rate for this project is 144%.

Project Description

Originally tenants had unlimited control of space temperature set points as the pneumatic controls offered no global control of the HVAC system. In order to reduce building HVAC energy consumption, the customer replaced aging pneumatic controls with a new DDC system. The installation of the DDC system allowed for the following control strategies to be implemented:

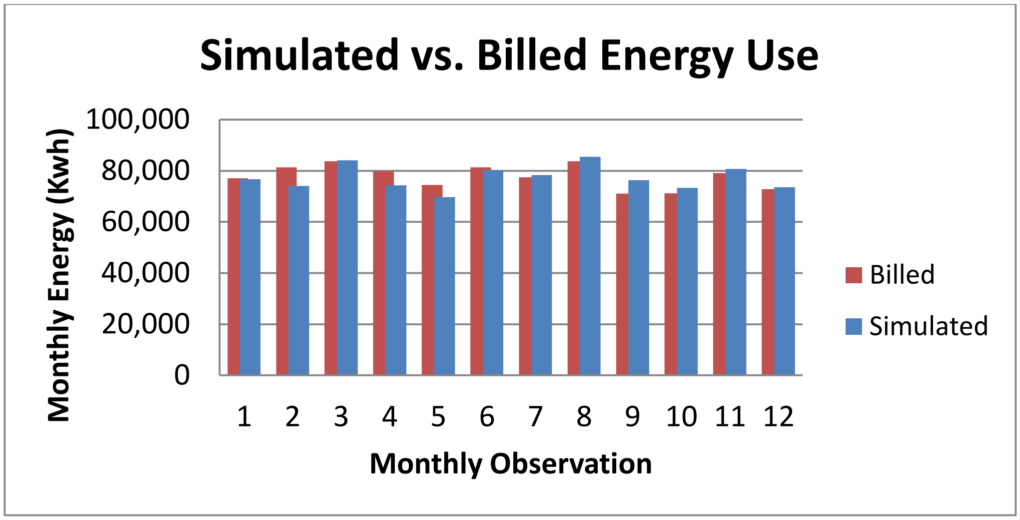
- Fan schedules, and
- Unoccupied temperature setbacks.

Measurement and Verification Effort

ADM visited the facility and confirmed the installation of the DDC system. During the M&V visit, site-specific construction details were collected to inform eQUEST simulation. These details included typical building construction, window construction, floor layout, HVAC zoning, HVAC equipment nameplates, and building space utilization. ADM also interviewed facility staff to determine HVAC sequence of operation, temperature set points, and typical hours of operation.

The ex post electrical savings were calculated using a calibrated eQUEST (ver. 3-65) computer simulation model, which was compiled based upon the fore mentioned collected details. The simulation was first built using the baseline schedules. The model was then calibrated using billing data and 2011-2012 weather data for the area. The results of the calibration effort are shown below:

eQUEST As-Built Calibration



The as-built model was created by changing the fan schedules and adding temperature setbacks. The baseline and as-built measure inputs are as follows:

	Baseline	*As-Built*
Fan Schedules	24/7	7am-10pm Mon-Sun
Unoccupied Heating	66	60
Unoccupied Cooling	76	78

The baseline controls used in the simulation were determined through interviews with site contacts. Parametric runs were used to make the appropriate changes within the model, in which the model was run using TMY3 weather. The annual savings is the difference between the annual consumption of the baseline and as-built eQUEST model, which can be seen in the following table:

Annual kWh Energy Savings

End Use	*Baseline*	*As-Built*	*Savings*
Lighting	226,715	226,715	0
Misc. Equipment	63,418	63,418	0
Heating	254,801	107,361	147,440
Cooling	311,514	218,514	93,241
Heat Rejection	0	0	0
Pumps	12	127	-115
Fans	70,292	42,671	27,621
DHW	0	0	0
Exterior	0	0	0
Total	926,993	658,806	268,187

Results

Verified Gross Savings/Realization Rates

Measure Category	Gross kWh Savings			Gross Ex Post Peak kW Reduction
	Ex Ante	Ex Post	Realization Rate	
DDC	186,848	268,817	144%	-1.74
Total	186,848	268,817	144%	-1.74

The ex ante documents indicate the energy savings calculation went through a series of edits in the application process. Claimed savings started at 442,462 kWh with the use of a facility metering approach. The ex ante savings estimate changed multiple times during the implementation process. This may have produced the lower ex ante savings estimate. The ex post analysis included the additional scheduling optimizations as identified and implemented by the contractor during the project installation.

Site N-11

Executive Summary

Project N-11 received new construction incentives from Ameren Missouri for installing lighting, occupancy sensors, high efficiency air compressors, Energy Star ice makers, and solid door freezers. The realization rate for this project is 103%.

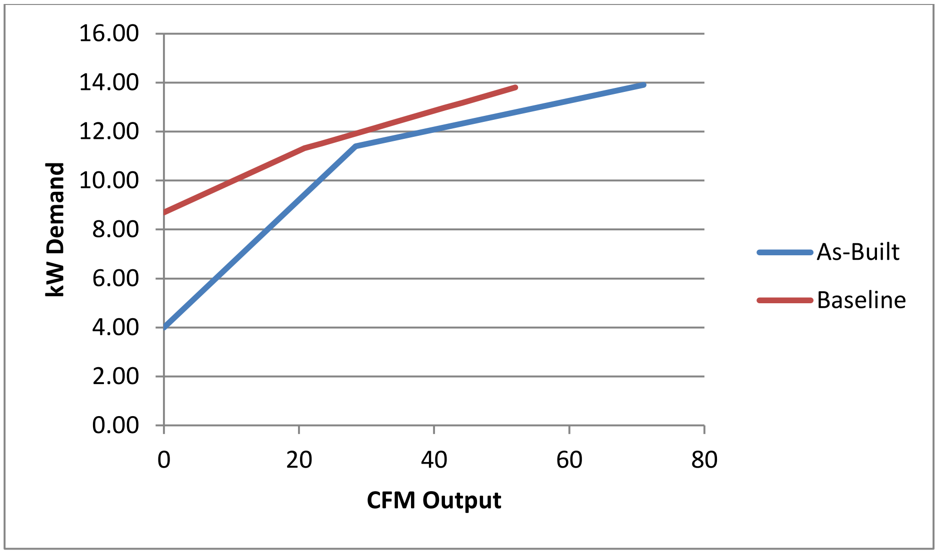
Project Description

The new construction lighting incentive consisted of:

- (56) Halogen fixtures
- (118) Halogen fixtures
- (2) LED fixtures
- (30) LED fixtures
- (10) LED fixtures
- (1) CFL fixture
- (1) 4’ 2LT8 fixture
- (3) CFL fixtures
- (1) 4' 3LT8 fixture
- (7) 4' 2L T8 fixtures
- (71) 4' 6LT5 fixtures
- (9) 2' 2L U-tube fixtures
- (4) 4' 4LT8 fixtures
- (58) 4' 4LT8 fixtures
- (3) 4' 2L T8 fixtures
- (1) 4' 1LT12 fixture
- (16) 8' 8LT8 fixtures
- Installation of 113 Occupancy Sensors

The facility installed two high efficiency Kaeser SK15 air compressors to support brewing operations at the facility. The newly installed compressors utilize both inlet modulation and blow down controls to modulate CFM output, while the assumed baseline Ingersoll Rand compressors only use inlet modulation controls. The differences between as-built and baseline compressor efficiencies can be seen in the following graph:

Compressor Efficiencies



Along with the installation of the new air compressors, the facility installed an Energy Star ice maker with a rated capacity of 368 lb. per day and a 69.2 ft^3 solid door freezer.

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and placed six photo-sensor loggers at the site (from 6/11/14 to 7/16/14) to monitor lighting operation. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

Lighting occupancy sensor energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times W \times N \times \left(t_{base} - t_{as-built} \right) / 1000 \right]$$

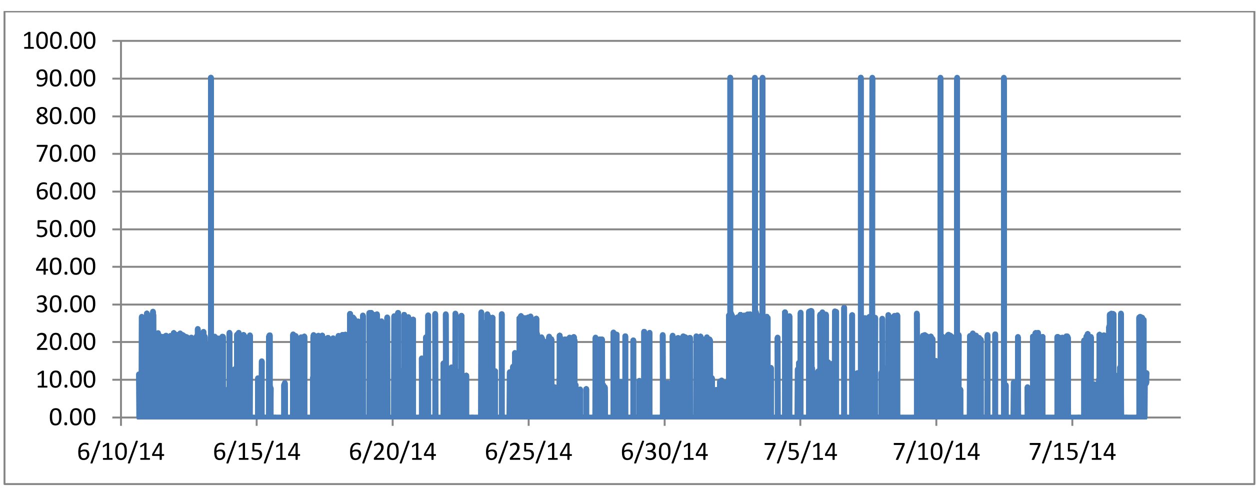
Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of occupancy sensors*
W	= *Wattage controlled by each occupancy sensor*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

ADM visited the facility and confirmed the installation of the air compressors, ice maker, and freezer. During the M&V visit, power monitoring equipment was installed on each of the air compressors. The installed power monitoring equipment recorded compressor amperage for five weeks at five minute intervals.

ADM used the power monitoring to calculate an average daily operating profile for each day of the week for the new compressor. Manufacturer's performance curves were used to calculate the as-built air demand profile based upon the kW profile from power monitoring. The results of this extrapolation can be seen in the following graph:

As-Built Compressor CFM Output



Assuming the CFM profile is the same in the baseline and as-built conditions, compressor performance curves were used to calculate the baseline compressors usage. The pre and post weekly profiles were then extrapolated to a year and energy savings were calculated by subtracting the post consumption from the pre.

Ice maker energy savings are calculated as follows:

$$kWh_{Savings} = \left({kWh}/{100lbs}_{base} - {kWh}/{100lbs}_{eff} \right) \times \frac{Cap}{100lbs} \times 365 \times LF$$

Where:

$kWh_{savings}$ = *Annual energy savings*

$kWh/100lbs_{base}$ = *Baseline efficiency, kWh per 100lbs of Ice*

$kWh/100lbs_{eff}$ = *As-Built efficiency, kWh per 100lbs of Ice*

Cap = *Rated capacity, lbs*

LF = *Load Factor, 0.75*

Solid door freezer energy savings are calculated as follows:

$$kWh_{Savings} = \left({kWh}/{Day}_{base} - {kWh}/{Day}_{eff} \right) \times 365$$

Where:

$kWh_{savings}$ = *Annual energy savings*

kWh/day_{base} = *Baseline efficiency, 0.4*Volume+1.38*

kWh/day_{eff} = *As-Built efficiency, 0.158*Volume+6.333*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
Halogen	1	56	4,280	50	7,270	6,482	11,771	1.09	182%
Halogen	1	118	13,528	75	7,270	20,489	37,204	1.09	182%
LED	1	2	420	138	7,270	637	1,156	1.09	182%
LED	1	30	1,376	30	7,270	2,084	3,783	1.09	182%
LED	1	10	153	10	2,870	232	166	1.09	72%
CFL	1	1	55	36	7,270	83	151	1.09	182%
4’ 2LT8	1	1	83	54	7,270	125	227	1.09	182%
CFL	1	3	151	33	7,270	229	416	1.09	182%
4' 3LT8	1	1	139	91	7,270	211	383	1.09	182%
4' 2L T8	1	7	653	61	7,270	989	1,795	1.09	182%
4' 6LT5	1	71	37,985	350	6,376	57,532	91,620	1.09	159%
2' 2L U-tube	1	9	839	61	7,270	1,271	2,308	1.09	182%
4' 4LT8	1	4	746	122	3,443	1,130	972	1.09	86%
4' 4LT8	1	58	10,816	122	3,443	16,382	14,089	1.09	86%
4' 2L T8	1	3	326	71	7,270	493	895	1.09	182%
4' 1LT12	1	1	64	42	3,443	97	84	1.09	86%
8' 8LT8	1	16	6,359	260	2,870	9,631	6,904	1.09	72%
Total						118,097	173,924		147%

The table shown below presents ex ante and ex post energy savings for the lighting controls installed under the project.

Lighting Controls Savings Calculations

Measure	Quantity	Controlled Wattage	Hours		Ex Ante kWh Savings	Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
			Old	New				
Controls	71	350	6,376	5,813		15,299	1.09	
Controls	42	623	5,412	5,035		10,805	1.09	
Total					69,642.00	26,105		37%

The table shown below presents ex ante and ex post energy savings for the installation of the Energy Star ice maker:

Ice Maker Savings Calculations

kWh/100 lbs Ice		Capacity	Ex Ante kWh Savings	Ex Post kWh Savings	kW Reduction
Base	As-Built				
7.56	6.1	368	2,695	1,466	0.22

The table shown below presents ex ante and ex post energy savings for the installation of the Energy Star freezer:

Freezer Savings Calculations

kWh/Day		Volume ft^3	Ex Ante kWh Savings	Ex Post kWh Savings	kW Reduction
Base	As-Built				
29.06	17.27	69.2	3,757	4,305	0.34

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	New Construction	118,097	173,924	147%	39.34
Lighting Controls	New Construction	69,642	26,105	37%	0.67
Air Compressor	New Construction	11,807	3,421	29%	1.04
Energy Star Freezer	New Construction	3,757	4,305	115%	0.34
Energy Star Ice Maker	New Construction	2,695	1,466	54%	0.22
Total		205,998	209,221	103%	41.61

The project-level realization rate is 103%. The realization rate is high because the ex post lighting operating hours verified during the M&V site visit had 12 measures (ranging from 6,376 to 7,270) higher than the lighting operating hours used to perform the ex ante savings estimate (4,380). In addition, the ex post savings analysis included a heating and cooling interaction factor for gas-heated light industrial in St. Louis (1.09), while the ex ante savings estimate did not account for heating and cooling interactive effects. For the lighting controls, the ex ante savings estimation assumes a greater impact on lighting hours than was measured and verified during the M&V site visit.

For the air compressors the realization rate is low due to the ex ante savings calculations for the high efficiency air compressors assuming an annual runtime of 2,912 hours with an average load of 50 CFM. From the five weeks of monitoring, It was determined that the compressors had a usage factor of 9.8% resulting in an annual runtime of 858 hours. During operational periods the average demand of the compressors was 15.4 CFM.

The ice maker also has a low realization rate because there was a deemed savings attributed to the Energy Star ice maker. The ex ante savings were based on the assumption that the ice maker has a rated consumption between 500 and 1,000 pounds per day. After reviewing manufacturer data it was determined that the ice maker has a capacity of 505 pounds per day at 70^{o}F air and 50^{o}F water, however energy savings calculations are calculated at a standard air temperature of 90^{o}F and water of 70^{o}F. At these temperatures the ice maker has a reduced capacity of 368 pounds per day

Site N-5

Executive Summary

Project N-5 received new construction incentives from Ameren Missouri for retrofitting lighting in the interior of their facility and installing lighting controls. The realization rate for this project is 144%.

Project Description

The customer retrofitted the following fixtures:

- (547) 6L T5 4 lamp circuit fixtures with (308) 4' 6LT5HO fixtures with (7) daylight controls
- (547) 6 L T 5 2 lamp circuit fixtures with (308) 4' 6LT5HO fixtures with (3) daylight controls

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and installed current monitoring loggers on (2) two lamp lighting circuits and (2) four lamp lighting circuits. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
$HCIF$	= *HVAC interaction factor*

Lighting occupancy sensor energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times W \times N \times \left(t_{base} - t_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of lighting controls*
W	= *Wattage controlled by each control system*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
6L T5 4 lamp circuit to 4' 6LT5HO	547	308	267	207	7,021	396,914	577,840	1.00	146%
6 L T 5 2 lamp circuit to 4' 6LT5HO	547	308	134	104	7,021	198,457	288,920	1.00	146%
Total						595,370	866,761		146%

The table shown below presents ex ante and ex post energy savings for the lighting controls installed under the project.

Lighting Controls Savings Calculations

Measure	Quantity	Controlled Wattage	Hours		Ex Ante kWh Savings	Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
			Old	New				
Controls	7	9,578.80	7,021	5,987	44,099	66,063	1.00	150%
Controls	3	9,578.80	7,021	6,482	22,049	17,212	1.00	78%
Total					66,148.00	83,275		126%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	New Construction	595,370	866,761	146%	123.44
Lighting Controls	New Construction	66,148	83,275	126%	0.23
Total		661,518	950,035	144%	123.67

The project-level realization rate is 144%. For the lighting retrofit, the realization rate is high mainly because the ex post lighting hours of operation verified during the M&V site visit (7,021) are greater than the lighting operating hours used to perform the ex ante estimation (4,822).

Although, the ex ante savings estimate assumes a greater impact from daylight harvesting hours than what was measured, it was offset by a reduction in scheduled hours of the four lamp lighting circuits, with the two lamp circuits used in the periods between shifts. Without the dual wattage lighting circuits, the baseline usage would have been the full six lamp fixtures operating.

Site N-8

Executive Summary

Project N-8 received new construction incentives from Ameren Missouri for retrofitting lighting in the interior of their facility and implementing lighting controls. The realization rate for this project is 98%.

Project Description

The customer retrofitted the following fixtures:

- (298) 4' 6LT5 HO fixtures and (10) daylight controls
- (297) 4' 6LT5 HO fixtures and (10) daylight controls

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and installed current monitoring loggers on (2) two lamp lighting circuits and (2) four lamp lighting circuits. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area}\left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built}\right)/1000\right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

Lighting controls savings are calculated as:

$$kWh_{savings} = \sum_{Area}\left[HCIF \times W \times N \times \left(t_{base} - t_{as-built}\right)/1000\right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of lighting controls*
W	= *Wattage controlled by each control system*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
LPD building 6 to 4' 6LT5 HO	298	298	400	311	7,021	174,210	186,182	1.00	107%
LPD building 7 to 4' 6LT5 HO	297	297	400	311	7,456	173,626	197,033	1.00	113%
Total						347,836	383,215		110%

The table shown below presents ex ante and ex post energy savings for the lighting controls installed under the project.

Lighting Controls Savings Calculations

Measure	Quantity	Controlled Wattage	Hours		Ex Ante kWh Savings	Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
			Old	New				
Controls	10	9,267.80	7,021	6,235	65,081	72,918	1.00	112%
Controls	10	9,236.70	7,456	7,322	65,081	12,343	1.00	19%
Total					130,162	85,261		66%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	New Construction	347,836	383,215	110%	52.94
Lighting Controls	New Construction	130,162	85,261	66%	0.33
Total		477,998	468,475	98%	53.27

The project-level realization rate is 98%. For the lighting retrofit, the realization rate is high mainly because the ex post lighting hours of operation verified during the M&V site visit (7,021 – 7,455) are greater than the lighting operating hours used to perform the ex ante estimation.

For the controls, the ex ante savings estimate assumes a greater impact from daylight harvesting hours than what was measured. The facility had covered up the roof skylights in the 2nd building, while installing a new roof after completing the lighting project. This low daylight savings was partially offset, by a reduction in hours of the four lamp lighting circuits, with the two lamp circuits used in the periods between shifts. Without the dual wattage lighting circuits, the baseline usage would have been the full six lamp fixtures operating.

Site N-4

Executive Summary

Project N-4 received new construction incentives from Ameren Missouri for retrofitting lighting in the exterior of their facility. The customer also received incentives for above code HVAC and window improvements. The realization rate for this project is 123%.

Project Description

The customer retrofitted the following fixtures:

- (96) MH Pole fixtures with (96) LED Pole fixtures in the exterior

The facility was also built to include above code improvements including:

- High Efficiency Windows
- Demand Controlled Ventilation (DCV)
- Economizer Controls

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$ = *Annual energy savings*

N = *Number of fixtures*

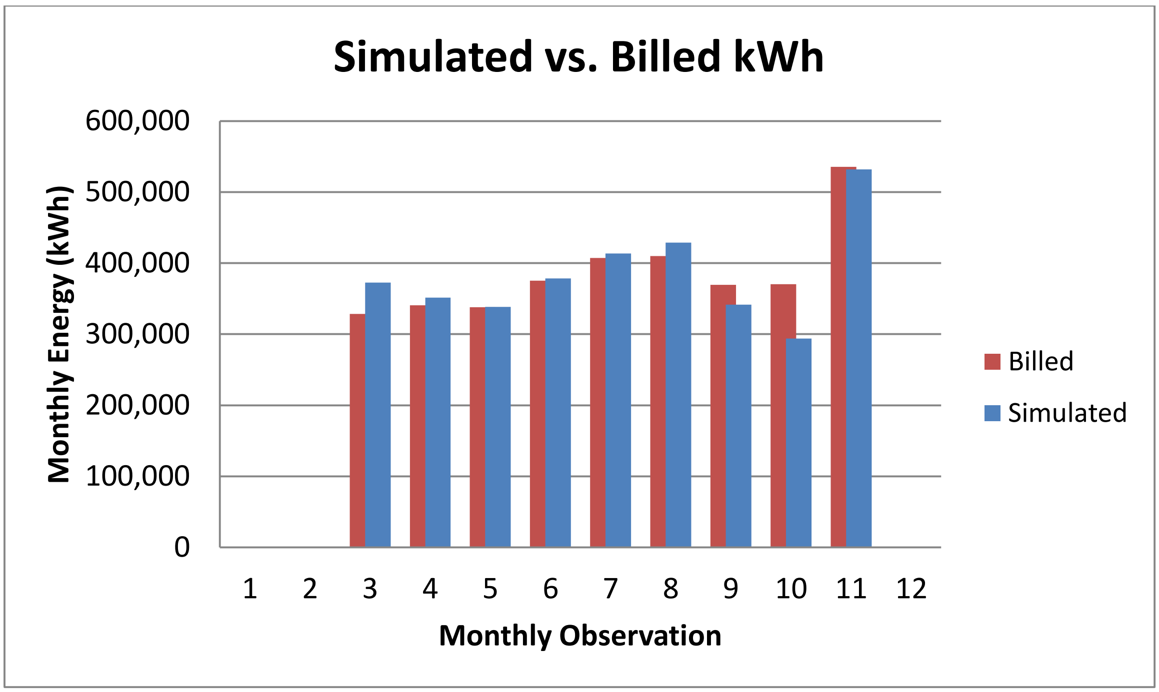
W = *Wattage of each fixture*

t = *Lighting operating hours*

HCIF = *HVAC interaction factor*

Above code energy savings for the HVAC and window improvements were calculated using eQUEST modeling of the facility. ADM compiled a model of the as-built facility based upon data collected during the M&V site visit. Upon the completion of the initial model, a custom weather file was created using 2014 NOAA weather data for the St. Louis area. Using this weather file and billing data for the facility, ADM was able to ensure that the model's energy load shape matched that of the bills. The results of this calibration effort can be seen below:

2014 Monthly kWh Calibration



Upon completion of the calibration for the as-built eQUEST model, a baseline model was created in which all the above-code measures were removed, and replaced with minimum standards as detailed by ASHRAE 90.1-2007. Once the baseline model was completed, the baseline and as-built models were run using TMY3 weather data for the region. The typical year annual savings is the difference between the two models' annual consumption and can be seen below:

As-Built Vs. Baseline Annual Energy Consumption

End-Use	Baseline kWh	As-Built kWh	Annual kWh Savings
Lighting	1,451,518	1,451,518	0
Miscellaneous Equipment	1,132,711	1,132,711	0
Heating	2,089,610	1,397,081	692,529
Cooling	877,088	1,004,973	-127,885
Heat Rejection	0	0	0
Pumps	152,338	350	151,988
Fans	270,030	242,556	27,474
Domestic Hot Water	0	0	0
Total	**5,973,295**	**5,229,189**	**744,106**

The tables shown below present ex ante and ex post energy savings for the lighting retrofit and above code HVAC measures performed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
MH Pole to LED Pole	96	96	1,020	275	4,308	309,120	308,260	1.00	100%
Total						309,120	308,260		100%

HVAC Savings Calculations

Measure	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross kWh Savings Realization Rate
HVAC	546,338	744,106	136%
Total	546,338	744,106	136%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Custom	309,120	308,260	100%	0.00
HVAC	Custom	546,338	744,106	136%	-235
Total		855,458	1,052,366	123%	-235

The project-level realization rate is 123%. The exterior lighting realization rate is 100%, which indicates a highly accurate ex ante savings estimation. The HVAC realization rate is 136%. It is higher due to the ex post analysis using a calibrated simulation. The ex-ante analysis was done before construction, so it could not be calibrated to billing data. The calibration accounted for actual building operations and efficiencies. The ex post model also has higher heating loads than the ex ante model that resulted from calibration and the weather normalization to TMY weather data. The ex post peak kW reduction is negative because the as-built cooling system is less efficient than code.

Site C-35

Executive Summary

Project C-35 received custom incentives from Ameren Missouri for retrofitting lighting in the exterior of their facility. The realization rate for this project is 98%.

Project Description

The customer retrofitted the following fixtures:

- (7) MH fixtures with (7) LED - fixtures in the exterior area
- (2) MH fixtures with (2) LED - fixtures in the exterior area
- (4) MH fixtures with (4) LED - fixtures in the exterior area

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
MH 400W to LED - Custom	7	7	461	209	4,311	7,726	7,604	1.00	98%
MH 400W to LED - Custom	2	2	461	20	4,311	3,863	3,802	1.00	98%
MH 100W to LED - Custom	4	4	132	30	4,311	1,787	1,759	1.00	98%
Total						13,376	13,165		98%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	custom	13,376	13,165	98%	0.12
Total		13,376	13,165	98%	0.12

The project-level realization rate is 98%. The realization rate is slightly low because the ex post lighting operating hours verified during the M&V site visit (4,311) is less than the lighting operating hours used to perform the ex ante energy savings estimate (4,380). This calculation was performed by the non-daylighting calculator for the current year in conjunction with the US Naval Observatory SunRise/SunSet table.

Site C-26

Executive Summary

Project C-26 received custom incentives from Ameren Missouri for retrofitting lighting in their facility. The realization rate for this project is 100%.

Project Description

The customer retrofitted (67) MH 175W fixtures with (67) LED in the garage .

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$ = *Annual energy savings*

N = *Number of fixtures*

W = *Wattage of each fixture*

t = *Lighting operating hours*

HCIF = *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit installed under the project.

Lighting Retrofit Savings Calculations

Measure	*Quantity (Fixtures)*		*Wattage*		*Hours*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
	Old	*New*	*Old*	*New*					
MH 175W to LED	67	67	210	53	8,760	92,146	92,146	1.00	100%
Total						92,146	92,146		100%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Custom	92,146	92,146	100%	10.52
Total		92,146	92,146	100%	10.52

The project-level realization rate is 100%, which indicates a highly accurate ex ante savings estimation.

Site N-1

Executive Summary

Project N-1 received New Construction incentives from Ameren Missouri for installing lighting in the interior and exterior of their facility, installing occupancy sensors, above code HVAC and garage ventilation systems, strip curtains, Energy Star computers, and low flow faucet aerators. The realization rate for this project is 96%.

Project Description

The customer installed the following:

- (222) LED exterior lighting fixtures
- (116) garage lighting fixtures
- (76) garage lighting fixtures
- (44) garage lighting fixtures
- (618) A fixtures
- (16) AD fixtures
- (30) C fixtures
- (34) D fixtures
- (72) E fixtures
- (23) E1 fixtures
- (65) E1A fixtures
- (82) E2 fixtures
- (10) E3 fixtures
- (12) E3A fixtures
- (86) E4 fixtures
- (66) E4A fixtures
- (25) E4B fixtures
- (3) E5 fixtures
- (2) E5A fixtures
- (7) EA fixtures
- (1241) F fixtures
- (378) F1 fixtures
- (24) F2 fixtures
- (32) F3 fixtures
- (105) F4 fixtures
- (82) FL fixtures
- (63) G fixtures
- (37) H fixtures
- (52) J fixtures
- (11) J1 fixtures
- (14) K fixtures
- (127) L fixtures

- (3) M 3' fixtures
- (48) M fixtures
- (220) N fixtures
- (28) P fixtures
- (16) Q fixtures
- (30) Q1 fixtures
- (23) R fixtures
- (28) S fixtures
- (470) SS fixtures
- (90) S6 fixtures
- (4) T fixtures
- (31) E2A fixtures
- (3) X fixtures
- (6) X1 fixtures
- (107) Fixture Mounted Occupancy Sensors
- (184) Infrared Occupancy Sensors
- (296) Infrared Occupancy Sensors
- (3) Strip Curtains
- (421) Energy Star Computers
- (72) Low Flow Faucet Aerators
- Above code HVAC and garage ventilation systems

Measurement and Verification Effort

During M&V, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings. The reduction of lighting operating hours associated with occupancy sensors is determined by multiplying the baseline hours by a Power Adjustment Factor of 0.7 (adapted from ASHRAE 90.1-2007).

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
$HCIF$	= *HVAC interaction factor*

Lighting occupancy sensor energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times W \times N \times \left(t_{base} - t_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$ = *Annual energy savings*

N = *Number of occupancy sensors*

W = *Wattage controlled by each occupancy sensor*

t = *Lighting operating hours*

HCIF = *HVAC interaction factor*

Strip curtain savings were verified using the Ameren TRM:

Estimated savings	5058 kWh per unit
Estimated demand savings credit	0.628 kW per unit

Energy Star Ice Machines savings were verified using the Ameren TRM:

Estimated savings 500 – 1000 lbs/24 hours	2,695 kWh/unit
Estimated demand savings 500 – 1000 lbs/24 hours	0.3077 kW/unit

Energy Star Personal Computer (PC) savings were verified using the Ameren TRM:

Estimated savings credit	149 kWh
Estimated demand savings credit	0.030 kW

Strip curtain savings were verified using the Ameren TRM:

Estimated savings	174 kWh
Estimated demand savings credit full size	0.017 kW/unit

Above code energy savings for the HVAC and garage ventilation measures were calculated using eQUEST modeling of the facility. ADM reviewed the ex ante simulation reports for the as-built facility and compared them to building plans and documentation. ADM also reviewed the baseline simulation reports. All the above-code measures were removed and replaced with minimum standards as detailed by ASHRAE 90.1-2007. The models were run using TMY weather data for the St. Louis area. The typical year annual savings is the difference between the two models' annual consumption.

The tables shown below present ex ante and ex post energy savings for the new construction measures performed under the project:

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
LED exterior lighting	222	222	152	53	4,308	87,196	93,909	1.00	108%
garage lighting	116	116	480	113	8,760	372,688	372,688	1.00	100%
garage lighting	76	76	480	113	8,760	244,182	244,182	1.00	100%
garage lighting	44	44	480	113	8,760	141,369	141,369	1.00	100%
A	618	618	85	63	3,337	44,989	49,265	1.10	110%
AD	16	16	85	63	3,337	1,163	1,273	1.10	110%
C	30	30	22	16	3,337	555	607	1.10	110%
D	34	34	85	63	3,337	2,475	2,710	1.10	110%
E	72	72	159	118	3,337	9,817	10,750	1.10	110%
E1	23	23	241	179	3,337	4,757	5,209	1.10	110%
E1A	65	65	242	180	3,337	13,520	14,805	1.10	110%
E2	182	182	401	298	3,337	62,671	68,628	1.10	110%
E3	10	10	319	237	3,337	2,739	2,999	1.10	110%
E3A	12	12	319	237	3,337	3,286	3,599	1.10	110%
E4	86	86	318	236	3,337	23,453	25,682	1.10	110%
E4A	66	66	320	238	3,337	18,151	19,876	1.10	110%
E4B	25	25	319	237	3,337	6,846	7,497	1.10	110%
E5	3	3	242	180	3,337	624	683	1.10	110%
E5A	2	2	242	180	3,337	416	456	1.10	110%
EA	7	7	160	119	3,337	963	1,054	1.10	110%
F	1,241	1,241	61	45	3,337	64,530	70,664	1.10	110%
F1	378	378	47	35	3,337	15,288	16,741	1.10	110%
F2	24	24	61	45	3,337	1,248	1,367	1.10	110%
F3	32	32	127	94	3,337	3,476	3,806	1.10	110%
F4	105	105	13	10	3,337	1,213	1,329	1.10	110%
FL	82	82	25	19	3,337	1,781	1,951	1.10	110%
G	63	63	43	32	3,337	2,330	2,551	1.10	110%
H	37	37	85	63	3,337	2,694	2,950	1.10	110%
J	52	52	128	95	3,337	5,708	6,251	1.10	110%
J1	11	11	43	32	3,337	407	445	1.10	110%
K	14	14	85	63	3,337	1,019	1,116	1.10	110%
L	127	127	82	61	3,337	8,952	9,803	1.10	110%

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
M 3'	3	3	18	13	3,337	45	49	1.10	110%
M	48	48	18	13	3,337	721	790	1.10	110%
N	220	220	43	32	3,337	8,135	8,908	1.10	110%
P	28	28	82	61	3,337	1,974	2,161	1.10	110%
Q	16	16	85	63	3,337	1,165	1,275	1.10	110%
Q1	30	30	51	38	3,337	1,317	1,443	1.10	110%
R	23	23	27	20	3,337	532	582	1.10	110%
S	28	28	92	68	3,337	2,200	2,409	1.10	110%
SS	470	470	27	20	3,337	10,862	11,894	1.10	110%
S6	90	90	7	5	3,337	520	569	1.10	110%
T	4	4	32	24	3,337	111	121	1.10	110%
E2A	31	31	403	299	3,337	10,711	11,729	1.10	110%
X	3	3	143	106	3,337	367	402	1.10	110%
X1	6	6	183	136	3,337	943	1,033	1.10	110%
removal of extra watts to match application	(4)	(4)	53	39	-	(180)	-	1.10	0%
Total						1,189,927	1,229,580		103%

Lighting Controls Savings Calculations

Measure	Quantity	Controlled Wattage	Hours		Ex Ante kWh Savings	Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
			Old	New				
Controls	107	83	3,337	2,336	42,479	9,700	1.10	23%
Controls	184	400	3,337	2,336	113,399	80,654	1.10	71%
Controls	296	527	3,337	2,336	228,038	170,970	1.10	75%
Total					383,916	261,324		68%

Strip Curtains Savings Calculations

Measure	*Quantity*	*Deemed kWh per unit*	*Ex Ante kWh Savings*	*Ex Post kWh Savings*	*Gross kWh Savings Realization Rate*	*Gross Peak kW Reduction*
Controls	3	5,058	15,174	15,174	100%	1.88
Total			15,174	15,174	100%	1.88

Energy Star Ice Machines Savings Calculations

Measure	*Quantity*	*Deemed kWh per unit*	*Ex Ante kWh Savings*	*Ex Post kWh Savings*	*Gross kWh Savings Realization Rate*	*Gross Peak kW Reduction*
Controls	0	2,695	26,950	0	0%	0.00
Total			26,950	0	0%	0.00

Energy Star PCs Savings Calculations

Measure	*Quantity*	*Deemed kWh per unit*	*Ex Ante kWh Savings*	*Ex Post kWh Savings*	*Gross kWh Savings Realization Rate*	*Gross Peak kW Reduction*
Controls	421	149	62,729	62,729	100%	12.63
Total			62,729	62,729	100%	12.63

Low Flow Faucet Aerators Savings Calculations

Measure	*Quantity*	*Deemed kWh per unit*	*Ex Ante kWh Savings*	*Ex Post kWh Savings*	*Gross kWh Savings Realization Rate*	*Gross Peak kW Reduction*
Controls	72	174	12,528	12,528	100%	1.22
Total			12,528	12,528	100%	1.22

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Strip Curtains	New Construction	15,174	15,174	100%	1.88
Ice Machines	New Construction	26,950	0	0%	0.00
Energy Star PCs	New Construction	62,729	62,729	100%	12.63
Low Flow Aerator	New Construction	12,528	12,528	100%	1.22
HVAC	New Construction	391,992	391,992	100%	111
Garage Ventilation	New Construction	765,171	765,171	100%	131
Lighting Retrofit	New Construction	1,189,927	1,229,580	103%	232.61
Lighting Controls	New Construction	383,916	261,324	68%	100.48
Total		2,848,387	2,738,498	96%	590.83

The project-level realization rate is 96%. For the lighting retrofit, the realization rate is slightly high because the ex post savings analysis included an HCIF for gas heated large office in St. Louis (1.10), while the ex ante savings estimate did not account for HVAC interactive effects. In addition, for the exterior lighting the ex ante savings estimate hours (4,000) are less than the ex post savings analysis (4,308). This calculation was performed by the non-daylighting calculator for the current year in conjunction with the US Naval Observatory SunRise/SunSet table. The realization rate for the lighting controls is low because the ex ante savings estimate (397 kWh, 616 kWh, and 770 kWh per sensor) was greater than the ex post savings analysis (91 kWh, 438 kWh, and 578 kWh per sensor).

All of the measures verified with the TRM with the exception of the ice machines have 100% realization rates. The installed ice machines were not Energy Star rated, so the verified savings are 0.

The garage ventilation realization rate is 100%. A case study published by DOE in 2013 found that garages could save between 0.6 and 4.7 kWh per square foot by improving ventilation energy efficiency. The garage in this project is 377,336 square feet. The expected savings normalized to per square foot are 2.03 kWh. This is within the average of the case study. Thus, ADM concludes that the ex ante savings estimations are justifiable.

ADM reviewed the provided eQUEST simulation documentation for the above code HVAC measures and verified the ex ante savings estimations.

Site R-4

Executive Summary

Project R-4 received incentives from Ameren Missouri for repairing compressed air leaks. The realization rate for this project is 106%.

Project Description

The customer repaired 212 CFM of compressed air leaks. The act of reducing air leaks in the facility produces energy savings, as the loading on the compressors is reduced.

Measurement and Verification Effort

ADM visited the facility, and it was confirmed that the leaks were repaired. This was accomplished through interviews with site contacts along with the review of the facility's repair logs.

ADM used the ex ante's baseline power monitoring to calculate an average daily operating profile for each day of the week for the compressed air system. This monitored data reflects the typically operation of the compressed air system with leaks being present. The compressed air demand profile for the repaired air leaks was determined by subtracting 212 CFM from the baseline compressed air demand profile. Since the site relies on multiple compressors, individual CAGI curves were used to derive an overall system efficiency curve.

The post kW profile was generated using the system performance curves and the demand profile without leaks. The pre and post weekly kW profiles were then extrapolated to a year, and energy savings were calculated by subtracting the post consumption from the pre.

The pre and post compressed air profiles can be seen in the following plot:

Compressed Air CFM Output

Results

Verified Gross Savings/Realization Rates

Measure Category	*Incentive*	*Gross kWh Savings*			*Gross Ex Post Peak kW Reduction*
		Ex Ante	*Ex Post*	*Realization Rate*	
Compressed Air Leaks	RCx	461,737	490,852	106%	33.07
Total		461,737	490,852	106%	33.07

The realization rate for this project is 106%. The differences in savings can be attributed to the utilization of operating profiles. ADM analysis was informed through the use of the baseline power monitoring. ADM didn't use the baseline CFM data because the data is inconsistent with the power monitoring. The ex ante relied on the CFM data, in which 249 CFM was added to the profile. ADM speculates that this was added to compensate for the dryer purge, however this is an incorrect practice as the monitored kW and CFM includes this. Since the site utilizes a VSD compressor, a lower demand profile saves more energy.

Site C-29, S-36

Executive Summary

Project C-29, S-36 received standard and custom incentives from Ameren Missouri for retrofitting lighting in the interior and exterior of their facility. The realization rate for this project is 99%.

Project Description

The customer retrofitted the following fixtures:

- (20) MH fixtures with (20) LED fixtures
- (1) MH pole fixture with (1) LED - Pole fixture
- (8) MH pole fixtures with (8) LED - Pole fixtures
- (28) 2' 2LT8 U-Tube fixtures with (28) LED fixtures
- (4) MH fixtures with (4) LED fixtures
- (1) MH fixture with (1) LED fixture
- (22) Incandescent fixtures with (22) LED fixtures

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
MH to LED	20	20	360	129	4,308	20,236	19,903	1.00	98%
Mh to LED - Pole	1	1	1,080	185	4,308	3,920	3,856	1.00	98%
MH to LED - Pole	8	8	1,080	185	4,308	31,361	30,845	1.00	98%
U-Tube - 2 Lamp T8 to LED	28	28	59	44	8,760	3,679	4,077	1.11	111%
MH to LED	4	4	360	129	8,760	8,094	8,094	1.00	100%
MH to LED	1	1	461	129	8,760	2,908	2,908	1.00	100%
Incandescent to LED	22	22	39	12	8,760	6,360	5,765	1.11	91%
Total						76,558	75,448		99%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Standard	6,360	5,765	91%	0.76
Lighting Retrofit	Custom	70,198	69,682	99%	2.34
Total		76,558	75,448	99%	3.09

The project-level realization rate is 99%. For the standard portion if the lighting retrofit, the realization rate is low mainly because during the M&V site visit the verified wattage (12w) is higher than the ex ante savings estimate (6w). The custom realization rate shows a highly accurate ex ante estimate.

Site C-30, S-13

Executive Summary

Project C-30, S-13 received standard and custom incentives from Ameren Missouri for retrofitting lighting in the interior of its facility. The realization rate for this project is 190%.

Project Description

The customer retrofitted the following fixtures:

- (60) Incandescent lamps with (60) LED lamps
- (360) Incandescent lamps with (360) LED lamps
- (1000) Incandescent lamps with (1000) LED lamps

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and placed two photo-sensor loggers at the site (from 3/4/14 to 3/25/14) to monitor lighting operation. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit installed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
Incandescent to LED	60	60	50	7	7,230	11,300	21,228	1.14	188%
Incandescent to LED	360	360	25	4	7,230	33,901	63,684	1.14	188%
Incandescent to LED	1,000	1,000	40	11	7,341	127,020	242,252	1.14	191%
Total						172,221	327,164		190%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Custom	33,901	63,684	188%	8.90
Lighting Controls	Standard	138,320	263,480	190%	37.67
Total		172,221	327,164	190%	46.57

The project-level realization rate is 190%., The realization rate is high mainly because the lighting hours of operation verified during the M&V site visit (ranging from 7,230 to 7,340) are greater than those used to perform the ex ante energy estimate (4,380).

Site C-6

Executive Summary

Project C-6 received custom incentives from Ameren Missouri for retrofitting lighting in the interior of a repurposed facility. The realization rate for this project is 96%.

Project Description

The customer retrofitted the following fixtures:

- (1) MH fixture with (208) 4' 8LT5 fixtures
- (1) 4' 8L T12 fixture with (157) 4' 8LT5 fixtures

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times t \times (ft^2_{base} \times W/ft^2_{base} - N_{as-built} \times W_{as-built})/1000$$

Where:

$kWh_{savings}$	= *Annual energy savings*
ft^2	= *Area square footage*
W/ft^2	= *Lighting Power Density*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
$HCIF$	= *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit installed under the project.

Lighting Retrofit Savings Calculations

Measure	Baseline		Post-Installation		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross Ex Post kWh Savings Rate Square Feet
	Square Feet	Lighting Power Density	Fixture Qty.	Fixture W.					
MH to 4' 8LT5	147,500	1.3	208	430	6,298	736,223	704,786	1.09	96%
4' 8L T12 to 4' 8LT5	107,500	1.3	157	430	6,298	519,839	497,642	1.09	96%
Total						1,256,062	1,202,428		96%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Ex Post kWh Savings Rate	
Lighting Retrofit	Custom	1,256,062	1,202,428	96%	255.50
Total		1,256,062	1,202,428	96%	255.50

The project-level realization rate is 96%. The realization rate is low mainly because the lighting hours of operation verified during the M&V site visit (6,297) are less than those used to perform ex ante energy estimation (7,196).

Site R-8 and C-22

Executive Summary

Projects R-8 and C-22 received incentives from Ameren Missouri for repairing compressed air leaks and installing a new (94) hp Gardner Denver VS70 to handle the compressed air demand. The combined realization rate for these projects is 87%.

Project Description

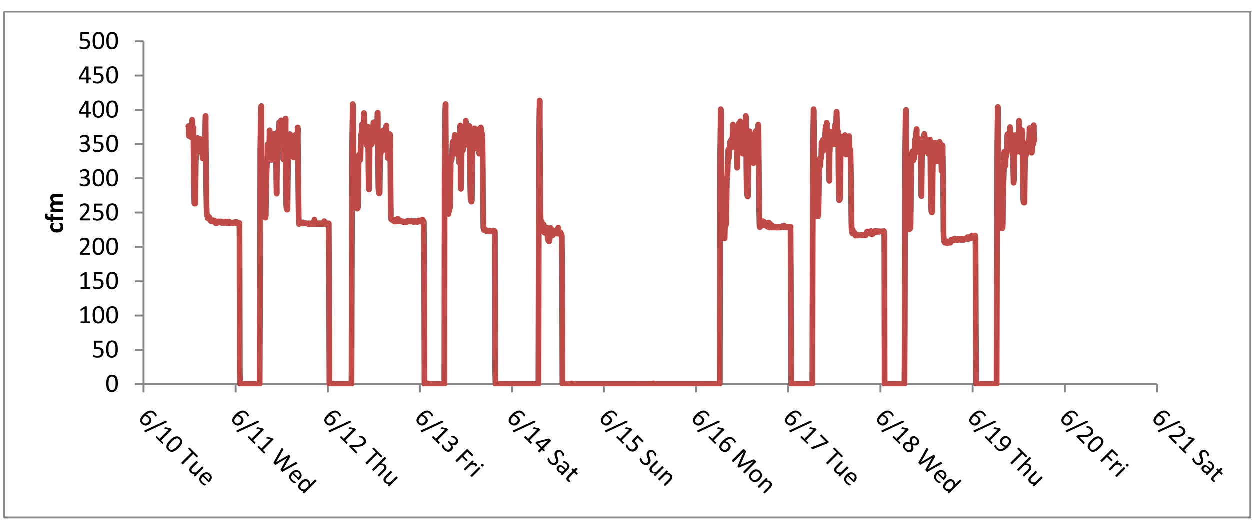
The customer repaired compressed air leaks and installed a new (94) hp Gardner Denver VS70 variable speed (VSD) compressor. The existing system utilized one (100) hp and one (25) hp fixed speed compressor. The advantage of the VSD is it allows the compressor to run at more efficient part loads when the demand is less than the max of the compressor. (90) CFM of air leaks were also repaired.

Measurement and Verification Effort

ADM visited the facility and confirmed the various components of the compressed air project. During the M&V visit, it was confirmed that the new compressor was installed and leaks were repaired.

ADM used power monitoring to calculate an average daily operating profile for each day of the week for the new compressor. Manufacturer's performance curves were used to calculate the as-built air demand profile based upon the kW profile from power monitoring. The results of this extrapolation can be seen in the following graph:

As-Built Compressor CFM Output



Assuming the CFM profile is the same in the baseline and as-built conditions, compressor performance curves were used to calculate the baseline compressors usage. The pre and post weekly profiles were then extrapolated to a year and energy savings were calculated by subtracting the post consumption from the pre. Energy usage from the new dryer was subtracted from compressor energy savings to find the gross annual kWh savings for the custom project.

Energy savings for the repaired air leaks were calculated by adding 90 CFM to the as-built compressor demand profiles. The same calculation methodology for the compressor savings was used to calculate leak savings.

Results

Verified Gross Savings/Realization Rates

Measure Category	*Incentive*	*Gross kWh Savings*			*Gross Ex Post Peak kW Reduction*
		Ex Ante	*Ex Post*	*Realization Rate*	
Compressed Air Leaks	RCx	35,361	37,668	107%	8.03
VSD Compressor	Custom	124,842	101,358	81%	12.06
Total	R-8 & C-22	160,203	139,026	87%	20.09

The combined realization rate for these projects is 87%. The realization rate for the RCx compressed air leaks repair project is 107%. The realization rate for the custom VSD Compressor project is 81%.

The differences in savings can be attributed to the utilized operating profiles, and the assumed hours of operation. ADM analysis was informed through the use of power monitoring equipment which recorded compressor kW at five minute intervals. The ex ante calculations relied on extrapolated pre-installation, fifteen second interval data.

The post monitoring also showed that the compressor was operating differently than anticipated by the ex ante analysis. The ex post found that the VSD compressor operates more loaded than expected. This contributed to the reduction in realized savings because the VSD compressor saves more energy at reduced loads.

Site C-17

Executive Summary

Project C-17 received custom incentives from Ameren Missouri for retrofitting lighting in the garage of their facility. The realization rate for this project is 62%.

Project Description

The customer retrofitted the following fixtures:

- (10) 8' 2LT12 fixtures with (10) 4' 4LT8 fixtures
- (177) 8' 1LT12 fixtures with (177) 4' 4LT8 fixtures

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and placed one photo-sensor logger at the site (from 3/12/14 to 3/25/14) to monitor lighting operation. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
$HCIF$	= *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
8' 2LT12 to 4' 4LT8	10	10	398	94	5,422	26,630	16,484	1.00	62%
8' 1LT12 to 4' 4LT8	177	177	190	94	5,422	148,850	92,134	1.00	62%
Total						175,480	108,618		62%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Custom	175,480	108,618	62%	20.03
Total		175,480	108,618	62%	20.03

The project-level realization rate is 62%. The realization rate is low mainly because the ex post hours of operation verified during the M&V site visit (5,422) were less than the lighting hours of operation used to perform the ex ante savings estimate (8,760).

Site C-36, S-21

Executive Summary

Project C-36, S-21 received custom and standard incentives from Ameren Missouri for retrofitting lighting in the interior of its facility. The realization rate for this project is 31%.

Project Description

The customer retrofitted the following fixtures:

- (120) Incandescent fixtures with (120) LED fixtures
- (24) Incandescent fixtures with (24) LED fixtures
- (10) Halogen fixtures with (10) LED fixtures
- (1) Halogen fixture with (1) LED fixture
- (3) Halogen fixtures with (2) LED fixtures
- (1) Halogen fixture with (1) LED fixture
- (2) Incandescent fixtures with (2) LED fixtures
- (6) Incandescent fixtures with (6) LED fixtures

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and placed one photo-sensor logger at the site (from 3/07/14 to 3/30/14) to monitor lighting operation. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	*= Annual energy savings*
N	*= Number of fixtures*
W	*= Wattage of each fixture*
t	*= Lighting operating hours*
HCIF	*= HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit installed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
Incandescent to LED	120	120	75	11	1,295	42,048	11,317	1.14	27%
Incandescent to LED	24	24	120	20	1,295	13,140	3,536	1.14	27%
Halogen to LED	10	10	120	34	1,295	4,709	1,267	1.14	27%
Halogen to LED	1	1	120	34	1,295	471	127	1.14	27%
Halogen to LED	3	2	90	34	1,295	1,106	298	1.14	27%
Halogen to LED	1	1	120	34	8,760	471	857	1.14	182%
Incandescent to LED	2	2	75	10	4,308	567	560	1.00	99%
Incandescent to LED	6	6	90	26	4,308	1,674	1,654	1.00	99%
Total						64,186	19,616		31%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Custom	6,757	2,549	38%	0.40
Lighting Retrofit	Standard	57,429	17,067	30%	2.80
Total		64,186	19,616	31%	3.23

The project-level realization rate is 31%. The realization rate is low mainly because the ex post lighting hours of operation verified during the M&V site visit for 7 measures (ranging from 1,294 to 4,308) are less than those used to perform the ex ante savings estimation (ranging from 4,360 to 5,475).

Site C-34, S-21

Executive Summary

Project C-34, S-21 received custom and standard incentives from Ameren Missouri for retrofitting lighting in the interior of their facility and installing occupancy sensors. The realization rate for this project is 300%.

Project Description

The customer retrofitted the following fixtures in the tunnel area:

- (8) HPS 250W fixtures with (8) LED - Custom fixtures

Occupancy sensors were installed on pre-existing 6-lamp T5HO fixtures

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and placed six photo-sensor loggers at the site (from 5/29/2014 to 6/25/2014) to monitor lighting operation. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	*= Annual energy savings*
N	*= Number of fixtures*
W	*= Wattage of each fixture*
t	*= Lighting operating hours*
$HCIF$	*= HVAC interaction factor*

Lighting occupancy sensor energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times W \times N \times \left(t_{base} - t_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	*= Annual energy savings*
N	*= Number of occupancy sensors*

W = *Wattage controlled by each occupancy sensor*

t = *Lighting operating hours*

HCIF = *HVAC interaction factor*

The table shown below presents expected and realized energy savings for the lighting retrofit installed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Expected kWh Savings	Realized kWh Savings	Heating Cooling Interaction Factor	Realization Rate
	Old	New	Old	New					
HPS 250W to LED - Custom	8	8	302	43	8,760	18,151	18,151	1.00	100%
Total						18,151	18,151		100%

The table shown below presents expected and realized energy savings for the lighting controls installed under the project.

Lighting Controls Savings Calculations

Measure	Quantity	Controlled Wattage	Hours		Expected kWh Savings	Realized kWh Savings	Heating Cooling Interaction Factor	Realization Rate
			Old	New				
Controls	200	351	7,353	1,567	123,200	406,176	1.00	330%
Total					123,200.00	406,176		330%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Realized Peak kW Reduction
		Expected	Realized	Realization Rate	
Lighting Retrofit	Custom	18,151	18,151	100%	2.07
Lighting Controls	Standard	123,200	406,176	330%	55.35
Total		141,351	424,327	300%	57.42

The project-level realization rate is 300%. For the lighting retrofit, the realization rate is 100%, which indicates a highly accurate ex ante savings estimation. For the lighting controls, the ex ante savings estimation assumes a lesser impact on lighting hours than was measured and verified on-site.

Site C-8, S-23

Executive Summary

Project C-8, S-23 received standard and custom incentives from Ameren Missouri for retrofitting lighting and installing occupancy sensors in the interior of their facility. The realization rate for this project is 105%.

Project Description

The customer retrofitted the following fixtures:

- (1) MH fixture with (1) LED fixture
- (4) MH fixtures with (8) LED fixtures
- (72) 4' 2LT12 fixtures with (72) 4' 2LT8 fixtures
- (39) 4' 4LT12 fixtures with (39) 4' 2LT8 fixtures
- (20) 4' 4LT12 fixtures with (20) 4' 2LT8 fixtures
- (66) 4' 6LT5HO fixtures with (66) 4' 6LT5 fixtures
- (11) MH fixtures with (11) LED fixtures
- (10) MH fixtures with (10) LED fixtures
- (31) MH fixtures with (31) 4' 2LT5HO fixtures
- (4) MH fixtures with (4) 4' 3LT5HO fixtures
- (13) HPS fixtures with (13) 4' 2LT8 fixtures
- (3) HPS fixtures with (3) 4' 3LT8 fixtures
- (8) Exit Sign fixtures with (8) Exit Sign LED fixtures
- (152) MH fixtures with (152) 4' 4LT5HO fixtures
- (1) Exit Sign fixtures with (1) Exit Sign LED fixture
- (4) 4' 2LT5HO fixtures with (4) 4' 2LT5HO fixtures
- (1) Halogen fixture with (1) MH fixture
- (139) MH fixtures with (139) 4' 4LT5HO fixtures
- Installation of 5 occupancy sensors in the open office area
- Installation of 42 occupancy sensors in various areas

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings. The reduction of lighting operating hours associated with occupancy sensors is determined by multiplying the baseline hours by a Power Adjustment Factor of 0.7 (adapted from ASHRAE 90.1-2007).

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

Lighting occupancy sensor energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times W \times N \times \left(t_{base} - t_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of occupancy sensors*
W	= *Wattage controlled by each occupancy sensor*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	*Quantity (Fixtures)*		*Wattage*		*Hours*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
	Old	*New*	*Old*	*New*					
MH to LED	1	1	132	15	8,760	1,025	1,121	1.09	109%
MH to LED	4	8	461	26	8,760	14,331	15,679	1.09	109%
4' 2LT12 to 4' 2LT8	72	72	62	44	8,760	11,353	12,420	1.09	109%
4' 4LT12 to 4' 2LT8	39	39	112	44	8,760	23,232	25,415	1.09	109%
4' 4LT12 to 4' 2LT8	20	20	112	86	8,760	4,555	4,983	1.09	109%
4' 6LT5HO to 4' 6LT5	66	66	342	305	8,760	21,392	23,403	1.09	109%
MH to LED	11	11	210	26	8,760	17,730	19,397	1.09	109%
MH to LED	10	10	461	180	8,760	24,616	26,929	1.09	109%
MH to 4' 2LT5HO	31	31	210	102	8,760	35,005	32,085	1.09	92%
MH to 4' 3LT5HO	4	4	295	160	8,760	4,730	5,175	1.09	109%
HPS to 4' 2LT8	13	13	116	44	8,760	4,100	8,970	1.09	219%
HPS to 4' 3LT8	3	3	173	65	8,760	2,838	3,105	1.09	109%
Exit Sign to Exit Sign LED	8	8	18	3	8,760	1,051	1,150	1.09	109%
MH to 4' 4LT5HO	152	152	461	202	8,760	374,359	377,281	1.09	101%
Exit Sign to Exit Sign LED	1	1	40	3	8,760	648	355	1.09	55%
4' 2LT5HO to 4' 2LT5HO	4	4	114	102	8,760	420	460	1.09	110%
Halogen to MH	1	1	90	25	8,760	569	623	1.09	109%
MH to 4' 4LT5HO	139	139	396	202	8,760	236,222	258,427	1.09	109%
Total						778,176	816,979		105%

The table shown below presents ex ante and ex post energy savings for the lighting controls installed under the project.

Lighting Controls Savings Calculations

Measure	*Quantity*	*Controlled Wattage*	*Hours*		*Ex Ante kWh Savings*	*Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
			Old	*New*				
Controls	5	1,101.60	6,260	4,382	3,080	11,316	1.09	367%
Controls	42	202	6,260	4,382	25,872	17,430	1.09	67%
Total					28,952.00	28,746		99%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Standard	1,699	1,505	89%	0.23
Lighting Retrofit	Custom	776,477	815,474	105%	124.57
Lighting Controls	Standard	28,952	28,746	99%	6.15
Total		807,128	845,725	105%	130.95

The project-level realization rate is 105%. For the lighting retrofit, the realization rate is high because the ex post savings analysis included a heating and cooling interaction factor for natural gas-heated/electric-cooling light manufacturing in St. Louis (1.09), while the ex ante savings estimate did not account for heating and cooling interactive effects. For the lighting controls, the ex ante savings estimation assumes a greater impact on lighting hours than was measured and verified on-site.

Site C-19

Executive Summary

Project C-19 received custom incentives from Ameren Missouri for retrofitting lighting in the interior and exterior of its facility. The realization rate for this project is 105%.

Project Description

The customer retrofitted the following fixtures:

- (160) MH 400W fixtures with (160) 4' 4LT5 fixtures
- (16) MH 400W fixtures with (16) 4' 4LT5 fixtures
- (7) MH 400W fixtures with (7) 2' 6L T5 fixtures in the parking lot
- (3) MH 400W fixtures with (3) 4L Wall Pack fixtures in the exterior

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

kWh $kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
MH 400W to 4' 4LT5	160	160	461	210	3,247	125,661	130,408	1.00	104%
MH 400W to 4' 4LT5	16	16	461	210	3,487	12,566	15,320	1.09	122%
MH 400W to 2' 6L T5	7	7	461	153	4,308	9,443	9,288	1.00	98%
MH 400W to 4L Wall Pack	3	3	461	102	4,308	4,717	4,640	1.00	98%
Total						152,387	159,656		105%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Custom	152,387	159,656	105%	15.25
Total		152,387	159,656	105%	15.25

The project-level realization rate is 105%. The ex post energy savings are higher than ex ante savings because the HCIF factor used for light manufacturing in St. Louis, MO (1.09) applied to a portion of the lighting retrofit is higher than what was used to perform ex ante savings estimation (1.00). In addition, 15 fixtures were discovered during M&V visit to be serving as emergency lighting with greater hours of operation (8760) than was assumed by the ex ante estimate (3,247).

Site S-5

Executive Summary

Project S-5 received incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 110%.

Project Description

The customer retrofitted the following fixtures:

- (1483) Incandescent lamps with (1483) LED lamps

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
$HCIF$	= *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	*Quantity (Fixtures)*		*Wattage*		*Hours*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
	Old	*New*	*Old*	*New*					
Incandescent to LED	1,483	1,483	100	15	2,920	368,081	403,048	1.10	110%
Total						368,081	403,048		110%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Standard	368,081	403,048	110%	35.42
Total		368,081	403,048	110%	35.42

The project-level gross kWh savings realization rate is 110%. The realizations rate is high because the ex post savings analysis included a heating and cooling interaction factor for gas-heated hotel in St. Louis (1.10), while the ex ante savings estimate did not account for heating and cooling interactive effects. For this project, the site would not allow monitoring in the hotel's guest rooms. During the M&V site visit information was provided that unoccupied rooms would have their lights turned on with draperies left open. The annual lighting hours of operation used to perform gross ex ante savings, 2920, were assumed when performing gross ex post savings.

Site C-32, S-12

Executive Summary

Project C-32, S-12 received standard and custom incentives from Ameren Missouri for retrofitting lighting in the interior of their facility and installing occupancy sensors. The realization rate for this project is 55%.

Project Description

The customer retrofitted the following fixtures:

- (18) MH fixtures with (18) LED fixtures in the exterior area
- (3) MH fixtures with (3) LED fixtures in the exterior area
- Installation of (244) occupancy sensors on existing lighting

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and placed two photo-sensor loggers at the site (from 7/16/14 to 8/26/14) to monitor lighting operation. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

Lighting occupancy sensor energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times W \times N \times \left(t_{base} - t_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	*= Annual energy savings*
N	*= Number of occupancy sensors*
W	*= Wattage controlled by each occupancy sensor*
t	*= Lighting operating hours*
HCIF	*= HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	*Quantity (Fixtures)*		*Wattage*		*Hours*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
	Old	*New*	*Old*	*New*					
MH to LED	18	18	450	140	4,308	24,440	24,039	1.00	98%
MH to LED	3	3	210	60	4,308	1,971	1,939	1.00	98%
Total						26,411	25,977		98%

The table shown below presents ex ante and ex post energy savings for the lighting controls installed under the project.

Lighting Controls Savings Calculations

Measure	*Quantity*	*Controlled Wattage*	*Hours*		*Ex Ante kWh Savings*	*Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
			Old	*New*				
Controls	244	222	2,802	1,604	150,304	71,177	1.10	47%
Total					150,304	71,177		47%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	*Incentive*	*kWh Savings*			*Gross Ex Post Peak kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Lighting Retrofit	Custom	26,411	25,977	98%	0.24
Lighting Controls	Standard	150,304	71,177	47%	26.17
Total		176,715	97,154	55%	26.41

The project-level realization rate is 55%. For the lighting retrofit, the realization rate is low mainly because the ex post lighting operating hours verified during the M&V site visit (4,308) is less than the lighting operating hours used to perform the ex ante energy savings estimate (4,380). This calculation was performed by the non-daylighting calculator for the current year in conjunction with the US Naval Observatory SnRise/SunSet table. For the lighting controls, the ex ante savings estimation assumes a greater impact on lighting hours than was measured and verified during the M&V on site visit. All of offices were located on the perimeter of the building with natural day light streaming in with the majority of the light fixtures/controls not in use

Site C-31

Executive Summary

Project C-31 received custom incentives from Ameren Missouri for retrofitting lighting in the interior of its facility. The realization rate for this project is 101%.

Project Description

The customer retrofitted the following fixtures:

- (47) 8' 2LT12 fixtures with (47) 8' 2L LED fixtures
- (9) 4' 2LT12 fixtures with (9) 4' 2L LED fixtures

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
8' 2LT12 to 8' 2L LED	47	47	110	44	8,760	27,174	27,445	1.01	101%
4' 2LT12 to 4' 2L LED	9	9	55	36	8,760	1,498	1,513	1.01	101%
Total						28,672	28,958		101%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Custom	28,672	28,958	101%	4.21
Total		28,672	28,958	101%	4.21

The project-level realization rate is 101%, which indicates a highly accurate ex ante savings estimation.

Site C-18, S-24

Executive Summary

Project C-18, S-24 received standard and custom incentives from Ameren Missouri for retrofitting lighting in the interior and exterior of their facility. The realization rate for this project is 103%.

Project Description

The customer retrofitted the following fixtures:

- (40) MH fixtures with (40) LED fixtures
- (14) MH fixtures with (14) LED fixtures
- (4) MH fixtures with (4) LED fixtures
- (4) MH fixtures with (4) LED fixtures
- (8) MH fixtures with (8) LED fixtures
- (8) MH fixtures with (8) LED fixtures
- (44) 4' 4LT8 fixtures with (44) LED fixtures
- (3) 2' 2LT8 U-tube fixtures with (3) LED fixtures
- (11) 4' 2LT8 fixtures with (11) LED fixtures
- (12) Incandescent fixtures with (12) LED fixtures
- (3) 4' 4LT8 fixtures with (3) LED fixtures
- (31) Incandescent fixtures with (31) LED fixtures
- (19) Fluorescent Case lamps with (19) LED Case lamps
- (9) Fluorescent Case lamps with (9) LED Case lamps
- (9) Fluorescent Case lamps with (9) LED Case lamps

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*

HCIF = *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	*Quantity (Fixtures)*		*Wattage*		*Hours*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
	Old	*New*	*Old*	*New*					
MH to LED	40	40	370	132	4,308	41,698	41,010	1.00	98%
MH to LED	14	14	1,080	279	4,308	49,117	48,307	1.00	98%
MH to LED	4	4	1,080	279	4,308	14,034	13,802	1.00	98%
MH to LED	4	4	461	93	4,308	6,447	6,341	1.00	98%
MH to LED	8	8	210	40	4,308	5,957	5,859	1.00	98%
MH to LED	8	8	370	55	4,308	11,038	10,856	1.00	98%
4' 4LT8 to LED	44	44	112	59	8,760	20,428	22,635	1.11	111%
2' 2LT8 U-tube to LED	3	3	59	30	8,760	762	844	1.11	111%
4' 2LT8 to LED	11	11	62	30	8,760	3,084	3,417	1.11	111%
Incandescent to LED	12	12	65	11	8,760	5,676	6,290	1.11	111%
4' 4LT8 to LED	3	3	112	59	8,760	1,393	1,543	1.11	111%
Incandescent to LED	31	31	50	5	8,760	12,220	13,540	1.11	111%
Fluorescent Case to LED Case	19	19	60	17	8,760	7,157	9,232	1.29	129%
Fluorescent Case to LED Case	9	9	40	9	8,760	2,428	3,132	1.29	129%
Fluorescent Case to LED Case	9	9	40	9	8,760	2,428	3,132	1.29	129%
Total						183,866	189,939		103%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Standard	29,908	35,325	118%	4.38
Lighting Retrofit	Custom	153,958	154,614	100%	4.96
Total		183,866	189,939	103%	9.33

The project-level gross kWh savings realization rate is 103%. The realization rate is high because the post savings analysis included a heating and cooling interaction factor for gas-heated retail (1.11 for the interior measures and 1.29 for three case fixture measures), while the ex ante savings estimate did not account for heating and cooling interactive effects.

Site C-21, S-32

Executive Summary

Project C-21, S-32 received standard and custom incentives from Ameren Missouri for retrofitting lighting in the interior and exterior of their facility. The realization rate for this project is 104%.

Project Description

The customer retrofitted the following fixtures:

- (40) MH fixtures with (40) LED fixtures
- (2) MH fixtures with (2) LED fixtures
- (1) MH fixture with (1) LED fixture
- (14) MH fixtures with (14) LED fixtures
- (8) MH fixtures with (8) LED fixtures
- (7) MH fixtures with (7) LED fixtures
- (45) 4' 4LT8 fixtures with (45) LED fixtures
- (2) 2' 2LT8 U-tube fixtures with (2) LED fixtures
- (18) 4' 2LT8 fixtures with (18) LED fixtures
- (12) CFL fixtures with (12) LED fixtures
- (4) 4' 4LT8 fixtures with (4) LED fixtures
- (4) MH fixtures with (4) LED fixtures
- (4) MH fixtures with (4) LED fixtures
- (19) Fluorescent Case lamps with (19) LED Case lamps
- (9) Fluorescent Case lamps with (9) LED Case lamps
- (9) Fluorescent Case lamps with (9) LED Case lamps

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$ = *Annual energy savings*

N = *Number of fixtures*

W = *Wattage of each fixture*

t = *Lighting operating hours*

HCIF = *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	*Quantity (Fixtures)*		*Wattage*		*Hours*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
	Old	*New*	*Old*	*New*					
MH to LED	40	40	370	132	4,308	41,698	41,009	1.00	98%
MH to LED	2	2	1,080	279	4,308	7,017	6,901	1.00	98%
MH to LED	1	1	1,080	279	4,308	3,508	3,450	1.00	98%
MH to LED	14	14	461	93	4,308	22,566	22,193	1.00	98%
MH to LED	8	8	210	40	4,308	5,957	5,858	1.00	98%
MH to LED	7	7	370	55	4,308	9,658	9,498	1.00	98%
4' 4LT8 to LED	45	45	112	59	8,760	20,893	23,149	1.11	111%
2' 2LT8 U-tube to LED	2	2	59	30	8,760	508	563	1.11	111%
4' 2LT8 to LED	18	18	62	30	8,760	5,046	5,591	1.11	111%
CFL to LED	12	12	55	13	8,760	4,415	4,892	1.11	111%
4' 4LT8 to LED	4	4	112	59	8,760	1,857	2,058	1.11	111%
MH to LED	4	4	295	58	4,308	4,152	4,084	1.00	98%
MH to LED	4	4	210	46	4,308	2,870	2,822	1.00	98%
Fluorescent Case to LED Case	19	19	60	17	8,760	7,157	9,232	1.29	129%
Fluorescent Case to LED Case	9	9	40	9	8,760	2,428	3,132	1.29	129%
Fluorescent Case to LED Case	9	9	40	9	8,760	2,428	3,132	1.29	129%
Total						142,157	147,564		104%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Standard	12,012	15,496	129%	1.77
Lighting Retrofit	Custom	130,145	132,069	101%	5.51
Total		142,157	147,564	104%	7.28

The project-level realization rate is 104%. The realization rate is high because the post savings analysis included a heating and cooling interaction factor for gas-heated retail (1.11 for the interior measures and 1.29 for three case fixture measures), while the ex ante savings estimate did not account for heating and cooling interactive effects.

Site C-7, S-17

Executive Summary

Project C-7, S-17 received standard and custom incentives from Ameren Missouri for retrofitting lighting in the interior of their facility and installing occupancy sensors. The realization rate for this project is 113%.

Project Description

The customer installed or retrofitted the following fixtures:

- (11,813) T8 lamps fixtures with (11,084) LED lamps fixtures
- Installation of (250) Occupancy Sensors

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings. The reduction of lighting operating hours associated with occupancy sensors is determined by multiplying the baseline hours by a Power Adjustment Factor of 0.7 (adapted from ASHRAE 90.1-2007).

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	*= Annual energy savings*
N	*= Number of fixtures*
W	*= Wattage of each fixture*
t	*= Lighting operating hours*
HCIF	*= HVAC interaction factor*

Lighting occupancy sensor energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times W \times N \times \left(t_{base} - t_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	*= Annual energy savings*
N	*= Number of occupancy sensors*

W = *Wattage controlled by each occupancy sensor*

t = *Lighting operating hours*

HCIF = *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	*Quantity (Fixtures)*		*Wattage*		*Hours*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
	Old	*New*	*Old*	*New*					
T8 lamps to LED lamps	11,813	11,084	33	14	4,246	1,027,780	1,156,638	1.16	113%
Total						1,027,780	1,156,638		113%

The table shown below presents ex ante and ex post energy savings for the lighting controls installed under the project.

Lighting Controls Savings Calculations

Measure	*Quantity*	*Controlled Wattage*	*Hours*		*Ex Ante kWh Savings*	*Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
			Old	*New*				
Controls	250	310.35	4,246	2,972	96,825	114,733	1.16	118%
Total					96,825	114,733		118%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	*Incentive*	*kWh Savings*			*Gross Ex Post Peak kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Lighting Retrofit	Custom	1,027,780	1,156,638	113%	305.75
Lighting Controls	Standard	96,825	114,733	118%	30.33
Total		1,124,605	1,271,371	113%	336.08

The project-level realization rate is 113%. The realization rate is high because the ex post savings analysis included an HCIF for electric large office in central Missouri (1.16), while the ex ante savings estimate did not account for the HVAC interactive effects. Also, the ex ante estimate did not take into account the 12 holidays which lower the annual baseline operating hours (from 4,380 to 4,246) and post operating hours (from 3,066 to 2,972).

Site S-2

Executive Summary

Project S-2 received incentives from Ameren Missouri for retrofitting lighting in the interior of its facility. The realization rate for this project is 90%.

Project Description

The customer retrofitted (4268) Incandescent lamps with (4268) LED lamps.

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and placed eight photo-sensor loggers at the site (from 01/17/14 to 01/30/14) to monitor lighting operation. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area}\left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built}\right)/1000\right]$$

Where:

$kWh_{savings}$ = *Annual energy savings*

N = *Number of fixtures*

W = *Wattage of each fixture*

t = *Lighting operating hours*

HCIF = *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit installed under the project.

Lighting Retrofit Savings Calculations

Measure	*Quantity (Fixtures)*		*Wattage*		*Hours*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
	Old	*New*	*Old*	*New*					
Incandescent to LED	4,268	4,268	60	8	2,787	648,053	582,600	0.94	90%
Total						648,053	582,600		90%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	kWh Savings			Realized Ex Post Peak kW Reduction
	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	648,053	582,600	90%	102.12
Total	648,053	582,600	90%	102.12

The project-level realization rate is 90%. The realization rate is low mainly because the lighting hours of operation verified during the M&V site visit (2,786) are less than those used to perform ex ante energy estimation (2,920).

Site S-30

Executive Summary

Project S-30 received standard incentives from Ameren Missouri for retrofitting lighting in the interior of its facility. The realization rate for this project is 77%.

Project Description

The customer retrofitted the following fixtures in the common area:

- (14) Incandescent lamps with (14) LED lamps
- (30) Incandescent lamps with (30) LED lamps
- (18) Incandescent lamps with (18) LED lamps

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and placed two photo-sensor loggers at the site (from 3/05/14 to 3/25/14) to monitor lighting operation. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
Incandescent to LED	14	14	50	10	8,760	4,906	5,377	1.10	110%
Incandescent to LED	30	30	50	30	5,266	5,256	3,463	1.10	66%
Incandescent to LED	18	18	70	13	5,266	8,988	5,922	1.10	66%
Total						19,150	14,762		77%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Standard	19,150	14,762	77%	2.88
Total		19,150	14,762	77%	2.88

The project-level realization rate is 77%. The realization rate is low mainly because the lighting hours of operation verified during the M&V site visit for two measures (5,266) are less than those used to perform the ex ante savings estimate (8,760).

Site S-37

Executive Summary

Project S-37 received standard incentives from Ameren Missouri for retrofitting lighting in the interior of its facility. The realization rate for this project is 110%.

Project Description

The customer retrofitted the following fixtures:

- (4) Incandescent lamps with (4) LED lamps
- (20) Incandescent lamps with (20) LED lamps

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
$HCIF$	= *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
Incandescent to LED	4	4	50	10	8,760	1,402	1,536	1.10	110%
Incandescent to LED	20	20	50	30	8,760	3,504	3,840	1.10	110%
Total						4,906	5,377		110%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Standard	4,906	5,377	110%	0.74
Total		4,906	5,377	110%	0.74

The project-level realization rate is 110%. The ex post energy savings are higher than the ex ante savings because the HCIF factor used for a large office in St. Louis, MO (1.096) is higher than what was used to perform ex ante savings estimation (1.00).

Site S-33

Executive Summary

Project S-33 received standard incentives from Ameren Missouri for retrofitting lighting in the exterior of its facility. The realization rate for this project is 49%.

Project Description

The customer retrofitted (15) Incandescent fixtures with (15) LED fixtures in the building exterior.

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$ = *Annual energy savings*

N = *Number of fixtures*

W = *Wattage of each fixture*

t = *Lighting operating hours*

HCIF = *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
Incandescent to LED	15	15	100	11	4,310	11,695	5,754	1.00	49%
Total						11,695	5,754		49%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Standard	11,695	5,754	49%	0.06
Total		11,695	5,754	49%	0.06

The project-level realization rate is 49%. The realization rate is low mainly because the lighting hours of operation verified during the M&V site visit (4,310) are less than those used to perform the ex ante savings estimate (8,760).

Site C-25, S-14

Executive Summary

Project C-25, S-14 received standard and custom incentives from Ameren Missouri for retrofitting lighting in the interior of their facility and installing occupancy sensors. The realization rate for this project is 109%.

Project Description

The customer retrofitted the following fixtures:

- (30) 4' 4L12 fixtures with (8) 4' 6LT8 fixtures
- (254) 4' 4LT12 fixtures with (117) 4' 6LT8 fixtures
- (9) MH fixtures with (4) 4' 6LT8 fixtures
- (124) 4' 4LT12fixtures with (72) 4' 4LT8 fixtures
- (21) 4' 4LT12 fixtures with (24) 4' 4LT8 fixtures
- (6) 4' 4LT12 fixtures with (6) 4' 2LT8 fixtures
- (28) 4' 4LT12 fixtures with (17) 4' 4LT8 fixtures
- (60) 4' 4LT12 fixtures with (27) 4' 4LT8 fixtures
- (249) 4' 4LT12 Watts fixtures with (59) 4' 4LT8 fixtures
- Installation of 143 Occupancy Sensors
- Installation of 63 Occupancy Sensors

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and placed eight photo-sensor loggers at the site (from 10/4/2014 to 12/1/2014) to monitor lighting operation. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*

HCIF = *HVAC interaction factor*

Lighting occupancy sensor energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times W \times N \times \left(t_{base} - t_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$ = *Annual energy savings*

N = *Number of occupancy sensors*

W = *Wattage controlled by each occupancy sensor*

t = *Lighting operating hours*

HCIF = *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	*Quantity (Fixtures)*		*Wattage*		*Hours*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
	Old	*New*	*Old*	*New*					
4' 4LT12 to 4' 6LT8	30	8	112	217	5,058	5,081	8,214	1.00	162%
4' 4LT12 to 4' 6LT8	254	117	112	217	4,894	9,572	14,972	1.00	156%
MH to 4' 6LT8	9	4	1,080	217	5,058	27,698	44,773	1.00	162%
4' 4LT12 to 4' 4LT8	124	72	112	95	3,138	22,053	22,114	1.00	100%
4' 4LT12 to 4' 4LT8	21	24	112	95	3,463	225	249	1.00	111%
4' 4LT12 to 4' 2LT8	6	6	112	54	1,650	1,089	574	1.00	53%
4' 4LT12 to 4' 4LT8	28	17	112	95	4,983	4,759	7,579	1.00	159%
4' 4LT12 to 4' 4LT8	60	27	112	95	4,983	13,001	20,705	1.00	159%
4' 4LT12 to 4' 4LT8	249	59	112	95	3,796	69,724	84,587	1.00	121%
Total						106,419	203,769		191%

The table shown below presents ex ante and ex post energy savings for the lighting controls installed under the project.

Lighting Controls Savings Calculations

Measure	Quantity	Controlled Wattage	Hours		Ex Ante kWh Savings	Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
			Old	New				
Controls	143	196	4,909	3,528	88,088	38,663	1.00	44%
Controls	63	305	3,711	2,495	48,510	23,368	1.00	48%
Total					136,598.00	62,031		45%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Custom	106,419	203,769	191%	44.82
Lighting Controls	Standard	136,598	62,031	45%	3.81
Total		243,017	265,799	109%	48.63

The project-level realization rate is 109%. For the lighting retrofit, the realization rate is high because the of operation verified during the M&V site visit for seven of the measures (ranging from 3,463 to 5,058), not accounting for the effect of lighting controls, are greater than the lighting hours of operation used to perform the ex ante savings estimate (3,129). For the lighting controls, the ex ante savings estimation assumes a greater impact on lighting hours than was measured and verified during the M&V site visit.

Site C-5, S-9

Executive Summary

Project C-5, S-9 received standard and custom incentives from Ameren Missouri for retrofitting lighting in the interior and exterior of their facility, installing occupancy sensors, HVAC scheduling, refrigeration controls, beverage and snack machine controllers, and a high efficiency ice maker. The realization rate for this project is 105%.

Project Description

The customer retrofitted and installed the following fixtures:

- (4031) T12 redesign fixtures with (4031) T8 redesign fixtures
- (564) Incandescent redesign fixtures with (564) CFL/LED redesign fixtures
- (68) CFL Exit Signs with (68) LED Exit Signs
- (43) Incandescent Exit Signs with (43) LED Exit Signs
- (3) Incandescent lamps with (3) CFL lamps
- (6) Incandescent lamps with (6) CFL lamps
- (15) Incandescent lamps with (15) CFL lamps
- (38) Incandescent lamps with (38) CFL lamps
- (17) Incandescent lamps with (17) CFL lamps
- (4) Incandescent lamps with (4) CFL lamps
- (191) Incandescent lamps with (191) CFL lamps
- (8) Incandescent lamps with (8) CFL lamps
- (3) Incandescent lamps with (3) CFL lamps
- (2) Incandescent lamps with (2) CFL lamps
- (14) Incandescent lamps with (14) CFL lamps
- (36) Incandescent lamps with (36) CFL lamps
- (4) Incandescent lamps with (4) LED lamps
- (4) Incandescent lamps with (4) LED lamps
- (57) Incandescent lamps with (57) LED lamps
- (6) Incandescent lamps with (6) LED lamps
- (1) Incandescent lamp with (1) LED lamp
- (10) Incandescent lamps with (10) LED lamps
- (48) Incandescent lamps with (48) LED lamps
- (24) Incandescent lamps with (24) LED lamps
- (14) Incandescent lamps with (14) LED lamps
- (4) Incandescent lamps with (4) LED lamps
- (4) Incandescent lamps with (4) LED lamps
- (18) Incandescent lamps with (18) LED lamps
- (16) Incandescent lamps with (16) LED lamps
- (77) Incandescent lamps with (77) LED lamps
- (2) Incandescent lamps with (2) LED lamps

- 139 Occupancy Sensors in common areas
- 45 Occupancy Sensors in common areas

Due to recommendations from a site wide energy audit the customer added ALC and Telkonet web based thermostats to a total of nine buildings in order to reduce HVAC system operation. Originally the HVAC systems in these nine buildings operated 24/7 regardless of occupancy; with the addition of the new controls scheduling has been put in place to eliminate HVAC usage during unoccupied periods.

Floating head pressure controls were also installed on a pair of compressors serving a walk-in freezer and cooler at the campus cafeteria. The controlled compressors have a combined horsepower of 100, and the addition of the floating head pressure controls allows the compressor to operate much more efficiently at reduced outdoor air temperatures. Along with the new refrigeration controls a new high efficiency energy star ice maker was installed.

The customer also installed (3) EnergyStar icemakers, occupancy sensors on (6) vending machines and (17) beverage machines. The occupancy sensors automatically shutoff display lighting and limit the compressor usage in the beverage machines when there are no potential clientele in the immediate vicinity.

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and placed five photo-sensor loggers at the site (from 04/25/2014 to 01/8/2015) to monitor lighting operation. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

Lighting occupancy sensor energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times W \times N \times \left(t_{base} - t_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	*= Annual energy savings*
N	*= Number of occupancy sensors*
W	*= Wattage controlled by each occupancy sensor*
t	*= Lighting operating hours*
HCIF	*= HVAC interaction factor*

During the M&V visit, ADM staff verified equipment installation, and verified that the HVAC setback schedules had been programmed into the EMS serving the nine buildings listed in the project application.

Savings for the HVAC scheduling was calculated through the use of a DEER eQUEST prototypical university model. The baseline model was modified so that all of the HVAC systems operated 24/7 with no temperature setbacks to reflect the operation of the actual HVAC systems before the installation of the new controls. Parametric runs were then used to implement the documented HVAC fan and temperature setback schedules. The pair of models where then ran using TMY3 weather data for the region in which the modeled annual energy savings was normalized to the square feet of conditioned area in the model. The ex post annual energy savings was then determined by multiplying the normalized annual energy savings by the total square feet of the nine buildings with the new controls.

The savings for the floating head pressure controls on the walk-in freezer and cooler compressors was calculated through the use of a DEER eQUEST Refrigeration prototypical grocery store model. The model was modified to best reflect the compressor configuration of the campus cafeteria walk-ins as the default model utilizes a multiplex compressor system which is not present at the campus. Parametric runs where then used to implement floating head pressure controls within the model and then the pair of models was run using TMY3 weather data for the region. The modeled energy savings was then normalized to the model's total compressor horsepower. The ex post annual energy savings was determined by multiplying the normalized annual energy savings by the total horsepower of the walk-in compressor horsepower.

Savings for the installation of the new Energy Star ice make was determined through the use of Energy Star's calculator which can be located on their web site.

Savings for the vending and beverage machine controllers were applied based upon the deemed savings from the Ameren TRM. The TRM reports a savings of 386 kWh per vending machine and 1,646 kWh per beverage machine resulting in a 100% realization rate for both measures.

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
T12 redesign to T8 redesign	4,031	4,031	92	50	3,290	440,053	608,707	1.09	138%
Incandescent redesign to CFL/LED redesign	564	564	164	42	3,682	292,734	266,347	1.06	91%
CFL Exit Sign to LED Exit Sign	68	68	12	4	8,760	8,935	5,199	1.09	58%
Incandescent Exit Sign to LED Exit Sign	43	43	30	4	8,760	10,170	10,685	1.09	105%
Incandescent to CFL	3	3	40	13	3,290	254	291	1.09	115%
Incandescent to CFL	6	6	40	9	3,290	719	668	1.09	93%
Incandescent to CFL	15	15	60	16	3,290	2,108	2,369	1.09	112%
Incandescent to CFL	38	38	60	13	3,290	2,817	6,411	1.09	228%
Incandescent to CFL	17	17	75	23	3,290	1,434	3,173	1.09	221%
Incandescent to CFL	4	4	75	13	3,290	129	890	1.09	688%
Incandescent to CFL	191	191	60	13	3,290	18,426	32,222	1.09	175%
Incandescent to CFL	16	16	100	23	3,290	4,759	4,422	1.09	93%
Incandescent to CFL	8	8	100	23	3,290	1,929	2,211	1.09	115%
Incandescent to CFL	3	3	100	23	3,290	528	829	1.09	157%
Incandescent to CFL	2	2	100	23	3,290	322	553	1.09	172%
Incandescent to CFL	14	14	100	23	3,290	563	3,869	1.09	688%
Incandescent to CFL	36	36	100	13	3,290	1,635	11,242	1.09	688%
Incandescent to LED	4	4	90	17	3,290	1,128	1,048	1.09	93%
Incandescent to LED	4	4	90	17	3,290	667	1,048	1.09	157%
Incandescent to LED	57	57	90	17	3,290	13,032	14,936	1.09	115%
Incandescent to LED	6	6	65	14	3,290	1,182	1,098	1.09	93%
Incandescent to LED	1	1	65	14	3,290	27	183	1.09	688%
Incandescent to LED	10	10	65	14	3,290	1,165	1,831	1.09	157%

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
Incandescent to LED	48	48	60	10	4,306	10,617	10,437	1.00	98%
Incandescent to LED	24	24	50	9	3,290	3,800	3,532	1.09	93%
Incandescent to LED	14	14	50	9	3,290	1,798	2,060	1.09	115%
Incandescent to LED	4	4	50	10	3,290	501	574	1.09	115%
Incandescent to LED	4	4	100	17	4,306	1,454	1,429	1.00	98%
Incandescent to LED	18	18	100	17	3,290	5,770	5,363	1.09	93%
Incandescent to LED	16	16	100	17	3,290	4,159	4,767	1.09	115%
Incandescent to LED	77	77	100	17	3,290	14,597	22,940	1.09	157%
Incandescent to LED	2	2	100	22	4,306	683	672	1.00	98%
Total						848,095	1,032,005		122%

The table shown below presents ex ante and ex post energy savings for the lighting controls installed under the project.

Lighting Controls Savings Calculations

Measure	Quantity	Controlled Wattage	Hours		Ex Ante kWh Savings	Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
			Old	New				
Controls	139	159	5,220	3,117	107,030	50,609	1.09	47%
Controls	45	121	5,220	3,117	17,415	12,478	1.09	72%
Total					124,445	63,087		51%

The table shown below presents ex ante and ex post energy savings for the HVAC scheduling and controls installed under the project.

HVAC Scheduling and Control Savings

Measure	Conditioned Area (ft2)	Savings (kWh/ft2)	Ex Ante kWh Savings	Ex Post kWh Savings	Gross kWh Savings Realization Rate
HVAC Scheduling	248,950	3.10	799,466	772,742	97%
Total			799,466	772,742	97%

The table shown below presents ex ante and ex post energy savings for the floating head pressure controls installed under the project.

Floating Head Pressure Control Savings

Measure	HP	eQUEST Savings (kWh/hp)	Ex Ante kWh Savings	Ex Post kWh Savings	Gross kWh Savings Realization Rate
Floating Head Pressure	100	299.5	32,818	29,950	91%
Total			32,818	29,950	91%

The table shown below presents ex ante and ex post energy savings for the EnergyStar ice maker installed under the project.

Ice Maker Savings Calculations

Measure	Quantity	Harvest Rate (lbs/day)	Energy use (kWh/100lbs)		Ex Ante kWh Savings	Ex Post kWh Savings	Gross kWh Savings Realization Rate
			Base	EnergyStar			
Ice Maker	3	650	6.2	5.5	8,085	4,982	47%
Total					8,085	4,982	47%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Custom	732,787	875,054	119%	219.00
Lighting Retrofit	Standard	115,308	156,952	136%	40.76
Lighting Controls	Standard	124,445	63,087	51%	8.96
HVAC Scheduling	Custom	799,466	772,742	97%	123.62
Refrigeration Floating Head Pressure Controls	Custom	32,818	29,950	91%	0.00
Beverage Vending Machine Control	Standard	27,982	27,982	100%	0.94
Lighted Snack Dispensing Machine Control	Standard	2,208	2,208	100%	0.00
ENERGY STAR® Ice Machine 500 to 1,000 lbs/day	Standard	8,085	4,982	62%	0.57
Total		1,843,099	1,932,957	105%	393.85

The project-level realization rate is 105%. For the custom lighting redesign, the realization rate is high mainly because the ex post wattage (92.43 base and 50.36 retro), not accounting for the effect of lighting controls, are greater than those used to perform ex ante estimation (74.2 base and 45.4 retro). For the standard lighting retrofit, the realization rate is high because the ex post hours of operation verified during the M&V site visit for 19 measures (3,290) were greater than the lighting hours of operation used to perform the ex ante savings estimate (ranging from 522 – 3,132). In addition, the ex post savings analysis included an HCIF for gas-heated University in central Missouri (1.09), while the ex ante savings estimate did not account for HVAC interactive effects. For the lighting controls, the ex ante savings estimation assumes a greater impact on lighting hours than was verified during the M&V site visit.

The realization rate is low for the EnergyStar ice machine which may be due to overestimation of the new ice machine harvest rate. The EnergyStar Commercial Kitchen calculator was used with appropriate product specifications and a value of 0.75 duty cycle per TRM.

Site N-12

Executive Summary

Project N-12 received incentives from Ameren Missouri for installing a new Uninterrupted Power Supply (UPS) unit. The realization rate for this project is 78%.

Project Description

In this new construction project, N-12 installed a high efficiency Liebert NX UPS system. The savings were calculated against the industry standard defined in PG&E's *Energy Efficiency Baselines for Data Centers* study (Integral Group, 2013).

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment and took power measurements. Savings were calculated using the difference in the baseline and as-built efficiency curves applied to the typical annual loading. The as-built efficiency was provided by the system manufacturer. The baseline efficiency curve was taken from PG&E's *Energy Efficiency Baselines for Data Centers* study which created a curve using the average of systems representing the industry standard. The 2013 edition of this study increases the baseline UPS efficiency by .2% when compared to the 2008 edition.

The system loading was determined from onboard readings. ADM visited the site twice, once in November and again in December. The November reading displayed 21.6% loading and the December reading displayed 24.6% loading. The second reading was used as the typical loading because the site is a new construction building and was in the progress of scaling up system use. UPS system loading is typically unvarying and falls within the 20%-40% range.

The more efficient UPS system also gains energy savings from a decreased conditioning requirement. These interactive effects were calculated using the COP of the split heat pump serving the area and applying it to the UPS energy reduction.

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*
	Expected	*Realized*	*Realization Rate*	
UPS System	72,270	56,303	78%	6.43
Total	**72,270**	**56,303**	**78%**	**6.43**

The site level realization rate for this project is 78%. The baseline and as built efficiency curves were marginally different and had a small impact on the savings. The major difference was between the ex ante calculations assumed 40% loading and the ex post's finding of 24.6% loading.

Site S-28

Executive Summary

Project S-28 received standard incentives from Ameren Missouri for retrofitting lighting in the interior of its facility. The realization rate for this project is 100%.

Project Description

The customer retrofitted (36) Incandescent fixtures with (36) LED fixtures

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Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit installed under the project.

Lighting Retrofit Savings Calculations

Measure	*Quantity (Fixtures)*		*Wattage*		*Hours*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
	Old	*New*	*Old*	*New*					
Incandescent to LED	36	36	75	7	8,760	21,444	21,444	1.00	100%
Total						21,444	21,444		100%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Standard	21,444	21,444	100%	2.45
Total		21,444	21,444	100%	2.45

The project-level Standard Incentive realization rate is 100%, which indicates a highly accurate ex ante savings estimation.

Site N-7

Executive Summary

Project N-7 received New Construction incentives from Ameren Missouri for retrofitting lighting in the interior and exterior of their facility, installing occupancy sensors, and installing EnergyStar ice machines. The realization rate for this project is 119%.

Project Description

The customer installed or retrofitted the following fixtures:

In their exterior:

- (17) MH fixtures with (17) LED fixtures
- (44) MH fixtures with (44) LED fixtures
- (10) MH fixtures with (10) LED fixtures

- Interior Redesign:

  - (835) LPD with (835) LED fixtures
  - (88) LPD with (88) LED fixtures
  - (12) LPD with (12) LED fixtures
  - (3) LPD with (3) LED fixtures in
  - (13) LPD with (13) LED fixtures
  - (107) LPD with (107) LED fixtures
  - (2) LPD with (2) LED 2' diam fixtures
  - (2) LPD with (2) LED 3' diam fixtures
  - (2) LPD with (2) LED 4' diam fixtures
  - (16) LPD with (16) 4' 8LT8 fixtures
  - (24) LPD with (24) 2' 4LT8 fixtures
  - (64) LPD with (64) 4' LED fixtures
  - (10) LPD with (10) LED -Pendant fixtures
  - (28) LPD with (28) LED fixtures
  - (10) LPD with (10) LED fixtures
  - (6) Scotsman CU3030 self-contained energy star ice machines

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and placed five photo-sensor loggers at the site to monitor lighting operation. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

Lighting occupancy sensor energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times W \times N \times \left(t_{base} - t_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of occupancy sensors*
W	= *Wattage controlled by each occupancy sensor*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

Ice machine energy savings are calculated based on EnergyStar deemed savings calculator:

$$kWh_{savings} = \frac{(kWh_{base,per100lbs} - kWh_{ee,per100lbs})}{100} \times DC \times H \times 365 days$$

Where:

$kWh_{savings}$	= *Annual energy savings*
$kWh_{base,per100lbs}$	= *Baseline case energy usage (kWh/100lbs)*
$kWh_{ee,per100lbs}$	= *Energy Efficient case energy usage (kWh/100lbs)*
DC	= *Duty cycle of ice maker representing time unit is making ice =0.75*
H	= *Harvest rate (lbs of ice made per day)*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
MH to LED	17	17	461	95	4,308	24,888	26,804	1.00	108%
MH to LED	44	44	461	124	4,308	59,312	63,878	1.00	108%
MH to LED	10	10	295	51	4,308	9,760	10,511	1.00	108%
LPD 1 to LED	835	835	102	48	6,835	178,587	345,188	1.11	193%
LPD 2 to LED	88	88	56	26	6,835	10,302	19,913	1.11	193%
LPD 3 to LED	12	12	168	78	6,835	4,214	8,146	1.11	193%
LPD 4 to LED	3	3	252	117	6,835	1,580	3,055	1.11	193%
LPD 5 to LED	13	13	49	23	6,835	1,346	2,602	1.11	193%
LPD 6 to LED	107	107	19	9	6,835	4,336	8,381	1.11	193%
LPD 7 to LED 2' diam	2	2	129	60	6,835	540	1,044	1.11	193%
LPD 8 to LED 3' diam	2	2	140	65	6,835	585	1,131	1.11	193%
LPD 9 to LED 4' dia	2	2	140	65	6,835	585	1,131	1.11	193%
LPD 10 to 4' 8LT8	16	16	482	224	6,835	16,138	31,192	1.11	193%
LPD 11 to 2' 4LT8	24	24	127	59	6,835	6,376	12,324	1.11	193%
LPD 12 to 4' LED	64	64	62	29	6,835	8,357	16,153	1.11	193%
LPD 13 to LED - Pendant	10	10	11	5	6,835	225	435	1.11	193%
LPD 14 to LED	28	28	30	14	6,835	1,765	3,412	1.11	193%
LPD 15 to LED	10	10	12	6	6,835	254	492	1.11	193%
Total						329,152	555,793		169%

The table shown below presents ex ante and ex post energy savings for the lighting controls installed under the project.

Lighting Controls Savings Calculations

Measure	Quantity	Controlled Wattage	Hours		Ex Ante kWh Savings	Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
			Old	New				
Controls	137	66	6,835	6,295	54,389	5,368	1.11	10%
Controls	137	315.67	6,835	6,295	105,545	25,832	1.11	24%
Total					159,934	31,200		20%

The table shown below presents ex ante and ex post energy savings for the EnergyStar ice makers installed under the project.

Ice Maker Savings Calculations

Measure	Quantity	Harvest Rate (lbs/day)	Energy use (kWh/100lbs)		Ex Ante kWh Savings	Ex Post kWh Savings	Gross kWh Savings Realization Rate
			Base	EnergyStar			
Ice Maker	6	217	9.8	8.5	9,912	4,621	47%
Total					9,912	4,621	47%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	New Construction	329,152	555,793	169%	66.63
Lighting Controls	New Construction	159,934	31,200	20%	0.00
Ice Maker	New Construction	9,912	4,621	47%	0.53
Total		498,998	591,615	119%	67.16

The project-level realization rate is 119%. For the lighting retrofit, the realization rate is high mainly because the ex post hours of operation verified during the M&V site visit for the interior lighting redesign (6,835) were higher than the lighting hours of operation used to perform the ex ante savings estimate (3,911). The data from five light loggers that were installed at the facility were used for the ex post hours. For the exterior lighting the ex post savings analysis hours of operation (4,308) were higher than the ex ante savings estimate (4,000). This calculation was performed by the non-daylighting calculator for the current year in conjunction with the US Naval Observatory SunRise/SunSet table. In addition, the ex post savings analysis included an HCIF for gas-heated small office in St. Louis (1.11), while the ex ante savings estimate did not account for HVAC interactive effects. For the lighting controls, the ex ante savings estimation assumes a greater impact on lighting hours than was measured and verified during the M&V site visit. For the EnergyStar ice machine savings, the realization rate is low (47%). This may be due to overestimation of the new ice machine harvest rate. The EnergyStar Commercial Kitchen calculator was used with appropriate product specifications and a value of 0.75 duty cycle per TRM.

Site S-18

Executive Summary

Project S-18 received standard incentives from Ameren Missouri for retrofitting lighting in the interior of its facility. The realization rate for this project is 108%.

Project Description

The customer retrofitted the following fixtures:

- (60) Incandescent lamps with (60) LED lamps
- (130) Incandescent lamps with (130) LED lamps

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit installed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
Incandescent to LED	60	60	75	13	8,760	32,587	35,031	1.08	108%
Incandescent to LED	130	130	50	5	8,760	51,246	55,089	1.08	108%
Total						83,833	90,121		108%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Standard	83,833	90,121	108%	11.32
Total		83,833	90,121	108%	11.32

The project-level realization rate is 108%. The ex post energy savings are higher than the ex ante energy savings because the HCIF factor used for health care in southern Missouri (1.08) is higher than what was used to perform the ex ante savings estimate (1.00).

Site S-34

Executive Summary

Project S-34 received standard incentives from Ameren Missouri for retrofitting lighting in the interior of its facility. The realization rate for this project is 108%.

Project Description

The customer retrofitted (14) Incandescent lamps with (14) LED lamps

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$ = *Annual energy savings*

N = *Number of fixtures*

W = *Wattage of each fixture*

t = *Lighting operating hours*

HCIF = *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	*Quantity (Fixtures)*		*Wattage*		*Hours*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
	Old	*New*	*Old*	*New*					
Incandescent to LED	14	14	75	13	8,760	7,604	8,174	1.08	108%
Total						7,604	8,174		108%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Standard	7,604	8,174	108%	1.03
Total		7,604	8,174	108%	1.03

The project-level realization rate is 108%. The ex post energy savings are higher than ex ante savings because the HCIF factor used for healthcare in southern Missouri (1.08) is higher than what was used to perform the ex ante savings estimate (1.00).

Site N-2

Executive Summary

Project N-2 received new construction incentives from Ameren Missouri for retrofitting lighting and installing controls in the interior of their facility. The realization rate for this project is 141%.

Project Description

The customer installed the following fixtures:

- (640) 4' 6LT5 HO - 4 L circuit fixtures and daylight controls
- (640) 4' 6LT5 HO - 2 L circuit fixtures with daylight controls
- Installation of (8) 8' 2LT12 fixtures

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and installed current monitoring loggers on (2) two lamp lighting circuits and (2) four lamp lighting circuits. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

Lighting occupancy sensor energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times W \times N \times \left(t_{base} - t_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*

N = *Number of control systems*

W = *Wattage controlled by system*

t = *Lighting operating hours*

HCIF = *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	*Quantity (Fixtures)*		*Wattage*		*Hours*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
	Old	*New*	*Old*	*New*					
LPD to 4' 6LT5 HO - 4 L circuit	640	640	458	207	7,021	774,767	1,127,931	1.00	146%
LPD to 4' 6LT5 HO - 2 L circuit	640	640	229	104	7,021	387,383	563,966	1.00	146%
Installation of 8' 2LT12	-	8	192	192	7,021	(7,408)	(10,785)	1.00	146%
Total						1,154,742	1,681,112		146%

The table shown below presents ex ante and ex post energy savings for the lighting controls installed under the project.

Lighting Controls Savings Calculations

Measure	*Quantity*	*Controlled Wattage*	*Hours*		*Ex Ante kWh Savings*	*Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
			Old	*New*				
Controls	13	9,952.00	7,021	5,987	104,183	137,273	1.00	132%
Controls	7	9,952.00	7,021	6,482	52,092	35,765	1.00	69%
Total					156,275.00	173,038		111%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	*Incentive*	*kWh Savings*			*Gross Ex Post Peak kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Lighting Retrofit	New Construction	1,154,742	1,681,112	146%	239.42
Lighting Controls	New Construction	156,275	173,038	111%	0.47
Total		1,311,017	1,854,150	141%	239.89

The project-level realization rate is 141%. For the lighting retrofit, the realization rate is high mainly because the ex post lighting hours of operation verified during the M&V site visit (7,021) are greater than the lighting operating hours used to perform the ex ante estimation (4,823).

Although, the ex ante savings estimate assumes a greater impact from daylight harvesting hours than what was measured, it was offset by a reduction in scheduled hours of the four lamp lighting circuits, with the two lamp circuits used in the periods between shifts. Without the dual wattage lighting circuits, the baseline usage would have been the full six lamp fixtures operating.

Site C-27, S-19

Executive Summary

Project C-27, S-19 received standard and custom incentives from Ameren Missouri for retrofitting lighting in the interior and exterior of their facility and installing occupancy sensors. The realization rate for this project is 88%.

Project Description

The customer retrofitted the following fixtures:

- (124) MH fixtures with (117) 4' 6LT5HO fixtures in the warehouse area
- (29) MV fixtures with (29) LED fixtures in the exterior area
- 117 Occupancy Sensors

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and placed three photo-sensor loggers at the site (from 10/7/2014 to 12/3/2014) to monitor lighting operation. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	*= Annual energy savings*
N	*= Number of fixtures*
W	*= Wattage of each fixture*
t	*= Lighting operating hours*
HCIF	*= HVAC interaction factor*

Lighting occupancy sensor energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times W \times N \times \left(t_{base} - t_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$ *= Annual energy savings*

N	*= Number of occupancy sensors*
W	*= Wattage controlled by each occupancy sensor*
t	*= Lighting operating hours*
HCIF	*= HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	*Quantity (Fixtures)*		*Wattage*		*Hours*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
	Old	*New*	*Old*	*New*					
MH to 4' 6LT5HO	124	117	461	358	3,874	47,805	59,185	1.00	124%
MV to LED	29	29	450	85	4,308	42,340	45,599	1.00	108%
Total						90,145	104,785		116%

The table shown below presents ex ante and ex post energy savings for the lighting controls installed under the project.

Lighting Controls Savings Calculations

Measure	*Quantity*	*Controlled Wattage*	*Hours*		*Ex Ante kWh Savings*	*Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
			Old	*New*				
Controls	117	358	3,874	2,966	72,072	38,038	1.00	53%
Total					72,072	38,038		53%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	*Incentive*	*kWh Savings*			*Gross Ex Post Peak kW Reduction*
		Gross Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	
Lighting Retrofit	Custom	90,145	104,785	116%	15.44
Lighting Controls	Standard	72,072	38,038	53%	1.93
Total		162,217	142,822	88%	17.37

The project-level realization rate is 88%. For the lighting retrofit, the realization rate is high mainly because the ex post hours of operation verified during the M&V site visit (3,874 – 4,308) were higher than the lighting hours of operation used to perform the ex ante savings estimate (3,129 – 4,000). For the lighting controls, the ex ante savings estimation assumes a greater impact on lighting hours than was measured and verified on-site.

Site S-8

Executive Summary

Project S-8 received standard incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 77%.

Project Description

The customer retrofitted the following fixtures:

- (297) lamps with (297) LED lamps
- (176) Incandescent lamps with (176) LED lamps

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
Lamp to LED	297	297	60	10	8,760	235,456	152,672	1.16	65%
Incandescent to LED	176	176	50	5	8,760	69,379	80,619	1.16	116%
Total						304,835	233,290		77%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Standard	304,835	233,290	77%	27.85
Total		304,835	233,290	77%	27.85

The project-level realization rate is 77%. The realization rate is low because the baseline wattage for one measure that was verified during the M&V site visit (60w) was less than the wattage used in the ex ante savings estimate (100w).

Site S-20

Executive Summary

Project S-20 received standard incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 108%.

Project Description

The customer retrofitted the following fixtures:

- (24) Incandescent lamps with (24) LED lamps
- (115) Incandescent lamps with (115) LED lamps

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
$HCIF$	= *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
Incandescent to LED	24	24	75	13	8,760	13,035	14,012	1.08	108%
Incandescent to LED	115	115	60	11	8,760	49,363	53,065	1.08	108%
Total						62,397	67,077		108%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Standard	62,398	67,077	108%	8.43
Total		62,398	67,077	108%	8.43

The project-level realization rate is 108%. The realization rate is high because the ex post savings analysis included an HCIF for gas-heated healthcare in southern Missouri (1.08), while the ex ante savings estimate did not account for HVAC interactive effects.

Site C-33, S-3

Executive Summary

Project C-33, S-3 received standard and custom incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 109%.

Project Description

The customer retrofitted the following fixtures throughout:

- (1700) Incandescent lamps with (1700) LED lamps
- (2) Incandescent lamps with (2) LED lamps
- (3) Incandescent lamps with (3) LED lamps
- (24) Incandescent lamps with (24) LED lamps
- (175) Incandescent lamps with (175) LED lamps
- (215) Incandescent lamps with (215) LED lamps

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
Incandescent to LED	1,700	1,700	60	11	4,380	364,854	398,056	1.09	109%
Incandescent to LED	2	2	90	18	4,380	631	688	1.09	109%
Incandescent to LED	3	3	65	13	4,380	683	745	1.09	109%
Incandescent to LED	24	24	65	14.5	4,380	5,309	5,792	1.09	109%
Incandescent to LED	175	175	25	3.5	2,920	10,956	11,986	1.09	109%
Incandescent to LED	215	215	15	3.5	4,380	10,830	11,815	1.09	109%
Total						393,263	429,082		109%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Standard	371,477	405,281	109%	130.78
Lighting Retrofit	Custom	21,786	23,801	109%	3.81
Total		393,263	429,082	109%	134.59

The project-level realization rate is 109%. For the lighting retrofit, the realization rate is high because the ex post savings analysis included an HCIF for gas heated healthcare in southern Missouri (1.09), while the ex ante savings estimate did not account for HVAC interactive effects.

Site N-3

Executive Summary

Project N-3 received new construction incentives from Ameren Missouri for retrofitting lighting in the interior of their facility and installing occupancy sensors. The realization rate for this project is 94%.

Project Description

The customer retrofitted the following fixtures:

- (428) MH fixtures with (428) 4' 8LT5 fixtures

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and placed four photo-sensor loggers at the site (from 10/4/14 to 10/23/14) to monitor lighting operation. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

Lighting occupancy sensor energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times W \times N \times \left(t_{base} - t_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$ = *Annual energy savings*

N = *Number of occupancy sensors*

W = *Wattage controlled by each occupancy sensor*

t = *Lighting operating hours*

HCIF = *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
MH to 4' 8LT5	428	428	794	465	7,275	982,914	1,023,462	1.00	104%
Total						982,914	1,023,462		104%

The table shown below presents ex ante and ex post energy savings for the lighting controls installed under the project.

Lighting Controls Savings Calculations

Measure	Quantity	Controlled Wattage	Hours		Ex Ante kWh Savings	Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
			Old	New				
Controls	428	465	7,275	6,507	263,776	152,915	1.00	58%
Total					263,776	152,915		58%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	New Construction	982,914	1,023,462	104%	140.56
Lighting Controls	New Construction	263,776	152,915	58%	1.18
Total		1,246,690	1,176,377	94%	141.74

The project-level gross kWh savings realization rate is 94%. For the lighting retrofit, the realization rate is high mainly because the ex post lighting operating hours verified during the M&V site visit (7,275) are higher than the lighting operating hours used to perform the ex ante savings estimate (6,987). This verified higher operating hour is due to the recently increased workload the facility has incurred. For the lighting controls, the ex ante savings estimation assumes a greater impact on lighting hours than was measured and verified during the M&V site visit.

Site C-11, S-10

Executive Summary

Project C-11, S-10 received standard and custom incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 83%.

Project Description

The customer retrofitted the following fixtures:

- (55) Incandescent fixtures with (55) LED fixtures
- (138) Incandescent fixtures with (138) LED fixtures
- (408) Incandescent fixtures with (408) LED fixtures
- (9) Incandescent fixtures with (9) LED fixtures
- (64) Incandescent fixtures with (64) LED fixtures
- (50) Incandescent fixtures with (50) LED fixtures
- (15) 2' 1LT12 fixtures with (15) LED fixtures
- (40) 4' 3LT8 fixtures with (40) LED fixtures
- (59) 4' 3LT8 fixtures with (59) LED fixtures
- (30) 4' 4LT8 fixtures with (30) LED fixtures
- (105) 4' 4LT8 fixtures with (105) LED fixtures
- (146) 8' 2lT12 fixtures with (146) LED fixtures
- (83) MH fixtures with (83) LED fixtures
- (39) 4' 4LT8 fixtures with (39) LED fixtures
- (51) 8' 2LT12 fixtures with (51) LED fixtures
- (24) 4' 3LT8 fixtures with (24) LED fixtures
- (4) 2' 2LT12 -U-tube fixtures with (4) LED fixtures
- (22) 4' 3LT8 fixtures with (22) LED fixtures
- (35) Incandescent fixtures with (35) LED fixtures
- (6) 8' 1LT12 fixtures with (6) LED fixtures
- (13) Incandescent fixtures with (13) LED fixtures
- (9) MH fixtures with (9) LED fixtures
- (15) 4' 4LT8 fixtures with (15) LED fixtures
- (21) MH fixtures with (21) LED fixtures
- (12) MH fixtures with (12) LED fixtures
- (45) MH fixtures with (45) LED fixtures
- (4) Case Lighting fixtures with (4) LED Case Lighting fixtures

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and placed six photo-sensor loggers at the site (from 11/1/2014 to 11/15/2014) to monitor lighting operation. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	*= Annual energy savings*
N	*= Number of fixtures*
W	*= Wattage of each fixture*
t	*= Lighting operating hours*
HCIF	*= HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
Incandescent to LED	55	55	60	8	3,347	18,790	10,558	1.10	56%
Incandescent to LED	138	138	65	7	3,347	52,586	29,547	1.10	56%
Incandescent to LED	408	408	40	3	3,347	99,181	55,727	1.10	56%
Incandescent to LED	9	9	60	6	6,434	3,193	3,449	1.10	108%
Incandescent to LED	64	64	100	9	6,434	38,264	41,332	1.10	108%
Incandescent to LED	50	50	50	5	3,347	14,783	8,306	1.10	56%
2' 1LT12 to LED	15	15	18	10	6,250	788	827	1.10	105%
4' 3LT8 to LED	40	40	85	54	6,250	8,147	8,549	1.10	105%
4' 3LT8 to LED	59	59	85	70	6,250	5,814	6,101	1.10	105%
4' 4LT8 to LED	30	30	112	70	953	8,278	1,324	1.10	16%
4' 4LT8 to LED	105	105	112	72	6,250	27,594	28,955	1.10	105%
8' 2lT12 to LED	146	146	110	80	6,250	28,777	30,196	1.10	105%
MH to LED	83	83	295	45	6,250	136,328	143,054	1.10	105%
4' 4LT8 to LED	39	39	112	50	7,141	15,886	19,046	1.10	120%
8' 2LT12 to LED	51	51	110	40	6,250	23,455	24,612	1.10	105%
4' 3LT8 to LED	24	24	85	25	7,141	12,580	11,342	1.10	90%
2' 2LT12 -U-tube to LED	4	4	59	20	6,250	1,025	1,075	1.10	105%
4' 3LT8 to LED	22	22	85	54	6,250	4,481	4,702	1.10	105%
Incandescent to LED	35	35	36	18	2,190	2,759	1,522	1.10	55%
8' 1LT12 to LED	6	6	100	45	2,190	1,445	797	1.10	55%
Incandescent to LED	13	13	65	50	2,190	854	471	1.10	55%
MH to LED	9	9	210	80	2,190	5,125	2,826	1.10	55%
4' 4LT8 to LED	15	15	112	72	2,190	2,628	1,449	1.10	55%
MH to LED	21	21	461	150	2,190	28,606	15,776	1.10	55%
MH to LED	12	12	1,080	400	2,190	35,741	19,711	1.10	55%
MH to LED	45	45	216	72	6,250	42,574	44,674	1.10	105%
Case Lighting to LED Case Lighting	4	4	85	28	8,760	1,716	2,576	1.29	150%
Total						621,398	518,506		83%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Standard	230,410	150,911	65%	43.39
Lighting Retrofit	Custom	389,272	365,019	94%	58.88
Case Lighting	Standard	1,716	2,576	150%	0.29
Total		621,398	518,506	83%	102.27

The project-level realization rate is 83%. The standard lighting retrofit realization rate is low mainly because the ex post hours of operation verified during the M&V site visit for 8 measures (2,190 – 6,434) were less than the lighting hours of operation used to perform the ex ante savings estimate (4,380 - 6,570). The custom lighting retrofit realization rate was also low from the verified hours of operation during the M&V site visit for seven measures (952 – 2,190) were less than the ex ante estimate (4,800 – 6,570).

Site C-14, S-11

Executive Summary

Project C-14, S-11 received standard and custom incentives from Ameren Missouri for retrofitting lighting in the interior of their facility and installing occupancy sensors. The realization rate for this project is 191%.

Project Description

The customer retrofitted the following fixtures:

- (97) HPS 400W fixtures with (101) 6 LAMP - F54HO - T5 fixtures with Occupancy Sensors
- (70) HPS 400W fixtures with (70) 6 LAMP - F54HO - T5 fixtures with Occupancy Sensors
- (23) 8ft - 1 Lamp T12 - F96 fixtures with (23) High Performance-T8 2L fixtures
- (104) HPS 400W fixtures with (113) 6 LAMP - F54HO - T5 fixtures with Occupancy Sensors
- (6) 4ft - 2 Lamp T12 - F40ES - EE Mag fixtures with (6) High Performance-T8 2L fixtures

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and placed three photo-sensor loggers at the site (from 10/7/2014 to 11/7/2014) to monitor lighting operation. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	*= Annual energy savings*
N	*= Number of fixtures*
W	*= Wattage of each fixture*
t	*= Lighting operating hours*
HCIF	*= HVAC interaction factor*

Lighting occupancy sensor energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times W \times N \times \left(t_{base} - t_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$ = *Annual energy savings*

N = *Number of occupancy sensors*

W = *Wattage controlled by each occupancy sensor*

t = *Lighting operating hours*

HCIF = *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	*Quantity (Fixtures)*		*Wattage*		*Hours*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
	Old	*New*	*Old*	*New*					
HPS to 4' 6LT5HO	97	101	469	358	8,760	81,775	81,775	1.00	100%
HPS to 4' 6L T5HO	70	70	469	358	8,760	68,065	68,065	1.00	100%
8' 1LT12 to High Performance-T8 2L 28W	23	23	65	49	6,296	3,224	2,317	1.00	72%
HPS 400W to 6 LAMP - F54HO - T5	104	113	469	358	8,760	72,901	80,045	1.10	110%
4ft - 2 Lamp T12 - F40ES to High Performance-T8 2L 28W	6	6	62	49	8,760	683	750	1.10	110%
Total						226,648	232,952		103%

The table shown below presents ex ante and ex post energy savings for the lighting controls installed under the project.

Lighting Controls Savings Calculations

Measure	Quantity	Controlled Wattage	Hours		Ex Ante kWh Savings	Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
			Old	New				
Controls	101	358	8,760	3,710	62,216	182,592	1.00	293%
Controls	70	358	8,760	3,710	43,120	126,549	1.00	293%
Controls	113	358	8,760	3,710	69,608	224,306	1.10	322%
Total					174,944.00	533,447		305%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Custom	226,648	232,952	103%	29.88
Lighting Controls	Standard	174,944	533,447	305%	25.32
Total		401,592	766,398	191%	55.20

The project-level realization rate is 191%. For the lighting retrofit, the realization rate is slightly high mainly because for two measures the ex post savings analysis included an HCIF for gas-heated light manufacturing in central Missouri (1.10), while the ex ante savings estimate did not account for HVAC interactive effects. For the lighting controls, the ex ante assumes a lesser impact on lighting hours than was verified during the M&V site visit.

Site S-6

Executive Summary

Project S-6 received standard incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 111%.

Project Description

The customer retrofitted the following fixtures:

- (246) Incandescent lamps with (246) LED lamps
- (140) Incandescent lamps with (140) LED lamps
- (154) Incandescent lamps with (154) LED lamps
- (402) Incandescent lamps with (402) LED lamps
- (330) Incandescent lamps with (330) LED lamps

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and placed three photo-sensor loggers at the site (from 9/18/2001 to 10/22/14) to monitor lighting operation. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
Incandescent to LED	246	246	40	5	8,760	75,639	85,926	1.14	114%
Incandescent to LED	140	140	52	6	8,760	57,028	64,783	1.14	114%
Incandescent to LED	154	154	52	12	8,760	54,636	62,067	1.14	114%
Incandescent to LED	402	402	40	5	8,760	123,958	140,816	1.14	114%
Incandescent to LED	330	330	52	12	1,989	34,749	30,198	1.14	87%
Total						346,010	383,790		111%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Standard	346,010	383,790	111%	53.57
Total		346,010	383,790	111%	53.57

The project-level gross kWh savings realization rate is 111%. The realization rate is high because the ex post savings analysis included a heating and cooling interaction factor for gas-heated healthcare in St. Louis (1.136), while the ex ante savings estimate did not account for heating and cooling interactive effects.

Site S-7

Executive Summary

Project S-7 received standard incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 111%.

Project Description

The customer retrofitted the following fixtures:

- (50) 60w Incandescent to be replaced by LED 18w lamp
- (24) 60w Incandescent to be replaced by LED 10w lamp
- (50) 35w Incandescent to be replaced by LED 7w lamp
- (96) 40w Incandescent to be replaced by LED 5w lamp
- (60) 60w Incandescent to be replaced by LED 10w lamp
- (230) 50w Incandescent to be replaced by LED 9w lamp
- (6) 100w Incandescent to be replaced by LED 19w lamp
- (650) 35w Incandescent to be replaced by LED 7w lamp

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
$HCIF$	= *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
Incandescent to LED	50	50	60	18	8,760	18,396	20,456	1.11	111%
Incandescent to LED	24	24	60	10	8,760	10,512	11,689	1.11	111%
Incandescent to LED	50	50	35	7	8,760	12,264	13,638	1.11	111%
Incandescent to LED	96	96	40	5	8,760	29,434	32,730	1.11	111%
Incandescent to LED	60	60	60	10	8,760	26,280	29,223	1.11	111%
Incandescent to LED	230	230	50	9	8,760	82,607	91,859	1.11	111%
Incandescent to LED	6	6	100	19	8,760	4,257	4,734	1.11	111%
Incandescent to LED	650	650	35	7	8,760	159,432	177,288	1.11	111%
Total						343,182	381,618		111%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Standard	343,182	381,618	111%	52.61
Total		343,182	381,618	111%	52.61

The project-level realization rate is 111%. The realization rate is high because the ex post savings analysis included a heating and cooling interaction factor for a gas – heated facility in St. Louis (1.11), while the ex ante savings estimate did not account for heating and cooling interactive effects. During the M&V site visit the lighting hours of operation were confirmed and match the ex ante savings estimate (8760).

Site C-4

Executive Summary

Project C-4 received custom incentives from Ameren Missouri for retrofitting lighting in the exterior of their facility. The realization rate for this project is 67%.

Project Description

The customer retrofitted the following fixtures:

- (1511) MH fixtures with (1511) Induction fixtures in the garage area

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
HCIF	= *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	*Quantity (Fixtures)*		*Wattage*		*Hours*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
	Old	*New*	*Old*	*New*					
MH to Induction	1,511	1,511	210	84	6,205	1,667,781	1,111,854	1.00	67%
Total						1,667,781	1,111,854		67%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Custom	1,667,781	1,111,854	67%	190.39
Total		1,667,781	1,111,854	67%	190.39

The project-level realization rate is 71%. The realization rate is low because the ex post hours of operation verified during the M&V site visit (5,840) were less than the lighting hours of operation used to perform the ex ante estimate (8,760).

Site S-25, S-27, S-26, S-29, and S-35

Executive Summary

Projects S-25, S-27, S-26, S-29, and S-35 received standard incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The overall realization rate for these projects is 99%.

Project Description

The customer retrofitted the following fixtures:

Project S-25:
- (157) Incandescent lamps with (157) LED lamps
- (128) Incandescent lamps with (128) LED lamps

Project S-27:
- (157) Incandescent lamps with (157) LED lamps
- (128) Incandescent lamps with (128) LED lamps

Project S-26:
- (157) Incandescent lamps with (157) LED lamps
- (128) Incandescent lamps with (128) LED lamps

Project S-29:
- (157) Incandescent lamps with (157) LED lamps
- (128) Incandescent lamps with (128) LED lamps

Project S-35:
- (60) Incandescent lamps with (60) LED lamps

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$ = *Annual energy savings*

N = *Number of fixtures*

W = *Wattage of each fixture*

t = *Lighting operating hours*

HCIF = *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	*Quantity (Fixtures)*		*Wattage*		*Hours*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Heating Cooling Interaction Factor*	*Gross kWh Savings Realization Rate*
	Old	*New*	*Old*	*New*					
Project S-25									
Incandescent to LED	157	157	60	11	1,145	8,898	8,819	0.99	99%
Incandescent to LED	128	128	120	15	1,145	15,389	15,251	0.99	99%
Project S-27									
Incandescent to LED	157	157	60	11	1,145	8,898	8,819	0.99	99%
Incandescent to LED	128	128	120	15	1,145	15,389	15,251	0.99	99%
Project S-26									
Incandescent to LED	157	157	60	11	1,145	8,898	8,819	0.99	99%
Incandescent to LED	128	128	120	15	1,145	15,389	15,251	0.99	99%
Project S-29									
Incandescent to LED	157	157	60	11	1,145	8,898	8,819	0.99	99%
Incandescent to LED	128	128	100	15	1,145	12,458	12,346	0.99	99%
Project S-35									
Incandescent to LED	60	60	120	15	1,145	7,214	7,149	0.99	99%
Total						101,431	100,523		99%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Project	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
			Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	S-25	Standard	24,287	24,070	99%	16.13
Lighting Retrofit	S-27	Standard	24,287	24,070	99%	16.13
Lighting Retrofit	S-26	Standard	24,287	24,070	99%	16.13
Lighting Retrofit	S-29	Standard	21,356	21,165	99%	14.18
Lighting Retrofit	S-35	Standard	7,214	7,149	99%	4.79
Total			101,431	100,524	99%	67.36

The overall project-level realization rate is 99%. The realization rate is slightly low because the ex post savings analysis included an HCIF for electric resistance heated hotel in St. Louis (0.991), while the ex ante savings estimate did not account for HVAC interactive effects. Various studies of guest room lighting operation show that the lighting hours are in fact significantly lower; more closely resemble residential operation. The ex post savings analysis cites the DEER 2005 guest room lighting operation estimate (1,145). This average value has been corroborated through ADM's extensive fixture-level and circuit-level monitoring of guest room lighting operation.

Site S-4

Executive Summary

Project S-4 received standard incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 49%.

Project Description

The customer retrofitted the following fixtures:

- (900) Incandescent lamps with (900) LED lamps
- (40) Incandescent fixtures with (40) LED lamps

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and determined the lighting operating schedule. These data were used to calculate energy savings.

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
$HCIF$	= *HVAC interaction factor*

The table shown below presents ex ante and ex post energy savings for the lighting retrofit performed under the project.

Lighting Retrofit Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
	Old	New	Old	New					
Incandescent to LED	900	900	100	10	1,145	354,780	91,915	0.99	26%
Incandescent to LED	40	40	40	2	8,760	13,315	13,195	0.99	99%
Total						368,095	105,110		29%

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Gross Ex Post Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	
Lighting Retrofit	Standard	368,095	105,110	29%	9.02
Total		368,095	105,110	29%	9.02

The project-level realization rate is 29%. The realization rate is low because the ex ante savings estimate for one of the two measures, installed in hotel guest rooms, was based on an overestimate of lighting operating hours. The ex ante estimate of 4,380 presumed over twelve hours of daily use. Various studies of guest room lighting operation show that the lighting hours of operation are in fact significantly lower; more closely resemble residential lighting operation. The ex post savings analysis cites the DEER 2005 guest room lighting operation estimate (1,145). This average value has been corroborated through ADM's extensive fixture-level and circuit-level monitoring of guest room lighting operation.

Appendix B: Program Staff Interview Guide

Roles & Responsibilities [All]

1. Let's start with a bit about you. Can you please confirm your current job title?
2. About how much of your time is devoted to the Ameren Missouri BizSavers program?
3. Which specific program are you involved in? (Standard, Custom, Retro-Commissioning, New Construction)
4. Have your responsibilities with regards to the BizSavers program chanced since last year?
    a. If so, how?

Program Management [Ameren Missouri Program Manager and Lockheed Deputy Program Manager]

Next I have just a couple of quick questions about current program staffing.

5. Have there been any changes to program staffing since last year?
    a. *[If yes]* What were the changes, and why?
    b. *[If needed]* Is there an updated organizational chart that reflects these changes that you can share with me?

6. [Ameren Missouri Program Manager:] Have there been any changes to the roles that CSAs (Customer Service Advisors) and KARs (Key Account Reps) play in the program?
    a. *[If yes]* What were the changes, and why?

Program Goals & Design [Ameren Missouri Program Manager & Lockheed Deputy Program Manager]

Now I'd like to hear about any updates to program goals, and to the types of businesses targeted.

[NOTE TO INTERVIEWER: AMEREN WOULD LIKE TO RECEIVE RESPONSES TO Q7 WHEN AVAILABLE, BEFORE ANALYSIS/REPORTING]

7. We understand that the net kWh goal for 2014 is higher than for 2013 *(Interviewer: see table).* How well do you think the programs are structured to meet these energy savings goals?
   a. Specifically, how well are the **measure** offerings structured to reach these goals?
   b. And how well are **incentive** levels structured to reach these goals?
   c. How about **trade ally support** – how well is it organized to help attain these goals?
   d. *[If indicates any issues]* What particular issues or concerns do you have about the programs? What needs to change to address those concerns? *[Probe about measures, incentives, trade ally support]*
   e. What if any concerns or plans do you have regarding minimizing free ridership?

Program	Annual NET kWh Savings Goals		
	2013 (9% OPT OUT)	2014 (12% OPT OUT)	2015 (20% OPT OUT)
Fast Track (Standard)	21,405,388	35,925,612	52,862,466
Custom	48,302,322	58,326,829	76,060,055
RCx	2,333,379	2,747,549	3,146,364
NCP	2,494,114	4,386,611	6,524,019
Total	74,535,202	101,386,601	138,592,906
Forecast (Gross)**		141,107,939	184,317,907

8. What other changes have there been to program goals for 2014—if any?
   a. *[If changes noted]* What are the reasons for those changes?

9. What changes to the program structure or processes are in place or planned for this year to help meet these goals—if any? By that I mean any changes to measures, incentive levels, marketing and outreach, trade ally support, staffing, or other processes.

    a. Why those?

    b. How are they going so far?

    [If not addressed]

    c. How do the recent changes to the Retro-commissioning program incentive structure seem to be working out?

    d. We understand that there may be new business energy efficiency programs in the works. What is the status on those plans?

10. The 2013 process evaluation found that participant and trade ally satisfaction was generally high. What if anything is planned for 2014 to further boost satisfaction?

    [Probe as needed areas of relatively low satisfaction, below]

    a. Non-lighting trade allies were less satisfied than lighting-only trade allies with the application process. Are any changes planned for non-lighting applications?

    b. For participants, satisfaction was lowest with the range of equipment that qualifies for incentives. Are any changes planned to expand the types of qualifying equipment?

11. The 2013 impact evaluation identified some measures that were not cost-effective, particularly in the New Construction and Retro-commissioning programs. Has this issue been addressed, or are there any plans to do so?

    a. *[If yes]* What is being done?

12. The impact evaluation also showed that savings achieved during 2013 were a bit under the target, particularly for New Construction and Retro-commissioning. What plans are in the works to address this?

Table 12 Summary of kWh Savings for BizSavers Program Components

Program Component	*Ameren kWh Savings Targets: 2013*	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Savings Realization Rate*	*Ex Post Net kWh Savings*	*Estimated Net to Gross Ratio*
Custom	48,682,732	51,535,015	48,256,533	94%	44,648,789	93%
Standard	21,573,968	23,793,935	25,766,774	108%	24,552,728	95%
New Construction	2,513,756	168,063	220,616	131%	206,936	94%
RCx	2,351,756	316,031	335,638	106%	223,759	67%
Total	75,122,212	75,813,044	74,579,561	98%	69,632,212	93%

13. We're aware of efforts to reach out to the small business (2M rate class) sector, including the new “Fast Track” online application process, the mailings, and other activities. How have these efforts been working out?

    a. What has reaction been to the Fast Track online application tool? Has it increased program accessibility for new or underserved customer segments?

    b. How have the other activities panned out so far—case studies, tear sheets, videos, social media posts, meetings/events/tradeshows, other (see 2013 BizSavers Marketing Log.xlsx)

    c. Are there any other plans to expand participation by small and medium sized businesses?

14. Thinking about all customers, regardless of size, are there any other opportunities for expanding market penetration that the program is pursuing, or planning to pursue?

    [Probe as needed] For example, are there other…

    a. Measures that could be supported?

    b. Building types to target?*

    c. Trade allies that could be served?

    d. Services that could be provided?

    *[*Interviewer: Top customer types served during 2013 were schools, retail, industrial, and warehouses (see table below). Target segments listed in the marketing plan include schools, retail, large office buildings, restaurants, manufacturing/warehouse, grocery/convenience, data centers, healthcare, parking, and hospitality.]*

Realized Gross kWh Savings for BizSavers Program Components by Building Type

Building Type	Program Component				
	Custom Incentives	Standard Incentives	New Construction Incentives	RCx Incentives	Total
All Other	26.6%	27.3%	0.0%	0.0%	26.7%
Fast Food Restaurant	0.0%	0.5%	0.0%	0.0%	0.2%
Full Service Restaurant	0.3%	2.7%	0.0%	0.0%	1.0%
Grocery and Convenience	4.4%	2.8%	0.0%	0.0%	3.9%
Large Industrial	11.2%	2.3%	0.0%	0.0%	8.3%
Large Office	8.7%	3.5%	0.0%	0.0%	7.0%
Large Retail	12.3%	6.6%	0.0%	0.0%	10.4%
Large School	7.4%	24.6%	0.0%	0.0%	12.8%
Lodging	0.5%	13.2%	0.0%	0.0%	4.5%
Other Industrial	8.8%	2.1%	93.8%	100.0%	7.3%
Other Office	4.3%	2.9%	0.0%	0.0%	3.9%
Other Retail	5.4%	7.1%	0.0%	0.0%	5.9%
Other School	2.5%	1.4%	0.0%	0.0%	2.1%
Warehouse	7.5%	3.1%	6.2%	0.0%	6.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

15. What challenges, if any, do you see to expanding market penetration? [Probe to relate barriers to specific market sectors.]
    a. *[If challenges mentioned]* What could the program do to overcome those challenges?
    b. *[If challenges mentioned]* What is preventing implementation of these changes?

Communication [All]

Next I'd like to hear briefly about how communication processes are working between and within staff at Ameren Missouri and Lockheed.

16. Overall, how would you characterize internal communications within your organization regarding the BizSavers program? By that I mean communication among program managers, support staff or others where you work.
    a. *[If issues]* What are they? Do you have any suggested solutions?

17. Overall, how would you characterize your communications with staff [IF RESPONDENT WORKS AT AMEREN: at Lockheed Martin / IF RESPONDENT WORKS AT LOCKHEED: at Ameren]?
    a. *[If issues]* What are they? Do you have any suggested solutions?

Marketing [Ameren Missouri Program Manager and Lockheed Marketing Manager]

Now, I'd like to hear about the current status of marketing activities for the program.

18. [AMEREN MISSOURI PROGRAM MANAGER] So far, have Lockheed Martin's efforts met your expectations for program marketing and outreach?
    a. What are they doing well?
    b. In what ways, if any, do they fall short of expectations?

19. [Lockheed Marketing Manager] We've reviewed the 2014 marketing plan, and we see the main strategies are: 1) market to past participants, 2) market to non-participants, 3) collaborate with Ameren Missouri outreach staff to share leads and coordinate efforts (for example, though the "Most Wanted" campaign), and 4) engage trade allies by recognizing top performers.
    a. Overall, what's your perspective about how those marketing and outreach strategies are working so far? *[Probe about activities specific to each strategy]*
    b. How does this differ by:
        - The various programs (Standard, Custom, New Construction, Retro-

commissioning)?

- Participant type?
- Trade ally type?

20. [Lockheed Marketing Manager] The marketing plan also calls for an effort to increase the proportion of non-lighting projects this year. What activities are in place to achieve that? How is that going so far?

21. [Lockheed Marketing Manager] We've reviewed the marketing tactics listed in the 2014 marketing plan.

    [Interviewer note: Tactics include media coverage (customer stories), trainings and sales presentations, e-newsletters, email campaigns, trade group outreach, marketing collateral, websites (tradeallynetwork.com and ActOnEnergy.com), participant and trade ally recognition, and campaigns.]

    a. We see that some of the trainings are now being offered as webinars. Have those started yet?

    b. We see there is a plan to send out follow-up surveys to webinar attendees. How can we work together to obtain those results?

    c. What other changes have been made, or are planned, for marketing tactics during 2014?

        - Why those changes?
        - How are those efforts going so far?

Trade Allies & Other Service Providers [Lockheed Marketing Manager and Lockheed Trade Ally Coordinator]

I'd also like to hear a bit more detail about how the program works with trade allies and other program partners.

22. Overall, how well are efforts working with trade allies and other service providers? By that I mean any contractors and vendors that the program interacts with, regardless of whether they are members of the Trade Ally Network, or not. This includes contractors, retailers, distributors, retro-commissioning agents, designers, and others.

    [Probe as needed] How well are efforts going in terms of:

    a. Recruiting,

b. Training,

c. Informing, and

d. Motivating trade allies and other service providers?

23. The process evaluation found that a number of contractors and vendors who are not members of the trade ally network were not aware of its existence. Others who had not renewed for the current program cycle were not aware they needed to resubmit an application to maintain their network status. What if anything is planned, or has been done recently, to increase awareness of the network with contractors and vendors, and to ensure that all former Trade Ally Network members are aware they need to re-apply?

24. How are things going with the tiered trade ally structure? Is it having any effect on level of engagement among trade allies? If so, how does the effect compare to expectations?

    a. What kinds of trade allies are motivated to participate?

    b. How are things going with encouraging trade allies to use co-branded marketing materials?

25. We understand that Lockheed will re-assess the tier ranking system of the TAs based on their performance throughout 2013, and that this may cause some TAs to lose their status as a Platinum, Gold or Silver TA. What is the plan for notifying them, and for working with them so they can maintain their existing level, or advance?

26. We also understand Lockheed plans to broaden the network to include distributors, installers, manufacturers, and financial companies relevant to program incentive offerings. How is that going so far? What else is planned?

    a. How well did the Distributor Partnership Program (DPP) campaign go in late 2013? What changes, if any, are planned for this program?

[Interviewer note: Lockheed distributed DPP program collateral to five TA companies with multiple showroom locations, and provided each with an initial training session.]

27. What other changes, if any, are planned for outreach to, and interaction with, trade allies and other service providers?

    a. Does this vary by individual program (Standard, Custom, RCx, New Construction)?

Tracking & Reporting [All]

Next, I'd also like to hear about tracking and reporting.

28. How well is the current tracking and reporting process working to meet your needs?

[INTERVIEWER NOTE: Lockheed provides: a) a weekly program report showing the projects, incentives and kWh savings in the cue, b) a monthly progress report showing kWh savings and expenditures, c) other monthly reports with project details, and d) a quarterly progress report. Click here *for a link to the list of reports available.]*

a. What reports or other information provided by Lockheed Martin do you find to be most useful?

b. Least useful (if anything)? Why?

c. Is all needed information available, or are some data points missing or not readily available? If so, what?

29. [Ameren Missouri and Lockheed Program Managers] We've been told that reporting was being developed to keep managers better informed about progress towards goals at the measure level. Has this reporting happened? What has been the result?

[Background for Interviewer from 2013 report: With the addition of Net Shared Benefits (NSB) goals, program managers need to understand how cost and the useful life of different measures roll up to meet both kWh savings and NSB goals. During 2013, an Ameren Missouri staffer mentioned that measure-level reports were being developed by the corporate planning group to keep managers informed of goal achievement.]

30. [Ameren Missouri and Lockheed Program Managers] Were there other tracking and reporting changes during 2013 or early 2014?

a. If any, how did they work out from your perspective?

Quality Control [Ameren Missouri Program Manager and Lockheed Deputy Program Manager]

Now let's talk about Quality Control…

31. From your perspective, how adequate are Lockheed's procedures for ensuring quality control?

32. What are typical types of QC issues that come up now?

    a. How is this different from in the past?

    b. Are the issues more common with specific types of trade allies, participants, contractors, or sectors?

    c. How are the issues addressed?

33. [Lockheed Deputy Program Manager] The 2013 evaluation indicated some cases where energy savings was overestimated. Issues included using the wrong standard to compute baseline values on some measures for New Construction, overestimating operating hours for lighting controls, and not taking into account interactive effects between refrigerated cases and HVAC systems. Have any steps been taken to address these situations?

    [Interviewer: For reference, see recommendations in 2013 year-end report, pages 10-12.]

    a. *[If steps taken]* How effective have these efforts been?

    b. *[If no steps taken]* Are any changes planned? Why or why not?

34. [Lockheed Deputy Program Manager] The evaluation also suggested that when lighting controls are implemented, the process should collect additional documentation about where the controls are installed and the fixtures they are connected to. What effect do you think this change would have on the accuracy of operating hours estimates for lighting control projects?

    a. Is there a better way to improve the accuracy of operating hours estimates? If so, what?
    b. Is there any other reason not to implement the evaluations recommendations? If so, what are they?

35. [Lockheed Deputy Program Manager] The 2013 evaluation also indicated some data quality issues within the tracking system. What if anything is changing to address any of those issues?

    [AS NEEDED] These included: a) site record data possibly pertaining to the overall company rather than to a specific building for companies with multiple buildings, b) inconsistent formatting of company name or site address, c) a high

proportion of records with the building end use listed as “other,” d) outdated consumption data, and e) inconsistent measure type names.

a. *[If steps taken]* How effective have these efforts been?

b. *[If no steps taken]* Are any changes planned? Why or why not?

[BACKGROUND FOR INTERVIEWER]

- **Multiple buildings at a single site** It appears that some of the information associated with an individual site’s records may pertain to the business entity as a whole rather than to a specific building. Introducing a building-specific identifier that would be related to the parent site field may encourage the entry of building-specific data associated with each project.
- **Inconsistent formatting of company or site.** Information for a given company or site is sometimes entered in various formats. For example, a single address for 15 projects at a single location may be recorded in five different ways: 1) One Street Name Dr.; 2) 1 Street Name Dr City Name; 3) #1 Street Name Dr; 4) 1 Street Name Drive; and 5) One Street Name Drive.
- **High proportion of records with “other” building end use.** The building end use type was coded as “other” for 20% of all projects, making that the second most common end use type. We suggest adding additional categories based on an analysis of the records coded as “other.” In many cases, information on the type of site is found in the parent site field. Additional categories could include parking lot and walkway.
- **Outdated consumption data.** As a quality assurance check, we calculated project savings as a percentage of each respective site’s annual consumption as recorded in the database. We found that the savings percentage figure was unusually or even impossibly high in many cases. The program implementation contractor confirmed that kWh consumption figures in the database may be old or incorrect figures imported from the Ameren Missouri customer database; the contractor bases its estimates of savings on its own assessments of baseline building energy consumption.
- **Inconsistent measure names.** The measure level database contained 3343 line items with efficient and baseline measure descriptions. After considerable effort, evaluators were able to aggregate that down to 123 separate categories of efficiency measure/baseline combinations (87 standard and 36 custom). This process could be considerably less time intensive if the measure listings were more standardized in the program dataset.

Conclusion [All]

36. What would you say are the greatest strengths of the program?

37. What would you say most needs to be changed about the program?

39. Is there anything else about the program that we have not discussed that you feel should be mentioned?

39. What would you like to learn from the program evaluation?

Those are all of my questions. Thank you very much for your time.

Appendix C: Trade Ally Training Evaluation Survey Form

Survey start

1. How did this event compare to your expectations?

   *(Please select **one**.)*

	Fell Far Short	Fell Somewhat Short	Met Expectations	Somewhat Exceeded	Far Exceeded
	1	2	3	4	5

2A. Please read the statements below, and indicate how much you disagree or agree with each one.

*(Please select **one** response per row.)*

	Strongly Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Strongly Agree	Not applicable
a. The information presented was clear	1	2	3	4	5	
b. All relevant topics were covered	1	2	3	4	5	
c. Supporting materials were helpful (handouts, slides, etc.)	1	2	3	4	5	
d. Examples were relevant	1	2	3	4	5	
e. The time was convenient	1	2	3	4	5	
f. The length of time was appropriate	1	2	3	4	5	
g. The location was convenient	1	2	3	4	5	

2B. Please rate the quality of the information provided for each of the following topics.

*(Please select **one** response per row.)*

Information quality was:	Poor	Fair	Good	Very Good	Excellent
a. Which energy efficiency technologies are right for your building(s)	1	2	3	4	5
b. How you can budget for your energy efficiency project(s)	1	2	3	4	5
c. Which BizSavers cash incentives you may receive	1	2	3	4	5
d. How to apply for BizSavers incentives	1	2	3	4	5

3. Overall, how do you rate this event?

   (Overall rating:.)

	Poor	Fair	Good	Very Good	Excellent
	1	2	3	4	5

4. Did this event encourage you to work with the BizSavers program in the future, or not?

   *(Select **one** response.)* [PROGRAMMER: LIST CAN BE SHOWN VERTICALLY INSTEAD OF HORIZONTALLY]

1. Yes	2. No	3. Not sure

5. Please provide any comments about this event: [TEXT BOX; ALLOW RESPONDENT TO SKIP]

6. What topic(s) would you like covered in future BizSavers events? [TEXT BOX; ALLOW RESPONDENT TO SKIP]

About You

7. ***Before January 2013,*** did your business or organization complete an energy efficiency project that received an incentive from the BizSavers program?

   [PROGRAMMER: LIST CAN BE SHOWN VERTICALLY INSTEAD OF HORIZONTALLY]

1. Yes	2. No	3. Not sure

8. What (if anything) might prevent you from working with the BizSavers program in the future? [TEXT BOX; ALLOW RESPONDENT TO SKIP]

9. Is your business or organization…?

   (Select all that apply.) [PROGRAMMER: LIST CAN BE SHOWN VERTICALLY INSTEAD OF HORIZONTALLY]

1. A business customer of Ameren Missouri	2. A contractor or trade ally	3. Something else (Please specify)

10. [IF Q9=1 (BUSINESS CUSTOMERS)]**:** What is your type of business or organization?

    *(Select **one** response.)*

1. Industrial	6. Grocery and convenience
2. Restaurant (not fast food)	7. School
3. Fast food restaurant	8. Lodging
4. Retail	9. Warehouse
5. Office	10. Other (please specify)

11. [IF Q9=2 (CONTRACTORS AND TRADE ALLIES)]**:** What is your type of business or organization?

    *(Select **one** response.)*

1. Architect	11. Industrial services
2. Developer or builder	12. IT or data center services
3. Distributor	13. Manufacturer
4. Electrical contractor	14. Manufacturer’s rep
5. Energy Auditor/Modeler	15. Mechanical contractor
6. Engineering	16. National account services

7. ESCO (Energy Service company)	17. Refrigeration services
8. Financial services	18. Retro-commissioning agent
9. Full service engineering	19. Sales Engineering
10. HVAC distributor	20. Other (please specify)

12. [IF Q9=2 (CONTRACTORS AND TRADE ALLIES)]: Is your business or organization a member of the Ameren Missouri Trade Ally Network?

*(Select **one** response.)* [PROGRAMMER: LIST CAN BE SHOWN VERTICALLY INSTEAD OF HORIZONTALLY]

1. Yes	2. No	3. Not sure

CLOSE. Those are all of our questions. Thank you very much for completing this survey. Please click the “Submit” button to finish.

Appendix D: Participant Online Survey

1. What is your job title or role?

    1. Facilities Manager
    2. Energy Manager
    3. Other facilities management/maintenance position
    4. Chief Financial Officer
    5. Other financial/administrative position
    6. Proprietor/Owner
    7. President/CEO
    8. Manager
    9. Other (Specify) ____

2. Which of the following, if any, does your company have in place at [LOCATION]? [Select all that apply]

    1. A person or persons responsible for monitoring or managing energy usage
    2. Defined energy savings goals
    3. A specific policy requiring that energy efficiency be considered when purchasing equipment
    4. Carbon reduction goals
    5. Other – please describe: ______________________________
    6. None of the above

    88. Don't know

Awareness [DO NOT DISPLAY]

3. How did you learn about Ameren Missouri's incentives for efficient equipment or upgrades? (Select all that apply)

    1. Received an informational brochure or newsletter
    2. From an Ameren Missouri Key Account Representative
    3. From an Ameren Missouri Customer Account Service Advisor
    4. From a program representative or service provider
    5. From Ameren Missouri's website
    6. TV / radio ad's sponsored by Ameren Missouri
    7. Friends or colleagues
    8. From an architect, engineer or energy consultant
    9. From an equipment vendor or building contractor
    10. Through past experience with the program
    11. Other (please explain)

    88. Don't know

[DISPLAY Q4 ONLY IF INCENTIVE TYPE = STANDARD]

4. In addition to the incentives for specific standard equipment upgrades you received, did you know you could qualify for incentives by proposing a custom energy-upgrade project that fits your specific facility needs?

   1. Yes
   2. No
   88. Don't know

[DISPLAY Q5 ONLY IF Q4 = 1]

5. Why didn't you choose the custom option that offers incentives for non-standard equipment? (Please select all that apply)

   1. All of the equipment I was interested in was listed on the Standard application.
   2. I'm interested in other equipment, but didn't want to do two applications (a custom one in addition to the standard incentive application).
   3. The custom application seems too complicated.
   4. Some other reason, please specify:______________________

[DISPLAY Q6 ONLY IF PROJECT = STANDARD OR CUSTOM OR RETRO-COMMISSIONING]

6. Is your firm considering undertaking any new construction or major building renovation projects within the next five years? [Such as adding a new wing, gutting an existing building, or building an entirely new building.]

   1. Yes → Are you in the design phase now? Yes/No/Don't know
   2. No
   88. Don't know

[DISPLAY Q7 IF Q6 =1]

7. Are you familiar with Ameren Missouri's New Construction Incentive program which currently expires 12/31/2015?

   1. Yes
   2. No
   88. Don't know

[DISPLAY Q8 AND Q9 ONLY IF PROJECT = NEW CONSTRUCTION]

8. You recently received incentives through Ameren Missouri's New Construction program. Which of this program's incentive options are you aware of? (Select all that apply)

   1. Whole Building Performance incentives
   2. Standard Lighting incentives
   3. Standard non-lighting incentives
   4. Custom measure incentives
   5. None of the above

9. How well did the New Construction program’s range of incentive options fit your needs?

Not at all				Completely	Don’t
1	2	3	4	5	know

[DISPLAY Q10 ONLY IF Q9 < 4]

10. What caused the range of incentive options offered to fail to meet your needs completely?_______

[DISPLAY Q11 and Q12 ONLY IF PROJECT = RETRO-COMMISSIONING]

11. You recently received incentives for a retro-commissioning project. Which of these other Ameren Missouri program incentives are you aware of?

    1. New Construction and major building renovation incentives
    2. Standard incentives for specific measures such as lighting, HVAC, refrigeration, and water heating equipment
    3. Custom incentives for non-standard measures
    4. None of the above

12. How well did the Retro-commissioning program’s range of incentive options fit your needs?

Not at all				Completely	Don’t
1	2	3	4	5	know

[DISPLAY Q13 ONLY IF Q12 < 4]

13. In what way did the range of incentive options offered fail to meet your needs completely?_______

Program Delivery Efficiency [DO NOT DISPLAY]

Application Process [do not display]

14. Regarding your organization’s decision to participate in the incentive program, who initiated the discussion about the incentive opportunity? Would you say…

    1. Your organization initiated it
    2. Your vendor or contractor initiated it
    3. The idea arose in discussion between your organization and your vendor or contractor
    4. Some other way. Please describe: ______
    88. Don’t Know

15. Which of the following people worked on completing your application for program incentives (including gathering required documentation)? (Select all that apply)

    1. Yourself
    2. Another member of your company

3. A contractor
4. An equipment vendor
5. A designer or architect
6. Someone else – please define: ________________________________
88. Don’t know

[DISPLAY Q16 through Q18 ONLY IF Q15 = MYSELF]

16. Which version of the application worksheet did you use?
    1. MS Excel spreadsheet
    2. PDF version
    3. Other – please specify: ____
    88. Don’t know

17. And how did you submit your application worksheets?
    1. As an email attachment
    2. By fax
    3. By postal mail
    4. Other – please specify: ____
    88. Don’t know

18. Thinking back to the application process, please rate <u>the clarity of information</u> on how to complete the application…

Not at all clear				Completely clear	Don’t know
1	2	3	4	5	

[DISPLAY Q19 ONLY IF Q18A OR 18B = 4]

19. What information, including instructions on forms, needs to be further clarified? _______

[DISPLAY Q20 ONLY IF Q15 = MYSELF]

20. Using a 5-point scale, where 1 = “completely unacceptable” and 5 = “completely acceptable,” how would you rate . . .

    a. …the ease of finding forms on Ameren Missouri’s website

Completely unacceptable				Completely acceptable	Don’t know	N/A – Did not get forms from website
1	2	3	4	5		

    b. …the ease of using the electronic application worksheets

Completely unacceptable				Completely acceptable	Don’t know
1	2	3	4	5	

c. …the time it took to approve the application

Completely unacceptable				Completely acceptable	Don't know
1	2	3	4	5	

d. …the effort required to provide required invoices or other supporting documentation

Completely unacceptable				Completely acceptable	Don't know	N/A – No documentation required
1	2	3	4	5		

e. …the overall application process

Completely unacceptable				Completely acceptable	Don't know
1	2	3	4	5	

21. Did you have a clear sense of whom you could go to for assistance with the application process?

    1. Yes
    2. No
    88. Don't know

[DISPLAY Q22 ONLY IF PROJECT = RETRO-COMMISSIONING]

22. Did you have a clear sense of who you could go to for assistance in finding a Retro-commissioning Service provider?

    3. Yes
    4. No
    89. Don't know

[DISPLAY Q23 ONLY IF PROJECT = NEW CONSTRUCTION]

23. Did you have a clear sense of whom you could go to for information about Design Team meetings?

[DISPLAY Q24 ONLY IF PROGRAM = CUSTOM OR RETRO-COMMISSIONING OR NEW CONSTRUCTION]

24. After initial submission, were you (or anyone acting on your behalf) required to resubmit or provide additional documentation before your application was approved?

    5. Yes
    6. No
    90. Don't know

[DISPLAY Q25 ONLY IF Q24=YES]

25. Which of the following were reasons that you had to resubmit your application? (Please select all that apply)

   1. Issues related to how energy savings were calculated
   2. [DISPLAY IF PROGRAM=RETRO-COMMISSIONING] Other issues related to the Audit
   3. [DISPLAY IF PROGRAM=NEW CONSTRUCTION-WHOLE BLDG PERF] Other issues related to the Technical Analysis study
   4. Issues related to additional supporting documentation such as invoices
   5. Other issues – please specify: ____________
   88. Don't know

26. How did the incentive amount compare to what you expected?

   1. It was much less
   2. It was somewhat less
   3. It was about the amount expected
   4. It was somewhat more
   5. It was much more
   88. Don't know

Equipment Selection [DO NOT DISPLAY]

[DISPLAY Q27 IF PROJECT = STANDARD or CUSTOM]

27. How did each of the following types of people affect your decision to install the efficient equipment? (Select all that apply)

	Provided no input	Input did not affect decision	Small effect on decision	Moderate to large effect on decision	Critical effect – could not have made decision without it	Don't know
a. Vendor (retailer)	()	()	()	()	()	()
b. Contractor (installer)	()	()	()	()	()	()
c. Designer or architect	()	()	()	()	()	()
d. Utility staff member, such as an account representative	()	()	()	()	()	()
e. BizSavers Program Representative	()	()	()	()	()	()
f. Someone else, please specify: _____________						

[DISPLAY Q28 IF ANY RESPONSES TO Q27 = "Moderate to large effect" OR "Critical effect"]

28. What did they do that affected your decision? _____ [OPEN-ENDED RESPONSE]

[DISPLAY Q29 IF PROJECT = RETRO-COMMISSIONING]

29. How did each of the following types of people effect your decision to install the efficient equipment? (Select all that apply)

	Provided no input	Input did not affect decision	Small effect on decision	Moderate to large effect on decision	Critical effect – could not have made decision without it	Don't know
a. Audit results	()	()	()	()	()	()
b. Contractor (installer)	()	()	()	()	()	()
c. Your Retro-commissioning Service Provider	()	()	()	()	()	()
d. Ameren Missouri staff member, such as an account representative	()	()	()	()	()	()
e. BizSavers Program Representative	()	()	()	()	()	()
f. Someone else, please specify: _______________						

[DISPLAY Q30 IF ANY RESPONSES TO Q29 = "Moderate to large effect" OR "Critical effect"]

30. What did they do that affected your decision? _____ [OPEN-ENDED RESPONSE]

[DISPLAY IF PROJECT = NEW CONSTRUCTON]

31. How did each of the following types of people effect your decision to install the efficient equipment? (Select all that apply)

	Provided no input	Input did not affect decision	Small effect on decision	Moderate to large effect on decision	Critical effect – could not have made decision without it	Don't know
a. The "design team" process	()	()	()	()	()	()
b. General Contractor	()	()	()	()	()	()
c. Designer or architect	()	()	()	()	()	()
d. The Technical Analysis Study (energy modeling estimates)	()	()	()	()	()	()
e. Ameren Missouri staff member, such as an account representative	()	()	()	()	()	()
f. BizSavers Program Representative	()	()	()	()	()	()
g. Someone else, please specify: _______________						

[DISPLAY Q32 IF ANY RESPONSES TO Q31 = “Moderate to large effect” OR “Critical effect”]

32. What did they do that affected your decision? _____ [OPEN-ENDED RESPONSE]
[DISPLAY Q33 ONLY IF PROGRAM = STANDARD]

33. You were required to submit a completed application, along with invoices and other documentation within 180 days of installing your project. Does this time frame limit the types of projects, like HVAC, water heating or other standard upgrades that you might propose to do through the program?

    10. No
    11. Yes → What would you have done given more time? ______

88. Don’t know[DISPLAY Q34 ONLY IF PROGRAM = RETRO-COMMISSIONING]

34. The program expects retro-commissioning projects to have an estimated completion date within 6 months after project approval. Did this time frame limit the scope of the retro-commissioning project you undertook, like equipment upgrades or implementation of re-commissioning practices?

    1. No
    2. Yes → What would you have done given more time? ______
    88. Don’t know

[DISPLAY Q35 ONLY IF PROGRAM = STANDARD or CUSTOM OR RETRO-COMMISSIONING]

35. Did you work directly with a retailer to purchase the incentivized equipment?

    1. Yes
    2. No
    88. Don’t know

[DISPLAY Q1 IF (Q35= YES AND PROGRAM = STANDARD or CUSTOM) OR (PROGRAM = NEW CONSTRUCTION)]

34A. How long did you have to wait for the program-qualified equipment?

    1. Readily available
    2. Less than 1 week
    3. 1-2 weeks
    4. 3-4 weeks
    5. 5-6 weeks
    6. More than 6 weeks
    88. Don’t Know

36. Please rate your satisfaction with ….

	1 – Very Dissatisfied	2	3	4	5 – Very Satisfied	Not sure	Not applicable – no equipment installed

a. … the equipment that was installed	()	()	()	()	()	()	()
b. … the quality of the installation	()	()	()	()	()	()	()

[DISPLAY Q37 IF (PROGRAM = STANDARD or CUSTOM) OR (PROGRAM = RETRO-COMMISSIONING AND RETRO-COMMISSIONING CUSTOM = YES)]

37. Who installed your program-qualified equipment or efficiency upgrades?

    1. Your own staff
    2. A contractor you've worked with before
    3. A contractor recommended by your Ameren Missouri BizSavers program (registered trade ally)
    4. A new contractor that someone else recommended
    5. Other – specify: ____________
    88. Don't know

Measurement and Verification [DO NOT DISPLAY]

38. After your project was completed, did a program representative inspect the work done through the program?

    1. Yes
    2. No
    88. Don't know

[DISPLAY Q39 If Q23=1]

39. Using the scale provided, please rate your agreement with the following statements:

	1-Not at all agree	2	3	4	5-Completely agree	Don't know
a. The inspector was courteous	()	()	()	()	()	()
b. The inspector was efficient	()	()	()	()	()	()

Customer Satisfaction [DO NOT DISPLAY HEADING; DISPLAY INTRO]

The following few questions pertain to your communications with the program staff. Program staff are anyone that reviewed your application, conducted site inspections, determined your incentive amount, or processed your incentive check. Program staff are not anyone hired by you to conduct an audit, design your system, or install your hardware.

40. In the course of doing this project did you have any interactions with program staff?

    1. Yes
    2. No
    88. Not sure

[DISPLAY Q41 AND Q42 If Q40 = 1]

41. On the scale provided, please indicate how knowledgeable were program staff about the issues you discussed with them?

1 – Not at all knowledgeable	2	3	4	5 – Very knowledgeable	Not sure
()	()	()	()	()	()

42. On the scale provided, please indicate how satisfied are you with:

	1 – Not at all satisfied	2	3	4	5 – Very satisfied	Not sure	Not applicable – had no questions or concerns
a. how long it took program staff to address your questions or concerns	()	()	()	()	()	()	()
b. how thoroughly they addressed your question or concern	()	()	()	()	()	()	()

43. How satisfied are you with:

	1 – Not at all satisfied	2	3	4	5 – Very satisfied	Not sure
a. the steps you had to take to get through the program	()	()	()	()	()	()
b. the amount of time it took to get your rebate or incentive	()	()	()	()	()	()
c. the range of equipment that qualifies for incentives	()	()	()	()	()	()
d. the program, overall	()	()	()	()	()	()

[DISPLAY Q44 If Q41, Q42a or b, or Q43a, b, c, or d = 1 or 2]

44. Please describe the ways in which you were not satisfied with the aspects of the program mentioned above?_______

Net-to-Gross Section [DO NOT DISPLAY]

Free-Ridership [Do Not Display]

45. Before you knew about the BizSavers Program, had you purchased and installed any energy efficient equipment at the [LOCATION] location?

1. Yes
2. No
88. Don't know

46. Has your organization purchased any significant energy efficient equipment in the last three years for which you did not apply for a financial incentive through an energy efficiency program at the [LOCATION] location?

    1. Yes. Our organization purchased energy efficient equipment but did not apply for incentive.
    2. No. Our organization purchased significant energy efficient equipment and applied for an incentive.
    3. No significant energy efficient equipment was purchased by our organization.
    4. Don't know

47. Before participating in the BizSavers Program, had you installed any equipment or measure similar to energy efficient [question("value"), id="220"] at the [LOCATION] location?

    1. Yes
    2. No

48. Did you have plans to install energy efficient [Measure/Equipment type] at the [LOCATION] location before participating in the BizSavers Program?

    1. Yes
    2. No

[DISPLAY Q49 (16A.) IF Q48 (16) = 1]

49. Would you have gone ahead with this planned installation even if you had not participated in the program?

    1. Yes
    2. No

50. How important was previous experience with the BizSavers Program in making your decision to install energy efficient [questionMeasure/Equipment type] at the [LOCATION] location?

    1. Did not have previous experience with program
    2. Very important
    3. Somewhat important
    4. Only slightly important
    5. Not at all important
    6. Don't know

51. Did a BizSavers Program or other Ameren Missouri representative recommend that you install energy efficient [Measure/Equipment type] at the [LOCATION] location?

    1. Yes
    2. No

[DISPLAY Q52 (18A.) IF Q51 (18) = 1]

52. If the BizSavers Program representative had not recommended installing the equipment, how likely is it that you would have installed it anyway?

    1. Definitely would have installed
    2. Probably would have installed
    3. Probably would not have installed
    4. Definitely would not have installed
    5. Don't know

53. Would you have been financially able to install energy efficient [Measure/Equipment type] at the [LOCATION] location without the financial incentive from the BizSavers Program?

    1. Yes
    2. No

54. If the financial incentive from the BizSavers Program had not been available, how likely is it that you would have installed energy efficient [Measure/Equipment type] at the [LOCATION] location anyway?

    1. Definitely would have installed
    2. Probably would have installed
    3. Probably would not have installed
    4. Definitely would not have installed
    5. Don't know

55. We would like to know whether the availability of information and financial incentives through the BizSavers Program affected the quantity (or number of units) of energy efficient [Measure/Equipment Type] that you purchased and installed at the [LOCATION].

    Did you purchase and install more [Measure/Equipment Type] than you otherwise would have without the program?

    1. Yes
    2. No, program did not affect quantity purchased and installed.

56. We would like to know whether the availability of information and financial incentives through the BizSavers Program affected the level of energy efficiency you chose for energy efficient [Measure/Equipment Type] at the [LOCATION].

    Did you choose equipment that was more energy efficient than you would have chosen because of the program?

    1. Yes
    2. No, program did not affect level of efficiency chosen for equipment.

[DISPLAY 57 (22A.) IF Q56 (22) = 1]

57. How much more efficient [Measure/Equipment Type] did you install? (i.e., "xx% more efficient")

58. We would like to know whether the availability of information and financial incentives through the BizSavers Program affected the timing of your purchase and installation of energy efficient [Measure/Equipment Type] at the [LOCATION].

    Did you purchase and install energy efficient [Measure/Equipment Type] earlier than you otherwise would have without the program?

    1. Yes
    2. No, program did not affect did not affect timing of purchase and installation.

[DISPLAY Q59 (23A.) IF Q58 (23) = 1]

59. When would you otherwise have installed the equipment?

    1. Less than 6 months later
    2. 6-12 months later
    3. 1-2 years later
    4. 3-5 years later
    5. More than 5 years later

Spillover [DO NOT DISPLAY]

60. Because of your experience with the BizSavers Program, have you bought, or are you likely to buy, energy efficient equipment without applying for a financial incentive or rebate?

    1. Yes, have already bought non-incentivized efficiency equipment because of the experience with the program.
    2. Yes, likely to buy efficiency equipment because of the experience with the program.
    3. No
    4. Don't know

[DISPLAY Q61 (IF Q60 (36.) = 2 OR 4]

61. We'd like to call you in a few months for a very short follow-up about other efficiency equipment purchases. If that would be all right. please provide us with the best person to contact and their phone number

    Name

    Phone number

[DISPLAY Q62 (IF Q60(36.) = 1)]

62. 36A. What energy efficient equipment did you purchase?

63. 36B. What motivated you to install this equipment?

64. 36C. Was this equipment installed at the same facility (or facilities) as the equipment for which you received a rebate?

    1. Yes
    2. Don't know
    3. No; Where was the equipment installed?: _________________

65. How important was your experience with the program to your decision to implement the additional energy efficiency measures?

    1. Very important
    2. Somewhat important
    3. Neither important or unimportant
    4. Somewhat unimportant
    5. Unimportant
    6. Don't know

66. How important was your past participation in any programs offered by Ameren Missouri to your decision to implement the additional energy efficiency measures?

    1. Very important
    2. Somewhat important
    3. Neither important or unimportant
    4. Somewhat unimportant
    5. Unimportant
    6. Don't know

67. . Why didn’t you apply for or receive incentives for those items?

    1. Didn't know whether equipment qualified for financial incentives
    2. Equipment did not qualify for financial incentives
    3. Too much paperwork for the financial incentive application
    4. Financial incentive was insufficient
    5. Didn't have time to complete paperwork for financial incentive application
    6. Didn't know about financial incentives until after equipment was purchased
    7. Other reason (please describe): _________________

Firmographic [DO NOT DISPLAY]

[Note to reviewer: The customer database has many fields indicating much of the “firmographic” data we will want to capture. However, we have not yet established how much of it is populated. Therefore, we propose the following questions. If the database provides sufficient firmographic data, we will be able to eliminate some or all of these questions.]

68. Which of the following best describes the type of work that your firm or organization does at [LOCATION]?

1. Industrial
2. Restaurant (not fast food)
3. Fast food restaurant
4. Retail
5. Office
6. Grocery and convenience
7. School
8. Lodging
9. Warehouse
10. Other – specify: ____
88. Not sure

69. Including all the properties, how many separate work locations does your organization own or lease space in, in Ameren Missouri territory? (A work location may consist of multiple buildings in close proximity to each other, such as a university campus – please indicate the number of locations)

    ____

70. How many square feet (indoor space) is the part of the property at [LOCATION] that your firm or organization occupies? (If your firm or organization occupies the entire property, indicate the total size of that property.)

    1. Less than 5,000
    2. 5,001 to 10,000
    3. 10,001 to 20,000
    4. 20,001 to 50,000
    5. 50,001 to 75,000
    6. 75,001 to 100,000
    7. 100,001 to 250,000
    8. 250,001 to 500,000
    9. 500,001 to 1,000,000
    10. More than 1,000,000
    88. Not sure

Appendix E: Non-Participant Survey

Screening [ASK ALL]

First, I need to ask a couple of questions to see if you are eligible for this survey.

S1. To the best of your knowledge, has your company or organization replaced or upgraded electricity-using equipment in the past three years for which it received or is expecting to receive a cash incentive from Ameren Missouri?

[Interviewer: "electricity-using equipment" means equipment that requires electricity to operate, such as lighting, motors, computers, etc.]

1. Yes *[THANK AND TERMINATE]*
2. No
98. Don't know
99. Refused

S2. What is your company or organization's primary business or activity?

[Do not read list. Record one response. Probe to code]

1. Restaurant
2. Grocery/convenience store
3. Industrial
4. Office
5. Retail
6. School
7. Lodging
8. Transportation & Warehousing
9. Government
10. Other, please describe _________
98. Don't know
99. Refused

[PROGRAMMER NOTE: WE WILL MONITOR SURVEY RESPONSES BY S2 AND MAY ESTABLISH QUOTAS FOR SPECIFIC CATEGORIES.]

[PROGRAMMER NOTE: IF S1 = 98 OR S1 = 99 (DON'T KNOW/REFUSED, RESPONDENT STILL QUALIFIES FOR SURVEY).]

S3. When it comes to purchasing energy-using equipment for your facilities/sites, do you …?

*[*Read list*]*

1. Make those decisions
2. Provide input to others who make those decisions
3. Have no involvement with those decisions [*INTERVIEWER: ASK FOR REFERRAL, THEN THANK AND TERMINATE*]

Program Awareness and Sources of Awareness

[ALL]
Q1. Before I called, were you aware that Ameren Missouri provides cash incentives for energy efficient equipment purchases and upgrades for existing and new buildings?

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know
99. Refused

[IF Q1 = YES]
Q2. Which of the following types of incentives were you aware of?

[MULTIPLE BINARY RESPONSE]

[Read each item]

1. Incentives to replace inefficient equipment in existing buildings
2. Incentives to incorporate energy efficiency into new construction designs
3. Incentives for retro-commissioning projects, which improve how building equipment and systems function together

[IF Q1 = YES]
Q3. How have you learned about the energy efficiency incentives from Ameren Missouri?

[Do not read; after each response, say: what else? Until respondent indicates no other sources]

1. A contractor or equipment vendor
2. Internet source (website, online search, web links, etc.)
3. Trade association (possible newsletters, websites, events)
4. News coverage (coverage of customer stories in news outlets)
5. Advertisement (bill insert, TV, radio or other advertising, newsletter, billboards, etc.)
6. Industry event (conference, seminar, workshop, etc.)
7. Utility or program representative(s) (includes person-to-person, phone, or email contact from Ameren Missouri or implementer marketing or sales representative, NOT contractor or vendor)
8. Word of mouth (friend, neighbor, family, co-worker, colleague)
9. Other, specify: ________________________
98. Don't know
99. Refused

Upgrades to Energy-using Equipment

Now I'd like to ask about any recent or planned equipment purchases.

[ASK ALL]

Q4. What equipment or building features, if any, has your business or organization replaced or upgraded in the past two years?

[MULTIPLE BINARY RESPONSE; HOWEVER, OPTIONS 11, 98, AND 99 CANNOT BE SELECTED IF ANY OTHER RESPONSES ARE SELECTED]

[Do not read list]

1. Windows
2. Insulation (ceiling, attic or wall)
3. Heating, cooling, HVAC
4. Water heating
5. Motors or motor controls
6. Cooking (ovens)
7. Refrigeration or freezing
8. Lighting or lighting controls
9. Data center or IT equipment
10. Other - specify: _______________
11. None
98. Don't know
99. Refused

[ASK IF Q4.11 NOT SELECTED AND Q4.98 NOT SELECTED AND Q4.99 NOT SELECTED]

Q5. Thinking about equipment replacements or upgrades that your company performed, did the efficiency rating for any of them exceed current codes and standards?

1. Yes
2. No
98. Don't know
99. Refused

[IF Q5 = YES]

Q6. Which equipment replacements or upgrades exceeded energy efficiency codes and standards?

[MULTIPLE BINARY RESPONSE]

[Do not read]

1. [IF Q4.1 is selected] Window
2. [IF Q4.2 is selected] Insulation
3. [IF Q4.3 is selected] HVAC
4. [IF Q4.4 is selected] Water heating
5. [IF Q4.5 is selected] Motor or motor control
6. [IF Q4.6 is selected] Cooking (oven)

7. [IF Q4.7 is selected] Refrigeration or freezing
8. [IF Q4.8 is selected] Lighting or lighting control
9. [IF Q4.9 is selected] Data center or IT equipment
10. [IF Q4.10 is selected] [INSERT OTHER SPECIFY]

[ASK IF Q5= YES]

Q7. Did you receive any financial incentives from any source for any of the replacements or upgrades that exceeded energy efficiency codes and standards?

1. Yes
2. No
98. Don't know
99. Refused

[IF Q7= YES]

Q8. For which of the replacements or upgrades did you receive financial incentives …?

[MULTIPLE BINARY RESPONSE]

[Do not read items]

1. [IF Q6.1 is selected] Windows
2. [IF Q6.2 is selected] Insulation
3. [IF Q6.3 is selected] HVAC
4. [IF Q6.4 is selected] Water heating
5. [IF Q6.5 is selected] Motors or motor controls
6. [IF Q6.6 is selected] Cooking (oven)
7. [IF Q6.7 is selected] Refrigeration or freezing
8. [IF Q6.8 is selected] Lighting or lighting controls
9. [IF Q6.9 is selected] Data center or IT equipment
10. [IF Q6.10 is selected] [INSERT OTHER SPECIFY]

[IF Q5= YES]

Q9. So you replaced or upgraded [INSERT SELECTED ITEMS FROM Q6] with equipment that exceeded energy efficiency codes and standards. On a scale of 1 to 5, where 1 means ‘no influence’ and 5 means ‘great influence,’ how much influence did each of the following have on the selection of that equipment?

[RANDOMIZE STATEMENTS; MATRIX QUESTION WITH 1-5 SCALE, FROM 1 = ‘NO INFLUENCE’ TO 5 = ‘GREATINFLUENCE’ AND 98 = DON’T KNOW, 99 = REFUSED]

[Ask each item and repeat scale if needed. If they indicate that some of these items were more of an influence for some equipment than for others, say: "On average, how much of an influence was it?"]

1. Increasing comfort
2. Reducing Operations & Maintenance costs
3. Increasing productivity

4. Achieving a "green" image for your company
5. Any energy-efficiency-related messaging you may have seen from Ameren Missouri

[ASK ALL]

Q10. And what equipment or building features, if any, does your business or organization plan to replace or upgrade in the coming two years?

[MULTIPLE BINARY RESPONSE; HOWEVER, OPTIONS 11, 98, AND 99 CANNOT BE SELECTED IF ANY OTHER RESPONSES ARE SELECTED]

[Do not read list]

1. Windows
2. Insulation (ceiling, attic or wall)
3. Heating, cooling, HVAC
4. Water heating
5. Motors and motor controls
6. Cooking (ovens)
7. Refrigeration / freezing
8. Lighting or lighting controls
9. Data center or IT equipment
10. Other - specify: _______________
11. None
98. Don't know
99. Refused

[ASK IF Q10.11 NOT SELECTED AND Q10.98 NOT SELECTED AND Q10.99 NOT SELECTED]

Q11. Will any of those equipment replacements or upgrades exceed energy efficiency codes and standards?

1. Yes
2. No
98. Don't know
99. Refused

[IF Q11= YES]

Q12. How likely is it that your company or organization will apply for cash incentives from Ameren Missouri for any of those energy efficient equipment replacements or upgrades?

1. 1 – not at all likely
2. 2
3. 3
4. 4
5. 5 – very likely
97. Not applicable

98. Don't know
99. Refused

[IF Q11 = YES]

Q13. And on a scale of 1 to 5, where 1 means ‘no influence’ and 5 means ‘great influence,’ how much influence did each of the following have on the decision to use energy efficiency equipment in those planned replacements?

[RANDOMIZE STATEMENTS; MATRIX QUESTION WITH 1-5 SCALE, FROM 1 = ‘NO INFLUENCE’ TO 5 = ‘GREATINFLUENCE’ AND 98 = DON’T KNOW, 99 = REFUSED]

[Ask each item and repeat scale if needed. If they indicate that some of these items were more of an influence for some equipment than for others, say: "On average, how much of an influence was it?"]

1. Increasing comfort
2. Reducing Operations & Maintenance costs
3. Increasing productivity
4. Achieving a "green" image for your company
5. Any energy-efficiency-related messaging you may have seen from Ameren Missouri

Barriers to Participating in Program

[IF Q12 <> 5]

Q14. What might keep your company from applying for Ameren Missouri’s energy efficiency incentives for retrofits?

[Do not read. Select all mentions. Follow initial response with “What else?]

1. Will purchase energy efficient equipment that does not qualify for incentives
2. Too much time or trouble
3. Incentives are too low
4. Prefers not to deal with utility
5. Not planning a retrofit project large enough to justify the effort to apply
6. Other - specify: ________________
97. Not applicable – all such decisions are made by a property or energy management firm
98. Don't know
99. Refused

[IF ANY PAST OR PLANNED DID NOT/ WILL NOT USE ABOVE-CODE EQUIPMENT – SEE END OF INSTRUMENT FOR SPECIFICS]

Q15. You indicated some past or planned equipment replacements or upgrades that include standard efficiency equipment. What are the reasons for not using above-code equipment in those cases?

[Do not read. Select all mentions. Follow initial response with “What else? If needed, probe to code response.]

1. Not interested in energy efficiency, not a priority
2. Lack of up-front capital to purchase higher efficiency equipment
3. Was not aware of Ameren Missouri incentives
4. Too much time or trouble to apply for incentives
5. Incentives are too low
6. Prefers not to deal with utility
7. Not aware of higher-efficiency options
8. Followed contractor or vendor equipment recommendations
9. Other - specify: ________________
97. Not applicable – all such decisions are made by a property or energy management firm
98. Don't know
99. Refused

[IF Q4 INDICATES ANY PAST EQUIPMENT REPLACEMENTS OR UPGRADES OR Q10 INDICATES ANY PLANNED EQUIPMENT REPLACEMENTS OR UPGRADES]

Q16. How much did input from each of the following types of people affect your company or organization’s past or planned equipment upgrades? For each one, please say whether they had no input, or whether their input had no effect, a small effect, a moderate effect, or a critical effect on the decision.

[Read each item. Repeat response options as needed]

1. Vendor or retailer
2. Contractor or installer
3. Designer or architect
4. Utility staff member, such as an account representative
5. Someone else, please specify: _________________

Interest in Retro-Commissioning

[ASK ALL]

Q17. The Ameren Missouri *BizSavers* program provides incentives to optimize certain energy-using systems in qualifying facilities. Would your facility qualify for such retro-commissioning incentives under any of these criteria…

[MATRIX QUESTION – RESPONSES ARE 1=YES, 2=NO, 98=DK, 99=RF]

1. Facility has at least 100,000 square feet of conditioned space
2. Facility uses high-electricity-usage equipment
3. Facility has an Energy Management System
4. Existing mechanical equipment are in relatively good condition

[ASK IF ANY PART OF Q17= YES]

Q18. The incentives for optimizing energy-using incentives pay up to 100% of the cost for technical studies and implementation plus 7 cents per kilowatt-hour saved. Based on that information, how likely is it your company or organization would apply for Ameren Missouri incentives to optimize energy-using systems? Please use a 1-to-5 scale where 1 means 'not at all likely' and 5 means 'very likely.'

1. 1 – not at all likely
2. 2
3. 3
4. 4
5. 5 – very likely
98. Don't know
99. Refused

[IF Q18 <> 5]

Q19. What might keep your company from applying for Ameren Missouri's energy efficiency incentives for building optimization?

[Do not read. Select all mentions. Follow initial response with "What else?]

1. Don't know enough about building optimization
2. Energy savings from optimization not worth the trouble
3. Too much time or trouble
4. Incentives are too low
5. Prefers not to deal with utility
6. Other - specify: _______________
97. Not applicable – all such decisions are made by a property or energy management firm
98. Don't know
99. Refused

Interest in New Construction

[ASK ALL]

Q20. Is your firm considering undertaking any new construction or major building renovation projects within the next five years?

[If needed: Such as adding a new wing, gutting an existing building, or building an entirely new building.]

1. Yes
2. No
98. Don't know
99. Refused

[IF Q20 = YES]

Q21. Is any project in the design phase now?

1. Yes
2. No
98. Don't know
99. Refused

[ASK Q20 = YES]

Q22. The Ameren Missouri New Construction program pays incentives of up to 4 cents per kilowatt-hour saved on whole-building design or 7 cents per kilowatt-hour saved for custom upgrades for specific equipment. Based on that information, how likely is it your company or organization would apply for Ameren Missouri incentives for a new construction project? Please use a 1-to-5 scale where 1 means ‘not at all likely’ and 5 means ‘very likely.’

1. 1 – not at all likely
2. 2
3. 3
4. 4
5. 5 – very likely
98. Don't know
99. Refused

[IF Q22 <> 5]

Q23. What might keep your company from applying for Ameren Missouri’s energy efficiency incentives for new construction?

[Do not read. Select all mentions. Follow initial response with “What else?]

1. Will use equipment that does not qualify for incentives
2. Too much time or trouble
3. Incentives are too low
4. Prefers not to deal with utility
5. Other - specify: ________________
97. Not applicable – all such decisions are made by a property or energy management firm
98. Don't know
99. Refused

Decision Making

[ASK ALL]

Q24. Which of the following energy-related policies and practices, if any, does your company have in place at your company or organization?

[Read List. Select all that apply]

1. A person or persons responsible for monitoring or managing energy usage
2. Defined energy savings goals
3. A specific policy requiring that energy efficiency be considered when purchasing equipment
4. Carbon reduction goals
5. Other – please describe: _____________________________
6. None of the above
98. Don’t know

99. Refused

Q25. In terms of energy savings, what is the longest payback period that your company or organization would consider for a capital improvement project investment?

1. 1 year or less
2. More than 1 but less than 2 years
3. More than 2 but less than 5 years
4. More than 5 years
5. It depends on the equipment installed
6. No specific payback period
98. Don't know
99. Refused

[ASK IF Q25 = 5 (IT DEPENDS)]

Q26. Please explain how it depends: ____________________________

Firmographics

We are almost finished. I'd like to ask you just a few final questions about your company.

Q27. Including your location, how many facilities does your organization own or lease in Ameren Missouri territory? And a "facility" could be a single building or group of buildings at a single location, such as a school campus.

[SINGLE RESPONSE]

[Do not read. Probe to code. If needed: A 'facility' may be a single building or a group of buildings at a single location. Multiple buildings at a single location, such as a school campus, are counted as a single facility.]

1. 1
2. 2-4
3. 5-9
4. 10-99
5. 100-499
6. 500+
98. Don't know
99. Refused

Q28. What is the approximate total square footage of the facility or facilities that your company or organization owns or leases in Ameren Missouri territory?

Q29. What is your job title?

[*Do not read list. Record one response. If necessary ask : is that most like {and read list}]*

1. Facilities Manager
2. Energy Manager

3. Other facilities management/maintenance position
4. Chief Financial Officer
5. Other financial/administrative position
6. Proprietor/Owner
7. President/CEO
8. Manager
9. Other (Specify) ____
98. Don't know
99. Refused

Q30. Thinking about the facility at your location, does your organization…

1. Own and occupy the entire building,
2. Own the building and occupy part of it while leasing parts to others,
3. Lease the space,
4. Other – specify: _______________
98. Don't know
99. Refused

Spillover Follow-Up

[ASK IF EITHER OF THESE CONDITIONS HOLDS:
Q5 = YES, Q9.5 = 2 OR 3 OR 4 OR 5;
Q11 = YES, Q13.5 = 2 OR 3 OR 4 OR 5]

Q31. We'd like to call you for a very short follow-up to get more details about your efficiency equipment purchases if that would be all right. Would you be the correct person to speak with?

1. Yes
2. No
98. Don't know
99. Refused

[ASK Q32 = NO]

Q32. Please provide us with the best person to contact and their phone number:

Name: [*RECORD NAME OR INDICATE OTHER RESPONSE*]

Phone number: [*RECORD PHONE NUMBER OR LEAVE BLANK IF NONE PROVIDED*]

Implementer Contact

[ASK ALL]

Q33. Would you be interested in having someone contact you to provide more information on Ameren Missouri's cash incentives for energy efficiency upgrades?

1. Yes – respondent is correct contact

2. Yes – respondent provides different contact: ________________
3. No
98. Don't know
99. Refused

Appendix F: Cost Effectiveness - Critical Technical Data

The following appendix presents the critical technical data used to develop the cost effectiveness test results, at the portfolio and program level. ADM contracted with a third party, Morgan Marketing Partners (MMP), to conduct the cost effectiveness analysis. ADM worked closely with MMP to assess the appropriateness of the inputs and to interpret the results.

One of the key objectives of the economic modeling was to assure that the analysis was comparable to the Ameren Missouri's planning analysis. This allows Ameren Missouri to compare evaluated results with the expected numbers within the plan. To accomplish this several steps were taken. First, the same analysis tool was used, DSMore. Second, the economic and financial assumptions used for developing the model were obtained from Ameren Missouri. Some of those assumptions include:

- Discount Rate = 6.95%
- Line losses = 4.84%
- Summer Peak would occur during the 16th hour of a July day on average
- Avoided Electric T&D = $31.01/kW
- Escalation rates for different costs occur at the component level with separate escalation rates for fuel, capacity, generation, T&D and customer rates carried out over 25 years.

The third step was to acquire the "Batch Tools" used by Ameren Missouri for input into DSMore. These batch tools are the input data for the model to run. By starting with the original DSMore Batch Tool used by Ameren Missouri and only modifying appropriate cells with new data from the evaluation, consistency again occurs. In particular the assumptions in the model are driven by measure loadshapes which tells the model when to apply the savings during the day. This assures that the loadshape for that end use matches the system peak impacts of that end use and provides the correct summer coincident savings. Measure lifetime assumptions were based on the Ameren Missouri measures database or the Missouri TRM that was used for planning, which was also included in the Batch Tool. Incremental costs for the measures were also in the Batch Tools received and not altered from the original planning assumptions.

The fourth step in the process was to acquire the 2014 Ameren Missouri spending data. This is the actual spending for 2014 broken down into implementation (contractor costs), incentives and administration (other portfolio costs), as shown in

Table *F-3*. These numbers are applied at the program level not the measure level. While applying incentives at the measure level is useful for planning purposes, it is unnecessary for the cost effectiveness modeling as the results are based on the program overall. This approach avoids any errors in application of the incentives by measure especially if incentives changed for a measure during the year.

There is no single best practice as to how to allocate certain expenses that were incurred during 2014 to individual energy efficiency programs. Such expenses include those incurred for EM&V, portfolio administration, and data tracking systems. This is the current approach for allocating those costs:

- All EM&V, portfolio administration, and data tracking costs incurred during 2014 were fully allocated to the programs for the purposes of testing program cost effectiveness during the 2014 program year. In other words, all program level benefits and costs summate to the portfolio level benefits and costs.
- Ameren Missouri's 2014 actual program costs are presented in Table F-3. However, net benefits and all other program cost/benefit ratios presented in this technical appendix utilize cost/benefit values that were from the aggregations where the costs were discounted from 2013. This approach was determined appropriate through discussions between MMP and Ameren Missouri Corporate Planning.
- EM&V, potential study, and data tracking costs were allocated to the programs in proportion to the net present value of monetized benefits attributable to each program as determined by the Utility Cost Test (UCT). Table F-1 and Table F-2 below provide additional details regarding the apportionment factor and allocation values.

Table F-1 Net Benefit Apportionment Factors (expressed in 2013 dollars)

Program	*NPV of UCT Benefits*	*Apportionment Factor*
Custom	$62,850,697	57.83%
Standard	$28,053,127	25.81%
New Construction	$10,695,169	9.84%
Retro-Commissioning	$7,083,620	6.52%
Total	$108,682,613	100%

Table F-2 Other Cost Allocation Values (expressed in 2014 dollars)

Program	*EM&V*	*Portfolio Admin*	*Data Tracking*	*Total*
Custom	$443,774	$258,969	$35,926	$738,669
Standard	$198,077	$115,590	$16,035	$329,702
New Construction	$75,516	$44,068	$6,113	$125,698
Retro-Commissioning	$50,016	$29,187	$4,049	$83,252
Total	$767,383	$447,814	$62,124	$1,277,321

Table F-3 Ameren Missouri Spending Data 2014 (expressed in 2014 dollars)

Ameren Missouri BizSavers Expenses 2014 (expressed in 2014 dollars)			
C&I EE PROGRAM COSTS (2014)	*Contractor Costs*	*Incentive Costs*	*Total Costs*
Prescriptive	$1,459,389	$2,509,194	$3,968,583
Custom	$1,966,395	$5,528,157	$7,494,552
Retro-commissioning	$626,585	$1,104,469	$1,731,054
New Construction	$363,733	$1,220,825	$1,584,557
Business - Other			
Total C&I Program Costs	$4,416,102	$10,362,644	$14,778,746
OTHER PORTFOLIO COSTS (2014)			
EM&V	$767,383		$767,383
Portfolio Admin	$447,814		$447,814
Data Tracking	$62,124		$62,124
Total C&I Other Portfolio Costs	$1,277,321		$1,277,321
Total Portfolio Costs	$5,693,423	$10,362,644	$16,056,067

Each cost test provides a benefit-cost ratio that reflects the net benefit or cost to a specific stakeholder. For example, the Utility Cost Test (UCT) takes into account all program costs and benefits from the utility (or program administrator) perspective, to demonstrate how the program impacts the utility relative to other program stakeholders. If the ratio is less than one, the costs outweigh the benefits; if the ratio is greater than one, the benefits outweigh the costs. Table F-4 below is a summary of benefit and cost inputs for each cost test performed.

Table F-4 Summary of Benefits and Costs Included in each Cost Effectiveness Test[49]

Test	Benefits	Costs
UCT	Perspective of utility, government agency, or third party implementing the program	
	▪ Energy-related costs avoided by the utility, ▪ Capacity-related costs avoided by the utility, including generation, transmission, and distribution	▪ Program overhead costs ▪ Utility/program administrator incentive costs, ▪ Utility/program administrator installation costs
TRC	Benefits and costs from the perspective of all utility customers (participants and non-participants) in the utility service territory	
	▪ Energy-related costs avoided by the utility, ▪ Capacity-related costs avoided by the utility, including generation, transmission, and distribution, ▪ Additional resource savings ▪ Applicable tax credits	▪ Program overhead costs, ▪ Program installation costs, ▪ Incremental measure costs (Whether paid by the customer of utility)
RIM	Impact of efficiency measure on non-participating ratepayers overall	
	▪ Energy-related costs avoided by the utility, ▪ Capacity-related costs avoided by the utility, including generation, transmission, and distribution	▪ Program overhead costs, ▪ Utility/program administrator incentive costs, ▪ Utility/program administrator installation costs, ▪ Lost revenue due to reduced energy bills
PCT	Benefits and costs from the perspective of the customer installing the measure	
	▪ Bill savings, ▪ Incremental installation costs ▪ Applicable tax credits or incentives	▪ Incentive payments, ▪ Incremental equipment costs
SCT	Benefits and costs from the perspective of society	
	▪ Energy-related costs avoided by the utility, ▪ Capacity-related costs avoided by the utility, including generation, transmission, and distribution, ▪ Additional resource savings ▪ Non-monetized benefits (and costs) such as cleaner air or health impacts (not quantified in this analysis)	▪ Program overhead costs, ▪ Program installation costs, ▪ Incremental measure costs (Whether paid by the customer of utility)

*Incentives are considered incremental measure costs

[49] EPA, Understanding Cost-Effectiveness of energy efficiency Programs: Best Practices, Technical Methods, and Emerging Issues for Policy-Makers, 2008. http://www.epa.gov/cleanenergy/documents/suca/cost-effectiveness.pdf, pg. 3-2

The following sections provide a detailed review of the cost test results at the portfolio and program levels. The majority of costs and savings are presented on a net basis, meaning that the net-to-gross ratio was applied to account for the impact of free ridership and spillovers. However, the participant borne costs, as applied to the Participant Cost Test (PCT), are presented on a gross basis. For the PCT, the participant cost is based on what a single customer sees as the value times the number of participants.

BizSavers Portfolio Level Cost Test Inputs and Results

The key financial benefit and cost inputs for the portfolio level Utility Costs Test (UCT) are provided below in Table F-5. Ameren Missouri's avoided cost of energy is $108.7 million (energy savings). Incentives and overhead totaled $15 million, which yields a benefit-cost ratio of 7.24. The UCT results show that the energy saved is approximately seven times greater than the portfolio costs, from the utility perspective.

Table F-5 Utility Cost Test (UCT) Inputs and Results - Portfolio Level

UCT Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production	$76,037,446	
Avoided Electric Capacity	$23,594,620	
Avoided T&D Electric	$9,050,546	
Incentives		$9,465,820
Implementation Costs		$4,352,550
EM&V, Admin, Data Tracking		$1,194,316
Total	$108,682,613	$15,012,685
TRC Benefit - Cost Ratio	7.24	

The TRC test results, shown in Table F-6, reflect the BizSavers Program impacts on all customers in the Ameren Missouri service territory, participants and non-participants. The participant measure costs, overhead, and other costs make up the total portfolio costs of $40.8 million. The benefits consist of the utility's total avoided costs of $108.7 million, which yields a benefit-cost ratio of 2.67. The results show that the overall portfolio benefits are more than twice as much as the costs.

Table F-6 Total Resource Cost Test (TRC) Inputs and Results - Portfolio Level

TRC Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production Avoided Electric Capacity Avoided T&D Electric	$76,037,446 $23,594,620 $9,050,546	
Participation Costs (net) Implementation Costs EM&V, Admin, Data Tracking		$35,223,686 $4,352,550 $1,194,316
Total	$108,682,613	$40,770,552
TRC Benefit - Cost Ratio	2.67	

The portfolio level RIM test reflects the program impacts on utility rates. Key inputs for the RIM test are displayed in Table F-7. The net benefits include the avoided utility costs of $108.7 million, and the costs of $126 million. The same costs are included in the RIM, as they are in the UCT; however lost revenues from reduced energy bills are also included. The financial data for the RIM test yields a benefit-cost ratio of .86. The ratio suggests that rates have potential to increase over time. However, a RIM < 1 does not always mean that rates will increase, in the long term. Energy efficiency programs are designed to reduce the capacity needs of the system, which may increase or decrease rates depending on the level of capital costs saved.[50]

Table F-7 Ratepayer Impact Measure Test (RIM) Inputs and Results - Portfolio Level

RIM Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production Avoided Electric Capacity Avoided T&D Electric	$76,037,446 $23,594,620 $9,050,546	
Incentives Implementation Costs EM&V, Admin, Data Tracking Lost Revenues		$9,465,820 $4,352,550 $1,194,316 $110,870,279
Total	$108,682,613	$125,882,965
RIM Benefit - Cost Ratio	0.86	

The portfolio level PCT reflects the program impacts on the participants; the key financial inputs are displayed in Table F-8. The portfolio level benefits include the program incentives and energy bill savings, which total $129.6 million. The costs include gross participant costs, totaling $39 million and yielding a benefit-cost ratio of 3.34. The participants' energy bill savings are more than three times the costs.

[50] EPA, Understanding Cost-Effectiveness of energy efficiency Programs: Best Practices, Technical Methods, and Emerging Issues for Policy-Makers, 2008. http: //www.epa.gov/cleanenergy/documents/suca/cost-effectiveness.pdf, pg. 3-6

Table F-8 Participant Cost Test (PCT) Inputs and Results – Portfolio Level

PCT Calculations		
Category	*Benefits*	*Costs*
Bill Savings (Gross) Incentives	$120,124,759 $9,465,820	
Participant Cost (Gross)		$38,851,938
Total	$129,590,579	$38,851,938
PCT Benefit - Cost Ratio	3.34	

The portfolio level PCT reflects the program impacts on the participants; the key financial inputs are displayed in Table F-8. The portfolio level benefits include the program incentives and energy bill savings, which total $129.6 million. The costs include gross participant costs, totaling $39 million and yielding a benefit-cost ratio of 3.34. The participants' energy bill savings are more than three times the costs.

The portfolio level SCT test results are shown in Table F-9. The portfolio level SCT benefit-cost ratio is 3.23.

Table F-9 Societal Cost Test (SCT) Inputs and Results - Portfolio Level

SCT Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production Avoided Electric Capacity Avoided T&D Electric	$101,229,611 $23,594,620 $11,843,136	
Participation Costs (net) Implementation Costs EM&V, Admin, Data Tracking		$36,574,498 $4,519,468 $1,240,117
Total	$136,667,367	$42,334,083
TRC Benefit - Cost Ratio	3.23	

BizSavers Custom Program Cost Test Inputs and Results

Each of the four cost tests were performed for each of the four BizSavers Programs, those results were rolled into the portfolio level analysis that was presented above. The following sections provide a more in-depth look at how each individual program performed from a cost-effectives perspective.

Key financial benefit and cost inputs for the custom program UCT are provided in Table F-10 below. The custom program attained $62.9 million in energy savings from avoided utility costs. Incentives, overhead, and other program costs totaled $7.7 million, which yields a benefit-cost ratio of 8.16. The UCT results show that the energy saved is approximately eight times greater than the program costs, from the utility perspective.

Table F-10 Utility Cost Test (UCT) Inputs and Results – Custom Program

UCT Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production Avoided Electric Capacity Avoided T&D Electric	$43,555,754 $13,963,580 $5,331,364	
Incentives Implementation EM&V, Admin, Data Tracking		$5,168,917 $1,838,612 $690,668
Total	$62,850,697	$7,698,197
UCT Benefit - Cost Ratio	8.16	

The TRC test results, shown in Table F-11, reflect the custom program impacts on all customers in the Ameren Missouri service territory, participants and non-participants. The participant measure costs, overhead, and other program costs total $24.5 million. The benefits consist of the utility's total avoided costs of $62.9 million, which yields a benefit-cost ratio of 2.56. The results show that the custom program benefits are more than two and a half times the program costs.

Table F-11 Total Resource Cost Test (TRC) Inputs and Results - Custom Program

TRC Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production Avoided Electric Capacity Avoided T&D Electric	$43,555,754 $13,963,580 $5,331,364	
Incentives Implementation EM&V, Admin, Data Tracking		$21,975,161 $1,838,612 $690,668
Total	$62,750,698	$24,504,441
TRC Benefit - Cost Ratio	2.56	

The custom program RIM test reflects the program impacts on utility rates. Key inputs for the RIM test are displayed in Table F-12. The net benefits include the avoided utility costs of $62.9 million. The same costs are included in the RIM, as they are in the UCT; however lost revenues from reduced energy bills are also included totaling $70.7 million. The financial data for the RIM test yields a benefit-cost ratio of .89. The ratio suggests that rates have potential to increase over time.

Table F-12 Ratepayer Impact Measure Test (RIM) Inputs and Results - Custom Program

RIM Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production	$43,555,754	
Avoided Electric Capacity	$13,963,580	
Avoided T&D Electric	$5,331,364	
Incentives		$5,168,917
Implementation		$1,838,612
EM&V, Admin, Data Tracking		$690,668
Lost Revenues		$63,077,945
Total	$62,850,697	$70,776,142
RIM Benefit - Cost Ratio	0.89	

The custom program PCT reflects the program impacts on the participants; the key financial inputs are displayed in Table F-13. The portfolio level benefits include the program incentives and energy bill savings, which total $75.7 million. The costs include measure incentives and gross participant costs; totaling $25 million and yielding a benefit-cost ratio of 3.00. The results indicate that participants' energy bill savings are more than three times the costs.

Table F-13 Participant Cost Test (PCT) Inputs and Results – Custom Program

PCT Calculations		
Category	*Benefits*	*Costs*
Bill Savings	$70,516,893	
Incentives	$5,168,917	
Participant Cost (Gross)		$25,210,542
Total	$75,685,810	$25,210,542
PCT Benefit - Cost Ratio	3.0	

The custom program SCT test results are shown in Table F-14. The custom program SCT benefit-cost ratio is 3.11.

Table F-14 Societal Cost Test (SCT) Inputs and Results – Custom Program

SCT Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production Avoided Electric Capacity Avoided T&D Electric	\$58,123,908 \$13,963,580 \$6,994,612	
Participation Costs (net) Implementation Costs EM&V, Admin, Data Tracking		\$22,817,898 \$1,909,122 \$717,154
Total	\$79,082,100	\$25,444,174
TRC Benefit - Cost Ratio	3.11	

BizSavers Standard Cost Test Inputs and Results

Key financial benefit and cost inputs for the standard program UCT are provided in Table F-15 below. The custom program attained \$28 million in energy savings from avoided utility costs. Incentives and overhead totaled \$4 million, which yields a benefit-cost ratio of 6.98. The UCT results show that the energy saved is approximately seven times greater than the program costs, from the utility perspective.

Table F-15 Utility Cost Test (UCT) Inputs and Results – Standard Program

UCT Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production Avoided Electric Capacity Avoided T&D Electric	\$20,380,748 \$5,567,339 \$2,105,039	
Incentives Implementation Costs EM&V, Admin, Data Tracking		\$2,346,137 \$1,364,552 \$308,276
Total	\$28,053,127	\$4,018,966
UCT Benefit - Cost Ratio	6.98	

The TRC test results, shown in Table F-16, reflect the standard program impacts on all customers in the Ameren Missouri service territory, participants and non-participants. The participant measure costs, overhead, and other program costs total \$8.4 million. The benefits consist of the utility's total avoided costs of \$28 million, which yields a benefit-cost ratio of 3.34. The results show that the standard program benefits are more than three times greater than the costs.

Table F-16 Total Resource Cost Test (TRC) Inputs and Results - Standard Program

TRC Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production Avoided Electric Capacity Avoided T&D Electric	$20,380,748 $5,567,339 $2,105,039	
Participant Cost (Net) Implementation Costs EM&V, Admin, Data Tracking		$6,722,735 $1,364,552 $308,276
Total	$28,053,127	$8,395,564
TRC Benefit - Cost Ratio	3.34	

The standard program RIM test reflects the program impacts on utility rates. Key inputs for the RIM test are displayed in .

Table *F-17*. The n benefits include the avoided utility costs of $28 million. The same costs are included in the RIM, as they are in the UCT; however lost revenues from reduced energy bills are also included totaling $34.8 million. The financial data for the RIM test yields a benefit-cost ratio of .81. The ratio suggests that rates have potential to increase over time.

Table F-17 Ratepayer Impact Measure Test (RIM) Inputs and Results - Standard Program

RIM Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production Avoided Electric Capacity Avoided T&D Electric	$20,380,748 $5,567,339 $2,105,039	
Incentives Implementation Costs EM&V, Admin, Data Tracking Lost Revenues		$2,346,137 $1,364,552 $308,276 $30,732,629
Total	$28,053,127	$34,751,595
RIM Benefit - Cost Ratio	0.81	

The standard program PCT reflects the program impacts on the participants; the key financial inputs are displayed in Table F-18. The standard program benefits include the program incentives and energy bill savings, which total $34.4 million. The costs include gross participant costs; totaling $7 million and yielding a benefit-cost ratio of 4.90. The results indicate that participants' energy bill savings are more than four and a half times the costs.

Table F-18 Participant Cost Test (PCT) Inputs and Results – Standard Program

PCT Calculations		
Category	*Benefits*	*Costs*
Bill Savings Incentives	$32,071,605 $2,346,137	
Participant Cost (Gross)		$7,019,439
Total	$34,417,742	$7,019,439
PCT Benefit - Cost Ratio	4.90	

The standard program SCT test results are shown in Table F-19. The standard program SCT benefit-cost ratio is 4.09.

Table F-19 Societal Cost Test (SCT) Inputs and Results – Standard Program

SCT Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production Avoided Electric Capacity Avoided T&D Electric	$27,293,716 $5,567,339 $2,778,156	
Participation Costs (net) Implementation Costs EM&V, Admin, Data Tracking		$6,980,549 $1,416,882 $320,099
Total	$35,639,211	$8,717,530
TRC Benefit - Cost Ratio	4.09	

BizSavers New Construction Cost Test Inputs and Results

Key financial benefit and cost inputs for the new construction program UCT are provided in Table F-20 below. The new construction program attained $10.7 million in energy savings from avoided utility costs. Incentives and overhead totaled $1.6 million, which yields a benefit-cost ratio of 6.69. The UCT results show that the energy saved is approximately seven times greater than the program costs, from the utility perspective.

Table F-20 Utility Cost Test (UCT) Inputs and Results– New Construction Program

UCT Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production Avoided Electric Capacity Avoided T&D Electric	$7,428,134 $2,364,031 $903,003	
Incentives Implementation EM&C, Admin, Data Tracking		$1,141,491 $340,096 $117,529
Total	$10,695,169	$1,599,117
UCT Benefit - Cost Ratio	6.69	

The TRC test results, shown Table F-21 reflect the new construction program impacts on all customers in the Ameren Missouri service territory, participants and non-participants. The participant measure costs, overhead, and other program costs total $6 million. The benefits consist of the utility's total avoided costs of $10.7 million, which yields a benefit-cost ratio of 1.73. The results show that the new construction program costs are almost twice as much as the benefits (energy savings.)

Table F-21 Total Resource Cost Test (TRC) Inputs and Results - New Construction Program

TRC Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production Avoided Electric Capacity Avoided T&D Electric	$7,428,134 $2,364,031 $903,003	
Participant Costs (net) Implementation EM&V, Admin, Data Tracking		$5,715,285 $340,096 $117,529
Total	$10,695,169	$6,172,911
TRC Benefit - Cost Ratio	1.73	

The new construction program RIM test reflects the program impacts on utility rates. Key inputs for the RIM test are displayed in Table F-22. The net benefits include the avoided utility costs of $10.7 million. The same costs are included in the RIM, as they are in the UCT; however lost revenues from reduced energy bills are also included totaling $12.3 million. The financial data for the RIM test yields a benefit-cost ratio of 0.87. The ratio suggests that rates have potential to increase over time.

Table F-22 Ratepayer Impact Measurement Test (RIM) Inputs and Results - New Construction Program

RIM Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production Avoided Electric Capacity Avoided T&D Electric	$7,428,134 $2,364,031 $903,003	
Incentives Implementation EM&V, Admin, Data Tracking Lost Revenues		$1,141,491 $340,096 $117,529 $10,746,126
Total	$10,695,169	$12,345,243
RIM Benefit - Cost Ratio	0.87	

The new construction program PCT reflects the program impacts on the participants; the key financial inputs are displayed in Table F-23. The new construction program benefits include the program incentives and energy bill savings, which total $12 million. The costs include measure incentives and gross participant costs, totaling $5.8 million and yielding a benefit-cost ratio of 2.08. The results indicate that participants' energy bill savings are approximately two times the costs.

Table F-23 Participant Cost Test (PCT) Inputs and Results – New Construction Program

PCT Calculations		
Category	*Benefits*	*Costs*
Bill Savings Incentives	$10,819,029 $1,141,491	
Participant Cost (Gross)		$5,761,092
Total	$11,960,520	$5,761,092
PCT Benefit - Cost Ratio	2.08	

The new construction program SCT test results are shown in Table F-24. The new construction program SCT benefit-cost ratio is 2.10.

Table F-24 Societal Cost Test (SCT) Inputs and Results – New Construction Program

SCT Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production	$9,898,081	
Avoided Electric Capacity	$2,364,031	
Avoided T&D Electric	$1,185,651	
Participation Costs (net)		$5,934,464
Implementation Costs		$353,139
EM&V, Admin, Data Tracking		$122,037
Total	$13,447,763	$6,409,639
TRC Benefit - Cost Ratio	2.10	

BizSavers Retro-Commissioning Cost Test Inputs and Results

Key financial benefit and cost inputs for the retro-commissioning program UCT are provided in

Table *F-25* below. The retro-commissioning program attained $7 million in energy savings from avoided utility costs. Incentives and overhead totaled $1.7 million, which yields a benefit-cost ratio of 4.18. The UCT results show that the energy saved is approximately four times greater than the program costs, from the utility perspective.

Table F-25 Utility Cost Test (UCT) Inputs and Results – Retro-Commissioning Program

UCT Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production	$4,672,810	
Avoided Electric Capacity	$1,699,670	
Avoided T&D Electric	$711,140	
Incentives		$809,274
Implementation		$809,290
EM&V, Admin, Data Tracking		$77,842
Total	$7,083,620	$1,696,406
UCT Benefit - Cost Ratio	4.18	

The TRC test results, shown Table F-26 reflect the retro-commissioning program impacts on all customers in the Ameren Missouri service territory, participants and non-participants. The participant measure costs, overhead, and other program costs total $1.7 million. The benefits consist of the utility's total avoided costs of $7 million, which yields a benefit-cost ratio of 4.17. The results show that the retro-commissioning program costs are more than four times as much as the benefits (energy savings.)

Table F-26 Total Resource Cost Test (TRC) Inputs and Results – Retro-Commissioning Program

TRC Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production Avoided Electric Capacity Avoided T&D Electric	$4,672,810 $1,699,670 $711,140	
Participant Costs (net) Implementation EM&V, Admin, Data Tracking		$810,505 $809,290 $77,842
Total	$7,083,620	$1,697,636
TRC Benefit - Cost Ratio	4.17	

The retro-commissioning program RIM test reflects the program impacts on utility rates. Key inputs for the RIM test are displayed in Table F-27. The net benefits include the avoided utility costs of $7 million. The same costs are included in the RIM, as they are in the UCT; however lost revenues from reduced energy bills are also included totaling $8 million. The financial data for the RIM test yields a benefit-cost ratio of 0.88. The ratio suggests that rates have potential to increase over time.

Table F-27 Ratepayer Impact Measure Test (RIM) Inputs and Results – Retro-Commissioning Program

RIM Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production Avoided Electric Capacity Avoided T&D Electric	$4,672,810 $1,699,670 $711,140	
Incentives Implementation EM&V, Admin, Data Tracking Lost Revenues		$809,274 $809,290 $77,842 $6,313,579
Total	$7,083,620	$8,009,985
RIM Benefit - Cost Ratio	0.88	

The retro-commissioning program PCT reflects the program impacts on the participants; the key financial inputs are displayed in Table F-28. The new construction program benefits include the program incentives and energy bill savings, which total $7.5 million. The costs include gross participant costs totaling $.9 million and yielding a benefit-cost ratio of 8.74. The results indicate that participants' energy bill savings are approximately nine times the costs.

Table F-28 Participant Cost Test (PCT) Inputs and Results – Retro-Commissioning Program

PCT Calculations		
Category	*Benefits*	*Costs*
Bill Savings Incentives	$6,717,232 $809,274	
Participant Cost (Gross)		$860,866
Total	$7,526,506	$860,866
PCT Benefit - Cost Ratio	8.74	

The retro-commissioning program SCT test results are shown in Table F-29. The retro-commissioning program SCT benefit-cost ratio is 4.82.

Table F-29 Societal Cost Test (SCT) Inputs and Results – Retro-Commissioning Program

SCT Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production Avoided Electric Capacity Avoided T&D Electric	$5,913,907 $1,699,670 $884,716	
Participation Costs (net) Implementation Costs EM&V, Admin, Data Tracking		$841,587.00 $840,326.00 $80,827
Total	$8,498,293	$1,762,740
TRC Benefit - Cost Ratio	4.82	

Cost of Conserved Energy (CCE)

The cost of conserved energy (CCE) by program describes the costs of acquiring the lifetime benefits of program energy savings. CCE takes into consideration the present value lifetime benefits (energy savings) produced by an energy efficiency program compared to the net present value of program costs. From a planning perspective, it is an indicator of the relative performance or economic attractiveness of any energy efficiency investment or practice. Table F-30 provides the data inputs that were used to develop the BizSavers CCE figures.

Table F-30 BizSavers CCE Inputs and Results

Program	*Lifetime Savings kWh*	*NPV Program Costs*	*CCE $/kWh*
Custom	1,119,191,144	$7,698,197	$.01
Standard	557,083,764	$4,018,966	$.01
RCx	106,792,897	$1,696,406	$.02
NC	191,427,013	$1,599,117	$.01
Portfolio	1,974,494,818	$15,012,685	$.01

Appendix G: Glossary of Terms

Adjustments: Modifications on ex ante analysis conditions (e.g. hours of lighting operation) because of observations made by ADM field technicians during the measurement and verification (M&V) on-site visit, which change baseline energy or energy demand values.

Baseline: The projected scenario where the subject project or program was not implemented. Baseline conditions are sometimes referred to as "business-as-usual" conditions. Baselines are defined as either project-specific baselines or performance standard baselines.

Confidence (level): A confidence level is a value that indicates the reliability of a calculated estimate from a sample. A higher confidence level indicates a stronger estimate that is more likely to lie within the population parameter. It is an indication of how close an estimated value derived from a sample is to the true population value of the quantity in question. The confidence level is the likelihood that the evaluation has captured the true impacts of the program within a certain range of values (i.e., precision).

Cost-effectiveness: The present value of the estimated benefits produced by an energy efficiency program compared to the estimated total costs to determine if the proposed investment or measure is desirable (e.g., whether the estimated benefits exceed the estimated costs from a societal perspective). It is an indicator of the relative performance or economic attractiveness of any energy efficiency investment or practice.

Cost of Conserved Energy (CCE): The additional cost that must be invested in order to implement a long-term energy-saving strategy or feature; e.g., the cost to a homeowner to install a green roof on his house or a solar heater for his swimming pool. In these examples, CCE may include not only the cost of the installation itself but the interest on money borrowed to pay for it.

Deemed Savings: An estimate of the gross energy savings or gross energy demand savings for a single unit of an installed energy efficiency measure. This estimate (a) comes from data sources and analytical methods that are widely accepted for the particular measure and purpose, and (b) is applicable to the situation being evaluated.

Demand: The time rate of energy flow. Demand usually refers to electric power measured in kW (equals kWh/h) but can also refer to natural gas, usually as Btu/hr., kBtu/hr., therms/day, etc.

Effective Useful Life: An estimate of the median number of years that the efficiency measures installed under a program are still in place and operable.

Energy Efficiency: The use of less energy to provide the same or an improved level of service to the energy consumer in an economically efficient way, or using less energy to perform the same function. "Energy conservation" is a term that has also been used, but it has the connotation of doing without a service in order to save energy rather than using less energy to perform the same function.

Energy Efficiency Measure: Installation of equipment, subsystems or systems, or modification of equipment, subsystems, systems, or operations on the customer side of the meter, for the purpose of reducing energy and/or demand (and, hence, energy and/or demand costs) at a comparable level of service.

Engineering Model: Engineering equations used to calculate energy usage and savings. These models are usually based on a quantitative description of physical processes that transform delivered energy into useful work such as heat, lighting, or motor drive. In practice, these models may be reduced to simple equations in spreadsheets that calculate energy usage or savings as a function of measurable attributes of customers, facilities, or equipment (e.g., lighting use = watts × hours of use).

Estimated Free Ridership Rate: I am not sure what this is exactly – mostly in regards to which level it is applied, like at the project/site level or program component level?

Estimated Net to Gross Ratio (NTG): See *Net to Gross Ratio (NTGR)*

Estimated Spillover Rate: I am not sure what this is exactly – mostly in regards to which level it is applied, like at the project/site level or program component level?

Evaluation: The performance of studies and activities aimed at determining the effects of a program. This includes any of a wide range of assessment activities associated with understanding or documenting program performance, assessing program or program-related markets and market operations; any of a wide range of evaluative efforts including assessing program-induced changes in energy efficiency markets, levels of demand or energy savings, and program cost-effectiveness.

Ex Ante: The saving calculated by the implementation contractor, Lockheed Martin, per the TRM. These numbers are developed prior to ADM's analysis.

Ex Post: The savings that have been verified by the EM&V contractor. This includes adjustments for equipment that may not have been installed, calculation errors, and differences in assumptions.

Free Rider: A program participant who would have implemented the program measure or practice in the absence of the program incentive. Free riders can be total (who would have implemented all of the same measures without the incentives), partial (who would have implemented some of the same measures without the incentives), or deferred (who would have implemented the measures, but at some time in the future).

Gross Ex Ante kWh Savings: The estimation of electrical energy (kWh) expected to be saved by implementating energy efficiency measures, calculated by the implementation contractor before measures are enacted and without considering externalities like free ridership and spillovers. Savings are typically reported as annual savings.

Gross Ex Ante Peak kW Savings: The estimation of electrical energy demand (kW) expected to be saved by implementating energy efficiency measures, calculated by the implementation contractor before measures are enacted and without considering externalities like free ridership and spillovers. Savings are typically reported as annual savings.

Gross Ex Post kWh Savings: The estimation of electrical energy (kWh) saved by implementing energy efficiency measures, calculated by ADM, after measures were enacted, and without considering externalities like free ridership and spillovers. Savings are typically reported as annual savings.

Gross Ex Post Peak kW Savings: The estimation of electrical energy demand (kW) saved by implementing energy efficiency measures, calculated by ADM, after measures were enacted, and without considering externalities like free ridership and spillovers. Savings are typically reported as annual savings.

Gross kWh Savings Realization Rate: The ratio of ex post (or “realized”) gross kWh savings over ex ante gross kWh savings.

Gross Peak kW Savings Realization Rate: The ratio of ex post (or “realized”) gross kW savings over ex ante gross kW savings.

Gross Realization Rate: The ratio of ex post gross energy savings over ex ante gross energy savings

Gross Savings: The change in energy consumption and/or demand that results directly from program-related actions taken by participants in an efficiency program, regardless of why they participated.

Impact Evaluation: An evaluation of the program-specific, directly induced changes (e.g., energy and/or demand usage) attributable to an energy efficiency program.

Interaction Factors: Changes in energy use or demand occurring beyond the measurement boundary of the M&V analysis.

kWh Savings Target: The goal of energy savings for programs and their components set by utility companies before the programs began.

Market Effect: A change in the structure or functioning of a market, or the behavior of participants in a market, that results from one or more program efforts. Typically, the resultant market or behavior change leads to an increase in the adoption of energy efficient products, services, or practices.

Measure: Energy efficient equipment or service that is implemented to conserve energy.

Measurement: A procedure for assigning a number to an observed object or event.

Measurement and verification (M&V): The data collection, monitoring, observations, and analysis by field technicians used for the calculation of ex post gross energy and demand savings for individual sites or projects. M&V can be a subset of program impact evaluation.

Metering: The collection of energy-consumption data over time through the use of meters. These meters may collect information with respect to an end-use, a circuit, a piece of equipment, or a whole building (or facility). Short-term metering generally refers to data collection for no more than a few weeks. End-use metering refers specifically to separate data collection for one or more end-uses in a facility, such as lighting, air conditioning or refrigeration. Spot metering is an instantaneous measurement (rather than over time) to determine an energy-consumption rate.

Monitoring: Gathering of relevant measurement data, including but not limited to energy-consumption data, over time to evaluate equipment or system performance. Examples include chiller electric demand, inlet evaporator temperature and flow, outlet evaporator temperature, condenser inlet temperature, and ambient dry-bulb temperature and relative humidity or wet-bulb temperature, for use in developing a chiller performance map (e.g., kW/ton vs. cooling load and vs. condenser inlet temperature).

Net Ex Post kWh Savings: The estimation of electrical energy (kWh) savings from programs or measures after the measures have been installed and after adjusting for possible externalities, such as free ridership and spillovers.

Net Ex Post Peak kW Savings: The estimation of electrical energy demand (kW) savings from programs or measures after the measures have been installed and after adjusting for possible externalities, such as free ridership and spillovers.**Net Savings:** The amount of energy reduced based on the particular project after subtracting the negative free ridership effects and adding the positive spillover effects. Therefore, net savings equal gross savings, minus free ridership, plus the summation of participant spillovers, non-participant spillovers, and other market effects. It is a better estimate of how much energy reductions occurred particularly because of the program incentive(s).

Net-to-Gross-Ratio (NTGR): A factor representing net program savings divided by gross program savings. It is applied to gross program impacts to convert gross program impacts into net program load impacts that are adjusted for free ridership and spillover. Net-to-Gross-Ratio (NTGR) = (1 – Free-Ridership % + Spillover % + Market Effects), also defined as Net Savings / Gross Savings.

Non-participant: A consumer who was eligible but did not participate in the subject efficiency program in a given program year. Each evaluation plan should provide a definition of a non-participant as it applies to a specific evaluation.

Participant: A consumer who received a service offered through the subject efficiency program in a given program year. The term "service" is used in this definition to suggest that the service can be a wide variety of services, including financial rebates, technical assistance, product installations, training, energy efficiency information or other services, items, or conditions. Each evaluation plan should define "participant" as it applies to the specific evaluation.

Peak Demand: The maximum level of metered demand during a specified period, such as a billing month or a peak demand period.

Peak kW Savings Target: The goal of energy demand savings set by the utility company for their program or program component before the program time frame begins.

Portfolio: Either (a) a collection of similar programs addressing the same market (e.g., a portfolio of residential programs), technology (e.g., motor-efficiency programs), or mechanisms (e.g., loan programs) or (b) the set of all programs conducted by one organization, such as a utility (and which could include programs that cover multiple markets, technologies, etc.).

Primary Effects: Effects that the project or program are intended to achieve. For efficiency programs, this is primarily a reduction in energy use per unit of output.

Process Evaluation: A systematic assessment of an energy efficiency program's process. The assessment includes documenting program operations at the time of the examination, and identifying and recommending improvements to increase the program's efficiency or effectiveness for acquiring energy resources while maintaining high levels of participant satisfaction.

Program: A group of projects, with similar characteristics and installed in similar applications. Examples could include a utility program to install energy-efficient lighting in commercial buildings, a developer's program to build a subdivision of homes that have photovoltaic systems, or a state residential energy efficiency code program.

Project: An activity or course of action involving one or multiple energy efficiency measures, at a single facility or site.

Ratepayer Impact Test (RIM): RIM tests measure the distributional impacts of conservation programs from the viewpoint of all of the utility's customers. The test measures what happens to average price levels due to changes in utility revenues and operating costs caused by a program. A benefit/cost ratio less than 1.0 indicates the program will influence prices upward for all customers. For a program passing the TRC but failing the RIM, average prices will increase, resulting in higher energy service costs for customers not participating in the program.

Regression Analysis: A statistical analysis of the relationship between a dependent variable (response variable) to specified independent variables (explanatory variables). The mathematical model of their relationship is the regression equation.

Reporting Period: The time following implementation of an energy efficiency activity during which savings are to be determined.

Secondary Effects: Unintended impacts of the project or program such as rebound effect (e.g., increasing energy use as it becomes more efficient and less costly to use), activity shifting (e.g., movement of generation resources to another location), and market leakage (e.g., emission changes due to changes in supply or demand of commercial markets). These secondary effects can be positive or negative.

Spillover: A positive externality related to a participant or non-participant enacting additional energy efficiency measures without an incentive because of a participant's experience in the program.. There can be participant and/or non-participant spillover rates depending on the rate at which participants (and non-participants) adopt energy efficiency measures or take other types of efficiency actions on their own (i.e., without an incentive being offered).

Stipulated Values: See "deemed savings."

Total Resource Cost Test (TRC): This test compares the program benefits of avoided supply costs against the costs for administering a program and the cost of upgrading equipment. This test examines efficiency from the viewpoint of an entire service territory. When a program passes the TRC, this indicates total resource costs will drop, and the total cost of energy services for an average customer will fall.

Uncertainty: The range or interval of doubt surrounding a measured or calculated value within which the true value is expected to fall with some degree of confidence.

Utility Cost Test (UCT): Also known as the Program Administrator Test (PACT), this test measures cost-effectiveness from the viewpoint of the sponsoring utility or program administrator. If avoided supply costs exceed program administrator costs, then average costs will decrease.