BizSavers Program Evaluation Report

January 2015 – December 2015

Prepared For:

Ameren Missouri

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Research Into Action

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1. Executive Summary

This report presents the results of the impact, process, and cost effectiveness evaluations of the BizSavers Custom, Standard, New Construction, and Retro-Commissioning Programs implemented during the 2015 calendar year (January through December). The evaluation, measurement and verification (EM&V) team was led by ADM Associates, Inc. ADM was joined by Research into Action, Inc., which performed the process evaluation of the programs. The primary evaluation activities include the following:

- The evaluation team collected data for the evaluation 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.
- The evaluation team developed samples for all four programs that provide for estimation of energy savings estimates at a 90% statistical confidence level. The statistical precision of energy savings estimates varies by program: 9.6% for the Custom Program, 9.2% for the Standard Program, 10.1% for new construction, and 9.7% for the Retro-Commissioning Program.
- Analysts performed gross ex post kWh energy savings calculations for each sampled project. The evaluation team used the results to estimate program-level gross realization rates.
- Customer participant surveys provided insight into the participants' decision-making processes, levels of satisfaction, and tendencies to invest in energy efficiency in the future. The results informed the net-to-gross analysis, spillover data collection, as well as the process evaluation.
- Trade ally surveys provided insight into the quantitative spillover impacts.
- Program staff interviews provided insight into the evolving nature of the program.
- The evaluation team administered surveys to Ameren Missouri trade ally training event participants to assess how well these events deliver program information.
- The evaluation team performed cost effectiveness analyses to determine portfolio-level and program-level cost benefit ratios referencing 2015 program expenditures, the incremental cost of implemented measures, as well as the monetized benefits of energy savings and peak demand reduction.

Table 1-1 provides a summary of these data collection efforts. The table lists data sources used for the evaluation, the data collection method, the dates during which data collection and/or analysis was performed, the research objectives, and the type of analysis performed (qualitative vs. quantitative).

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

*Data Source**	*Method*	*Dates*	*Research Objective*	*Analysis Type*
Pre-install site visit(8)	On-site M&V	January to December 2015	Verify baseline operating conditions	Qualitative
Post-install site visit(78)	On-site M&V	January to December 2015	Verify measure installation and collect end-use metering data	Qualitative
Program staff (7), Ameren Missouri(2), Lockheed Martin(5)	In-depth interview	September to December 2015	Program function; communication; tracking and reporting; quality control	Qualitative
Program documentation	Document review	January to December 2015	Program function; tracking and reporting; quality control	Qualitative
Database analysis	Database review	Jan-15	Number of projects; project type and details; data quality	Quantitative
Participants, Standard and Custom Programs (843)	Online survey	March 2015 to January 2016	Program experiences; installed equipment; satisfaction with program	Quantitative
Participants, New Construction and Retro-Commissioning Programs (12)	In-depth Interview	November to December 2015	Program experiences; installed equipment; satisfaction with program	Qualitative
Near-participants, Standard and Custom Programs (10)	In-depth Interview	Nov-15	Program awareness; reason for program withdrawal; other energy efficiency activities; satisfaction with program	Qualitative
Trade allies and non-allied service providers (57)	Telephone survey	September to October 2015	Program awareness, energy decision-making, upgrades to energy-using equipment, barriers to participating in program, and interest in Ameren Missouri programs	Quantitative and qualitative
Retro-commissioning service providers (4) and NC trade allies (5)	In-depth Interview	October to November 2015		
Event attendees (7 attendees)	Online survey	May to October 2015	Event satisfaction; experience with training; Intention to work with BizSavers; firmographics	Quantitative and qualitative
Economic and Financial Assumption, 2015 Ameren Program Expenditures	Cost Effectiveness Analysis	Jan-16	Develop economic models for cost testing	Quantitative
DS More Batch Tools	Cost Effectiveness Analysis	Jan-16	Develop measure-level EUL and incremental costs	Quantitative

*Data Source**	*Method*	*Dates*	*Research Objective*	*Analysis Type*
DS More Batch Tools	Cost Effectiveness Analysis	Jan-16	Summarize program-level costs and benefits, detailing each cost test input	Quantitative

Table 1-2 provides a summary of the evaluated energy savings for the portfolio of 2015 BizSavers Programs. The table displays the ex ante, gross ex post, and net ex post energy savings as compared with the 2015 adjusted energy savings goals.

Table 1-2 Summary of kWh Savings for BizSavers Programs

Program Component	*Adjusted kWh Savings Targets 2015*	*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	74,225,000	173,413,090	180,356,468	104%	183,922,275	102%	248%
Standard	51,587,000	60,206,547	66,999,720	111%	69,539,890	104%	135%
New Construction	6,367,000	29,664,868	29,192,255	98%	27,883,540	96%	438%
RCx	3,070,000	41,015,120	36,949,499	90%	36,359,794	98%	1184%
Total	135,249,000	304,299,625	313,497,943	103%	317,705,499	101%	235%

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

During this period, the Custom Program gross ex post energy savings totaled 180,356,468 kWh, while Standard Program gross ex post energy savings totaled 66,999,720 kWh. The gross kWh savings realization rate for the Custom Program is 104%, while the gross kWh savings realization rate for the Standard Program is 111%. The New Construction Program gross ex post energy savings totaled 29,192,255 kWh, while the Retro-Commissioning Program gross ex post savings totaled 36,949,499 kWh. The gross kWh savings realization rates for these two programs are 98% and 90%, respectively.

By definition, 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 are attributable to the effects of the program.

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

During 2015, the Custom Program achieved 248% of its energy savings goal with ex post net energy savings of 183,922,275, while the Standard Program achieved 135% of its energy savings goal with ex post net energy savings of 69,539,890 kWh. The estimated net-to-gross ratio for the Custom Program is 102% and the estimated net-to-gross ratio for the Standard Program is 104%. The New Construction Program achieved 438% of its energy savings goal with ex post net energy savings of 27,883,540 kWh, while the Retro-Commissioning Program achieved 1184% of its energy savings goal with ex post net energy savings of 36,359,794 kWh. The estimated net-to-gross ratios of these programs are 96% and 98%, 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.

During 2015, the evaluation team collected data from trade allies to better understand how the BizSavers Program is influencing the un-incented lighting equipment being sold in the Ameren Missouri service territory. The report refers to program-influenced, un-incented lighting sales as program non-participant spillover. Section 4.2.2.2 and Appendix F: Non-participant Spillover Methodology presents the non-participant spillover evaluation methodology and the non-participant spillover energy savings.

Table 1-3 summarizes the 2015 gross ex post peak kW reductions. The gross ex post peak demand savings total 22,662 kW for the Custom Program, and 21,623 kW for the Standard Program. The gross ex post peak kW savings total 20,819 kW for the New Construction Program, and 1,197 kW for the Retro-Commissioning Program. The ex post net peak demand savings for the Custom Program are 23,629 kW, while the ex post net peak demand savings for the Standard Program are 22,948 kW. The ex post net peak demand savings for the New Construction and Retro-Commissioning Programs total 19,564 kW and 1,180 kW, respectively.

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

Program Component	*Peak kW Savings Targets: 2015*	*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*[1]	*Percent of Goal Achieved*
Custom	21,865	25,943.02	22,662.11	87%	23,628.50	104%	108%
Standard	9,316	14,680.48	21,623.40	147%	22,947.93	106%	246%
New Construction	2,015	3,437.96	20,818.89	606%	19,564.11	94%	971%
RCx	648	719.30	1,196.54	166%	1,179.97	99%	182%
Total	33,844	44,780.76	66,300.94	148%	67,320.50	102%	199%

1.1. Impact Conclusions

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

- During 2015, the BizSavers Program had the highest participation and energy savings levels to date. Applicants submitted a uniquely large number of final applications during the last two months of the program year, immediately prior to the deadline for submission. This upturn in program activity may be associated with applicant and trade ally anticipation of cessation of program incentives.
- ADM engineers conducted post-installation site visits for seventy-eight projects implemented during 2015. They also performed eight pre-installation visits to determine the pre-implementation operating conditions for larger energy saving projects. The seventy-eight projects for which post-installation site visits were performed included measures implemented under the Standard, Custom, New Construction and Retro-Commissioning Programs, with seventeen of the seventy-eight projects receiving incentives through more than one program.
- For lighting controls, variation between ex ante and gross ex post energy savings persisted during 2015. As compared with previous program years, the program improved the ex ante savings assumptions by accounting for additional data collected from the application, resulting in gross realization rates, on average,

[1] 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.

being closer to 100%. The evaluation team observed high realization rates for control measures with an unbounded upper controlled wattage range. An example of this measure type is *Lighting Controls Occ Sensor Dual Tech Controlling Circuit >150 watts*. Therefore, a sensor controlling 300 watts has the same ex ante savings as a sensor controlling 151 watts, given identical operating hours.

- Also mentioned in prior year evaluation reports, ADM applies heating and cooling interaction factors to all custom and standard lighting projects, which has consistently resulted in a higher-than-average realization rate for lighting projects. While the TRM states that the unity value of 1.0 for HCIF may be applied, ADM obtains the heating and cooling system information during site visits to support application of more accurate heating and cooling interaction factors, and applies these factors in calculation of energy savings of all lighting and lighting control measures.[2]

- ENERGY STAR® ice makers had low realization rates. The ex ante kWh savings was determined by the efficient ice maker capacity and matching TRM deemed savings. The evaluation team utilized the algorithm in the Ameren TRM, which accounts for base and efficient energy usage along with a 75% load factor. Also, the Commercial Kitchen Equipment Energy Star Calculator was referenced to estimate the baseline equipment efficiency, which was unknown. The efficient equipment usage was estimated based on the performance data sheet for the installed icemaker.

  The TRM deemed ice maker kWh savings value could not be replicated with the savings algorithm. It is likely that the baseline efficiency used in the deemed estimate is far too inefficient or the load factor may not have been applied.

- The program implementation contractor did not consistently document estimated peak kW impacts in the program tracking system. The implementation contractor allocated considerably greater efforts toward documenting estimated kWh energy savings, in comparison with that allocated toward documenting estimated peak kW impacts. This practice may be related to the implementation contractor's sense of the comparative importance of kWh and peak kW as program performance metrics.

- The evaluation team identified inconsistencies with the measure-level data field "Units." Measure-level "Units" are a key input to the cost effectiveness analysis; therefore, accuracy is important. The evaluation team identified inconsistencies

[2] See "Appendix L: Heating and Cooling Interactive Factors" for a presentation of the heating and cooling interaction factors developed and applied by ADM.

when reviewing measure unit savings, as the quantity was often a value of one (1) with exceptionally high kWh savings. Although these values produce variation in the per unit measure savings, they did not affect the total project savings.

- Not all project documentation was readily available for evaluation review in the program tracking system, LM Captures. ADM was provided with login ID's to access all project data stored in LM captures, but ADM analysts made additional documentation requests for approximately one third of the sampled projects. In most cases, program staff was able to retrieve the documentation from a separate server. It was undetermined if the lack of supporting project documentation was a function of the storage capacity of the system or an internal protocol that does not require all documentation to be uploaded to the program tracking system. One contributing factor may be the influx of program activity late in the program year and the focus of implementation resources on project review and not on administrative data entry tasks that facilitate evaluation.
- The overall portfolio of BizSavers Programs and each individual program is cost effective according to the TRC and UCT tests. The cost effectiveness analysis provides a list of custom, standard and new construction measures associated with a TRC test result less than one (Chapter 6.)
- Approximately 16% of the total program gross ex post kWh savings was associated with replacement of incandescent lighting with LEDs. Federal energy conservation regulations such as the EISA Act of 2007 established baselines for minimally efficient lighting and other equipment. The sell-through period for the rollout of the last incandescent lamp has occurred with the 40 watt lamp effective phaseout date of January 1, 2014. ADM evaluated all general illumination screw-in lamps from 310 to 2600 lumens with this federal regulation to determine the minimally efficient baseline that could have been purchased in the absence of the program.

1.2. Impact Recommendations

Based on the above conclusions, the evaluation team offers the following impact recommendations for consideration in planning future program cycles. Appendix M: Update to 2014 EM&V Recommendations provides an update on the status of recommendations from prior program years.

- To improve the ex ante savings calculation for lighting control measures the program implementer should consider the cost and benefits associated with collecting additional information. Exact controlled wattage and the existing lighting hours-of-use are two parameters that could further improve the realization rate of lighting control measures.

- ADM suggests that program staff apply heating and cooling interaction factors (HCIF) by building type, as mentioned 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, which are available in Appendix L: Heating and Cooling Interactive Factors.
- To improve the ex ante calculation for ENERGY STAR® ice machines, the program implementer should consider collecting information on the efficiency of the replaced ice machine and baseline data.
- To increase the accuracy of peak demand impacts, the implementation contractor should revise data collection and data entry protocols. The implementation contractor may develop kW savings estimation algorithms that account for applicant kWh savings and the end use of the installed measures. Additionally, the implementation contractor could require applicants to provide kW savings estimates for projects for which an energy model was created – energy models are often created by the applicant or trade ally for new construction and retro commissioning projects.
- The program implementer should consider revising implementation protocols to improve the accuracy of the measure-level “Unit” data field. The inconsistencies are easily identified, as the quantity of units is often a value of one (1) with conspicuously high kWh savings. These weighted values produce uncertainty in measure-level cost effectiveness testing.
- The program implementer should consider a solution to improve operational protocols or system technical enhancements that would ensure all project documentation is available in the program tracking system for evaluator review.
- To improve the ex ante savings estimates for screw-in general illumination lighting the program team should consider adjusting the baseline wattage as well as the lumen equivalence to align with the federal standard—EISA Act of 2007.

1.3. Regulator Research Questions – Process Conclusions and Recommendations

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 2015, 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?

- Findings from this evaluation point to several possible types of "market imperfections" or structural factors that may affect the ability of Ameren Missouri customers to undertake energy efficiency upgrades (on their own or through the BizSavers programs). The previous evaluation identified three of these: cost, lack of program awareness, and business size. This evaluation provided evidence that other factors may include geography and possibly the level of preparation of retro-commissioning service providers. Several of these factors are to some degree interrelated.
- Cost. The higher upfront cost of energy efficient equipment is a barrier; even when the equipment pays for itself in the long term, the first cost must compete with other priorities. Evidence includes the high NTG ratios for the BizSavers program and the interviews and surveys with trade allies and participants, which emphasized the importance of incentives in driving the efficiency upgrades.
- Awareness. Data from the trade ally survey suggests that about half of Ameren Missouri customers were unaware of the incentives *before the trade allies discussed them*. This suggests an awareness level of about 50% at the start of the 2015 program year, consistent with data from the previous (2014) evaluation's survey of nonparticipant customers. The degree to which the trade allies' efforts increased overall program awareness in the past program year depends on their increased reach into the market. Lack of awareness is a particular concern for the New Construction Program: of surveyed BizSavers participants that had not received the new construction incentives, 70% were not aware of those incentives. Although the program met its 2015 goals, lack of awareness may prevent future program expansion. Finally, evidence from retro-commissioning service providers (RSPs) suggests that awareness of the retro-commissioning incentives is lower in customer types that do not typically employ in-house facility managers.
- Business size. Businesses in the small rate class constitute a smaller percentage of program savings than their share of annual kWh usage. This holds true both for small accounts that are part of a larger aggregate of accounts (chains, franchises, and such) and those that are not part of a larger aggregate ("small businesses").

Surveyed trade allies tended to report that limited capital caused lower uptake of energy efficiency in small businesses.

- Geography. BizSavers projects and participants are disproportionately more from St. Louis and its suburbs than from more remote areas of the Ameren Missouri service territory, and the savings from projects in St. Louis and its suburbs are disproportionately higher than elsewhere. This may be at least partly due to the fact that customers in the smallest rate class – in particular, those that are not part of a larger aggregate – make up a higher percentage of accounts outside of St. Louis and its suburbs.
- Preparation of Retro-commissioning Service Providers. Finally, some evidence suggests that some RSPs may not provide customers with an adequate explanation of the purpose of retro-commissioning and of the processes that make it distinct from an equipment retrofit project. Customers that do not fully understand what the retro-commissioning process involves may be less likely to undertake a retro-commissioning project and may be less likely to realize the full potential savings of a project. Further, the industrial segment appears to be dominated by an RSP that specializes in air compression, which may create a barrier to learning about building optimization.

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 previous evaluations, the range of business types in Ameren Missouri territory were well represented among standard and custom retrofit projects, suggesting that the program is effectively reaching the main segments of the target market. As noted above, small businesses constitute are somewhat under-represented in terms of savings.
- The current evaluation found evidence that awareness of the Retro-Commissioning Program may vary among business types, being greatest among those that typically employ in-house facility managers, such as hospitals, large hotels and casinos, and universities. Some evidence suggests that there may be greater awareness of the retro-commissioning compressed air option than the building optimization among industrial customers, resulting from that fact that one RSP that specializes in compressed air service serves a high share of the industrial market. Such findings do not necessarily suggest a need to alter the way the target market segment is defined, but rather to adjust some aspects of program delivery (see below).

Research Question 3: Do program measures reflect the diversity of end-use needs and available technologies for target segment?

- As previous evaluations found, participant and trade ally surveys showed satisfaction with the range of program-eligible equipment, delivery time for ordered equipment, and the quality of the equipment and the installation. The standard incentive application covered the equipment needs of most participants who used that option. Findings from the trade ally survey from this year's evaluation suggest that T-12 lighting makes up more than one-third of tube lighting in Ameren Missouri service, which suggests that the program-eligible tube lighting types remain viable replacements options.

- Retro-commissioning participants continue to be highly satisfied with the services they received, the cost savings, and the performance of the program measures. Industrial customers, however, may not be completely aware of the full range of retro-commissioning options available to them because one RSP that specializes in compressed air service serves a high share of the industrial market.
- The interviewed new construction participants generally indicated that the range of program-eligible equipment met their needs, but this must be viewed in the context that the program reached most of these participants after the design phase, when their "equipment needs" largely consisted of lighting. In 2015, about 40% of new construction savings came from lighting measures. In a broader context, the ability of the New Construction Program to meet the diversity of end-use needs and available technologies is limited by the ability of program staff to become involved before building design takes place. On a related note, the interviewed new construction trade allies reported that the modeling requirements for doing custom measures in new construction projects took too long to fit within the construction timelines; earlier program involvement in new construction projects could reduce the time pressure that may limit savings from custom measures.

Research Question 4: Are communication and delivery channels/mechanisms appropriate for the target market segment?

- The BizSavers program exceeded savings goals for 2015. The program implementer reported using a wide range of marketing outreach channels and methods to reach end-use customers and service providers (e.g., contractors, vendors, and distributors). The implementer introduced some new outreach approaches in 2015, including conducting targeted outreach to decision makers representing customer account aggregates or "towers." Evidence suggests that this approach has been effective within St. Louis and suburbs but not as effective in outer areas. Findings indicate that program participants and trade allies are in general satisfied with information received from program staff. The evaluation team identified a few areas where enhanced program communication and/or delivery may help ensure continued program growth in future cycles.
- As indicated above, there is still evidence of low awareness of BizSavers incentives in general and of new construction incentives in particular. Even participants with

past BizSavers program experience did not seek out new construction incentives prior to designing their building.

- There is some evidence that some RSPs may not provide detailed explanations of retro-commissioning to prospective customers. Retro-commissioning does not appear to be a core part of the business of many approved RSPs. One-third of the approved RSPs had not yet done any projects, and another third had done very little of the project work. Further, as noted above, the program may not be effective in providing information on building optimization to industrial customers that may get their information primarily from one RSP that specializes in air compression. The implementer's general outreach to trade allies does not encompass specific work with RSPs, which may limit the program's ability to ensure that RSPs are appropriately prepared to provide information on the range of retro-commissioning options and benefits.
- Despite a wide range of activities designed to improve the program's reach into small businesses, this sub-segment is still under-represented in program savings. Program staff reported plans for incorporating distribution of free direct-install measures, which have been found to be a cost-effective method for achieving savings in the small business segment,[3,4,5] in future offerings.
- Implementer staff reported that the Ameren Missouri customer database does not identify the customer business or building type; therefore, the implementer cannot use customer data to support targeted marketing and outreach.

Research Question 5: Are there better ways to address market imperfections to increase adoption of each program measure?

- Any future program implementer should work to increase promotion of the new construction and retro-commissioning incentives to customers doing standard and custom retrofit projects. In particular, given that most retrofit participants planning new construction or major renovation projects are unaware of new construction incentives, increasing the awareness of those incentives and of the importance of involving the program staff early in the design phase could have a significant impact on savings. Things to consider may include providing incentives or other forms or recognition to retrofit contractors who refer customers to the New Construction or

[3] 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.

[4] 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.

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

Retro-Commissioning Program as well as targeting customers that have submitted applications for retrofit incentives with direct marketing and outreach that focuses on new construction and retro-commissioning incentives.

- Any future program implementer should intensify outreach to architects and design engineers to improve New Construction Program uptake. Suggested activities include producing more case studies (based on recent projects) and fact sheets to provide information on design options (something that Lockheed did early in the program); providing seminars on specific design options and features; and offering recognition to “green leaders” in the architecture and design fields.
- Any future program implementer should work with RSPs to ensure that they are appropriately prepared and understand the value of fully explaining all aspects of retro-commissioning to prospective participants, focusing on equipment optimization and monitoring. It may be valuable to encourage and support RSPs that currently do not serve industrial customers to enter that segment.
- Ameren Missouri and any future implementer should continue and expand outreach efforts in parts of the Ameren Missouri service territory outside of St. Louis and its suburbs, particularly to small businesses in those areas. The inclusion of free direct install of low-cost measures, to generate immediate cost-effective savings and generate interest in future projects, may help address the fact that small businesses outside of St. Louis and its suburbs are particularly under-represented in program savings.
- Ameren Missouri should consider adding customer type information to its customer database. This would be a large undertaking, but it would make it easier for programs to identify any under-served segments and improve reach into those segments. It also would improve assessments of program reach to various business and building types. Segmenting the nonresidential sector in the same way as CBECS would permit comparisons of Ameren Missouri customer segmentation with statewide and nationwide data.

2. Introduction

This report presents the results of the impact, process, and cost effectiveness 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 2015 calendar year.

2.1. Program Descriptions

The design of the BizSavers Program is to help businesses identify and implement energy saving projects. The four program components evaluated in this report are as follows:

- Standard incentives: which are payments for the installation or use of specific energy efficient equipment.
- Custom incentive: 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 level of savings (<500,000kWh=$0.02/kWh, >500,000 kWh=$0.03/kWh).The implementation incentive is paid at $.07/kWh saved. The total customer incentive is the sum of both the study incentive and the implementation incentive.[6]
- New Construction Program offers a holistic energy efficiency approach to building design and construction. Expanded building footprint, new buildings and gut-and-rehab for change of purpose may qualify for New Construction incentives. The New Construction Program offers four types of incentives -- Standard, Custom, Installed Interior Lighting and Whole Building Performance. Actual incentive opportunities are evaluated and determined on a case-by-case basis during a project design team meeting following receipt of the application.

[6] https://www.ameren.com/-/media/missouri-site/Files/UEfficiency/businessenergyefficiency/BizSavers/RetrocommissioningIncentiveGuidelines.pdf

Table 2-1 New Construction Program Incentives

Whole Building Performance	*Custom (Lighting)*	*Custom (Non-lighting)*	*Installed Interior Lighting*	*Standard*
$0.02/kWh	$0.06/kWh	$0.07/kWh	$0.40/watt reduced	See Form 100S
$0.03/kWh				
$0.04/kWh				

Table 2-2 shows the gross ex ante kWh savings by program during the 2015 calendar year. There were 1,932 custom projects with a gross ex ante energy savings of 173,413,090 kWh. During the same period, there were 2,180 standard projects with gross ex ante savings of 60,206,547 kWh. There were sixty-seven new construction projects completed with gross ex ante savings of 29,664,868 kWh, and forty retro-commissioning projects with gross ex ante savings of 41,015,120 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	1,932	173,413,090	25,943.02
Standard	2,180	60,206,547	14,680.48
New Construction	67	29,664,868	3,437.96
RCx	40	41,015,120	719.30
Total	4,179	304,299,625	44,780.76

2.2. Program Trends in 2015

During 2015, the Custom and Standard Programs both started strong and experienced surges in activity late in the year. Figure 2-1 Custom Program Gross Ex Ante Savings by Measure Start-up Month plots the Custom Program activity based on gross ex ante savings by project start-up month. In late April, there was a surge in Custom Program activity due to the expiration of the T-12 bonus incentive. In Q4 Ameren Missouri announced that there would be a delay to the program start in 2016 while the Missouri Public Service Commission reviewed and approved the plan for the next 3-year program cycle. As a result, customers submitted completion applications for approximately 60.4M kWh in Custom Program gross ex ante savings in November 2015.

Figure 2-2 plots the Standard Program gross ex ante savings by project start-up month. Standard Program activity was similar to Custom in that it started strong and surged late in the year. Customers submitted completion applications for approximately 15M kWh in gross ex ante savings in November.

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

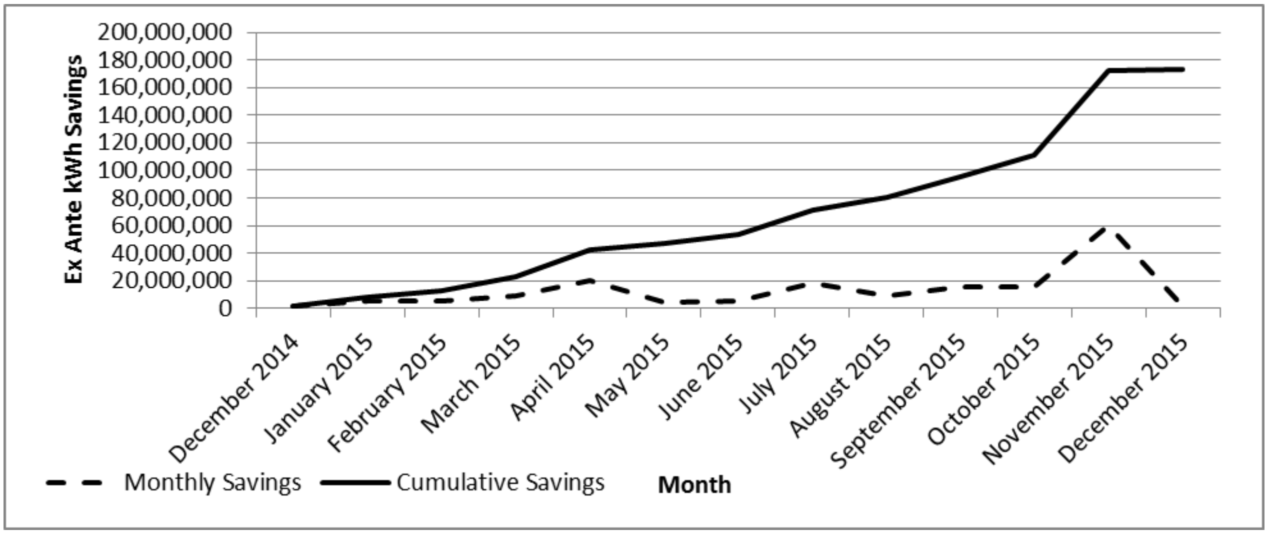
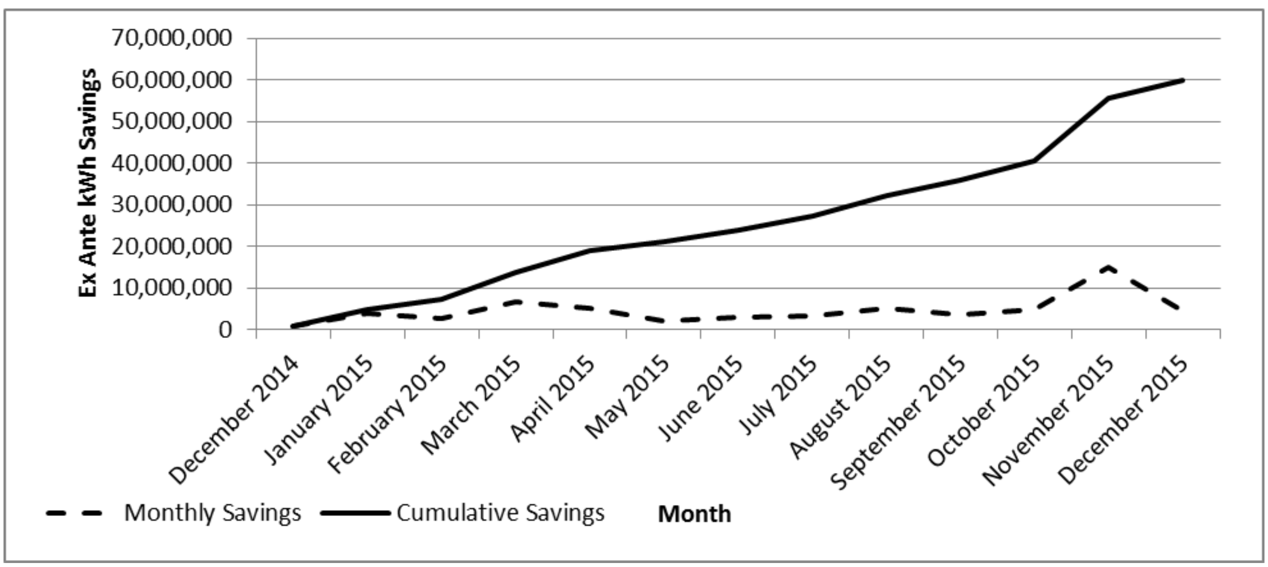


Figure 2-2 Standard Program Gross Ex Ante Savings by Measure Start-up Month



The New Construction and Retro-Commissioning Programs got off to a slow start in 2015. However, the New Construction Program picked up momentum by summer and the Retro-Commissioning Program gained traction by August. Both programs exceeded their energy savings goals by the end of 2015. *Figure 2-3* and Figure 2-4 below display the gross ex ante program savings by month as well as cumulatively. New construction and retro-commissioning customers submitted completion applications for approximately 7.3M kWh and 21.5M, respectively, in gross ex ante savings in November.

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

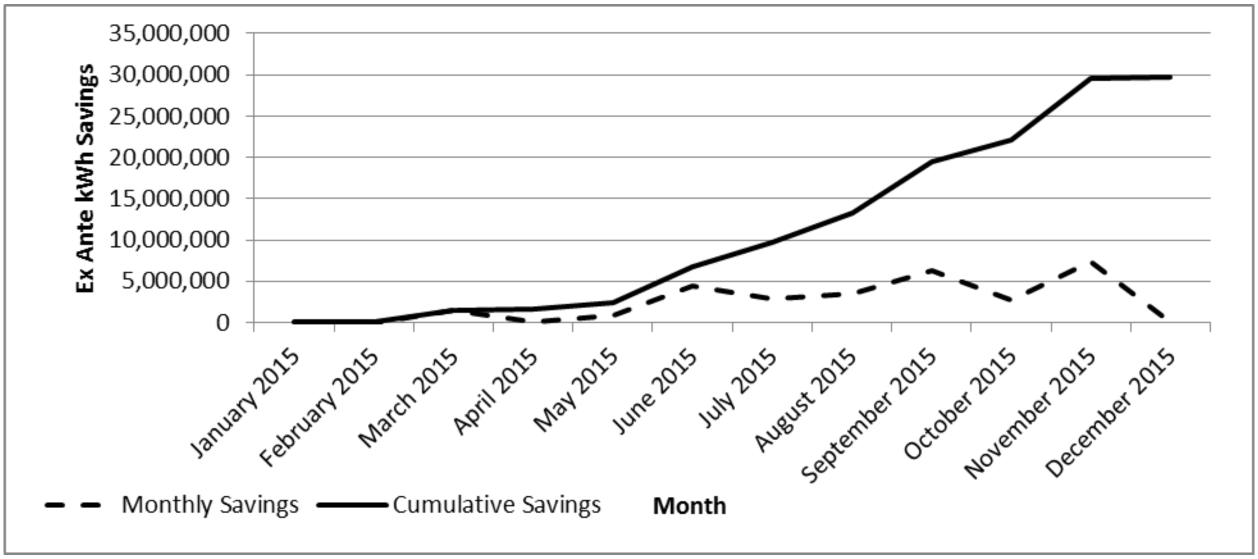
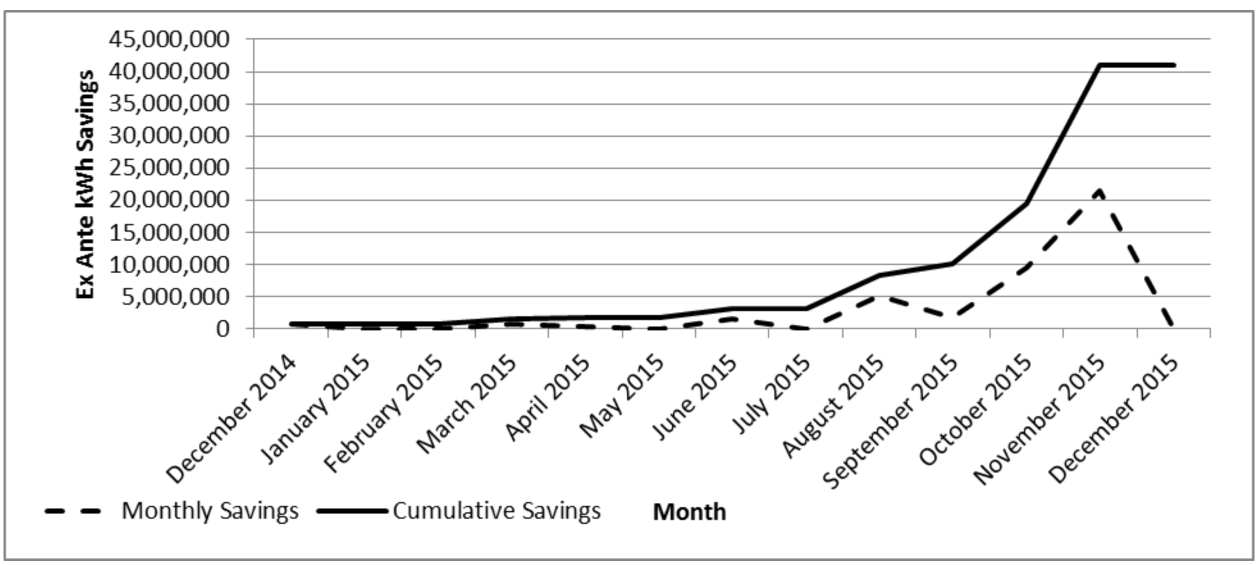


Figure 2-4 Retro-commissioning Gross Ex Ante Savings by Project Start-Up Month



2.3. Organization of Report

This report on the impact and process evaluation of the program for the period January 2015 through December 2015 is as follows:

- Chapter 3 presents and discusses the methods used for and the results obtained from estimating gross ex post 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: Project-Level Analyses
- Appendix B: Program Staff Interview Guide
- Appendix C: Trade Ally Training Evaluation Survey Form
- Appendix D: Participant Online Survey
- Appendix E: TA Semi-Structured Interview Guide
- Appendix F: Non-participant Spillover Methodology
- Appendix G: TA Spillover Survey – Contractor Version
- Appendix H: TA Spillover Survey – Vendor Version
- Appendix I: TA Semi Structured Interview Guide - NC
- Appendix J: TA Semi Structured Interview Guide - RCx
- Appendix K: Near Participant In-depth Interview Guide
- Appendix L: Heating and Cooling Interactive Factors
- Appendix M: Update to 2014 EM&V Recommendations
- Appendix N: Cost Effectiveness - Critical Technical Data
- Appendix O: Glossary of Terms

3. Estimation of Gross Ex Post Savings

This chapter explains the estimation of gross ex post kWh savings and gross ex post peak kW savings for year 2015 program participants from measures installed in their facilities. ADM performed impact analyses in accordance with evaluation requirement 4 CSR 240-22.070 (8). 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: Project-Level Analyses 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 2015 calendar year, there were 1,932 projects with custom measures having gross ex ante savings of 173,413,090 kWh annually and 2,180 projects with standard measures having gross ex ante savings of 60,206,547 kWh annually. There were sixty-seven new construction projects with gross ex ante annual savings of 29,664,868 kWh, and there were forty retro-commissioning projects with gross ex ante annual savings of 41,015,120 kWh. The evaluation team used stratified statistical sampling for all four programs.

The basis for the estimation of savings for all four programs is 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 9.6%, and the actual relative precision of the Standard Program sample is 9.2%. ADM calculated the actual relative precision of the New Construction Program sample is 10.1%, while the Retro-Commissioning Program precision is 9.7%.

Table 3-1 Statistical Precision by Program

Program	*Statistical Precision*
Custom	9.6%,
Standard	9.2%
New Construction	10.1%,
Retro-commissioning	9.7%.

The sample selection projects were ones completed throughout the 2015 program year. The evaluation team developed quarterly samples 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 evaluation 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 3-2 Population Statistics Used for Sample Design for Custom Program

	Stratum 1	*Stratum 2*	*Stratum 3*	*Stratum 4*	*Stratum 5*	*Totals*
Strata boundaries (kWh)	35,286 <	35,287 – 318,730	140,217 - 318,730	318,731 - 1,196,658	1,196,659 - 3,909,947	-
Number of projects	1112	529	189	86	16	1,932
Total kWh savings	16,111,708	37,454,280	39,602,946	44,525,164	35,718,992	173,413,090
Average kWh Savings	14,483	70,802	209,539	517,734	2,232,437	89,758
Standard deviation of kWh savings	9,122	8,023	50,141	218,580	808,088	242,171
Coefficient of variation	0.63	0.40	0.24	0.42	0.36	2.70
Final design sample	9	6	7	9	9	40

Table 3-3 shows the number of standard projects in 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 achieves the desired statistical precision.

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)	15,176 <	15,177 - 44,682	44,683 - 119,443	119,444 - 255,284	255,285 - 1,017,680	-
Number of projects	1286	556	239	78	21	2,180
Total kWh savings	7,842,867	14,837,325	16,455,121	12,618,911	8,452,323	60,206,457
Average kWh Savings	6,099	26,686	68,850	161,781	402,492	27,618
Standard deviation of kWh savings	3,911	8,146	19,822	33,162	199,029	54,129
Coefficient of variation	0.64	0.31	0.29	0.20	0.49	1.96
Final design sample	9	8	6	4	10	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 new construction 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)	85,483 <	85,484 - 387,912	387,913 - 847,934	847,935 - 1,767,204	1,767,205 - 2,641,881	
Number of projects	28	20	8	6	5	67
Total kWh savings	1,110,906	4,090,362	5,007,155	7,939,586	11,516,859	29,664,868
Average kWh Savings	39,675	204,518	625,894	1,323,264	2,303,372	442,759
Standard deviation of kWh savings	20,413	79,251	140,403	278,576	245,174	660,704
Coefficient of variation	0.51	0.39	0.22	0.21	0.11	1.49
Final design sample	2	3	1	2	2	10

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

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

	Stratum 1	*Stratum 2*	*Stratum 3*	*Stratum 4*	*Stratum 5*	*Totals*
Strata boundaries (kWh)	743,020 <	743,021 - 1,521,595	1,521,596 - 2,008,672	1,521,596 - 2,008,672	2,008,673- 7,455,328	
Number of projects	13	14	8	2	3	40
Total kWh savings	3,510,075	8,083,698	9,525,817	3,866,998	16,028,532	41,015,120
Average kWh Savings	270,006	577,407	1,190,727	1,933,499	5,342,844	1,025,378
Standard deviation of kWh savings	112,714	109,732	221,250	-	2,009,147	1,402,864
Coefficient of variation	0.42	0.19	0.19	0.05	0.38	-
Final design sample	2	1	1	1	3	8

The sample of custom projects, shown in Table 3-6, account for approximately 16% of the total Custom Program's gross ex ante kWh savings. The sample of standard projects, shown in Table 3-7, account for approximately 10% 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	20,699,912	35,718,992	58%
4	4,183,710	44,525,164	9%
3	1,804,954	39,602,946	5%
2	264,702	37,349,280	1%
1	135,071	16,111,708	1%
Total	27,088,349	173,413,090	16%

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	4,558,504	8,452,323	54%
4	764,009	12,618,911	6%
3	374,552	16,455,121	2%
2	222,698	14,837,325	2%
1	55,018	7,842,867	1%
Total	5,974,781	60,206,547	10%

The sample of new construction projects, shown in Table 3-8, account for approximately 30% 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 50% of the total Retro-Commissioning Program's gross ex ante kWh savings.

Table 3-8 Gross Ex Ante Savings - 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	4,685,669	11,516,859	41%
4	2,634,753	7,939,586	33%
3	668,180	5,007,155	13%
2	722,517	4,090,362	18%
1	58,480	1,110,906	5%
Total	8,769,599	29,664,868	30%

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*
5	16,028,532	16,028,532	100%
4	1,858,326	3,866,998	48%
3	1,227,000	9,525,817	13%
2	730,106	8,083,698	9%
1	732,876	3,510,075	21%
Total	20,576,840	41,015,120	50%

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. Examination of each application to determine whether the following types of information is included:

- 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.

ADM notified Ameren Missouri in two ways with the selection of projects for the M&V sample:

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 the installation of energy efficiency measures, the installation was correct, 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 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 for analysis. 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. Table 3-10 summarizes the set of methods to determine gross savings for these listed projects. Project-specific information on procedures used to estimate savings of sampled projects is contained in Appendix A: Project-Level Analyses

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. An analysis of sites with relatively high or low realization rates 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: Project-Level Analyses

The following discussion describes the basic procedures used for estimating savings from various measure types.

3.1.4.1. Method 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. Participants often complete retrofit projects in combination with the installation of lighting control measures, such as motion sensors or daylight controls. Controls reduce the operating hours and/or current passing thorough the connected fixture or group of 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 with comparable average operating hours. For industrial customers, expected usage areas include fabrication areas, clean rooms, office space, hallways/stairways, and storage areas. Designation of typical usage area is 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.

Using the on-off profile and fixture wattages calculation provides the post-retrofit kWh. The Calculation of dividing the total kWh usage calculated during Ameren Missouri’s peak period of the day by the number of hours in the peak period provides the fixture demand.

The calculation difference between the peak period baseline demand and post-installation peak period demand of the effected lighting equipment provides the peak period demand savings, per the following formula:

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

The calculation of dividing the total kWh usage during the peak period by the number of hours in the peak period provides for the baseline and post-installation average demands. Calculating the lighting peak kW as equal to the average hourly kWh savings that occurred during the peak period, based either on metered or verified data.

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

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

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

- Results from the monitored sample calculate the average operating hours of the metered lights in each period for every unique building type/usage area.
- Applying this average operating hours 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. Similarly, the post-retrofit energy usage is calculated. The calculated energy savings are the difference between baseline and post-installation energy usage.
- Savings from lighting measures in conditioned spaces factored by the region-specific, building type-specific heating and cooling interaction factors (HCIF) 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. See the factors shown in Appendix L: Heating and Cooling Interactive Factors. Note that the kWh HCIF is calculated as 1 + *HIF* + *CIF*.

ADM calculates energy savings for lighting controls by one of two methods, depending on the availability of data. With sufficient monitoring data, applying an algorithm to time series monitoring data to estimate the lighting operating hours prior to implementation of lighting controls. For each monitored hour during which there was no lighting use, the assumption that in the absence of lighting controls, there would have been no lighting use. For each monitored hour during which there was any lighting use, the assumption that in the absence of lighting controls, there would have been lighting use during the entire hour. The application of these assumptions generates assumed baseline lighting operating hours.

In the absence of sufficient monitoring data, an alternative method was employed to estimate baseline lighting operating hours prior to implementation of lighting controls: divide the verified lighting operating hours after implementation of lighting controls by 0.7. This method is based on an assumption found in ASHRAE 90.1-1989, that implementation of lighting controls is generally associated with a 30% reduction is lighting operating hours.

3.1.4.2. Method for Analyzing Savings for Motors

Estimates of the energy savings from use of high efficiency motors on HVAC and non-HVAC applications derived an "after-only" analysis. With this method, energy usage is determined only for the high efficiency motor and only after installation. High efficiency motor nameplate data, one time power measurements, and/or power monitoring equipment determine energy use. Data collected estimate the energy use for the motor application in the absence of high efficiency motor installation. 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, calculation for demand and energy savings can be as follows:

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

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.

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

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.

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

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.[7]

Obtaining from different sources the information on motor efficiencies needed for the calculation of savings.

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 are in Ameren Missouri's program records. Taking care using nameplate efficiency ratings of replaced motors, unless the company maintains good documentation of their equipment. If there is a rewound motor, 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, establishing the baseline efficiency as the efficiency of a new, standard efficiency motor. However, in cases of early replacement, the efficiency of the old motor is used for the length of the remaining life.[8]

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. [9]

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

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

[9] 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:

The data collection from several sources is required to carry out these plans for determining savings.

- 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. Collection of data by ADM staff 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), lighting occupancy sensors, lighting dimmers and controls, air conditioning, high efficiency motors, etc.
- As a fourth source of data, monitoring selected end-use equipment to develop information on operating schedules and power draws.

3.1.4.3. Method 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. Summarizing the interplay of these two factors 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, have been estimated to account for 50% to 60% of total motor energy use in the non-residential sectors. Energy saving VFDs may be 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.

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

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 implementation of multiple VFDs 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. Method 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. Evaluation of savings from such measures through engineering analysis of compressor performance curves, supported by data collected through short-term metering.

ADM field staff obtains nameplate information either for the pre-retrofit equipment 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 inspects 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 the customer or contractor does not supply power-monitoring data, 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 selection of 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. Method 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 40 custom projects, 37 standard projects, 10 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. In this section are the results of that analysis results. Note that detailed, site-level analysis results are presented in Appendix A: Project-Level Analyses.

3.2.1. Gross Ex Post kWh Savings

The gross ex post kWh savings for the Custom Program during the 2015 calendar year are summarized by sampling stratum in

Table 3-11. Overall, gross ex post energy savings of 180,356,468 kWh were equal to 104% of the gross ex ante savings.

Table 3-12 shows the ex ante and ex post Custom Program energy savings by sample project.

Table 3-11 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	35,718,992	33,884,412	95%
4	44,525,164	48,119,948	108%
3	39,602,946	41,033,208	104%
2	37,349,280	38,240,856	102%
1	16,111,708	19,078,044	118%
Total	173,413,090	180,356,468	104%

Table 3-12 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	3,707,600	3,531,645	95%
C-2	2,699,324	2,699,324	100%
C-3	2,695,794	2,467,515	92%
C-4	2,519,308	2,564,820	102%
C-5	2,420,400	1,635,519	68%
C-6	2,213,550	2,205,692	100%
C-7	1,683,975	1,687,061	100%
C-8	1,495,805	1,468,026	98%
C-9	1,264,156	1,377,132	109%
C-10	871,855	932,172	107%
C-11	546,875	537,657	98%
C-12	529,655	540,310	102%
C-13	502,713	463,104	92%
C-14	402,960	410,442	102%
C-15	337,608	324,980	96%
C-16	335,272	371,158	111%
C-17	331,873	356,451	107%
C-18	324,899	585,212	180%
C-19	308,797	308,789	100%
C-20	281,099	271,060	96%
C-21	260,927	411,115	158%
C-22	257,322	249,084	97%
C-23	256,914	145,664	57%
C-24	248,180	274,975	111%
C-25	191,715	209,453	109%
C-26	59,734	62,254	104%
C-27	51,154	51,107	100%
C-28	41,566	40,998	99%
C-29	39,666	40,421	102%
C-30	36,316	35,811	99%
C-31	36,266	39,670	109%
C-32	29,761	34,138	115%
C-33	28,132	37,015	132%
C-34	15,739	18,054	115%
C-35	15,554	12,775	82%
C-36	15,238	17,584	115%
C-37	11,950	11,972	100%
C-38	11,186	16,239	145%
C-39	4,031	8,651	215%
C-40	3,480	3,511	101%
All Non-Sample Projects	146,324,741	153,897,908	105%
Total	173,413,090	180,356,468	104%

The gross ex post kWh savings for the sampled Custom Program are presented by measure in Table 3-13.

Table 3-13 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*
DX-Redesign	83,833	24,623	29%
HVAC-Ductwork Sealing	148,848	59,955	40%
Controls-Refrigeration Condenser Motors	256,914	145,664	57%
Building Envelope - Reduce Infiltration	803,751	526,528	66%
Controls-Guest Room Energy Management, Electric Heating	2,420,400	1,635,519	68%
Controls-Direct Digital Controls	3,707,600	3,531,645	95%
CFL-GU 24 pin based CFL -30W	243,705	234,503	96%
T5-T5 Replacing HID/Inc/Fluorescent	332,747	322,083	97%
Induction-Induction Replacing HID/Inc/Fluor	1,495,805	1,468,026	98%
Process-Industrial-Induction Tube Welder	546,875	537,657	98%
T8-400 Watt HID to 6 Lamp T8	258,220	254,280	98%
LED-Exterior LED replacing 175W-400W HID	1,020,514	1,007,972	99%
LED-Exterior LED replacing Linear Fluorescent	4,427,824	4,427,816	100%
LED-Exterior LED replacing 1000W HID	1,687,970	1,690,989	100%
Pump-High Efficiency Pumps	2,519,308	2,564,820	102%
Lighting-LED-LED Replacing T12	974,499	1,017,324	104%
LED-High Bay LED replacing 175W-400W HID	714,331	762,730	107%
T8-4' T8 replacing 4' Fluorescent	1,216,576	1,319,801	108%
T8-2' T8 Fluorescent replacing 2' Fluorescent	188,477	205,321	109%
HVAC-Controls-HVAC Optimization - SP Control	191,715	209,453	109%
LED-LED replacing Incandescent	36,266	39,670	109%
Lighting-LED Replacing 4ft - 3 lamp T8	81,608	90,139	110%
T5-4 Lamp T5 High Bay low BF	742,073	821,231	111%
Lighting-LED Replacing 4ft 4-lamp T12	237,773	263,274	111%
LED Fixture Replacing HID Fixture <175 Watts	248,180	274,975	111%
LED-2' LED Fixture Replacing Fluorescent	1,261	1,398	111%
LED-4' LED Tube replacing Fluorescent Fixture	95,935	106,651	111%
Lighting-LED Replacing 8ft 2-lamp T8 VHO	97,454	121,315	124%
LED-LED Redesign	241,040	305,246	127%
No Loss Drains-No Loss Drains Replacing Cond	18,560	24,468	132%
Lighting-T8-T8 Replacing T12	80,045	107,894	135%
Lighting-Redesign-Replacing T12	11,186	16,239	145%

Measure Name	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Savings Realization Rate*
Air Compressor-Adding an Air Compressor to Aid Low Load Conditions	275,036	486,308	177%
System-Compressed Air Optimization	31,303	74,437	238%

The gross kWh savings of the Standard Program during the 2015 calendar year are summarized by sampling stratum in Table 3-14. Overall, gross ex post kWh savings of 66,999,720 kWh were equal to 111% of the gross ex ante kWh savings.

Table 3-14 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	8,452,323	8,428,489	100%
4	12,618,911	15,119,705	120%
3	16,4255,121	18,725,612	114%
2	14,837,325	18,878,617	127%
1	7,842,867	5,847,297	75%
Total	60,206,547	66,999,720	111%

Table 3-15 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 Project

ID	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Savings Realization Rate*
S-1	1,017,680	964,559	95%
S-2	567,897	585,305	103%
S-3	547,513	203,751	37%
S-4	533,134	1,109,542	208%
S-5	343,392	240,442	70%
S-6	343,392	240,442	70%

ID	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Savings Realization Rate*
S-7	335,805	371,487	111%
S-8	308,659	341,467	111%
S-9	299,432	285,693	95%
S-10	261,600	202,962	78%
S-11	221,540	205,549	93%
S-12	205,772	227,645	111%
S-13	198,742	356,207	179%
S-14	137,955	126,018	91%
S-15	88,704	82,097	93%
S-16	63,277	69,999	111%
S-17	61,285	70,286	115%
S-18	59,410	47,667	80%
S-19	53,100	120,002	226%
S-20	48,776	36,182	74%
S-21	36,800	79,862	217%
S-22	34,830	37,684	108%
S-23	29,424	63,906	217%
S-24	28,881	30,520	106%
S-25	28,616	3,238	11%
S-26	23,453	25,948	111%
S-27	23,214	25,403	109%
S-28	17,480	16,794	96%
S-29	12,096	4,533	37%
S-30	10,725	6,467	60%
S-31	8,887	9,832	111%
S-32	6,654	6,014	90%
S-33	5,000	4,965	99%
S-34	4,317	3,818	88%
S-35	3,931	2,708	69%
S-36	2,853	2,398	84%
S-37	555	284	51%
All Non-Sample Projects	54,231,766	60,788,044	112%
Total	60,206,547	66,999,720	111%

The gross ex post kWh savings for the sampled Standard Program are presented by measure in Table 3-16.

Table 3-16 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*
Refrigeration-ENERGY STAR® Ice Machine->1,000	12,096	4,533	37%
IT-Desktop Virtualization/Thin Client (2)	137,955	126,018	91%
Refrigeration-Refrigerator Door-LED Lighting	58,344	53,687	92%
IT-PC Power Management Software-(Per Desktop PC To Be Managed)	1,017,680	964,559	95%
Lighting-T8-T8 Replacing T12	12,086	11,755	97%
Building Envelope - Reduce	307	302	98%
Refrigeration-Automatic Door Closers	6,810	6,810	100%
Refrigeration-Electronically Commutated Motor-ECM (Refrigeration Only)	73,984	73,984	100%
Refrigeration-Glass Refrigeration Door-Heater Controls	91,589	91,589	100%
Refrigeration-Strip Curtain	60,696	60,696	100%
Lighting-Incandescent to LED-Lamp	4,314,715	4,373,711	101%
LED Lamps - pre-EISA	226,838	230,735	102%
HVAC-Ductwork Sealing	99,784	109,250	109%
T8-4' T8 replacing 4' Fluorescent	354	388	110%
Lighting-LED or ELD Exit Sign-Replacing Incand	5,913	6,526	110%
Lghtg Ctls-Occ Sensor Fixture Mounted-High Watt Fixture, >200 and <=500 watts Total	190,514	262,129	138%
Lghtg Ctls-Occ Sensor Single Tech-Controlling Circuit >120 Watts Total	197,029	286,360	145%
Lghtg Ctls-Occ Sensor Fixture Mounted-Low Watt Fixture, >50 and <=200 Watts Total	16,800	29,184	174%
Lghtg Ctls-Occ Sensor Dual Tech-Controlling Circuit >150 Watts Total	323,449	680,808	210%
Lghtg Ctls-Occ Sensor Single Tech-Controlling Circuit >50 and <=120 Watts Total	39,750	180,243	453%

The gross kWh savings of the New Construction Program during the 2015 calendar year are summarized by sampling stratum in

Table 3-17. Overall, gross ex post kWh savings of 29,192,255 kWh were equal to 98% of the gross ex ante kWh savings. Table 3-18 shows the ex ante and ex post New Construction Program annual energy savings by sample project.

Table 3-17 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	11,516,859	10,977,863	95%
4	7,939,586	7,091,086	89%
3	5,007,155	5,163,002	103%
2	4,090,362	4,730,538	116%
1	1,110,906	1,229,766	111%
Total	29,664,868	29,192,255	98%

Table 3-18 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	2,475,090	2,173,312	88%
N-2	2,210,579	2,293,065	104%
N-3	1,530,245	950,900	62%
N-4	1,104,508	1,402,278	127%
N-5	668,180	688,977	103%
N-6	387,912	363,519	94%
N-7	192,834	313,362	163%
N-8	141,771	158,716	112%
N-9	40,797	43,254	106%
N-10	17,683	21,483	121%
All Non-Sample Projects	20,895,269	20,783,389	99%
Total	29,664,868	29,192,255	98%

The gross ex post kWh savings for the sampled New Construction Program are presented by measure in Table 3-19.

Table 3-19 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*
Controls-Direct Digital Controls	300,652	19,053	6%
Lghtg Ctls-Occ Sensor Single Tech-Controlling Circuit >50 and <=120 Watts	24,381	5,388	22%
Miscellaneous-New Construction-Energy Efficiency Upgrades Over Baseline Building	967,211	319,180	33%
Envelope-Windows-NC	205,317	70,604	34%
Lghtg Ctls-Occ Sensor Dual Tech-Controlling Circuit >150 Watts	242,250	128,248	53%
Lghtg Ctls-Occ Sensor Single Tech-Controlling Circuit >120 Watts	77,280	52,863	68%
Chiller-Chiller Plant	686,416	595,315	87%
Process-Industrial-Injection Molding	187,680	170,108	91%
T8-4' T8 replacing 4' Fluorescent	47,616	44,147	93%
New Construction - Lighting-Exterior Lighting	40,500	42,957	106%
Lighting-New Construction - Lighting	4,622,902	4,981,169	108%
LED-Exterior LED replacing 175W-400W HID T	200,354	223,814	112%

Measure Name	*Gross Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross kWh Savings Realization Rate*
LED-Exterior LED replacing Linear Fluorescent	9,465	10,641	112%
Process-Industrial-Dryer_508	274,176	316,493	115%
HVAC-Heat Recovery-NC	646,289	862,837	134%
Controls-Install Free Cooling Equipment/Controls	106,270	143,074	135%
Lghtg Ctls-Occ Sensor Fixture Mounted-High Watt Fixture, >200 and <=500 watts	37,500	62,506	167%
Variable Speed Air Compressor-Replace Fixed Speed Air Compressor with Variable Speed	93,350	365,610	392%

The gross kWh savings of the Retro-Commissioning Program during the 2015 calendar year are summarized by sampling stratum in Table 3-20. Overall, gross ex post kWh savings of 36,949,499 kWh were equal to 90% of the gross ex ante kWh savings. Table 3-21 the ex ante and ex post Standard Program annual energy savings by sample project.

Table 3-20 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*
5	16,028,532	14,652,157	91%
4	3,866,998	3,311,671	86%
3	9,525,817	6,522,460	68%
2	8,083,698	9,333,289	115%
1	3,510,075	3,129,922	89%
Total	41,015,120	36,949,499	90%

Table 3-21 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	7,455,328	6,193,990	83%
R-2	5,117,103	5,676,705	111%
R-3	3,456,101	2,781,462	80%
R-4	1,858,326	1,591,458	86%
R-5	1,227,000	840,144	68%
R-6	730,106	842,967	115%
R-7	379,800	317,261	84%
R-8	353,076	336,242	95%
All Non-Sample Projects	20,438,280	18,369,270	90%
Total	41,015,120	36,949,499	90%

The gross ex post kWh savings for the sampled Retro-Commissioning Program are presented by measure in Table 3-22.

Table 3-22 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 Total	63,200	42,976	68%
Controls-Minimize Outside Air Total	300,200	204,136	68%
HVAC-Controls-HVAC Optimization - Waterside Total	741,253	588,157	79%
HVAC-Controls-HVAC Optimization - Airside Total	2,058,480	1,650,103	80%
HVAC-Controls-HVAC Optimization - Set Point Control Total	17,413,707	16,095,774	92%

Gross ex post kWh savings of the Custom and Standard Programs during the 2015 calendar year are shown by building type in Table 3-23.

Table 3-23 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	6.3%	4.8%	0.0%	0.0%	4.6%
Lodging	4.9%	31.8%	0.7%	3.0%	9.6%
Warehouse	4.6%	1.3%	12.7%	0.0%	4.1%
Office	15.4%	9.5%	6.5%	5.8%	12.1%
Industrial	20.6%	1.8%	10.8%	9.9%	14.5%
Education	13.1%	9.6%	27.0%	19.7%	14.6%
Entertainment/Re	4.2%	7.3%	2.6%	3.9%	4.5%
Healthcare	6.0%	10.2%	26.7%	56.8%	15.7%
Retail	5.4%	6.7%	10.7%	0.0%	5.4%
Faith-Based	1.2%	4.6%	0.2%	0.9%	1.7%
Gas Station	1.9%	0.5%	0.0%	0.0%	1.1%
IT/Data Center	1.6%	0.0%	0.0%	0.0%	0.9%
Food & Beverage Service	0.9%	7.5%	0.2%	0.0%	2.0%
Parking Garage	2.1%	1.5%	1.0%	0.0%	1.6%
Government	8.5%	2.6%	0.0%	0.0%	5.3%
Automotive Services	3.3%	0.2%	1.1%	0.0%	2.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

3.2.2. Gross Ex Post Peak kW Savings

Table 3-24 shows the gross ex post peak kW reductions of the Custom, standard, new construction, and Retro-Commissioning Programs during the 2015 calendar year. The gross ex post peak savings are 22,662 kW for the Custom Program, 21,623 kW for the Standard Program, 20,819 kW for the New Construction Program, and 1,197 kW for the Retro-Commissioning Program. The high gross peak kW realization rates for the New Construction Program and the RCx Program are largely a result the 0 ex ante peak kW estimate for a number of measures. There are actually positive peak demand savings associated with these measures.

Table 3-24 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	25,943.02	22,662.11	87%
Standard	14,680.48	21,623.40	147%
New Construction	3,437.96	20,818.89	606%
RCx	719.30	1,196.54	166%
Total	44,780.76	66,300.94	148%

4. Estimation of Net Ex Post Savings

This chapter reports the results from estimating the net impacts of the program during calendar year 2015, 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: Participant Online Survey 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

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 and net-to-gross ratios for the BizSavers Program for the period January 2015 through December 2015. While Ameren Missouri's BizSavers Program 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.[10]

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 2016, 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 607 customer decision makers for projects completed during the 2015 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

[10] 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	49%	4%	15%	43%	15%
Standard	24%	2%	28%	57%	28%
NC	39%	2%	26%	70%	4%
RCx	79%	2%	2%	19%	0%

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 49% 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. The subsequent responses resulted in 8% of total gross ex post Custom Program savings to be associated with free-ridership.

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	1.85%	100.00%
Y	Y	N	Y	1.68%	100.00%
Y	Y	Y	Y	0.00%	100.00%
Y	Y	Y	N	0.47%	66.67%
N	Y	N	Y	1.28%	66.67%
N	N	N	Y	2.35%	33.33%
N	Y	N	N	7.76%	33.33%
N	Y	Y	Y	0.06%	33.33%
N	N	N	N	22.55%	0.00%
N	N	Y	N	9.90%	0.00%
N	N	Y	Y	1.79%	0.00%
N	Y	Y	N	1.28%	0.00%
Required program incentive to implement measures				49.04%	-
Custom Program free-ridership score				8.08%	

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 75% 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. The subsequent responses resulted in 5% of total gross ex post Standard Program savings to be associated with free-ridership.

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	1.36%	100.00%
Y	Y	N	Y	0.35%	100.00%
Y	Y	Y	Y	0.00%	100.00%
Y	Y	Y	N	0.04%	66.67%
N	Y	N	Y	1.81%	66.67%
N	N	N	Y	2.76%	33.33%
N	Y	N	N	3.67%	33.33%
N	Y	Y	Y	0.00%	33.33%
N	N	N	N	8.76%	0.00%
N	N	Y	N	5.64%	0.00%
N	N	Y	Y	1.06%	0.00%
N	Y	Y	N	0.10%	0.00%
Required program incentive to implement measures				74.47%	-
Standard Program free-ridership score				5.08%	

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, 61% 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. The subsequent responses resulted in 10% of total gross ex post New Construction Program savings to be associated with free-ridership.

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	1.72%	100%
Y	Y	N	Y	0.00%	100%
Y	Y	Y	Y	0.00%	100%
Y	Y	Y	N	0.00%	66.67%
N	Y	N	Y	2.55%	66.67%
N	N	N	Y	0.00%	33.33%
N	Y	N	N	19.86%	33.33%
N	Y	Y	Y	0.00%	33.33%
N	N	N	N	4.98%	0%
N	N	Y	N	9.03%	0%
N	N	Y	Y	0.60%	0%
N	Y	Y	N	0.52%	0%
Required program incentive to implement measures				60.73%	0%
New construction free ridership score				10.04%	

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. Savings of 0% percent are associated with respondents who indicated that they were financially unable to implement the project in the absence of the program incentive. The subsequent responses resulted in 2% of total gross ex post retro-commissioning savings to be associated with free-ridership.

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	2.02%	100%
Y	Y	N	Y	0.00%	100%
Y	Y	Y	Y	0.00%	100%
Y	Y	Y	N	0.00%	66.67%
N	Y	N	Y	0.00%	66.67%
N	N	N	Y	0.00%	33.33%
N	Y	N	N	0.00%	33.33%
N	Y	Y	Y	0.00%	33.33%
N	N	N	N	97.98%	0%
N	N	Y	N	0.00%	0%
N	N	Y	Y	0.00%	0%
N	Y	Y	N	0.00%	0%
Required program incentive to implement measures				0.00%	0%
Total				2.02%	

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. Table 4-7 below provides a summary of the program-level free ridership scores stated above.

Table 4-7: Percent of kWh Savings Associated with Free-ridership

Program Component	% of savings associated with free-ridership
Custom	8.08%
Standard	5.08%
New Construction	10.04%
RCx	2.02%

4.2.2. Results of Estimation of Spillover Energy Savings

During 2015 spillover energy impacts were assessed from program participants and non-participants. *Table 4-10* 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. Unlike in previous years the evaluation team assed only non-lighting participant spillover; the trade ally survey collected data for all potential lighting spillover which is discussed in next section. Twelve respondents indicated that they "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 non-lighting 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 the decision to install those measures was influenced by the program.

ADM attempted to contact all twelve of the program participants whose survey responses indicated a likelihood of non-lighting spillover energy impacts. Of the twelve participants contacted, two installed equipment that were influenced by the program. However, the savings were negligible and were not included in the impact analysis.

4.2.2.2. Program Non-Participants

During 2015, the evaluation team assessed non-participant spillover energy savings through data collected via trade ally surveys. Appendix F: Non-participant Spillover Methodology provides a detailed description of the methodology used for the analysis. The evaluation team's objective was to take a conservative approach to estimate non-participant spillover energy savings that occurred outside of the program but were influenced through upstream program partners, program trade allies. The evaluation team deemed it appropriate to focus only on lighting measure groups for which kWh energy savings could be reliably estimated.

The data collected was reflective of 2014 sales estimations, therefore the evaluation team determined is analytically appropriate to develop a deemed spillover rate that would be applied to the 2015 gross lighting ex ante kWh savings. The evaluation team used the lower bound spillover savings estimation (11,510,886 kWh) divided by 2014 gross lighting ex ante (100,519,333 kWh) to calculate a 11.45% non-participant spillover rate. When applied to the 2015 gross lighting ex ante kWh the result is 22,066,991 kWh in non-participant lighting kWh spillover savings attributed to the BizSavers Program in 2015. Table 4-8 below provides a summary.

Table 4-8: Non-Participant Spillover kWh Savings

	2014	2015
Gross lighting kWh	100,519,333	192,701,000
Non Participant Spillover	11,510,886	22,066,991
Factor	11.45%	11.45%
Source	2014 Study	Applied

Table 4-9 below provides a summary of participant and non-participant spillover kWh energy savings.

Table 4-9 Summary of Spillover kWh Energy Savings

Program	*Spillover Total*	*Participant Spillover*	*Non Participant Spillover*
Custom	18,012,690	3,497,293	14,515,397
Standard	6,154,273	17,165	6,137,109
New Construction	1,623,109	208,623	1,414,486
RCx	-	-	-
Total	25,790,072	3,723,081	22,066,991

4.2.3. Net Ex Post kWh Savings

Table 4-10 summarizes the program-level net ex post kWh savings. During this period, net ex post energy savings for the Custom Program totaled 183,922,275 kWh, while net ex post savings for the Standard Program totaled 69,539,890 kWh. The estimated net-to-gross ratio for the Custom Program is 102% and 104% for standard. The net ex post energy savings for the New Construction Program totaled 27,883,540 kWh, while net ex post savings for the Retro-Commissioning Program totaled 36,359,794 kWh. The estimated net-to-gross ratio for the New Construction and Retro-Commissioning Programs are 96% and 98%, respectively.

Table 4-10 Summary of Free-ridership, Spillovers, and Net kWh Savings by Program

Program	*Estimated Free Ridership*	*Spillovers*	*Gross Ex Post kWh Savings*	*Net Ex Post kWh Savings*	*Estimated Net-to-Gross Ratio*
Custom	14,446,883	18,012,690	180,356,468	183,922,275	102%
Standard	3,614,104	6,154,273	66,999,720	69,539,890	104%
New Construction	2,931,824	1,623,109	29,192,255	27,883,540	96%
RCx	589,705	-	36,949,499	36,359,794	98%
Total	21,582,516	25,790,072	313,497,943	317,705,499	101%

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

Table 4-11 below provides the free-ridership and spillover values as a percent of net ex post kWh savings. At the portfolio level kWh savings associated with free ridership represents 6.79% of total ex post net kWh savings. Additionally, at the portfolio level spillover kWh savings represents 8.12% of total BizSavers ex post net kWh savings.

Table 4-11: Summary of Free-ridership and Spillover as Percent of Gross Ex Post kWh

Program Component	*Net Ex Post kWh Savings*	*Estimated Free Ridership*	*FR as a % of Ex Post Net kWh*	*Spillovers*	*SO as a % of Ex Post Net kWh*
Custom	183,922,275	14,446,883	7.85%	18,012,690	9.79%
Standard	69,539,890	3,614,104	5.20%	6,154,273	8.85%
New Construction	27,883,540	2,931,824	10.51%	1,623,109	5.82%
RCx	36,359,794	589,705	1.62%	-	0.00%
Total	317,705,499	21,582,516	6.79%	26,029,673	8.12%

The following tables provide program-level savings summaries by measure type. The number of units and net ex post energy savings of the Custom, Standard, New Construction and Retro-Commissioning Programs are displayed in Table 4-12, Table 4-13, Table 4-14 and Table 4-15, respectively.

Table 4-12 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	5,226	7,760,214	8,129,234	7,706,821
HVAC	13,060	27,171,177	26,893,360	24,676,730
IT	700	1,386,757	1,462,883	1,388,938
Lghtg Ctls	1,913	865,832	919,185	868,847
Lighting	266,848	120,340,050	126,756,360	116,362,057
Miscellaneous	4	56,640	67,068	51,870
Motors	6,386	4,748,820	4,888,896	4,507,445
Process	275	1,341,746	1,356,043	1,111,428
Refrigeration	1,470	3,771,644	3,671,267	3,505,688
VFD	4,809	5,592,362	5,866,319	5,383,910
Envelope	1,400	377,848	345,852	345,852
Total		173,413,090	180,356,468	165,909,585

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

Table 4-13 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	5	63,744	75,212	72,432
IT	24,727	3,478,487	3,578,506	3,455,965
Lghtg Ctls	12,344	4,208,841	5,284,356	5,060,583
Lighting Controls	287,513	48,431,232	52,592,582	50,681,354
Refrigeration	3,826	3,397,304	3,707,119	3,436,650
VFD	677	596,909	723,736	642,483
Water Heat	52	30,030	38,209	36,148
Total		60,206,547	66,999,720	63,385,616

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

Table 4-14 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	450	226,455	268,511	253,446
HVAC	3,931	11,410,074	11,000,782	9,707,234
IT	247	52,754	50,766	45,668
Lighting Controls	2,882	1,442,080	1,537,995	1,359,935
Lighting	603	12,172,912	12,352,059	11,237,205
Miscellaneous	9	3,178,769	2,689,458	2,419,351
Process	2	461,856	586,370	586,370
Refrigeration	832	482,689	493,553	441,722
Study	11	-	-	-
VFD	14	22,392	23,089	20,770
Water Heat	55	9,570	9,390	8,447
Envelope	32	205,317	180,284	180,284
Total		29,664,868	29,192,255	26,260,431

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

Table 4-15 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	3,275	4,467,997	4,270,566	4,207,157
HVAC	8,498	35,888,498	32,113,545	31,595,730
Lighting Controls	22	38,129	33,999	33,999
VFD	90	620,496	531,389	522,908
Total		41,015,120	36,949,499	36,359,794

4.2.4. Net Ex Post Peak kW Savings

The net ex post peak kW savings of the program during the 2015 calendar year are summarized by program in Table 4-16. The net ex post peak savings for the Custom Program are 23,628 kW, while the net ex post peak savings for the Standard Program are 22,947 kW. The net ex post peak savings for the New Construction Program are 19,564 kW, while the net ex post peak savings for the Retro-Commissioning Program are 1,179 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 might 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 4-16 Summary of Free Ridership, Spillovers, and Net Peak kW Impacts by Program

Program	*Estimated Free Ridership*	*Spillovers*	*Gross Ex Post Peak kW Savings*	*Net Ex Post Peak kW Savings*	*Estimated Net-to-Gross Ratio*
Custom	1,899.84	2,856	22,662.11	23,628.50	104%
Standard	1,100.56	2,425	21,623.40	22,947.93	106%
New Construction	2,028.53	774	10,818.89	19,564.11	94%
RCx	16.57	-	1,196.54	1,179.97	99%
Total	5,035.50	6,055	66,300.94	67,320.50	102%

5. Process Evaluation

This chapter presents the results of the process evaluation of the Ameren Missouri BizSavers Programs during 2015. 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 eight main sections. The first section presents a summary of evaluation data sources and high-level summaries of process findings. The remaining sections provide details of methods and findings for each data source with separate sections for New Construction and Retro-Commissioning specific feedback.

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. As summarized in Table 5-1, the team interviewed or surveyed seven staff members of Ameren Missouri and its implementation contractor, Lockheed Martin; more than 800 program participants and near-participants; fifty-six trade allies; and eleven attendees of program outreach and education 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. High-level findings follow.

Table 5-1 Evaluation Data Collection Activities

*Data Source**	*Method*	*Dates*	*Key Research Topics*	*Analysis Type*
Program staff (7) Ameren Missouri (2) Lockheed Martin (5)	In-depth interview	September to December 2015	Program function; communication; tracking and reporting; quality control	Qualitative
Program documentation	Document review	January to December 2015	Program function; tracking and reporting; quality control	Qualitative
Database analysis	Database review	January 2015	Number of projects; project type and details; data quality	Quantitative
Participants, Standard and Custom Programs (843)	Online survey	Though 2015	Program experiences; installed equipment; satisfaction with program	Quantitative
Participants, New Construction and Retro-Commissioning Programs (12)	In-depth Interview	November to December 2015	Program experiences; installed equipment; satisfaction with program	Qualitative
Near-participants, Standard and Custom Programs (10)	In-depth Interview	November 2015	Program awareness; reason for program withdrawal; other energy efficiency activities; satisfaction with program	Qualitative
Trade allies and non-allied service providers (57)	Telephone survey	September to October 2015	Program awareness, energy decision-making, upgrades to energy-using equipment, barriers to participating in program, and interest in Ameren Missouri programs	Quantitative and qualitative
Retro-commissioning service providers (4) and NC trade allies (5)	In-depth Interview	October to November 2015		
Event attendees (7 attendees)	Online survey	May to October 2015	Event satisfaction; experience with training; Intention to work with *BizSavers*; firmographics	Quantitative and qualitative

* The final sample sizes are in parentheses.

5.1.1. Program Staff Feedback

Staff contacts reported that reporting structure, titles, and general responsibilities had remained the same since the previous evaluation. One new piece of information was that the Outreach Coordinator, whose outreach responsibilities include recruiting and providing program information to trade allies, has little involvement with retro-commissioning service providers (RSPs), the trade allies who promote and work with participants in the Retro-Commissioning Program component.

Program staff continued to reach customers and trade allies through direct outreach, public events and webinars, mass mailings, email blasts, fact sheets, the program website, and mass media. New activities included a campaign consisting of quarterly challenges designed to motivate greater activity among trade allies, with the promise of a free banner ad on the BizSavers website, and the aggregation of small accounts with common decision makers into customer “towers” for direct outreach.

The program reaches smaller customers through a newsletter, chamber of commerce events, outreach to trade allies that work with smaller businesses, and distributing program information through local distributors. Segment-specific outreach occurs through trade allies; targeted email blasts, videos, and fact sheets; and direct outreach to contacts for customer towers associated with specific business segments.

Contacts continued to report that most Ameren Missouri KAEs and CSAs actively supported the BizSavers program, although some are more active than are others.

The BizSavers Trade Ally Network (TAN) grew to more than 330 members in 2015; new TAN members from the southern and northwestern extremes of the territory reportedly had resulted in more projects from those areas.

5.1.2. Program Database

As of the end of Q4 2015, the vast majority of completed projects continued to be in the standard and customer programs. The evaluation team carried out an analysis of the participant database to identify characteristics of participating participants, the projects they have done, and the service providers associated with them. The analysis provides information on how the project population compares to the broader business population from nationwide data. The analysis results show the following:

- Standard and custom projects dominated participation, with about one quarter more Standard than custom projects.
- Small accounts constitute a smaller percentage of total program savings than their share of electric reportable usage would predict. This is true whether or not those small accounts are part of a customer "tower," but those that are part of a tower did larger projects and more projects than those that are not part of a tower.
- BizSavers gained 1,261 new participants in 2015, decreasing the nonparticipant population by an estimated 5%. "Upper bound" estimates of BizSavers penetration into the market are 6% for the 2M rate class, 32% for 3M, 60% for 4M and 11M, and 10% overall.
- The distribution of participants across building end-use types is largely consistent with the distribution in the population, except that it over-represents lodging and under-represents warehouses.
- Participants and savings are more likely to come from within the St. Louis metro and suburban areas than the distribution of businesses would predict.
- Customers in "towers" (see Section 5.1.1) had more BizSavers projects than other customers, and the mean number of projects per customer increased for "tower" customers over 2015, while it remained flat for non-tower customers.

- The program delivered the incentive within 30 days after project installation for 97% of Fast Track V2 projects. The program delivered the incentive within the contractually mandated 45 days for 99% of inspection track projects.
- Fewer than half of participating contractors are members of the Trade Ally Network (TAN), but TAN members did four-fifths of the projects completed in 2015.

5.1.3. Standard and Custom 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, but program-related outreach was associated with more than half of project-related savings.

Participants with standard-only projects largely reported being unaware of custom incentives; those who were aware of customer incentives reported that standard incentives covered all equipment of interest.

Participants were moderately proactive in deciding to implement an efficiency upgrade. Proactivity was greatest among those reporting defined energy savings goals, policies requiring purchase of energy efficient equipment, or staff assigned responsibility for energy management.

Participants generally were satisfied with the application process and most other aspects of participation, but one-quarter of custom incentive applicants had to resubmit or provide additional supporting documentation. A clear understanding of how to get assistance with the application was positively related to the reported amount of interaction with program staff and to program satisfaction.

Finally, one-third of surveyed participants reported considering a new construction or major building renovation project within the next five years, half of whom reported the project was in the design phase. Of those considering such a project, 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 caused customers to discontinue applications – the few exceptions being those who failed to meet program deadlines. Instead, near-participants typically discontinued their projects for internal pragmatic reasons, such as lacking the budget to implement the project. Near-participants were largely satisfied with their experience in

BizSavers, and most expressed interest in participating in the future. Findings also suggest these Ameren Missouri customers have a positive attitude toward saving energy but may need program assistance to convert attitude into action.

5.1.5. Trade Allies

Evaluation staff interviewed trade allies on training received, perceptions of program marketing, customer program awareness, and program experience.

Additional focus on small businesses could improve program uptake. Service providers reported that businesses with limited capital, small businesses, and businesses who lease space are least likely to agree to program-qualifying equipment. Although not specifically mentioned by providers, businesses with limited capital and those that lease space likely are disproportionately small businesses. Further, service providers were more likely to report low awareness of the BizSavers program among small businesses than among any other group.

Findings suggest a considerable amount of T-12 lighting remains in Ameren Missouri's territory. Service providers report that, on average, T-12s make up about one-third of all tube lighting in Ameren's service territory.

Outreach to service providers is effective, but improvement in some areas is possible. About half of surveyed service providers reported attending Ameren Missouri BizSavers events, which all respondents found to be satisfactory. Additionally, nearly half of providers reported being aware of Ameren's money-saving deals challenge. However, most providers found the challenge to have limited influence on their efforts to sell program-qualified equipment.

5.1.6. Event Attendees

The event survey collected data on attendees' experience with the event, their satisfaction, and firmographic characteristics. Surreys with attendees of online trade ally webinars revealed that attendees were largely satisfied with the events and found them to be helpful and informative.

5.1.7. Retro-Commissioning-Specific Findings

Participants and providers are highly satisfied with the program. Participants received the services they anticipated, and all were satisfied with the cost savings and performance of the program measures. Providers reported the program saves energy, assists their businesses, and largely meets the needs of customers. The only concern noted by participants and providers is the lack of program consistency over time and the uncertainty and project delays the three-year renewal process creates in the marketplace.

Analysis of the retro-commissioning project data showed a marked distinction between industrial and other customer types: all of the former did only air compression projects and no building optimization, while non-industrial customers did both air compression and building optimization. The combined participant and RSP feedback from the current and previous evaluation shows that a single RSP that specializes in air compression work accounted for all of the industrial air projects. That RSP appears to serve a large share of the industrial segment, which may explain why no building optimization has been done in the industrial segment. If industrial customers' information on retro-commissioning comes only from someone who specializes in air compression, they may not learn the benefits of building optimization.

5.1.1. New Construction-Specific Findings

As the evaluation team found previously in the evaluation of the 2014 program, findings suggest that a key opportunity for increased savings is to become involved earlier in new construction projects. However, current findings suggest that even those with past efficiency or renewable program experience did not seek out new construction incentives prior to designing their building, suggesting a lack of connection among participants across the various program offerings. Without an impetus such as a utility or program representative, contractor, or corporate pro-efficiency policies, New Construction Program participation is limited.

Results suggest that when design professionals are more involved in the construction project, program staff become involved earlier in a project, thus increasing the odds of doing more involved projects with deeper savings.

Half or fewer of the surveyed new construction participants were aware of the whole building performance, standard non-lighting, or custom measure incentives.

5.2. Program Staff Feedback

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. This section describes the roles of staff in each organization and their interactions.

5.2.1.1. Ameren Missouri

BizSavers program staff are under the Managing Supervisor, Business Energy Efficiency Programs, who reports to the Manager, Energy Efficiency and Demand Response (EERD).

The program manager reports to the BizSavers managing supervisor. The program manager is responsible for portfolio management activities such as program design and quality control. The program manager directly oversees the Standard, Custom, and Retro-Commissioning Programs and is assisted by a program specialist who oversees the New Construction Program and a staff member who deals with program accounting and post-inspections, drafts policies, and handles the opt-out process. A project management supervisor responsible for the tracking system also reports directly to the managing supervisor.

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 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 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. Figure 5-1 shows all staff members and their reporting relationships. The green boxes indicate Lockheed Martin staff that are available as backup to program staff.

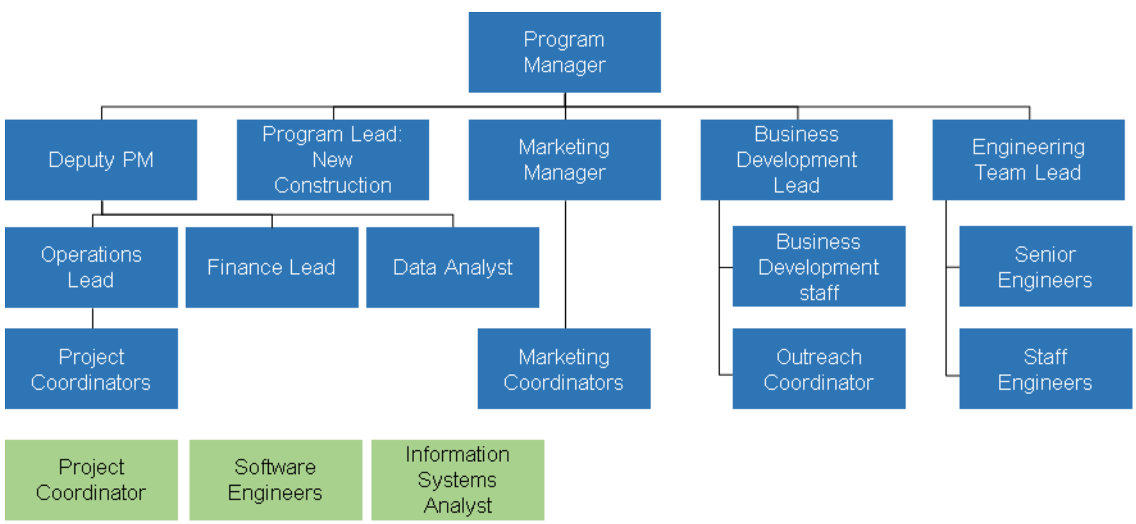


Figure 5-1 Lockheed Martin BizSavers *Program Organizational Chart*

In 2014, Lockheed Martin added four full-time staff, including someone to fill the newly created position of "outreach coordinator," who works largely in recruiting and providing program information to trade allies but has broader outreach responsibilities. In the staff interviews for 2015, the Outreach Coordinator clarified that that position has little involvement with retro-commissioning service providers (RSPs), the trade allies who promote and work with participants in the Retro-Commissioning Program component.

The BizSavers staff continues to use the same approach to managing projects. Business development representatives (BDs) carry out direct outreach in coordination with program marketing staff, Ameren Missouri customer service staff, trade groups, and service providers. Project coordinators (PCs) manage the application process and may conduct pre-inspections for straightforward projects. Engineers review applications, field questions, sign off on incentive offers, and conduct inspections for more complex projects. A “triple-team” consisting of a BD, a PC, and an engineer handles each application from submittal to project completion.

All interviewed staff confirmed that the reporting structure, titles, and general responsibilities had remained the same since 2014. The only changes were that marketing and outreach had slowed down in the second half of 2015 in anticipation of the end of the program cycle. Marketing and outreach staff were spending more time updating program documents and website content for future program cycles.

Most of Lockheed Martin 2015 staff also worked on the program during the 2013 and 2014 program years, and half of those worked on the program during the previous cycle or had previous related experience. In the 2013 process evaluation, some staff reported they would benefit from additional training on energy efficiency technologies and measures. Lockheed Martin staff reported in 2014 that two business development staff completed CEM training and in the 2014 and 2015 evaluations, program management staff reported that business development staff had undergone additional internal and external training.

5.2.2. Program Communication

The staff contacts interviewed in 2015 report that communication both within and between their respective organizations, including between program staff and the Ameren Missouri key account executives (KAEs) and customer support agents (CSAs), remains excellent. As previously, contacts described good cross-functional communication supported by effective communication tools.

In the 2014 evaluation, Lockheed staff reported that Ameren Missouri’s hiring of a new energy efficiency marketing manager had produced an improvement in its approval process for Lockheed Martin’s marketing and outreach activities. The 2015 staff interviews did not indicate any further concerns about that approval process.

5.2.3. Program Marketing and Outreach

During the initial round of interviews, the evaluation team obtained detailed descriptions from program staff on program marketing and outreach activities and objectives. In

2014 and 2015, the evaluation team re-interviewed marketing staff to obtain updates on activities and objectives reported previously and to inquire about new activities.

In 2015, program staff continued to use many communication channels to educate customers. In addition to conducting direct outreach to key targeted customers and trade allies via in-person, phone, and email direct communications, program staff held public "lunch and learns" and other events held for large customers and trade allies and conducted broader outreach through mass mailings, email blasts, fact sheets, the program website, radio, and newspaper advertising, and webinars. Key messaging in the email blasts to trade allies and customers centered on submitting applications prior to equipment purchase and improving the quality of applications, such as by submitting accurate invoices.

The following subsections highlight specific outreach and marketing activities from 2015. These include the introduction of a new "money-savings deals" campaign to motivate increased trade ally promotion of the program and the continued development of customer "towers," begun in 2014, to identify single, large organizations that account for multiple, smaller accounts.

5.2.3.1. Outreach Events

According to records shared by Lockheed Martin, in 2015, outreach staff delivered forty-three group presentations to more than 2,500 attendees (see Section 5.7 for detail). This is a decrease from the fifty-one events, with more than 8,000 attendees, in 2014.[11] The program decreased the number of events in anticipation of the program closeout.

5.2.3.2. Email Activities

Outreach staff distributed the BizSavers *Solutions* monthly e-newsletter to a high of 3,985 customers and trade allies early in 2015 and a low of 3,788 as the program cycle neared an end. In addition, Lockheed delivered the following topic-specific e-mails to "opt in" lists of customers (e-blasts):

- Electrical Board of Missouri and Illinois (EBMI) workshop to 1,156 trade allies and customers (January)
- T-12 completion date reminders to 223 trade allies and customers with ongoing projects and T-12 promotion reminder to 3,039 other trade allies and customers (March)
- Application update to 954 trade allies (April)

[11] The 2014 year-end evaluation report incorrectly included check presentations in the count of group presentations and thus reported sixty-six group presentations. However, that report also under-counted the attendees, as it was based on a preliminary total.

- VendingMiser® webinar invitation to 2,041 trade allies (May)
- Money-Saving Deals announcement to 876 customers and trade allies (May)
- Set the Pace Event notice to 2,412 trade allies (June)
- Archdiocese Energy Summit notice to 743 customers (July)
- 4 Simple Steps notice to 558 trade allies and customers with in-process projects (July)
- End-of-Year Completions Schedule notice to 1,546 trade allies with in-process projects (October)
- End-of-Cycle 3 Memorandum to 1,555 trade allies with in-process projects (November)
- Various Trade Ally Award winner notices through May.

Some of the above emails supported specific outreach campaigns, described below.

5.2.3.3. The Money-Saving Deals Campaign

In 2015, Lockheed Martin began a new campaign, the “Money-Savings Deal” campaign, aimed at motivating trade allies to sell more efficiency projects. In each of the first three quarters of 2015, Lockheed established a new challenge for trade allies – those trade allies that achieve the challenge goal get a free banner ad to promote their deals on the BizSavers website. The initial (Q1) challenge was to double sales from previous quarter, with fourteen trade allies winning the challenge. The Q2 challenge was to complete projects with 40 or more beverage vending machine controls as standard Fast Track measures; two trade allies met that challenge. Note that Lockheed also conducted a webinar on VendingMiser, a brand of vending machine controls, during the Q2 challenge.

The Q3 challenge was to be among the top ten companies with the most projects in that quarter. Lockheed did not run a challenge for Q4 because the program was hitting quotas and so a new challenge was not needed.

5.2.3.4. Customer Towers

In 2014, Lockheed Martin began a project to use Ameren Missouri customer account data to identify groups of accounts that are part of single, large organizations that likely make or influence equipment-related decisions at the account level. Examples include business chains and franchises, school districts, and large campus-like organizations, such as airports. In the 2015 evaluation, Lockheed staff reported having identified 781 such customer “towers” that each represented at least two million kWh of aggregate usage and collectively accounted for more than twenty-six thousand billing accounts and more than ten billion kWh of annual usage. Lockheed staff reported that five business development staff had been calling on contacts for towers, with “great” results.

Lockheed staff provide a point of contact for each customer tower with an account report that shows all accounts within the tower, ranked by energy usage, and energy usage charts to show patterns of usage. The purpose is to help facility staff prioritize upgrades at the various facilities. Lockheed also provides a projects report to show these customers where they have and have not addressed energy efficiency.

As Section 5.3.6 shows, targeting outreach to customer towers appears to have been a successful strategy for reaching small accounts. Note, however, that Lockheed’s analysis illustrates that many small accounts are not, in fact, “small customers” in the sense of small businesses with limited capital and other resources. We discuss the implications of this in Section 5.3.6 and elsewhere.

5.2.3.5. Targeting Smaller Customers

Staff feedback in the 2015 evaluation expanded on and clarified some of the information provided in the previous evaluation on efforts to reach small and midsized businesses. The primary channels for reaching smaller customers are the BizSavers Solutions newsletter, events at chambers of commerce, which tend to draw smaller customers than other events, and working with trade allies that work with smaller businesses. One staff contact noted that the development of customer towers (see Section 5.2.3.4) might be useful in this regard, by allowing Lockheed to identify a chain of small businesses that a trade ally may approach. (From that staff’s perspective, once the multiple “small” businesses are aggregated into a tower, they become a large business.) One staff member also reported that the program is working with the Building Owners and Managers Association (BOMA) to get building owners to work with property managers to reach small businesses.

In 2014, staff described the Distributor Partnership Program (DPP), an effort to raise program awareness with smaller business “walk in” customers by providing six local distributors with marketing collateral and poster boards as well as DPP-specific paper applications and information on online applications. In the 2014 evaluation, program staff reported that the program was “working well,” one mentioning a particular distributor that was doing a “great job” in bringing in multiple projects. In the 2015 evaluation, however, one informant said that the program’s success depended on having managerial support from the distributor – the in-store sales manager for one distributor was “not so interested” in getting customers to complete applications.

Information reported in the BizSavers Marketing Monthly Summary seems to support the above statement. The number of DPP-specific applications received in 2015 ranged from a low of 12 (for the distributor whose sales manager reportedly did not support the program) to a high of 316. Note, however, that the second-highest tally was 94 and the remaining three were all in the 20-to-50 range. Lockheed staff noted that the purpose of DPP is not necessarily to drive many point-of-purchase applications, but to raise awareness, which may later result in an on-line application. Unfortunately, there is no way to track the number of online applications that resulted from DPP.

5.2.3.6. Targeting Specific Customer Segments

Ameren Missouri does not identify customer segment (office, food service, and so forth) in its customer database, which makes it necessary for the program to identify targeted businesses in other ways. In previous evaluations, staff had reported several strategies for reaching targeted groups: through targeted public events; by focused outreach in areas with a high density of a targeted type; by working with trade allies that serve targeted segments; and by sending e-blasts to government agencies (a targeted segment) through the U.S. Department of Energy's Federal Energy Management Program (FEMP). Lockheed Martin also places segment-specific videos and fact sheets on the BizSavers website.

In 2015, business development staff also assigned business segments to the customer towers (see Section 5.2.3.4) and used that information in targeting outreach activities.

5.2.3.7. Outreach to New Construction Customers

Evaluation staff asked the Lockheed Martin new construction program lead about the program's experience in conducting outreach with potential new construction customers. This partly was to shed light on findings from the previous evaluation that the program influenced many projects only after the design phase was completed, limiting the achievable savings. The contact noted that many customers still think of the New Construction Program as a rebate program. Customers come to the program after design completion, asking how much the program will give them for the efficiencies they already have included in the design. In those cases, the program contact explained to them that they were not eligible for incentives. The contact also noted, however, that the program has had greater participation than in previous years, with more customers thinking long-term.

5.2.3.8. Coordination with Ameren Missouri Account Support Staff

The 2015 evaluation also obtained follow-up information on the program's coordination with Ameren Missouri account support staff.

Previously, Ameren Missouri and Lockheed Martin staff reported that most Ameren Missouri KAEs and CSAs actively supported the BizSavers program; that key performance indicators for KAEs and CSAs included energy efficiency metrics; and that program staff carried out active outreach to the KAEs and CSAs and provided monthly reports on program interactions with customers.

In 2015, staff contacts continued to report good coordination between the BizSavers program and Ameren Missouri account support staff but did acknowledge that some KAEs and CSAs are more active than others. One contact also noted that some of the key accounts have shifted among KAEs. The variation in level of program interest among account staff, coupled with changes in which staff are responsible for which accounts, may help explain why one interviewed "near participant" reported receiving less information on possible energy efficiency projects from Ameren Missouri staff (see Section 5.5).

5.2.3.9. Market Response

Informants noted that they met their key objective of bringing targets representing the kWh savings goal into the project pipeline in the first six months of 2015 in anticipation of the cycle close-out. One referred to a "freight train" of project completions – about 200 per month – in August, with the expectation that the rate might double or triple in the last months of the year.

5.2.4. Working with Trade Allies and Other Service Providers

The evaluation team obtained current information about TAN membership, the program's communication with trade allies and non-affiliated service providers, trade ally training, and the tiered trade ally structure.

5.2.4.1. Trade Ally Network (TAN) Membership

In 2015, Lockheed Martin staff reported that the BizSavers Trade Ally Network (TAN) had grown to more than 330 members, from about 190 members in 2013 and 280 by the end of 2014. A contact reported that the program had added TAN members from the southern and the northwestern extremes of the service territory, resulting in more projects from those areas.

By the end of Q3 2015, with the program cycle ending, the program was no longer actively seeking new TAN members but was still adding a few new members every month that were seeking the program out as a result of client encouragement. In addition, Lockheed was still attempting to re-sign firms that had been TAN members in the previous program cycle but had not yet re-signed for the current cycle.

5.2.4.2. Communicating and Training

As reported in previous evaluations, program staff provide program updates to trade allies and non-TAN service providers via regular newsletters, ad hoc email notices, and group events. Group events include check presentations, orientation and training events, and equipment-specific seminars. Lockheed Martin records show the following trade-ally-specific events held in 2015:

- Seven trade ally orientations (total of fifty attendees).
- Three equipment-specific seminars (total of 140 attendees).
- A trade ally awards banquet (165 attendees).

The above events are in addition to some thirty other events open to both trade allies and large customers (see Section 5.7).

One of the program's new communication strategies, starting in May 2015, was to set up monthly "open houses" or "workshops" in which trade allies may meet one-on-one with members of the business development team. A program contact reported that TAN members said they had recommended that other service providers meet with business development staff at those workshops, which would convince them to join the TAN. The most recent of these events was October 2015.

5.2.4.3. Outreach to New Construction Trade Allies

Evaluation staff asked the Lockheed Martin program lead for New Construction about outreach to architects and design engineers. This partly was to shed light on findings from the previous evaluation that the program influenced many projects only after the design phase was completed, limiting the achievable savings. The contact noted that, after six years, the program had started developing relationships with these trade allies around Missouri. Developing such relationships is important to allow the program to set up design team meetings with customers.

5.2.4.4. Co-Branding

In the previous evaluation, staff contacts indicated moderate trade ally interest in co-branding, although large trade allies often have corporate guidelines against co-branding. This was consistent with findings from the 2013 survey of trade allies, in which two-thirds of the TAN members reported having co-branded their services. To increase co-branding in the next program cycle, a program contact reported that Lockheed is considering providing more information about co-branding in the materials that trade allies will have to sign to renew their TAN membership.

5.2.4.5. Trade Ally Tiers

BizSavers continues to maintain a tiered TAN structure. "Silver" allies have fewer than twenty-five projects and less than 1 million kWh savings. "Gold" allies, who have completed twenty-five to forty-nine projects or saved 1-5 million kWh, get expanded co-branded program collateral and program window clings. "Platinum" trade allies, those with completed fifty or more projects or achieved at least five million kWh in savings, get the Gold benefits plus vehicle magnets, sponsored events, and other rewards as well as acknowledgement at the annual awards banquet.

Previously, staff contacts reported the belief that while TAN members were happy to achieve the Gold or Platinum levels, the desire to achieve the next level was not a strong motivator.

One contact did report that, for the next cycle, the program is considering some changes to how the program assesses tier status. Currently, the tier level is based on a trade ally's total sales since joining the TAN, but the program is considering basing tier level on sales over a shorter period, which would provide for greater mobility among the tiers. The program is also considering establishing different criteria for the various tiers for different types of trade allies.

The evaluation team followed up on previously identified concerns about the tiered system, including how to deal with the fact that multiple trade allies often will work together on a project, but only the one that submitted the paperwork receives the credit. Program contacts reported they were reviewing that issue, but as of 2015, the program had not resolved it.

5.2.5. Program Application Processes

In 2014, Lockheed revised the online application to address concerns reported by participants and trade allies. The 2014 evaluation found that participants were generally satisfied with the application process although the rated ease of finding the online application and using application worksheets were lower than in 2013. Program staff did not report any additional website revisions in 2015, but they reported efforts to improve trade allies' familiarity with the incentive applications, carried out as part of the trade ally outreach described in Section 5.2.4 and by proactively reaching out to trade allies that had any mistakes or miscommunications during application submittal.

5.2.6. Project Tracking Processes

In previous evaluations, staff contacts described the project tracking system (called "LM Captures"), including upgrades done in 2014 to make data easier to find. In 2015, program contacts reported that the tracking system continues to function effectively and that there had been no significant revisions to the system since the previous evaluation.

5.2.7. Program Measures

In the previous evaluation, Lockheed contacts reported a desire to add more non-lighting measures to the standard measures list, largely in response to a finding from the 2013 trade ally survey that non-lighting allies reported lower satisfaction with the incentive application. For the 2015 evaluation, staff reported that the only program changes that had occurred were an adjustment of TRM values for occupancy sensors based on EM&V results and "a couple of other nonsignificant changes." Contacts reported that Lockheed had made "a lot" of suggestions to Ameren Missouri for additional changes in the future, mostly for lighting measures. In particular, Lockheed would like more variations in the measure "buckets" so they can more accurately identify savings and incentives.

5.3. Database Analysis

As of the end of Q4 2015, the vast majority of completed projects continued to be in the standard and customer programs. The evaluation team carried out an analysis of the participant database to identify characteristics of participating participants, the projects they have done, and the service providers associated with them. The analysis provides information on how the project population compares to the broader business population from nationwide data.

The following subsections provide an overall analysis of projects and participants; show analyses of program participation by building end-use type, business size (rate class), and geographic area; and show information on contractor participation.

5.3.1. Overall Analysis of Projects and Participants

The analysis identified 1,659 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 1,659 participants collectively had completed 3,281 projects across 2,395 separately identifiable buildings by the end of Q4 2015. While a large majority of participants had a single completed project, those participants with multiple completed projects accounted for almost two-thirds (65%) of completed projects (Table 5-2).

Table 5-2 Participants with Single and Multiple Projects

Participant Type	*Participants (n=1,659)*	*Buildings (n=2,395)*	*Projects (n=3,281)*
Associated with one project	69%	79%	35%
Associated with multiple projects	31%	21%	65%
Total	100%	100%	100%

Overall, the 2015 BizSavers program outperformed the previous year; both the number of completed projects and participants increased by 72%, the total kWh savings increased 83%, the number of buildings increased 56% and average kWh savings per project and per participant were over 5,000 kWh higher than the previous year (Table 5-3). Participants completed, on average, more projects in 2015 than in 2014, returning close to the number of projects per participant in 2013.

Table 5-3 Completed Projects – 2013, 2014, and 2015 Comparison

Category	*2013*	*2014*	*2015*
Number of projects	1,218	1,912	4,179
Number of buildings	1,041	1,537	2,395
Number of participants	589	1,110	1,659
Average number of projects per participant	2.1	1.7	2
Average number of projects per building	1.2	1.3	1.4
Total kWh Savings	74,535,202	143,992,637	304,299,625
Average kWh savings per project	61,195	75,310	72,816
Average kWh savings per participant	126,545	129,723	183,214

5.3.2. Business Size (Rate Class)

The evaluation team could not use building size data to analyze participation by business size, as the percentage of project records with no square footage data is too high to use for any analytical purpose, having increase by a factor of two and a half since 2013 (Table 5-4).

Table 5-4 Missing Square Footage Data by Program Year

Program Year	*Percentage Missing Data*
2013	25%
2014	41%
2015	62%

To evaluate how well BizSavers is reaching small business customers, the evaluation team evaluated the distribution of projects, buildings, and participants across the four commercial rate classes – 2M, 3M, 4M, and 11M – each representing increasingly larger-volume accounts. The team separated the 2M rate class into those that Lockheed Martin staff had aggregated into customer towers (see Sections 5.2.3.4 and 5.3.6) and those that were not a part of a tower. As explained above, the customer towers may represent small accounts, but they do not necessarily represent small businesses, while small accounts that are not part of a customer tower are more likely to be small businesses.

In terms of number of electric customer and savings compared to usage, the BizSavers program underrepresents accounts in the small commercial rate class (2M), regardless of whether or not they are included in customer towers. As Table 5-5 shows, while the 2M class represents a relatively small share of reportable usage, its share of savings is even smaller – the share of savings is 60% or 70% as large as its share of usage.

Table 5-5 Participation, Savings, and Population by Rate Class

Rate class	*Percentage of…*						Ratio of Savings % to Usage %
	Projects (n=3,281)	Buildings (n=2,387)	Participants (n=1,659)	Total Savings	Electric Customers	Electric Reportable Usage	
2M-nt*	33%	39%	47%	9%	79.2%	15%	0.6
2M-t*	6%	8%	3%	2%	13.8%	3%	0.7
3M	50%	46%	42%	49%	6.6%	42%	1.2
4M	8%	6%	7%	20%	0.4%	19%	1.0
11M	3%	1%	1%	19%	< 0.0%	20%	1.0
Total	100%	100%	100%	100%	100%	100%	1.0

* t = "in a customer tower"; nt = "not in a customer tower."

As expected, as the rate class increases, so do the mean savings per project as well as the mean number of projects per building and (generally) per participant (Table 5-6). Note also that 2M customers that were part of a customer tower did larger and more projects, on average, than those *not* in a customer tower. In fact, 2M customers that were in a tower did more projects, on average, than did 3M and 4M customers.[12] Incentive type did not vary by rate class (Table 5-7).

Table 5-6 Total and Average kWh Savings by Rate Class

Rate Class	Total kWh Savings	*Mean kWh Savings per…*			Est. Mean # Projects per Building*	Est. Mean # Projects per Participant**
		Project (n=3,281)	Building (n=2,387)	Participant (n=1,659)		
2M-nt***	23,303,868	21,759	24,765	28,454	1.1	1.3
2M-t***	6,403,476	31,858	33,881	106,725	1.1	3.4
3M	130,176,966	79,961	118,450	177,112	1.5	2.2
4M	52,695,960	189,554	376,400	439,133	2.0	2.3
11M	51,468,988	499,699	1,906,259	2,144,541	3.0	4.3
Total	264,049,258	80,478	110,204	150,199	1.4	1.9

* Estimated by dividing the mean savings per building by the mean savings per project.

** Estimated by dividing the mean savings per participant by the mean savings per project.

*** t = "in a customer tower"; nt = "not in a customer tower."

[12] Note that tower customers were not limited to the 2M rate class but also included 3M customers. However, the current analysis focuses on 2M customers that are or are not part of a tower as the 2M class as a whole is under-represented in project savings but the 3M class is not.

Table 5-7 Rate Class by Incentive Type

Rate Class	*Standard (n=2,001)*	*Custom (n=1,617)*
2M	42%	38%
3M	49%	49%
4M	8%	9%
11M	1%	4%
Total	100%	100%

5.3.3. Penetration of the Target Market

The project database shows 2,992 unique companies with completed projects from 2013 through 2015. To estimate the rate of penetration this represents of Ameren Missouri business customers in the various rate classes, the evaluation team calculated the mean participant electricity usage and divided that into the total customer usage to yield an estimate of the number of Ameren Missouri customers in each rate class. Dividing the number of participants by the estimated number of customers generated an estimated penetration rate for each rate class (Table 5-8).

Table 5-8 Estimated Penetration by Rate Class

Rate Class	*Number of 2015 Participants*	*Mean kWh Usage per Participant*	*Total MWh Customer Usage*	*Estimated Number of Customers*	*Estimated Penetration Rate*
2M	830	134,860	3,387,984	25,122	6%
3M	697	2,068,646	8,096,881	3,914	32%
4M	116	10,540,732	3,680,436	349	60%
11M	17	76,608,341	3,891,883	51	60%
Total	1659	2,458,617	19,057,183	29,436	10%

A concern with the above analysis is that the total of 29,436 customers is well below the count of 88,279 businesses in Ameren Missouri territory identified from U.S. Census data.[13] That count was obtained by matching ZIP codes in Ameren Missouri service territory to those in the Census data. This may over-count the number of businesses in Ameren Missouri territory as Ameren Missouri may serve only part of some ZIP codes; however, it is not likely that would account for the entire difference between the Census count and that shown in the above table. Another possible factor is the fact that "participant" in the above table is defined using the "Company Name (Parent Company)" field in the project database, and that field often is associated with multiple, separately identified sites. If the "businesses" as identified in the Census data are more akin to the

[13] Source: US Census County Business Patterns http://www.census.gov/econ/cbp/index.html. Census data showed number of businesses by ZIP code, which the evaluation team matched to Ameren Missouri service territory ZIP codes.

entities identified as “sites” in the database than to “companies,” that could account for much of the difference.

As it stands, the figures in the above table should be considered to represent a likely upper bound on program penetration rates.

Subtracting the total number of companies that have received BizSavers incentives in the 2013-2015 program cycle (2,992) from the estimated total number of business customers yields an estimate of 26,444 customers that have not yet participated in BizSavers. In 2015, 1,261 companies received BizSavers incentives for the first time in the current program cycle. Thus, the number of nonparticipants decreased by about 5% since the 2014 program year, leaving much potential for increased participation.

5.3.4. Building End-Use Type

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 5-9. Nineteen percent of participants had projects that combined both types of measures, and those types of projects accounted for 13% of all projects and happened in 21% of the buildings.

Table 5-9 Incentive Types of Participants and Completed Projects

Incentive Type	*Participants (n=1,659)*	*Buildings (n=2,395)*	*Projects (n=3,281)*
Standard (with or without Custom)	67%	63%	61%
Custom (with or without Standard)	55%	57%	49%
Standard only	53%	42%	48%
Custom only	42%	36%	37%
Custom and Standard	18%	21%	13%
New Construction	2%	2%	1%
Retro-commissioning	1%	1%	1%
Total	115%	101%	100%

At both the participant, building, and project levels, the most common building end uses were lodging, office, and retail (Table 5-10). Together, those three end-use types made up 38% of all projects.

Table 5-10 Building End-Use Types

Building End -Use Type	*Participants (n=1,659)*	*Buildings (n=2,395)*	*Projects (n=3,281)*
Lodging	13%	10%	12%
Office	13%	13%	14%
Retail	12%	14%	15%
Education	8%	8%	5%
Faith-Based	8%	7%	8%
Food & Beverage Service	8%	9%	10%
Healthcare	7%	5%	4%
Industrial	7%	7%	9%
Entertainment/Recreation	6%	5%	6%
Grocery and Convenience	6%	6%	6%
Warehouse	4%	5%	6%
Government	4%	3%	3%
Automotive Services	2%	3%	3%
Gas Station	2%	2%	3%
Other*	1%	1%	1%
Total	100%	100%	105%

* Other includes IT/data centers and parking garages.

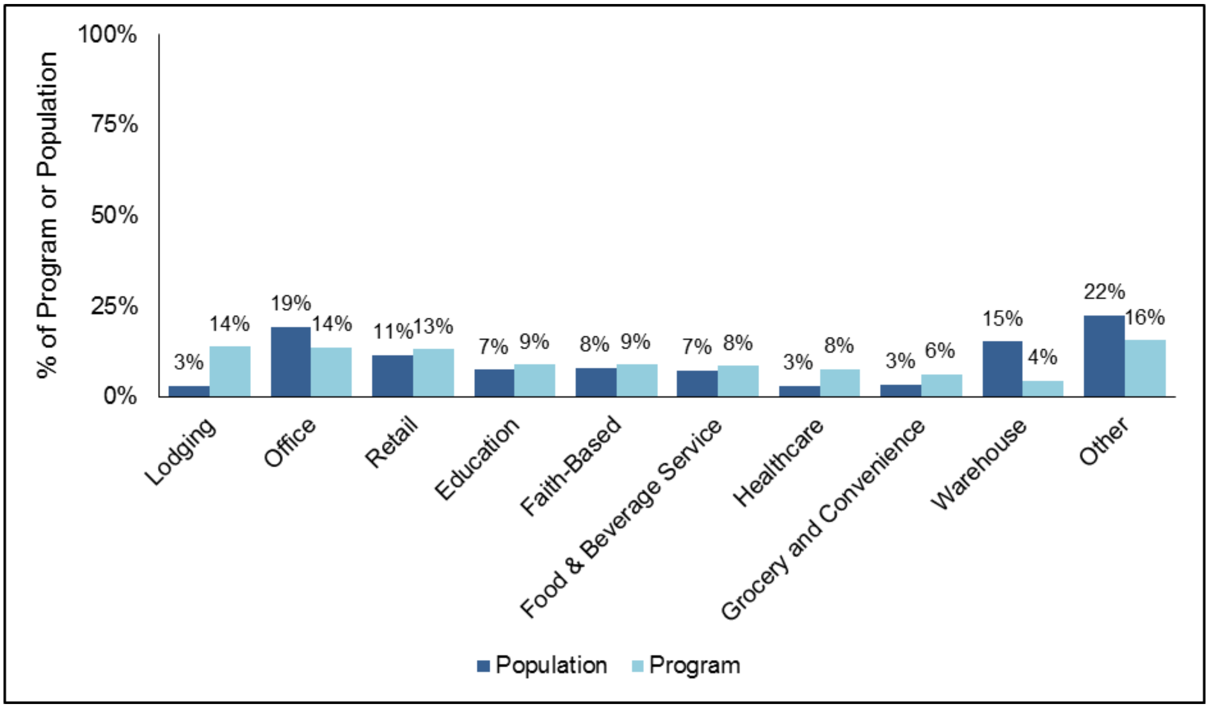


Figure 5-2 shows the distribution of 2015 BizSavers non-industrial customers across building end-use types as it compares to the likely distribution of commercial buildings in the broader population. The population data are from the Commercial Buildings Energy Consumption Survey (CBECS), a nationwide survey of commercial buildings conducted by the U.S. Energy Information Administration.[14] This comparison excludes industrial customers, as CBECS addresses only commercial, non-industrial businesses.[15] Overall, the comparison indicates that the distribution of customers across building end-uses matches well with the distribution of buildings in the population, but over represents lodging and underrepresents warehouses.

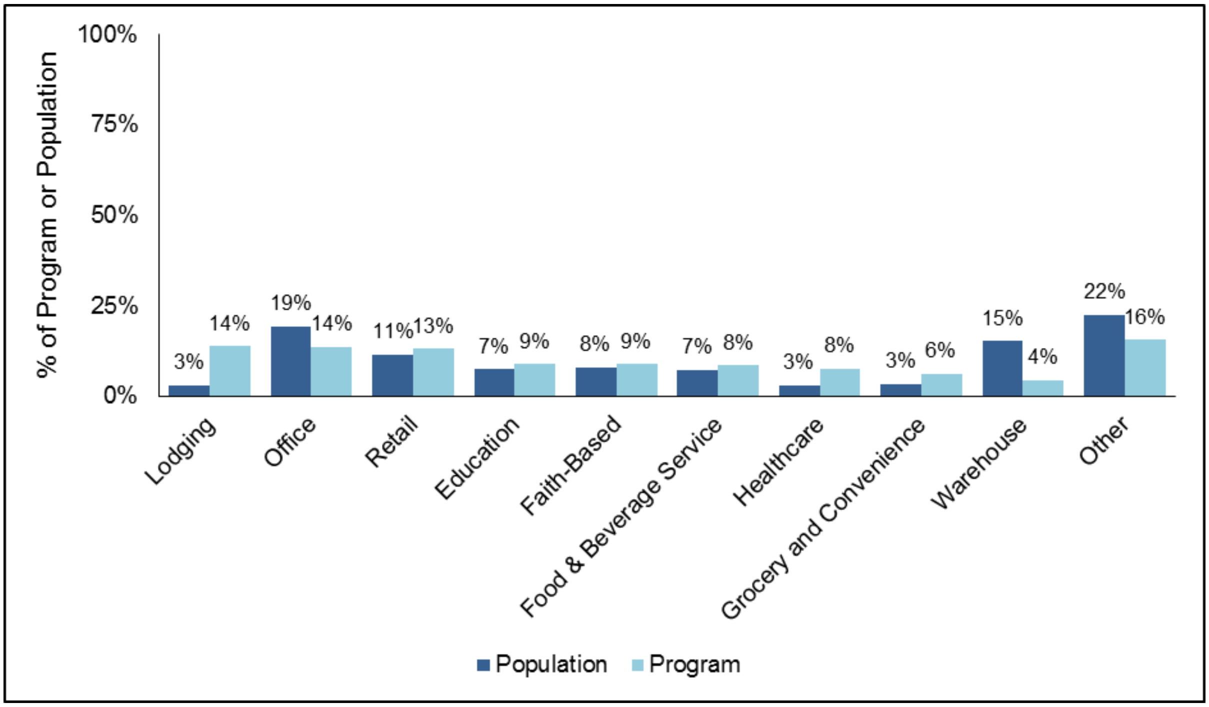


Figure 5-2 Distribution of Participants by Building End-Use Types, Compared to Population Data[a]

[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.

Analyses further examined building type by custom or standard incentive type.[16] Completed standard projects were more common than custom projects at both the project level and the participant level, as previously shown in Table 5-9. One-fifth of participants had projects that combined both types of measures, and those types of projects accounted for just over one-sixth (18%) of all projects.

For both standard and custom projects, two of the three most common building end uses were office and retail (Table 5-11). However, standard and custom projects each

[14] Source: http://www.eia.gov/consumption/commercial/data/2012/

[15] 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 5-10.

[16] 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.

had higher rates of a particular end use, respectively; industrial and education end uses were more common in custom projects and lodging and faith-based end uses were common in standard projects.

Table 5-11 Building End-Use Types by Incentive Type

Building End -Use Type	*Standard (n=2001)*	*Custom (n=1617)*
Lodging	18%	5%
Retail	12%	11%
Office	11%	16%
Faith-Based	11%	5%
Food & Beverage Service	10%	4%
Healthcare	8%	4%
Education	7%	11%
Entertainment/Recreation	6%	6%
Grocery and Convenience	5%	7%
Government	3%	5%
Industrial	3%	12%
Warehouse	3%	7%
Gas Station	1%	3%
Automotive Services	<1%	4%
Parking Garage	<1%	1%
IT/Data Center	0%	2%
Total	100%	100%

5.3.5. Geographic Area

About two-fifths of participants, buildings, and projects were in St. Louis and its near suburbs, and about another two-fifths were in the outer suburban areas (Table 5-12), with the metro area and suburbs together constituting more than 80% of participants, buildings and projects. Based on ZIP code level business patterns data from the U.S. Census Bureau, both projects and participants are disproportionately from St. Louis and its suburbs, relative to the distribution of businesses.

The majority of project *savings* came from within St. Louis and its near suburbs. The areas outside of St. Louis and its suburbs are responsible for less savings compared to the rate of participation and the population of businesses.

Table 5-12 Geographical Distribution of Completed Projects

Area	*Participants (n=1,659)*	*Buildings (n=2,387)*	*Projects (n=3,281)*	*Savings*	*Businesses**
St. Louis and near suburbs**	44%	41%	45%	51%	33%
Outer suburbs***	43%	41%	39%	34%	32%
All other areas	20%	17%	16%	15%	35%
Total	100%	100%	100%	100%	100%

* Data from US Census Bureau County Business Patterns http://www.census.gov/econ/cbp/
** ZIP codes 63100-63199.
*** ZIP codes 63000-63099 and 63300-63399.

The distribution of rate classes differed markedly among the St. Louis metro area, the outer suburbs, and other parts of Ameren Missouri's service territory (

Figure 5-3).[17] In particular, customers in the small (2M) rate class that are *not* in a customer tower make up a greater percentage of the building mix in areas outside of St. Louis and its immediate suburbs. Given the disproportionately low amount of program savings in the small rate class, this finding may also suggest a geographic inequity in the distribution of savings.

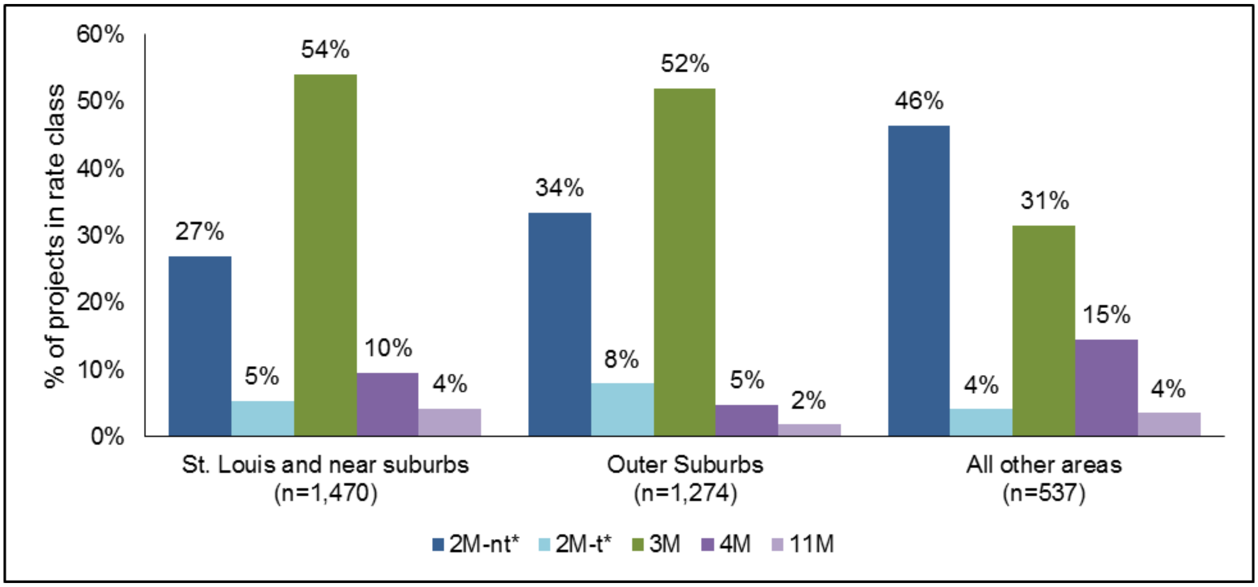


Figure 5-3 Rate Class Distribution by Location

* t = "in a customer tower"; nt = "not in a customer tower."

Note, however, that the 2M customers that are in customer towers are least represented in the outer suburbs. Thus, while the development of customer towers may be an effective way of reaching small-account customers in general, it does not appear to have helped the program reach such customers outside of St. Louis and its suburbs.

The distribution of projects across zip codes was similar for the standard and Custom Programs (Table 5-13).

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[17] The differences in the distribution of rate classes among the areas is statistically significant (Chi-square, at $p < .001$).

Table 5-13 Geographical Distribution of Completed Projects

Area	*Standard (n = 2,001)*	*Custom (n = 1,617)*
St. Louis and near suburbs	47%	41%
St. Louis suburbs	37%	42%
All other areas	16%	17%
Total	100%	100%

5.3.6. Customer Towers

In the past year, the BizSavers program took a new approach to outreach by organizing customer accounts into "towers," which identify companies or other entities that have multiple accounts. Of the 1,659 participants, 345 were part of a tower (Table 5-14). Towers completed 43% of all projects, with an average of 4.1 projects per participant, compared to an average of 1.4 for non-towers.

Table 5-14 Participation and Projects in Tower and Non-Tower Groups

Account type	*Number of Participants*	*Mean Number of Projects per Participant*	*% of projects*
Tower	345	4.1	43%
Not Tower	1,314	1.4	57%

Towers also had an increasing mean number of projects per quarter (

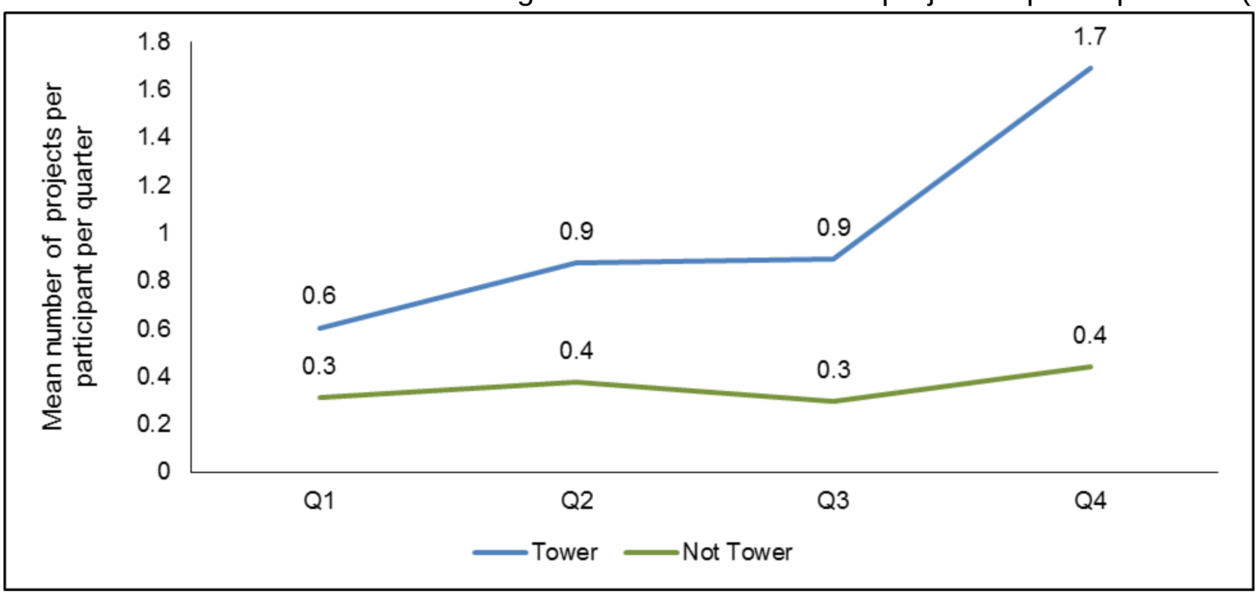

Figure 5-4). In every quarter, towers both had more projects on average than non-tower participants, but also an increasing mean number of projects in every quarter that was not mirrored by non-tower participants.

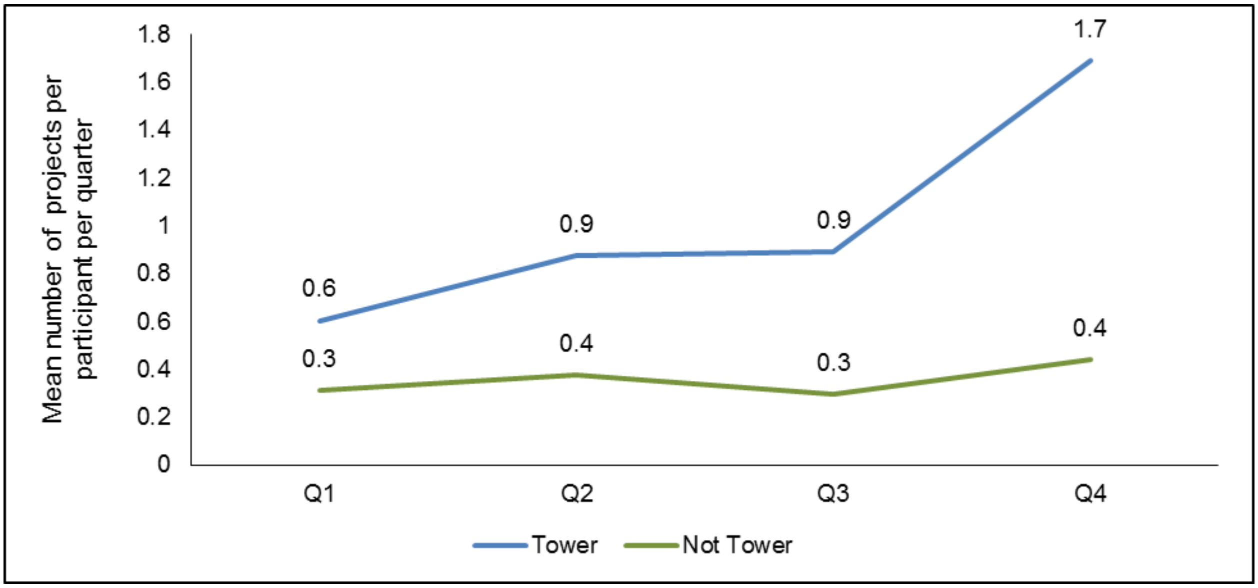

Figure 5-4 Comparison of Tower and Non-Tower Participants on Project Completion

5.3.7. Interval between Project Completion and Incentive Delivery

The evaluation team examined the time interval between completion of project installation and delivery of the incentive, separately for Fast Track V2 and Inspection Track projects. Table 5-15 shows that the program delivered the incentive within thirty days after project installation for all Fast Track projects, 97% of Fast Track V2 projects, and 83% of Inspection Track projects, a 2% and 10% decrease respectively from the end of 2014. The program delivered the incentive within the contractually mandated forty-five days for all but sixteen (1%) inspection track projects.

Table 5-15 Time from Project Installation to Incentive Delivery

Time Interval	*Fast Track V2 Projects (n=1,588)*	*Inspection Track Projects (n=1,693)*
7 days or fewer	15%	6%
8 to 15 days	46%	35%
16 to 30 days	37%	42%
31 to 45 days	2%	16%
More than 45 days	<1%	1%
Total	100%	100%

5.3.8. Analysis of Contractors

The evaluation team analyzed information on all contractors associated with completed 2015 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 5-16 shows the breakdown of active contractor firms by Network membership and energy savings for 2015. 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 (80%) 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 2015.

Table 5-16 Trade Ally Network Membership and Energy Savings

Trade Ally Network (TAN) Membership	*Count*	*Percent of All Contractor Firms*	*kWh Savings**	*Percent of Total kWh Savings*	*Average kWh Savings Per Trade Ally Membership Type*
TAN Member	158	43%	211,227,259	80%	1,336,881
Platinum	53	14%	122,412,898	46%	2,309,677
Gold	30	8%	44,911,125	17%	1,497,038
Silver	58	16%	25,284,761	10%	435,944
Not Tiered	17	5%	18,618,475	7%	1,095,204
Not TAN Member	211	57%	52,821,999	20%	250,341
Total	369	100%	264,049,258	100%	715,581

* 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.

Contractors located inside Ameren Missouri service territory completed the majority (87%) of completed projects (Table 5-17). While contractors are completing more projects across the board, the highest growth in contractor participation is coming from those located in the southern portion of Ameren Missouri service territory and states outside of Missouri.

Table 5-17 Geographic Distribution of Trade Allies by Projects Completed

Location	*2015*		*2014*		*Project Growth*
	TA Projects	*TA Projects %*	*TA Projects*	*TA Projects %*	
Saint Louis and near suburbs	1277	39%	725	39%	76%
Outlying suburbs	1188	36%	692	37%	72%
North*	11	0%	6	0%	83%
South**	158	5%	65	3%	143%
Central***	130	4%	105	6%	24%
Missouri, outside Ameren territory	6	0%	2	0%	200%
Bordering state	110	3%	59	3%	86%
Other state	314	10%	155	8%	103%

Location	*2015*		*2014*		*Project Growth*
Total	3194	97%****	1809	97%	77%

*ZIP codes 63400-63599, 64000-64099, 64400-64499, and 64600-64699
**ZIP codes 63600-63999, 64800-64899, 65400-65599, and 65700-65799
***ZIP codes 65000-65300
****Eighty-seven projects with no identified contractor, or a contractor without a ZIP code in the database were excluded from analysis.

The relatively slow growth in participating contractors from the central region, and the low overall number of contractors from the north region mirrors the slower growth of projects in those areas (Table 5-18). The southern region experienced both the highest growth in contractor-completed projects (143%) and the highest growth in completed projects outside of the metro area (70%).

Table 5-18 Geographic Distribution of Completed Projects and Growth Between 2014 and 2015

Location	*2015 Projects*	*2014 Projects*	*Growth*
Saint Louis and Near Suburbs	1470	801	84%
Outlying Suburbs	1274	750	70%
North	35	28	25%
South	236	139	70%
Central	266	194	37%
Total	3281	1912	72%

5.4. Participant Online Survey

Throughout 2015, the evaluation team invited 1,792 2015 program participants to take an online survey and received 843 unique responses, for a response rate of 46%.

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 843 surveyed respondents, twenty-five had completed new construction projects and none had completed a retro-commissioning project. Appendix D provides the full survey instrument.

5.4.1. Description of Sample

Of the 843 survey respondents, 62% had completed custom projects and 58% had completed standard projects (22% had completed both and contributed to both totals). In addition, twenty-five respondents had completed new construction projects, and none 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 (36%), while most others were the company owner, president, or a top officer or director (33%) or reported some other management or administrative responsibility (28%). 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 office and retail facilities the most common.

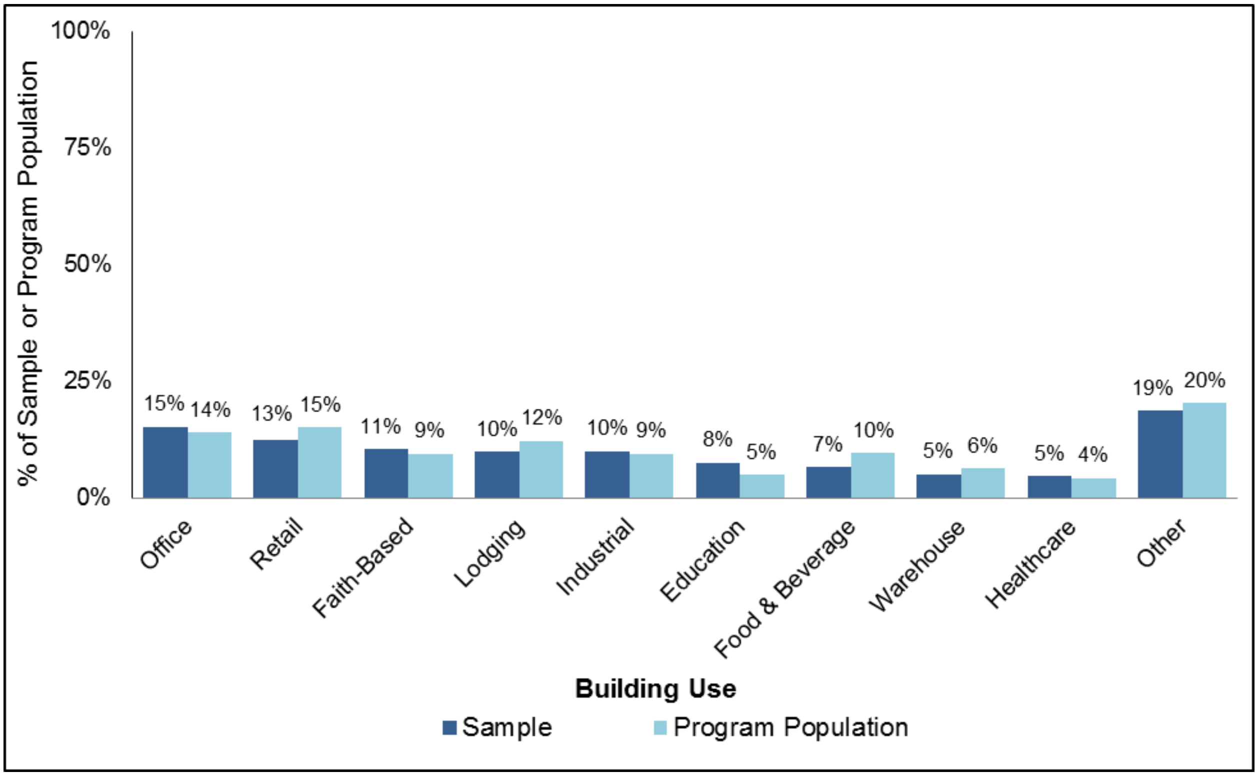

Figure 5-5 Type of Building – Sample Compared to Program Population (n = 843)

The size of the facility where the project occurred varied from less than 10,000 square feet (30% of respondents) to more than 500,000 square feet (7% of respondents; Figure 5-6). More than half (57%) of respondents reported facilities of 50,000 square feet or less.[18] Respondents were much more likely (43% vs. 6%) to be in buildings over 50,000 feet, as opposed to the national stock of buildings. Buildings less than 10,000 feet made up a much smaller (30% vs. 72%) proportion of the sample than the population (Figure 5-6).

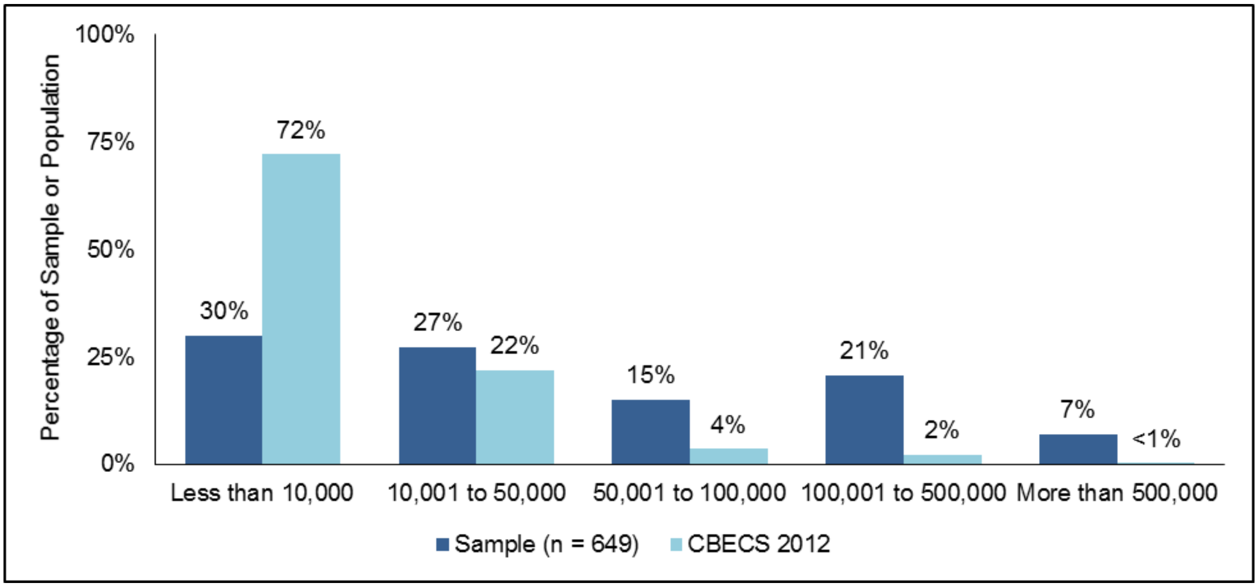

Figure 5-6 Building Size – Sample Compared to Population[19]

Among respondents who reported the number of locations within Ameren Missouri territory (59% of the sample), 72% reported five or fewer locations, 19% reported six to twenty-five locations, and 9% reported more than twenty-five.

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. More respondents reported face-to-face outreach (contact by an Ameren Missouri key account representative, customer account advisor, or a program business development representative) than reported program mass or direct marketing (including brochures, newsletters, and broadcast ads).[20]

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[18] The large amount of missing data in the database (62% of database project records were missing building square footage) made comparison of the building size reported by survey respondents to the project database inappropriate.

[19] The population data are from the Commercial Buildings Energy Consumption Survey (CBECS).

[20] This does not imply that mass or direct marketing actually reached fewer respondents; rather, it conceivably could reflect a recall bias in favor of the more personal form of outreach.

Table 5-19 Sources of Program Awareness (n = 843; multiple responses allowed)

Source	*Count*	*Percent*
Contractor, vendor, consultant, and other similar sources	454	54%
Program marketing or outreach	296	35%
Program mass or direct marketing	73	9%
Program face-to-face outreach	186	22%
Program website	98	12%
Other program outreach (e.g., “lunch and learns”)	44	5%
Sources other than Ameren or contractor, vendor, or consultant	281	33%
Past program experience	152	18%
Friend, colleague, professional association	149	18%
Do not know	56	7%
No response	13	2%

In addition to examining the percentage of respondents that reported each source of awareness, the evaluation team also examined the percentage of project-related energy savings associated with each source. Figure 5-7 shows that, while awareness from trade allies (contractors, vendors, or consultants) was more commonly reported than program outreach or other sources of awareness, awareness from trade ally and program sources generated similar levels of savings. Thus, program-related outreach is responsible for a significant proportion of program savings and is an important source program awareness.

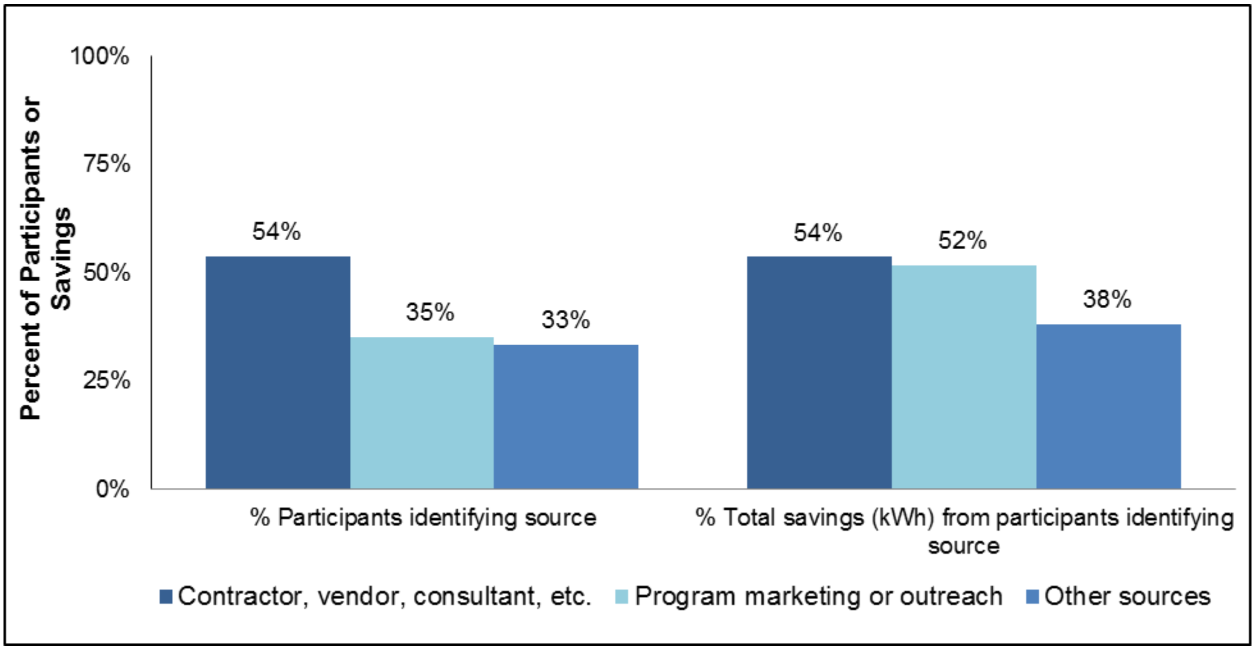

Figure 5-7 Sources of Program Awareness: Participants and Associated Savings Reached by Each Source (n = 843; multiple responses allowed)[21]

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

The survey asked the 300 respondents with standard-only projects whether they were aware of incentives for custom projects. Eighty-five respondents (28%) reported they were aware of those incentives. Of those eighty-five respondents, fifty-one (60%) indicated they did not choose the Custom Program option because the Standard Program application covered all equipment of interest to them. Four respondents stated that the custom application seemed too complicated. The remaining fifteen either did not explain why they did not apply for customer incentives or said they did not know the reason.

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.

About half of respondents 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. Less than one-fifth, however, reported having

[21] We excluded eighty-five respondents (10%) from this analysis because the project was not administratively complete at the time of the survey and did not have project savings allocated.

defined energy-saving goals or an energy efficient equipment purchase policy (Figure 5-8).

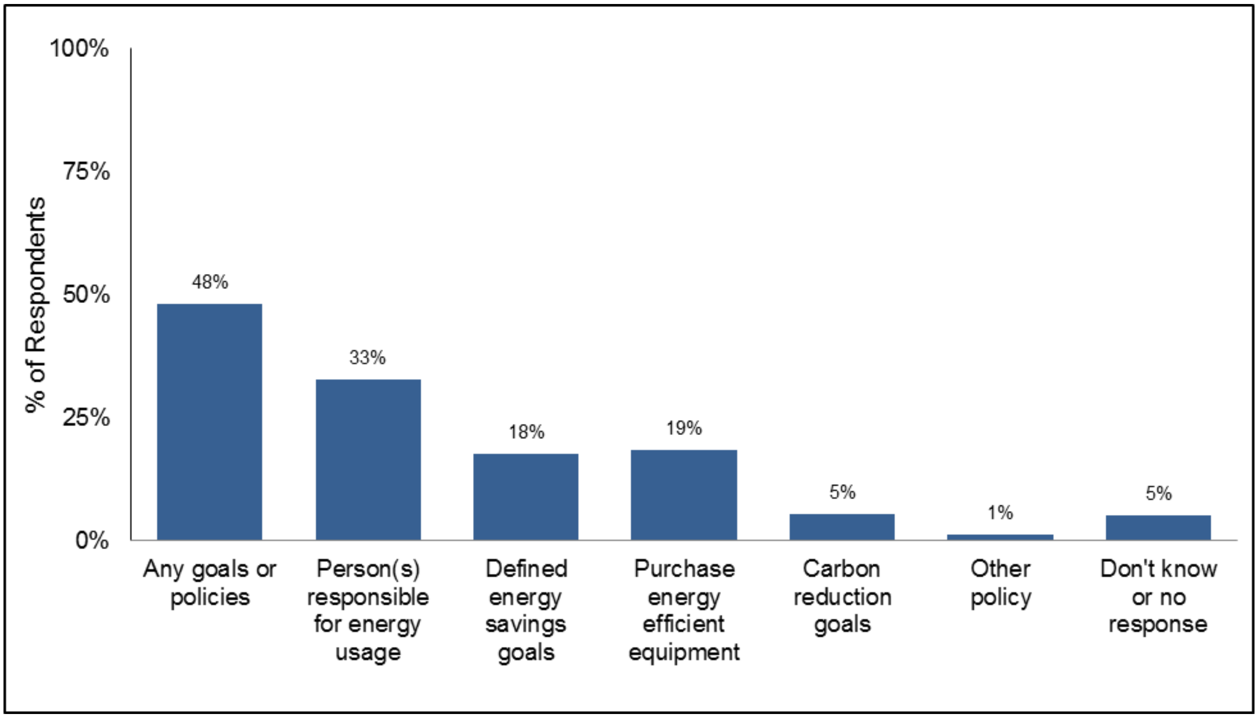

Figure 5-8 Energy Related Policies (n = 843)

Nearly half of respondents reported that a vendor or contractor presented the idea to participate in the program, while about one-quarter reported that the idea originated within their organization and one in five reported that the idea came up in a discussion with their vendor or contractor (Figure 5-9).

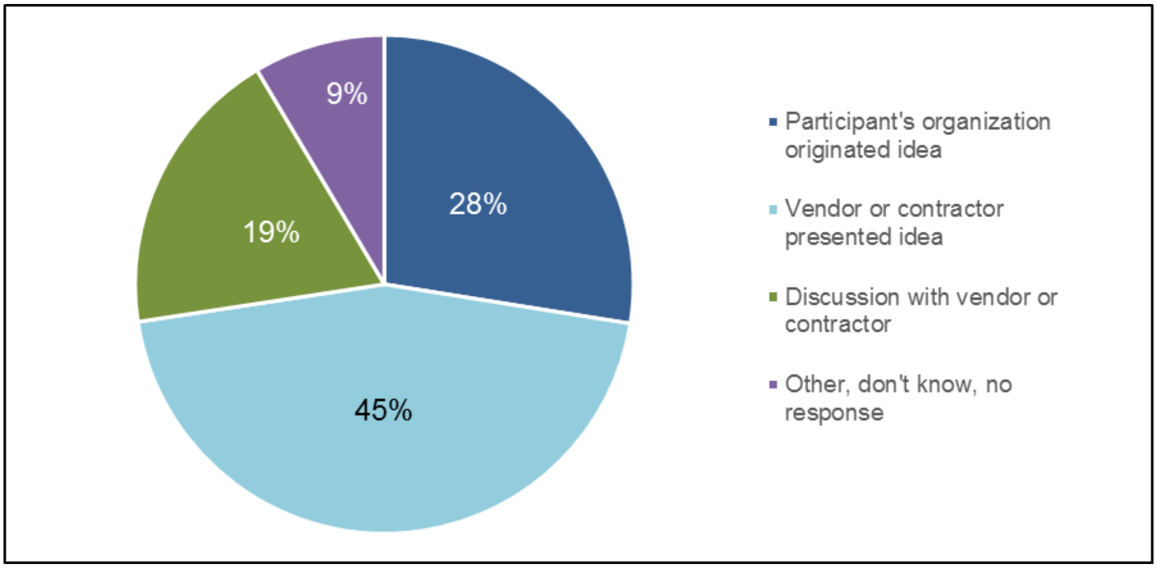

Figure 5-9 Party Initiating Discussion about Program Participation (n = 843)

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.

Three types of reported policies were related to organizational initiatives focused on energy efficiency upgrades. Organizations that had defined energy savings goals, a specific policy requiring energy efficiency, a person(s) responsible for energy decisions, or more than one energy related policy in place were significantly more likely to initiate the decision to upgrade their equipment (Figure 5-10). This finding suggests that organizations with energy-related policies take a more proactive approach to energy savings.

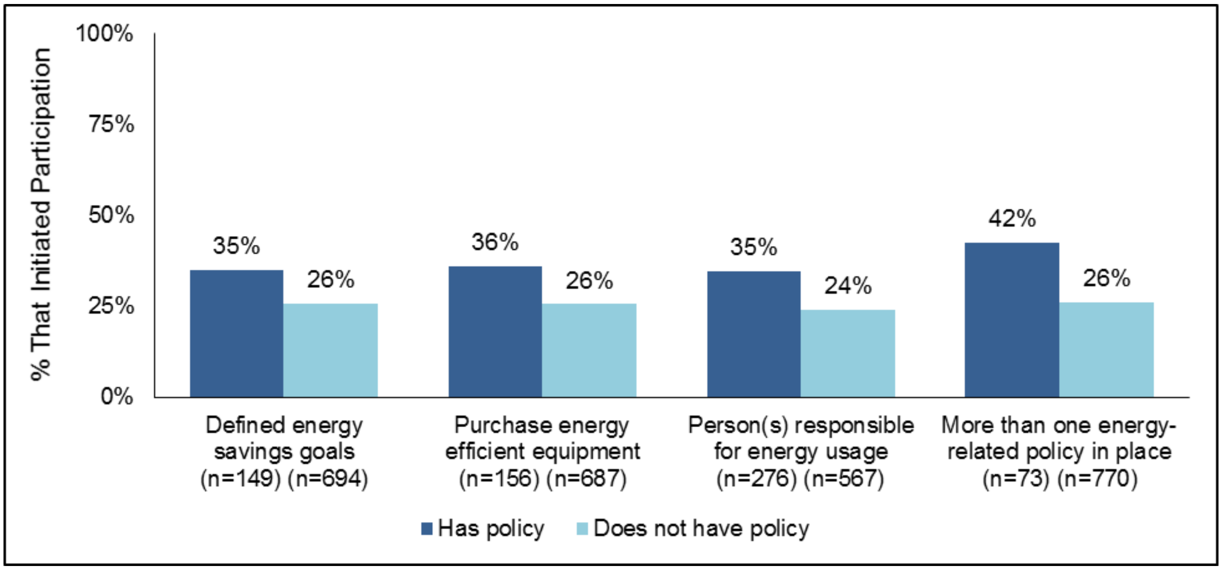

Figure 5-10 Initiation of Participation, by Presence of Energy Related Policies

5.4.6. Persons Affecting Customer Decisions

Figure 5-11 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 at least a moderate influence on the decision, and about one-third reported at least a moderate influence on the part of a contractor. By contrast, one-quarter or fewer said that either utility staff or a BizSavers program representative had at least a moderate influence.

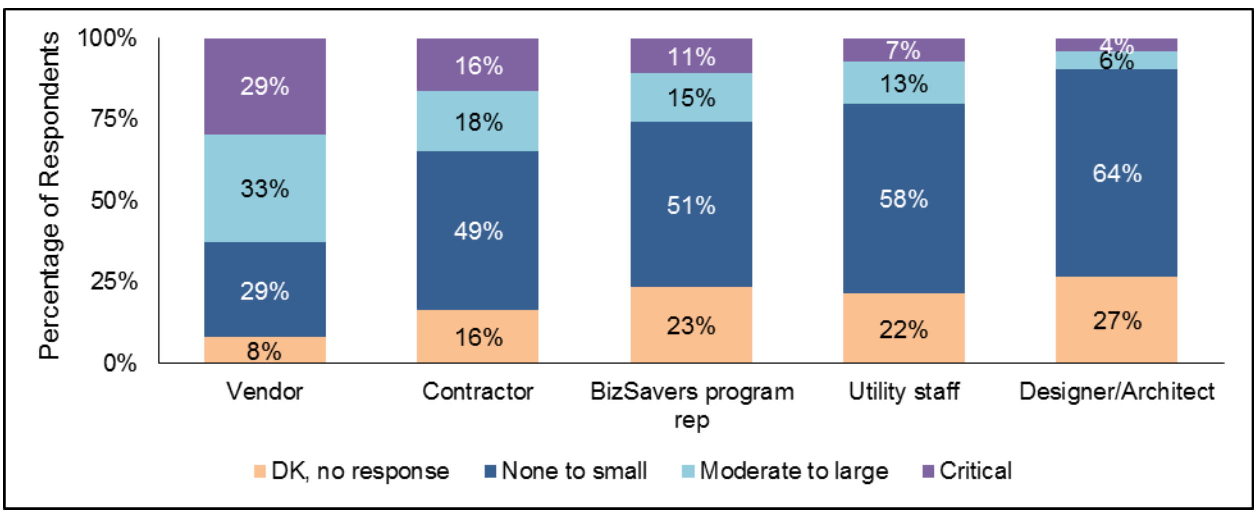

Figure 5-11 Influence of Vendors, Contractors, and Utility Staff on Decision to Install Efficient Equipment (n = 820)

The respondents who reported that someone had at least a "moderate" level of influence (n = 668) were asked what that person (or people) did that influenced them. Of the 132 who provided a response, forty-three (33%) 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 forty-five (34%) respondents indicated the person (or people) provided assistance in the form or "project approval" or "general encouragement and guidance." Fewer ten 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 (70%) 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 – most commonly, a vendor. Two-fifths 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	588	70%
Vendor	384	46%
Contractor	251	30%
Program representative	8	1%
Applicant*	562	70%
Applicant, with outside help	335	40%
Do not know / no response	20	2%
Total	843	100%

* Survey respondent or co-worker.

Of the 562 respondents who reported that they or a co-worker played a direct role in the application, 504 (90%) said they were directly involved. A follow-up question asked those 504 respondents about how they completed and submitted the application.

More than half (59%) of respondents reported submitting a fast track application. Of those, 18% used the online version and the rest used a downloadable version and submitted it later by email. Somewhat more than one-third (37%) submitted a version of the application other than the fast track version, of whom 8% reported using the online version with the rest using the downloadable version. The remaining 5% of respondents did not know or did not report what version they used.

Of the 541 respondents with custom projects, 136 (25%) reported they had to resubmit or provide additional supporting documentation before their application could be approved. Of those 136, nearly two-thirds (61%) reported being asked to provide additional supporting documentation, such as invoices. About one-fifth (19%) stated that the issue was related to how they (or their proxy) had calculated energy savings. Twenty-five respondents reported other miscellaneous issues and ten said they did not know why they had to resubmit (multiple responses were allowed).

Of the 486 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 (53%) or that they did not know or did not provide a response (36%).

5.4.8. Equipment

Of 578 respondents who worked directly with a retailer, more than half (57%) reported that they had received their equipment within two weeks of ordering it from a service provider (Figure 5-12).

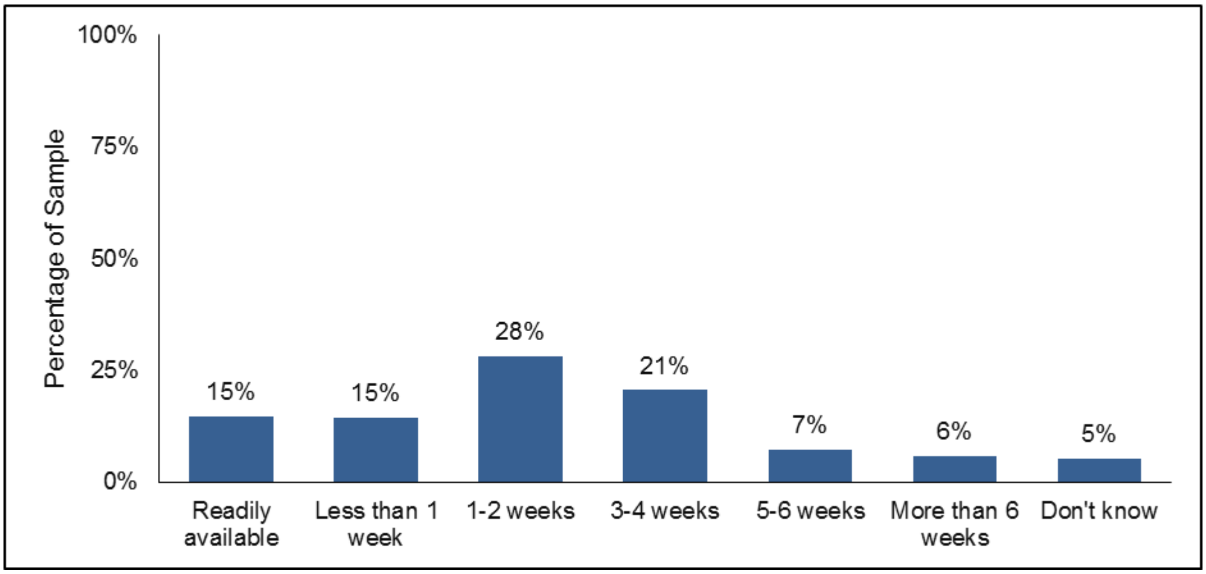

Figure 5-12 Waiting Time to Receive Equipment for Retailer (n = 295)

About half (47%) 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 5-13).

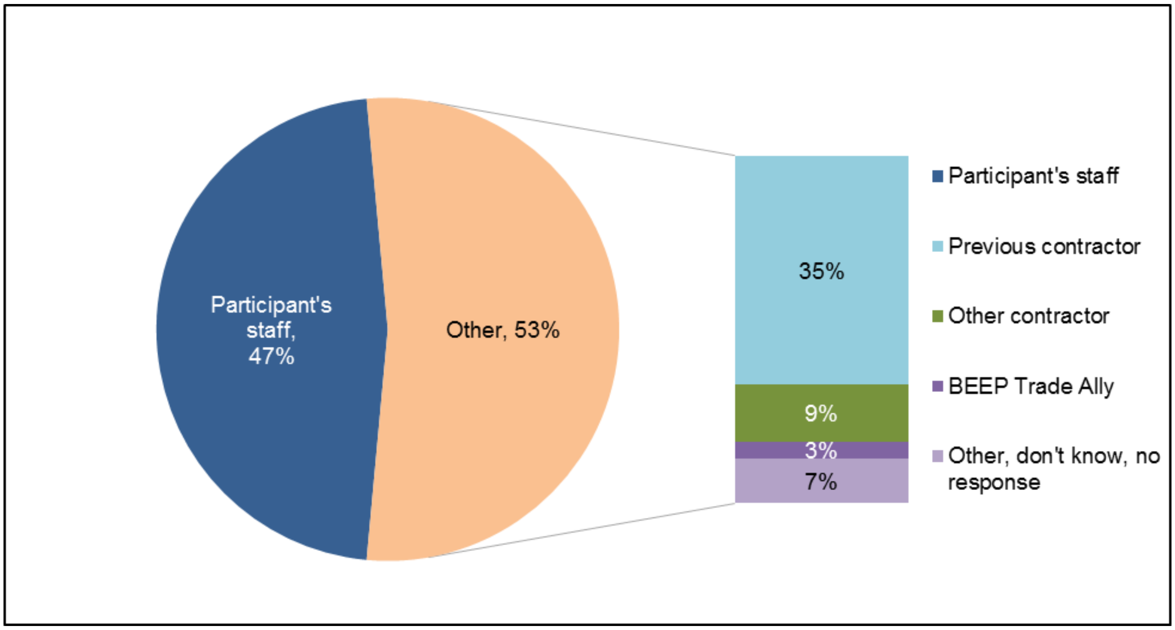

Figure 5-13 Distribution of Who Installed Project (n = 820)

5.4.9. Customer Satisfaction with the Program

All respondents rated their satisfaction with the program overall and various aspects of participation.[22] On their overall experience, 83% of participants indicated high satisfaction (Figure 5-14). 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.

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

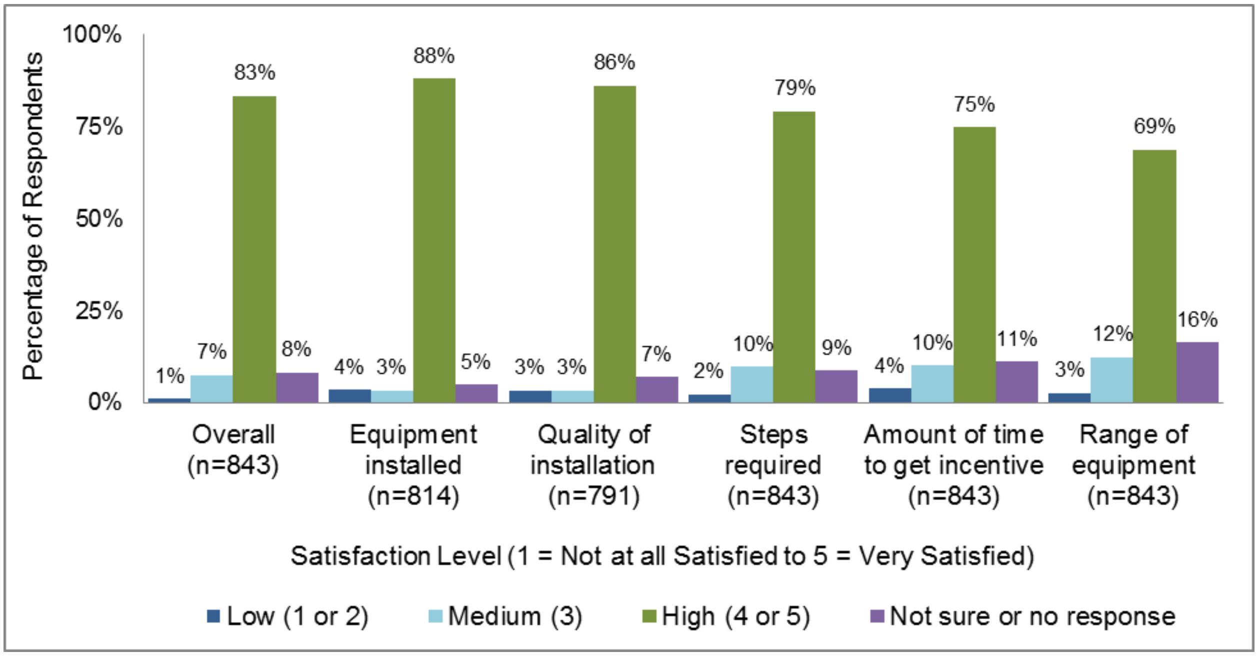

*Figure 5-14 Satisfaction with Participation**

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

Providing more detail about satisfaction with the application process, the 504 respondents who had a role in completing their application rated several aspects of their experience with the process, including the clarity of application instructions.[23] As Figure 5-15 shows, respondents rated most aspects highly. The one exception is that fewer than half of the respondents reported that the application instructions were clear, but that is because about half of respondents did not provide *any* rating for the clarity of application instructions. Of those respondents that *did* rate the clarity of the instructions, the large majority provided a high rating. The rated clarity of instruction was unrelated to whether respondents reported receiving outside help on the application.

[23] 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."

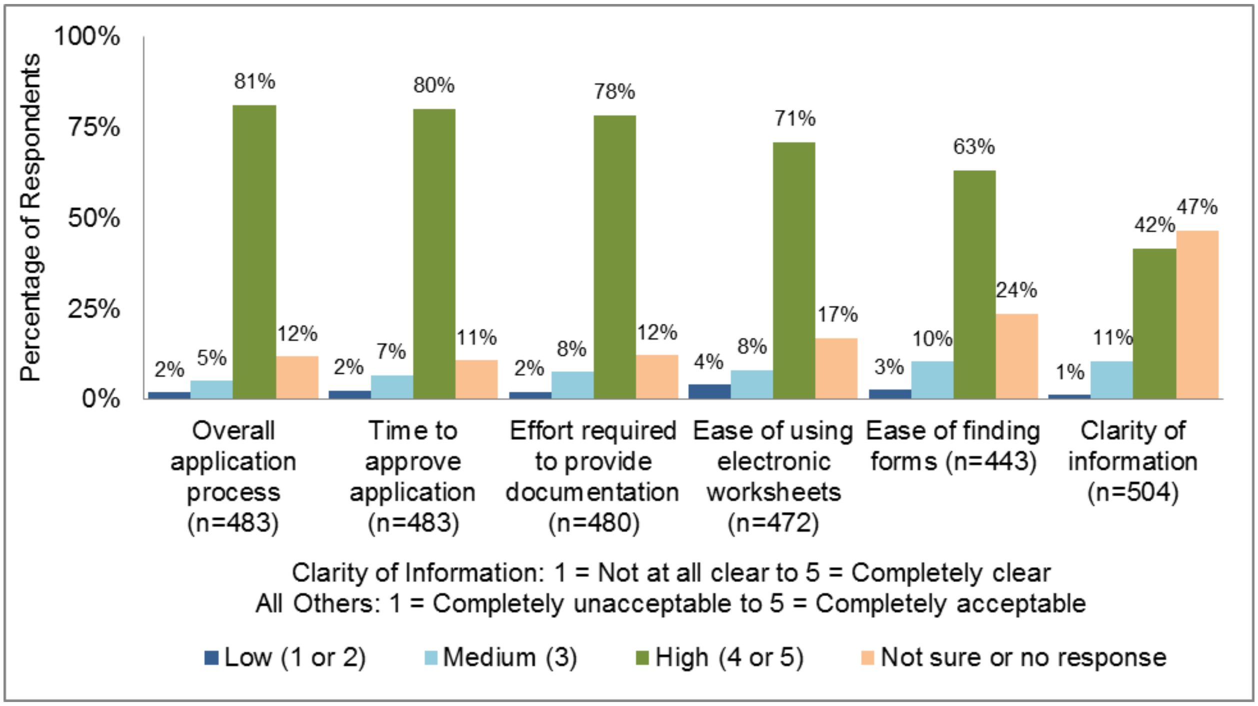

*Figure 5-15 Clarity of Application Instructions and Acceptability of Application Process**

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

Of the 504 respondents who had a role in completing their applications, 432 (86%) said they had a clear sense of whom they could go to for assistance with the application process. Those 432 respondents were more likely than the seventy-two other respondents to rate several aspects of the application process as acceptable (Figure 5-16).

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. In any case, these findings indicate that about seven percent of all survey respondents 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.

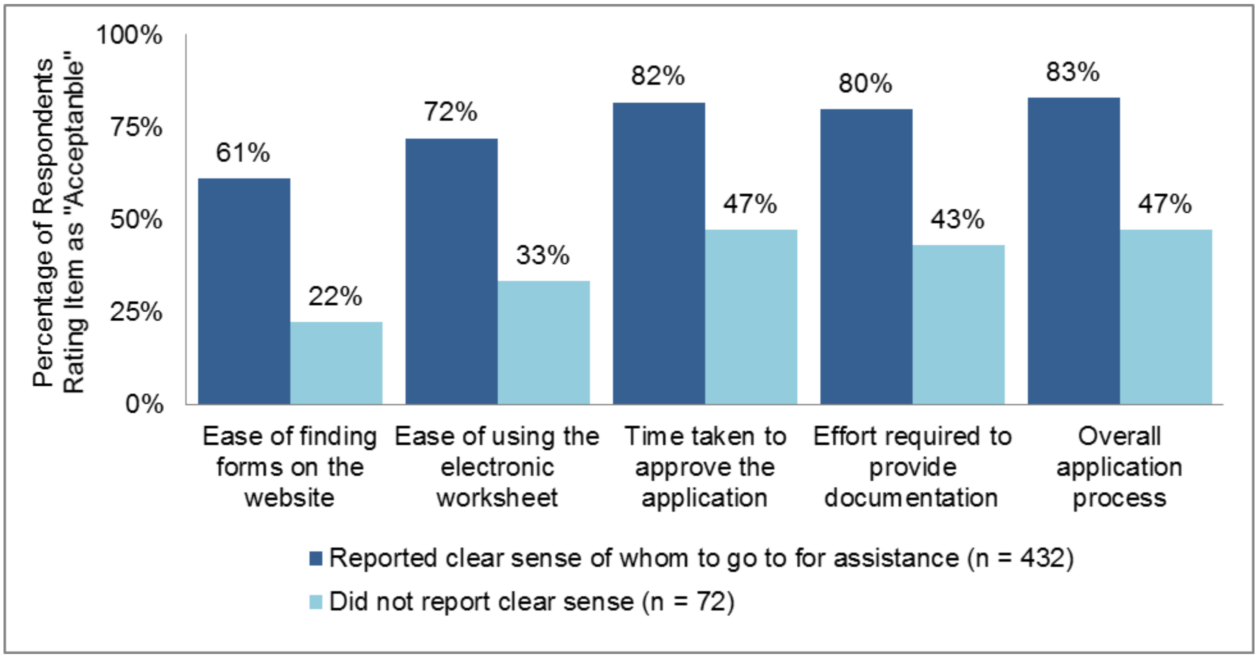

*Figure 5-16 Clarity of Application Instructions and Acceptability of Application Process**

* "Acceptable" is defined as a rating of 4 or 5 on a 5-point scale, from completely unacceptable to completely acceptable. All differences are statistically significant by *chi-square*, at $p \leq .001$.

When asked whether they had interacted with program staff during the project, 378 of the 843 respondents (45%) reported such interactions; 348 (41%), reported no interactions; and 117 (14%) were not sure or did not respond. Of the 378 respondents who interacted with program staff, 336 (89%) 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 (89%). 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 (55% vs. 39%, respectively).

One-third of respondents (277 or 33%) reported that a program representative had inspected the completed project, 239 (28%) reported that no inspection occurred, and 327 (39%) did not know or did not respond. Of the 277 who reported an inspection, about four-fifths indicated high agreement (a 4 or 5 on a 5-point scale) that the inspector had been courteous and efficient (83% for both statements).

When asked how their incentive amount compared to what they had expected to receive, a large majority (77%) of respondents reported that the incentive was at least as much as they had expected (Figure 5-17).

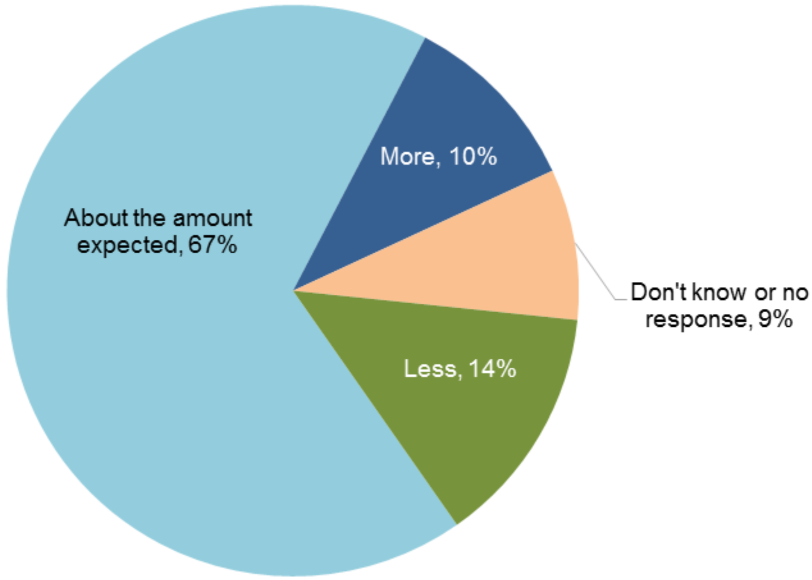

Figure 5-17 How Incentive Compared with Expectations (n = 843)

5.4.10. New Construction Program Awareness

The survey identified respondents who had not completed a new construction project in 2015 but were considering a new construction or major building renovation project within the next five years to assess awareness of the New Construction Program. One-third of the total sample – 262 respondents – reported considering such a project within the next five years, half (48%) of whom were already in the design phase. Fewer than one-third (29%) of those 262 respondents were aware of the New Construction Program, and awareness did not differ between those already in and those not yet in the design phase.

To identify possible implications for promoting the New Construction Program through the Standard and Custom *retrofit* programs, the evaluation team examined whether awareness of the New Construction Program was related to how respondents learned about the retrofit program they participated in. There was such a relationship: among respondents who reported learning about their program from an Ameren Missouri or BizSavers representative, 48% knew of the New Construction Program, compared to 22% of all other respondents. In contracts, among those who reported program awareness came through a trade ally, 21% knew of the New Construction Program, compared to 42% of all other respondents.

Clearly, Ameren Missouri and BizSavers representatives are more effective in promoting the New Construction Program than are trade allies who focus on retrofits. Finding ways to motivate retrofit trade allies to promote the New Construction Program could conceivably produce greater awareness of that program, enabling the program to reach more projects in the design phase.

5.5. 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 ten 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.

5.5.1. Sampling Approach

From January 1, 2013 to November 3, 2015, 428 Ameren Missouri customers initiated 588 applications for BizSavers standard or custom incentives that they later discontinued. Our previous experience suggested that, with customers who had discontinued projects as well as ongoing or completed ones, the discontinued applications reflected a de-prioritization of those projects rather than process issues. We therefore focused our data collection effort on those with discontinued applications and no ongoing or completed projects. As of the time of sampling (November 3, 2015), fifty-six customers had discontinued projects in 2015 but had no ongoing or completed ones in 2015. The team excluded four customers for whom the program implementer had discontinued their applications as ineligible, leaving fifty-two near-participants.

We attempted to reach the primary contact for each discontinued project for those fifty-two near-participants. We able to reach twenty-eight contacts, of whom ten were able to speak to their experience in the program; those represent the focus of this report section. Of the remaining eighteen contacts:

- Ten provided brief explanations as to why they discontinued the project: three each reported the company changed ownership, they failed to meet a program deadline, or that they changed their minds about the project (one because of insufficient incentive), and one reported that the project was on hold.
- Three reported that they did not realize that the incentive application had been discontinued.
- One did not recall the described project.
- Four refused to provide details.

The ten interviewed near-participants represented a variety of property types from multiple cities in Missouri (Table 5-21).

Table 5-21 Property Type and Location of Sampled Sites (n=10)

Property Type	*Count*
Manufacturing facility with onsite offices	2
Manufacturing facility	1
Office building	1
University building - residence hall	1
High school - athletic field pavilion	1
Commercial glass shop	1
Retail store	1
Restaurant	1
Traffic lights	1
City	Count
St. Louis	4
Dexter	1
Jefferson City	1
O'Fallon	1
Union	1
Washington	1
Wentzville	1

Responding organizations varied in size, reporting:

- From one to about 100 locations in Ameren Missouri territory
- From six to about 500 persons employed at those locations
- From about 12,000 to about 1,000,000 square feet across those locations

All but one of the respondents reported they own the property associated with the discontinued project. Most (seven of ten) respondents served in higher-level management roles, two were engineers, and one was a maintenance supervisor.

The interviews covered how the respondents learned about the program; how they decided which energy efficiency measures to pursue; and their experiences with program processes, requirements, and staff. The research team also asked near-participant respondents why they decided to discontinue their projects.

5.5.2. Upgrade Plans and Program Awareness

Respondents reported how they learned about the program and whether the upgrade idea arose internally or in response to an external suggestion. Half of the respondents reported learning about the program from a trade ally while the other half learned about it through other means. Figure 5-18 shows the patterns that emerged regarding the initiation of the upgrade idea. Six of the ten respondents reported the upgrade plan originated within their organization, while the other four said a program trade ally approached them with both the upgrade idea and the information about the incentives.

Of the six whose organizations initiated the upgrade idea, four said their organization knew of the program before initiating the upgrade plan; the other two said their organizations initiated the plan without knowledge of the program.

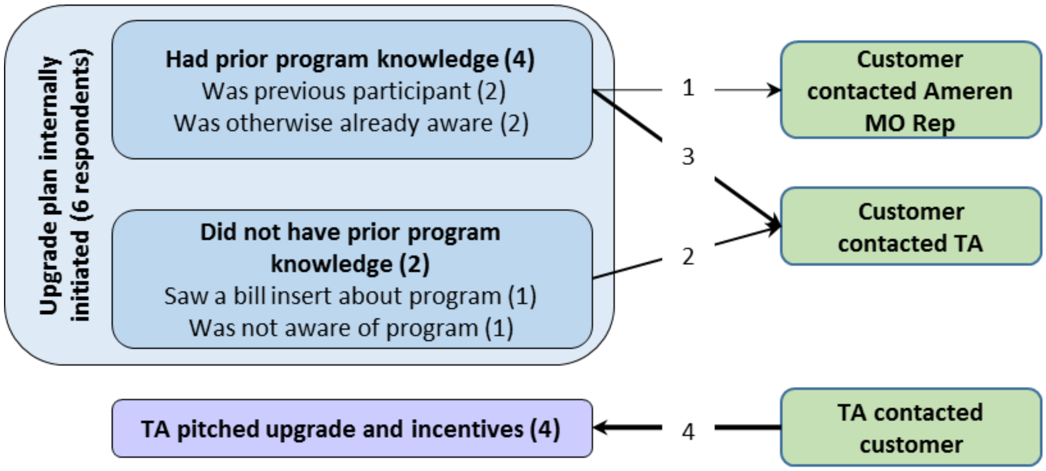

Figure 5-18 How Upgrade Plans and Program Participation Originated (n=10)

5.5.3. Experience and Satisfaction with Application Process

Respondents were largely satisfied with their limited experience in the program (Figure 5-19). They were least satisfied with the amount of required documentation.

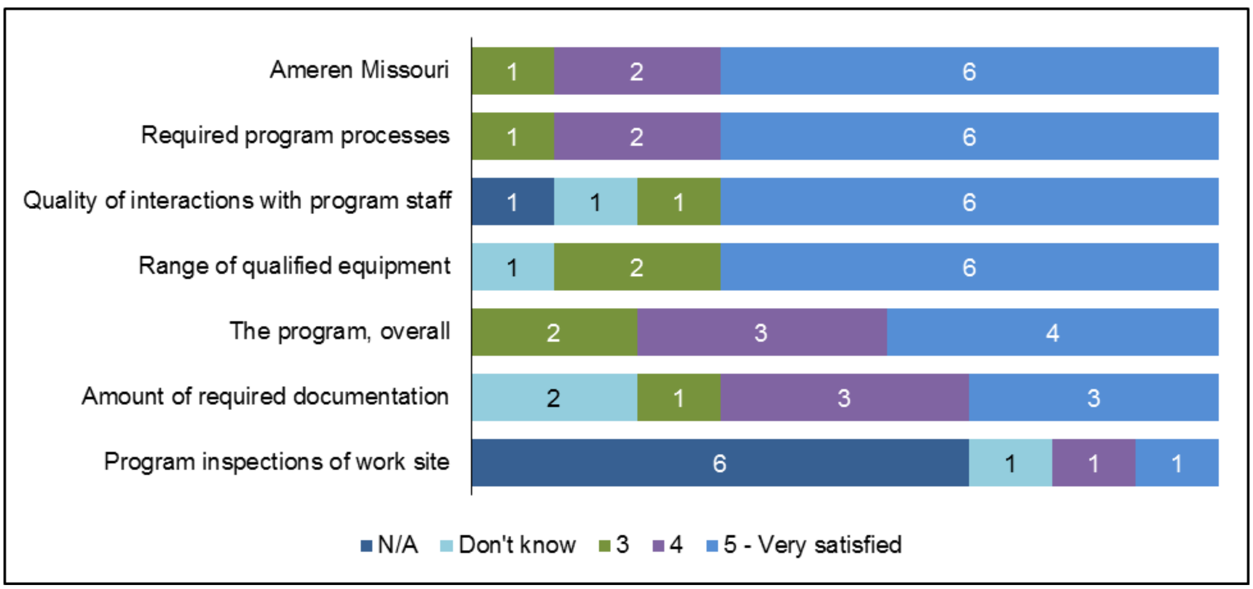

*Figure 5-19 Near-participant Satisfaction (n=9)**

* One respondent reported no involvement in the application process. We excluded this respondent from the satisfaction questions.

Respondents were equally split among those who said their contractor or vendor completed the entire application on their behalf, that they collaborated with their contractor or vendor to complete the application, or that they completed the application by themselves or with a coworker. Of five who reported being "heavily" involved in completing the application, two described the application as "fairly easy" or "very good"; the other three reported some challenges – Excel formula glitches, difficulty in grouping lighting measures together on the application, and the amount of time involved – but described the application overall as "straightforward" or "not that bad."

Five respondents offered a total of six suggestions for improving various aspects of the program, including the application process. Half of the comments had to do with providing greater outreach or assistance with efficiency. Two respondents simply suggested expanding efforts to explain the program to potential participants, such as via pamphlets or emails, while the third suggested there had been a recent decrease in one-on-one assistance to business customers seeking to lower energy use in their buildings:

> *"My biggest thing would be more assistance from Ameren directly. Years ago we had an account rep that would come to our plant and talk about possible energy efficiency projects we could do. They offered analysis on what we were doing - they do not have that anymore. Now whenever I call Ameren, I have to go through three or four levels of voicemail and they refer me to back and forth between departments. That gets frustrating."*

Although the above comment appears to be a minority position, it underscores the important role that customer support staff may have in promoting energy efficiency.

One respondent offered two suggestions for streamlining the application and approval process. This respondent suggested that the application paperwork could be staggered so that participants provide some of the information before the starting the project and then provide ancillary information (such as checking account numbers) following project completion, noting that this would minimize the upfront burden of getting a qualifying project started. This respondent also suggested that Ameren Missouri simplify the custom application forms (especially for larger projects) by accepting inexact documentation and providing "ballpark" incentive offers at the onset:

> *"For example, there's a public building we manage - if we filled out the application to swap out the lights for LEDs, we would have to go through each individual bulb, determine the wattage/voltage, count them up (there's thousands of bulbs), then pick the replacement product and how long it will take/cost. That is a big task."*

Finally, one respondent suggested providing customers advance knowledge of whether Ameren Missouri will offer BizSavers incentives for the following year – specifically, declaring future incentive offerings by the third quarter of each year so businesses have time to plan and budget their projects for the following year.

5.5.4. The Decision to Discontinue the Application

Respondents reported pragmatic reasons for discontinuing their BizSavers applications; no respondent said a negative experience in the program compelled them to discontinue their project. Instead, respondents most commonly said they lacked the funds needed to execute the project (four mentions) or that management decided for non-budgetary reasons not to go through with the upgrade (three mentions; Table 5-22). Two respondents said they wanted to complete a project through the program but that delays prohibited them from finishing the project before the program deadline, which led them to cancel the project indefinitely. One respondent canceled their project because they were able to find a cheaper lighting upgrade, noting they were unsure whether the alternate lighting project was less efficient than that planned through BizSavers.

Table 5-22 Near-participant Reasons for Discontinuing BizSavers *Applications (n=10)*

Reason for discontinuing project	Count
Lacked budget for project	4
Management decision (other than lack of budget)	3
Unable to finish project prior to program deadline	2
Found a cheaper option	1

Four of the ten near-participants – two of those that missed the deadline and two that lacked the budget – said they discussed their reasons for discontinuing their projects with program staff and that program staff said they understood.

5.5.5. Other Energy Saving Actions

The interview included several questions about past and future plans to undertake efficiency upgrades as well as energy management and monitoring practices currently followed. This information provides a sense of the respondents' proclivity to carry out energy-saving actions with and without the BizSavers program.

Three of the ten respondents said they had applied for Ameren Missouri incentives in the past and nine said they would consider doing so in the future, while was not sure whether they would consider applying for incentives again. This information provides further evidence that faulty program processes did not lead to these project discontinuations.

Of the nine who expressed interest in applying for incentives in the future, seven were interested in lighting incentives (Table 5-23). Near-participants reported interest in various non-lighting measures for existing buildings, specifically: HVAC, manufacturing equipment, insulation, windows, and doors.

Table 5-23 Types of Incentives Near-participants Expressed Interest In (Multiple Responses Allowed; n=9)

Incentive	*Count*
Existing Buildings (Standard or Custom) lighting	7
Existing Buildings non-lighting	5
New construction	2
Retro-commissioning	2

Half of the respondents said they are likely to buy energy efficient equipment without applying for a rebate from Ameren Missouri because of their program experience. Again, lighting upgrades were most commonly mentioned (three mentions), but single respondents each mentioned attic insulation, air compressors, retro-commissioning, and production process or behavior changes (such as shifting operating hours).

While the above findings indicate positive attitudes toward taking energy saving actions, other findings suggest those attitudes may not lead to action without program assistance. Specifically, none of the responding near-participants reported having already installed any energy efficiency measures because of their experience with the program. Further, respondents reported minimal energy management and monitoring practices at their facilities (Table 5-24). Respondents most commonly said they optimize HVAC efficiency via thermostat settings (five mentions).

Table 5-24 Energy Management and Monitoring Practices (Multiple Responses Allowed; n=10)

Energy Monitoring/Management Strategy	*Count*
Use thermostat settings to optimize HVAC energy efficiency	5
Monitor electricity bills	2
Turn off lights when not occupying area	1
Air sealing	1
None	1
Don't know	2

5.6. Trade Ally and Non-Allied Service Provider Survey

In November 2015, evaluation staff conducted semi-structured interviews with fifty-six service providers who completed retrofit projects in the Ameren Missouri BizSavers standard and Custom Programs. (Evaluation staff conducted separate in-depth interviews with trade allies who completed new construction and retro-commissioning projects; see Section 5.8.2 and Section 5.9.2.) The interviews covered topics related to training received, perceptions of program marketing, customer program awareness, and program experience. Appendix J: TA Semi Structured Interview Guide - RCx provides the full interview guide.

5.6.1. Sampling and Data Collection Approach

The sampling goals were to complete interviews with a sufficiently large sample of contacts from service provider firms that did retrofit projects to achieve 90% confidence and 10% precision of estimates, while prioritizing service providers that had undertaken large numbers of projects and/or projects with high savings. Unique service provider firms ("service providers") served as the sampling unit. The population is all firms that worked on at least one BizSavers retrofit project that began in 2015. Since the population of retrofit service providers is finite and relatively small, the minimum sample size required for 90/10 confidence/precision depends on the population size.[24]

The exact size of the provider population is unknown. At end of October 2015, the program database identified 297 firms that did at least one retrofit project (with a mean of 7.1 projects per firm) but also identified another ninety-one retrofit projects with no service provider listed. The evaluation staff conservatively assumed a mean of three projects for the unidentified firms, yielding thirty unidentified firms for a total population of 327. Assuming an additional ten firms did retrofit projects only in the last two months of the year yields a total population of 337 firms with retrofit projects in 2015. For that size population, a sample of 56 yields results with at least 90/10 confidence/precision.

Excluded records without adequate contact information from the list of 297 identified firms yielded a sample frame of 199 service provider firms. To increase the chances of interviewing larger-volume or higher-savings service providers while maintaining randomization, staff multiplied a randomly generated number[25] for each service provider by that provider's total 2015 project ex ante savings. The evaluation staff then sorted the list of service providers on the weighted random number, from high to low.

An experienced member of the research team called the service provider firms. The interviewer asked to speak with the individual at each firm with the highest number of unique BizSavers projects (identified from the program database). If that person was unable or unwilling to complete the interview, the interviewer asked to speak with another contact associated with that firm. Calls continued until we achieved the target sample. In total, the interviewer attempted contact with 155 service providers and completed interviews with 56 respondents, achieving a completion rate of 36%. Table 5-25 shows dispositions.

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[24] See, for example, "Estimating a Proportion for a Small, Finite Population," Penn State, Eberly College of Science web page: https://onlinecourses.science.psu.edu/ stat414/node/264.

[25] We used the Mersenne Twister method. Heidelberger, Coutre, and L'Ecuyer. 1998. "Mersenne twister: a 623-dimensionally equidistributed uniform pseudo-random number generator." *ACM Transactions on Modeling and Computer Simulation* 8:3-30. Available at: http://dl.acm.org/citation.cfm?id = 272995. Last accessed on January 27, 2014.

Table 5-25 Service Provider Interview Sample Dispositions

Disposition	*Count*
Frame	199
Attempted	155
Not able to contact	78
Able to contact	77
Completed survey	56
Refused	12
Not eligible*	9
Not attempted	44

* Duplicate numbers, bad numbers, or did not pass screening.

Although nearly half the firms in the sample frame were *not* members of the Ameren Missouri trade ally network (TAN), the weighted approach strongly favored TAN members as they had substantially higher 2015 program savings than did non-members. As a result, all but one respondent was a TAN member.

5.6.2. Service Provider Characteristics

Interviewed service providers represented a diverse group in terms of program activity. More than three-quarters (79%) of providers had experience with lighting projects and the same share (79%) had non-lighting experience, with more than half (57%) having experience with both. Two providers had New Construction or Retro-Commissioning Program experience. Service providers worked on a minimum of one and a maximum of 165 BizSavers projects in 2015 (Table 5-26).

Table 5-26 Number of Ameren Missouri BizSavers *Projects per Service Provider during 2015 (n = 56)*

Number of Projects	*Count*	*Percent*
1	10	18%
2 to 10	34	61%
11 to 25	6	11%
26 or more	6	11%
Total	56	100%
Mean	13	
Median	4	

Service provider firms ranged widely in size, with one reporting more than 300 locations; more than half (56%) had only one location, with about one-quarter (27%) reporting from two to five locations, and the remainder having more than five locations. The number of employees also varied, from 1 to 1,500, with a median of fifteen. Service providers reported serving all areas of Ameren Missouri's territory (Table 5-27).

Table 5-27 Areas Served by Service Providers
(n = 56, Multiple Responses Allowed)

Area Served	*Count*	*Percent*
St. Louis Metro	36	64%
Outer St. Louis suburbs	35	63%
Southeastern Missouri	33	59%
North/Central Missouri	31	55%
Statewide	23	41%

Service providers reported working for a wide range of customer types, most commonly for office buildings, industrial/manufacturers, and educational entities (Figure 5-20).

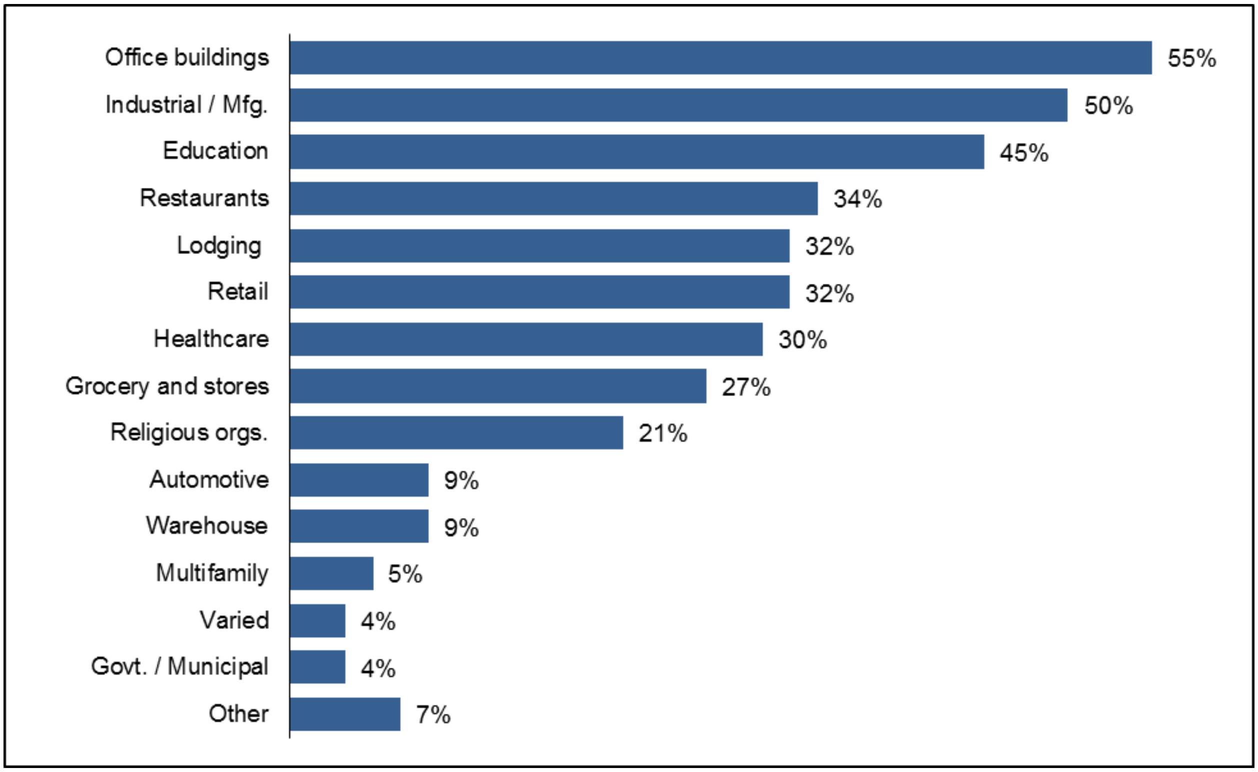

Figure 5-20 Service Provider Customer Sector/Building Types
(n = 56, Multiple Responses Allowed)

Service providers varied in the degree to which their work focused on a limited number of customer types or distributed across many types. About two-fifths said they do work for two to three customer types, with the remaining respondents split about evenly among those who reported working for only a single customer type, four to five types, or at least six types (Figure 5-21).

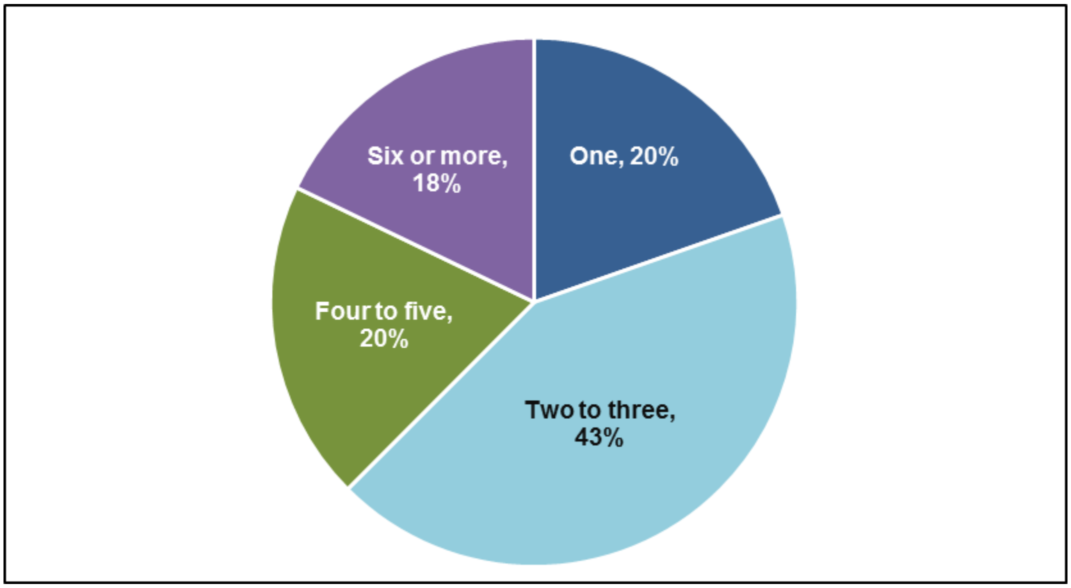

Figure 5-21 Number of Customer Types Served (n = 56)

Lighting-only service providers were significantly more likely than non-lighting service providers to report working with restaurant (41% vs. 8%) and retail clients (39% vs. 8%).[26] This likely reflects the large amount of lighting in restaurant and retail establishments.

Businesses that own their building space, lease their space, or manage building space for others may have different motives regarding equipment upgrades. To provide information on the degree to which the program is reaching these business types through service providers, the survey asked respondents what percentage of their customer base each type made up.

All respondents reported working with building owners, and those made up the largest proportion of service providers' customer bases (66% on average; Table 5-28). While three-quarters of respondents reported working with businesses that lease space, most (60%) of those reported that such customers make up one-quarter or less of their customer base. Property management firms were the least-served of these customer types: about one-third of providers reported working with such firms, and about half of them reported that such firms make up one-quarter or less of their customer base.

[26] Restaurants: $p = 0.04$; Chi Square = 3.13; $n = 56$. Retail: $p = .05$; Chi Square = 2.70; $n = 56$.

Table 5-28 Percent of Customers Served, by Building Ownership
*(n = 53, Multiple Responses Allowed)**

Percent of Customers	*Building Owners*		*Businesses that Lease Space*		*Property Management Firms*	
	Count	*Percent*	*Count*	*Percent*	*Count*	*Percent*
None	0	0%	13	23%	34	61%
1% to 25%	9	16%	24	43%	10	18%
26% to 50%	10	18%	9	16%	7	13%
51% to 75%	8	14%	3	5%	2	4%
76% to 99%	18	32%	4	7%	0	0%
All	8	14%	0	0%	0	0%
Don't know	3	5%	3	5%	3	5%
Total*	53	100%	53	100%	53	100%
Mean	66%		23%		11%	

To obtain information on how well the program is reaching small building owners, we also asked survey respondents what percentage of their building-owning customers have buildings with a total area of less than 200,000 square feet. Nearly all (98%) service providers reported working with at least one customer of this type, with about three-quarters (72%) of providers reporting that more than half of their building-owning customers are in this category.

5.6.3. Service Provider Use of Co-branding

Members of the Ameren Missouri trade ally network (TAN) enjoy several benefits resulting from their membership. One benefit is the ability to use the Ameren Missouri logo to co-brand their services. Of the fifty-five TAN members, nineteen (35%) reported co-branding their services. Of the remaining 36 who did not use co-branding services, one-third (33%) reported that program staff had reached out to someone at their firm about using co-branding. We asked the sixteen TAN members who reported not co-branding what additional information or assistance would encourage them to co-brand their services. Fourteen respondents expressed an interest in co-branding in the future, of whom eleven requested program staff contact them to discuss co-branding.[27] Two additional respondents reported not being responsible for marketing decisions.

5.6.4. Training

We asked service providers whether they had attended any public events held to educate contractors and customers about the BizSavers program (e.g., workshops, seminars, and trade shows). More than half (55%) reported they or someone else at

[27] Evaluation staff forwarded a list of these service providers to program staff.

their firm had attended at least one public event (39% and 16%, respectively). Of those that reported personally attending an event, more than half (55%) indicated attending one or two events, with the remaining providers reporting having attended between three and five events. As shown in Figure 5-22 nearly all services providers who attended public events agreed that the event durations were appropriate, the times and locations were convenient, the relevant topics were covered, the correct levels of detail were presented, and the information was clearly presented.

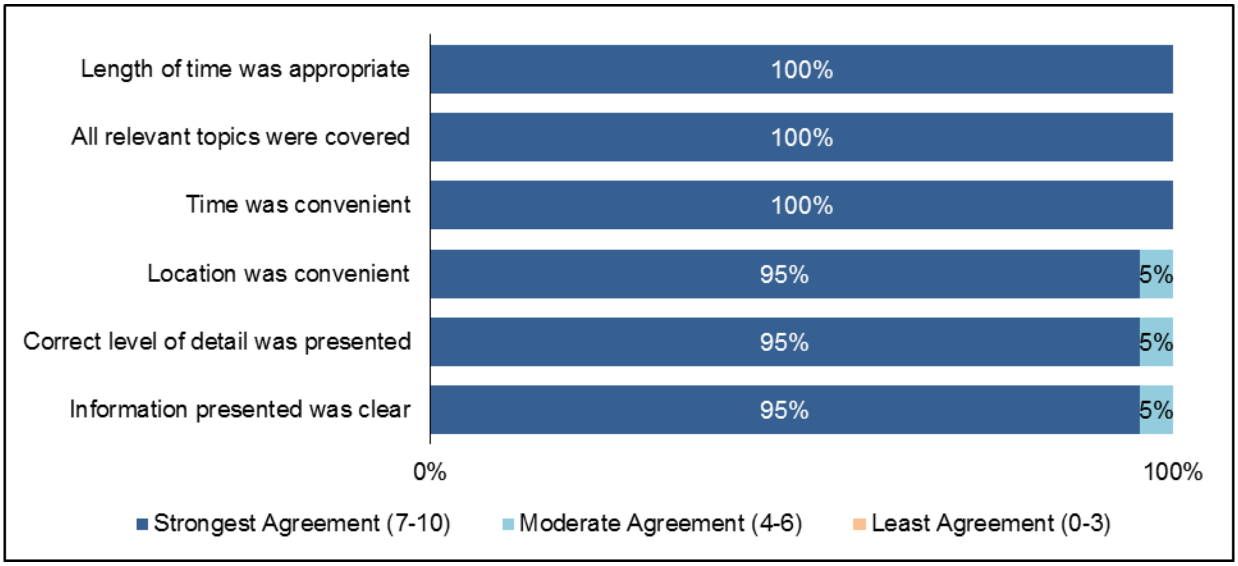

*Figure 5-22 Rated Satisfaction with Ameren Missouri Events (n = 22)**

** Respondents rated agreement with each statement on a 0-10 scale, from "do not agree at all" to "strongly agree." For this legend, we collapsed the scale responses into three categories as defined parenthetically in the figure legend.

Similarly, a large majority of service providers who attended an Ameren Missouri event reported that topics presented during the event were sufficiently covered (Figure 5-23).

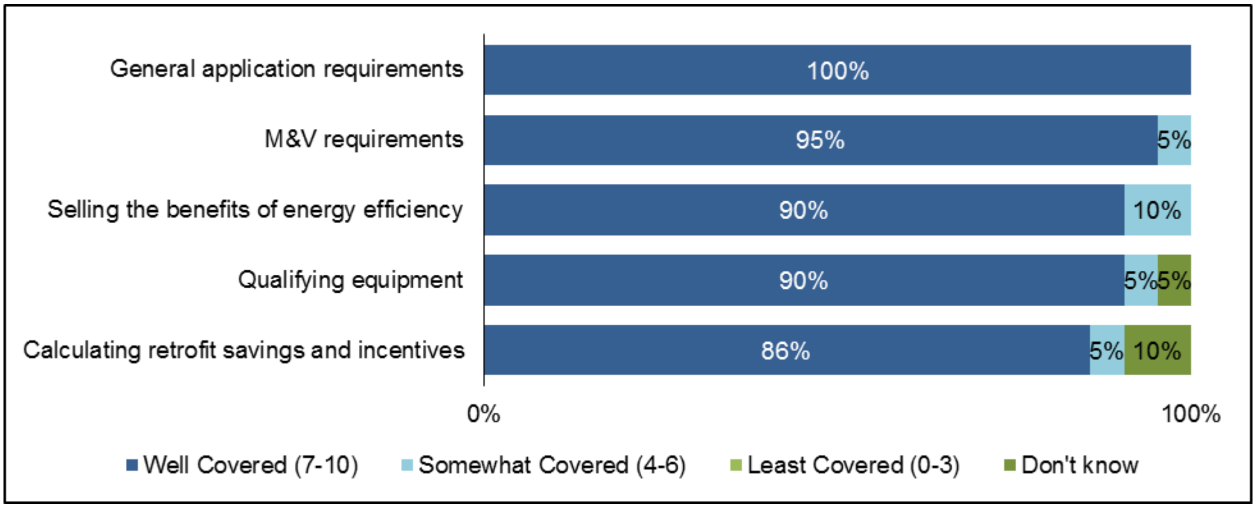

*Figure 5-23 Coverage of Topics Presented at Events (n = 21)**

* Respondents rated the coverage of each topic on a 0-10 scale, from "not at all" to "extremely well." For this legend, we collapsed the scale responses into three categories as shown parenthetically in the figure legend. One respondent did not answer this question.

Five service providers offered suggestions for additional information or training, with two suggesting more information on changes to program rules and guidelines and one each suggesting additional webinar events, audit training, and more focus on small businesses.

Twenty of the twenty-two providers who attended an Ameren Missouri event reported being aware of Ameren Missouri's BizSavers *Solutions* newsletter for contractors and customers. All twenty reported receiving it, of whom about three-quarters (14 of 20) reported finding the newsletter to be very useful (a 7 to 10 on a 0-10 scale, where 0 was "not at all useful" and 10 was "extremely useful"). Of the remaining six, five reported a moderate usefulness rating (from 3 to 6) and one reported not finding the newsletter useful (providing a "2" on the same scale).

5.6.5. Program Marketing and Customer Awareness of Incentives

Overall, service providers indicated varying levels of customer awareness of BizSavers incentives (Figure 5-24). About one-third of providers reported high levels of customer prior awareness (i.e., more than three-quarters of their customers were aware of the program before the provider mentioned it to them), about one-quarter reported low levels of awareness (i.e., one-quarter or fewer of their customers had prior knowledge of the program), and the rest reported prior moderate awareness levels.

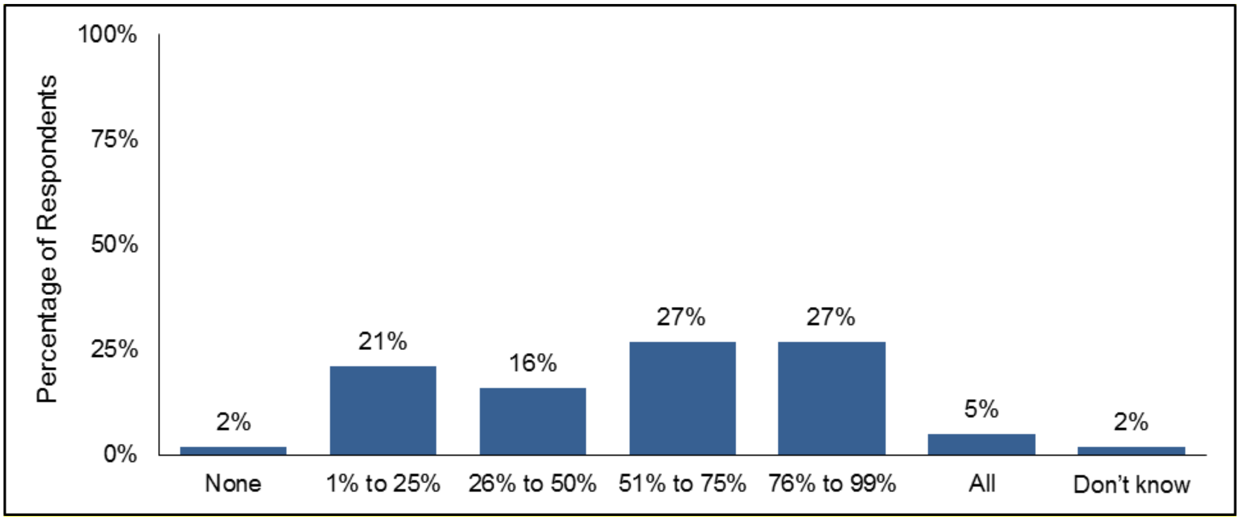

Figure 5-24 Percentage of BizSavers *Customers that Already Knew of Program before Provider Mentioned It (n = 56)*

Multiplying the mid-point of each customer awareness range by the percentage of respondents who reported that range yields an overall estimate awareness. By this method, we can estimate that about half of these respondents' customers were aware of the BizSavers incentives before the respondent discussed them.[28] This estimate is consistent with the finding from the nonparticipant customer survey conducted for the 2014 program year evaluation.[29]

One goal of the evaluation was to assess the extent to which the BizSavers programs are reaching the entire business market sector. To support this goal, we asked the forty-five service providers who reported working with more than one sector type to identify the sector in which program awareness was lowest. Most (67%) reported that program awareness varies and was not lower in any one sector than in others. Among the remaining fifteen providers, nine reported program awareness was lowest among small businesses, two mentioned gas stations, and one each mentioned small commercial office buildings, IT facilities, those in leased spaces, small-to-medium manufacturers, supermarkets, and religious organizations (multiple mentions allowed).

5.6.6. Promotion of the BizSavers Brand and Energy Efficiency

To investigate service providers' efforts to sell efficiency, we asked providers to report the percentage of their retrofit jobs in which they proposed equipment that would qualify for BizSavers incentives. The majority (49, or 88%) reported always proposing qualifying equipment. The remaining providers reported proposing qualifying equipment

[28] The same result held up when the evaluation staff weighted the responses by the respondents' total 2015 program savings.

[29] 2014 BizSavers Evaluation Report

in half their jobs (three mentions), in 70% of their jobs, and 80% of their jobs (one mention each). Two providers reported proposing qualifying equipment in fewer than 100% of their jobs but did not provide an estimate.

The BizSavers implementation contractor runs periodic “challenges” for trade allies to stimulate greater efforts to promote energy efficiency. To assess the effectiveness of these events, the survey asked service providers about their awareness of what had been the most recent challenge – the “money-saving deals” challenge[30], in effect from July through September 2015 – and how influential it was on their efforts to sell program-qualified equipment. Nearly half (48%) of providers reported being aware of the challenge. Of those who were aware of the challenge, just under one-third (30%) reported it had at least a moderate influence on them (a rating of at least 4 on a 0-10 scale, from “no influence” to “a great influence”). More than half of the providers (56%) indicated the challenge had no influence and 15% indicating a low level of influence (a 1 to 3 rating).[31]

5.6.7. Customer Acceptance of Energy Efficiency Recommendations

Of the forty-nine providers who reported proposing program-qualified equipment to all customers, about two-fifths (43%) said that business type did not affect whether customers agreed to program-qualified equipment (Table 5-29). Those who did identify business types less likely to accept recommendations of program-qualified equipment focused largely on factors relating to limited resources rather than to the types of services provided or geographic location.

Table 5-29 Types of Businesses Who Are Less Likely to Agree to Program-Qualified Equipment (n = 49, Multiple Responses Allowed)

Business Type	*Count*	*Percent*
No specific business type	21	43%
Businesses with limited capital	10	20%
Small businesses	7	14%
Businesses who lease space	6	12%
Businesses with limited time or staff resources	4	8%
Other	5	10%
Don’t know	3	6%

[30] This challenged stipulated that the 10 service providers that completed the greatest number of *BizSavers* projects from July through September 2015 would be given the opportunity to advertise a money-saving deal on the *BizSavers* website.

[31] The percentages 30%, 56%, and 15% sum to 101% because all three rounded up.

Six respondents (11%) reported that at least one of their customers had rejected qualifying equipment because the application process was too burdensome. Among those providers, four reported that ten or fewer customers rejected equipment for this reason, with the remaining two reporting between twelve and twenty. These six respondents are generally low-volume providers, representing fewer than five percent of all projects completed by all service providers in 2015; therefore, caution should be exercised in generalizing from these findings. The types of business that have rejected qualifying equipment due to a burdensome application process varied.

Anecdotal reports from an evaluation done elsewhere suggested that some service providers may offer discounts on qualifying equipment in lieu of applying for program incentives. If this does occur, it potentially represents an uncounted source of program “spillover” savings, as the program influenced the providers to offer the discounts that produced those savings. To assess the possible existence of such a spillover source, the survey asked respondents whether they offered such discounts in lieu of applying for BizSavers incentives.

Two respondents reported they offer such discounts, one of whom reported doing so only for small custom projects. One of those two respondents said that three to four customers had installed qualifying equipment because of such discounts; the other was unable to provide an estimate.

5.6.8. Program Rules and Equipment Recommendations

We asked all fifty-six respondents whether the program rules for calculating energy savings limited the equipment they recommend to their clients. Three-quarters of providers reported program rules *do not* limit their equipment recommendations. Of the fourteen providers who reported that program rules limited their recommendations, five commented on the rules relating to T-12 lighting[32] and four reported they affect LED fixtures.[33] An additional four providers reported program rules relating to payback periods affect other types of equipment, including high-end lighting fixtures (two mentions), cooler lighting, electronically commutated and anti-sweat motors, and increased wattage florescent fixtures (one mention each).

[32] In some cases, they were commenting on the removal of incentives for T-12 replacements, in others, they were commenting on the change of rules regarding the baseline for T-12 replacements, and in some cases, the comments were not clear.

[33] Two said that program-allowable ROI is shorter than the lifespan. The other two both said that the program does not cover higher-quality fixtures and that the application forms do not easily accommodate projects that involve reducing the number of lighting fixtures because LEDs are brighter.

5.6.9. Prevalence of T-12 Lighting

To determine the prevalence of T-12 lighting in Ameren Missouri's service territory, we asked the forty-one lighting service providers to estimate the percentage of tube lighting in the territory that T-12s comprise. On average, providers reported that T-12s make up more than one-third of tube lighting in the Ameren Missouri service area (Table 5-30).

Table 5-30 Percent of All Tube Lighting that is T-12 in Ameren Missouri Service Territory (n = 41)

Percentage	*Count*	*Percent*
Less than 20%	6	15%
20% to 39%	17	41%
40% to 59%	12	29%
60% or more	6	15%
Total	41	100%
Mean	37%	

5.6.10. Interactions with Program Staff

Fifty-two of the fifty-six service providers reported seeking assistance from program staff during the project application and approval processes (Table 5-31). The most common type of assistance sought was questions regarding questions about filling out incentive applications, followed by inquiries into the status of an application. All but one provider who sought assistance reported that program staff provided them with the assistance they were seeking, with the one remaining provider reporting they did not know whether they received the assistance sought.

Table 5-31 Types of Assistance Service Providers Sought from Program Staff (n = 56; Multiple Responses Allowed)

Type of Assistance Sought	*Count*	*Percent*
Questions about how to fill out incentive application	35	63%
Check on status of incentive application	29	52%
General program information	7	13%
Check on status of Trade Ally Network application	3	5%
Questions about the Trade Ally Network application	3	5%
Specific questions on individual projects	2	4%
Other, specify	2	4%
None	4	7%

5.6.11. Program Satisfaction

Overall, service providers reported high levels of satisfaction with all program elements (Figure 5-25). Providers reported being least satisfied with the level of incentives offered through the BizSavers program.

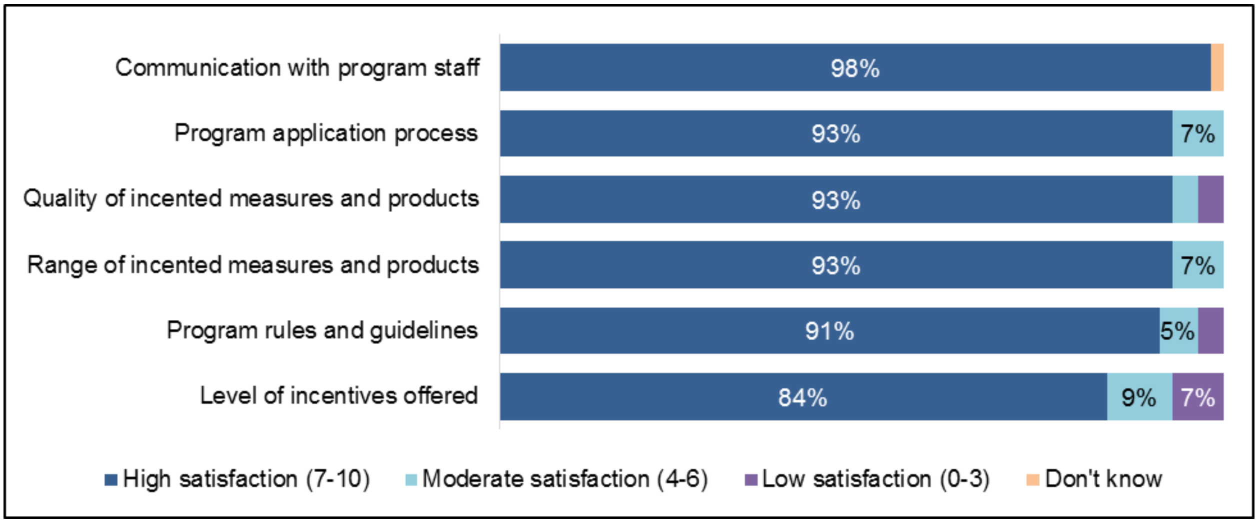

Figure 5-25 Satisfaction with Elements of the BizSavers *Program (n = 56)**

* Respondents rated satisfaction on a 0-to-10 scale, from "not at all satisfied" to "extremely satisfied." For this figure, we collapsed responses into low, moderate, and high satisfaction, as shown parenthetically in the figure legend. The figure does not show percentages lower than 5%.

When asked what the best parts of the BizSavers program were, service providers most often indicated the incentives, increased sales, the overall program design (and ease of participating in the program), and working with program staff (Table 5-32).

Table 5-32 Best Elements of BizSavers *Program*
(n = 56; Multiple Responses Allowed)

Program Element	*Count*	*Percent*
Incentives	18	32%
Increased sales	18	32%
Overall program design / Ease of program	15	27%
Working with program staff	15	27%
Increasing awareness of/interest in energy efficiency	4	7%
Customer satisfaction	3	5%
Other	5	9%
Do not know	2	4%

We had two sources of input on what changes to the BizSavers program service providers might like to see: 1) we asked those providers who expressed dissatisfaction (a 6 or below on a 0-10 scale) with any program element why they were dissatisfied; and 2) we asked all providers what improvements to the program they would like to see. Combining responses, service providers most commonly suggested increasing incentive amounts (twelve mentions), having additional prescriptive measures (eight measures), and having or reinstating T-12 replacement incentives (seven mentions; Table 5-33).

Table 5-33 Service Providers' Suggested Program Changes
(n = 56; Multiple Responses Allowed)

Suggested Change	*Count*	*Percent*
Increase incentive amounts	12	21%
More prescriptive measures	8	14%
T-12 incentives	7	13%
Changes to program rules and requirements	6	11%
Simplify/shorten application process	6	11%
Other additional measures covered	6	11%
More higher quality measures	4	7%
Continue covering/increase incentives for T-8 or T-12 to LED conversions	3	5%
Higher incentives for T-12s	3	5%
Program extension/stability	3	5%
Other	6	11%
Nothing	14	25%

5.7. Event Survey

Ameren Missouri periodically sponsors informational events for business owners and managers, as well as the contractors that serve the nonresidential sector. Table 5-34 summarizes the type of events that took place in 2015 in Ameren's service territory. The program implementer, Lockheed Martin, hosted over half (56%) of these events. In 2015, there were 61 BizSavers sponsored events, with approximately 2,589 attendees. [34]

[34] The evaluation team had only attendee counts, not attendee lists, so we could not determine how many of the attendees were unique individuals or represented unique trade ally firms or customers.

Table 5-34 BizSavers *Events Sponsored by the* BizSavers *Program*

Event Type	*Count*	*Percent*
Check presentations	18	30%
General monthly meetings	7	11%
Open house events	7	11%
Online trade ally orientation webinars	7	11%
Large industry events (Summits, Expos, Forums, Conferences, Workshops, and Trade shows)	6	10%
Vendor, contractor, or realtor sponsored events	4	7%
Seminars	3	5%
Events at community/professional organizations (Chamber of Commerce, Rotary Club, Lions Club)	1	2%
Other	8	13%
Total events	61	100%
Events hosted by Lockheed Martin	34	56%
Total attendees	2,589	
Average number of attendees per event	42	

The evaluation team sent invitations to an online survey to participants of the seven online trade ally orientation webinars held between January and October 2015. Of fifty participants invited to take the survey in 2015, seven responded. The survey included questions regarding attendees' experience with the event and firmographic characteristics.

5.7.1. Respondent Characteristics

Six of the seven survey respondents reported being either a contractor or trade ally, with the remaining respondent reporting they were previously a trade ally. Respondents reported four business or organization affiliations, including electrical contractors, energy auditor/modelers (two mentions each), manufactures, and consultants (one mention each). One respondent did not indicate their organization affiliation. Five respondents reported their business or organization was a member of the Ameren Missouri Trade Ally Network (TAN), of which four reported being members of the TAN less than one year. Two of the seven respondents reported they had already completed a BizSavers project through the program.

5.7.2. Satisfaction

Overall, attendees reported being satisfied with the orientation webinars. All but one respondent reported that the webinar met or exceeded their expectations. Additionally, nearly all respondents rated the webinar as either good (three mentions), very good (two mentions), or excellent (one mention). Further demonstrating high levels of satisfaction with the webinars, all but one attendee agreed that relevant topics were covered, graphical information was helpful, examples were relevant, and the length of time was appropriate. While most attendees agreed that information presented during the webinar was clear, two attendees reported neither agreeing nor disagreeing with this statement.

We also asked attendees to rate the quality of information provided during the webinar. Most attendees reported information pertaining to how to use the custom application and how to apply for BizSavers incentives was either “very good” or “excellent” (six and five mentions, respectively). Fewer attendees rated information related to the appropriateness of energy efficient technologies, budgeting for energy efficient projects, and that availability of BizSavers incentives (four of seven providing a response of “very good” or “excellent”). One attendee reporting the webinar did not cover these three topics.

All attendees reported the time between receiving the webinar email invitation and participating in the webinar was "about right." Three attendees offered suggestions on improvements to the webinar, including more preparation, improved communication, more interaction, clearer goals, and offering the webinar on a monthly basis (one mention each).

Finally, the webinar appears to be successful in cultivating and retaining participating parties, as all but two respondents indicated that the event encouraged them to work with the BizSavers program in the future (two reported they were “not sure”). When asked what might prevent them from working with the BizSavers program in the future, two attendees indicated program eligibility dates and knowledge of the program.

5.8. Retro-Commissioning-Specific Feedback

This section summarizes project data specific to the Retro-Commissioning Program and summarizes feedback from RSPs and retro-commissioning participants.

5.8.1. Retro-Commissioning Project Analysis

Since 2013, Ameren Missouri began seventy-three retro-commissioning projects. Of those, sixty-two are complete or will be complete by November 30, 2015; of the remaining eleven projects, nine were discontinued and two are on hold.

Retro-commissioning projects typically occur in the industrial, education, healthcare, and office sectors, and these projects take many months to complete. As can be seen in Table 5-35, nearly 90% of retro-commissioning projects occurred in these four sectors and more than 80% took more than six months to complete, averaging thirteen months from inception to completion.

Table 5-35 Retro-commissioning Project Characteristics

Characteristic	*Count*
Building Type	
Industrial	21
Education	16
Healthcare	10
Office	8
Entertainment/Recreation	4
Lodging	2
Faith-Based	1
All buildings	*62*
Time to Complete	
Less than 6 months	12
6 to 12 months	19
12 to 18 months	15
More than 18 months	16

Ameren Missouri paid, or is committed to paying, retro-commissioning customers almost $4.8 million for 56,766,823 kWh saved starting in 2013 and concluded by November 30, 2015. While industrial and educational facilities were the most common retro-commissioning project types, representing 60% of all projects, they constituted just over one-third of program savings, and tended to be the smallest projects in terms of average savings. Healthcare projects, while one-sixth of all projects, represented more than half of all savings and were almost three times larger on average than those in the next largest sector, education (Figure 5-26).

	Projects		*Savings (MWh)*		
Building Type	*Count*	*%*	*Sum*	*Percent*	*Mean*
Healthcare	10	16%	29,588	52%	2,959
Education	16	26%	10,898	19%	681
Industrial	21	34%	9,900	17%	471
Office	8	13%	2,721	5%	340
Entertainment	4	6%	1,967	3%	492
Lodging	2	3%	1,329	2%	664
Faith-Based	1	2%	353	1%	353
TOTAL	62	100%	56,756	100%	915

Figure 5-26 Retro-commissioning Projects and Savings

All twenty-one industrial retro-commissioning projects were compressed air projects and shared the same RSP; none of those projects included building optimization. All other building types received building optimization measures. No customers received refrigeration optimization services.

Ameren Missouri approved twenty-three retro-commissioning service providers,[35] twenty of whom specialize in building optimization. Seven also specialize in compressed air retro-commissioning, and none specialize in refrigeration retro-commissioning. Of the twenty-three listed on the Ameren website, eleven providers completed at least one retro-commissioning project from 2013 to 2015. In addition, three providers not listed as approved completed four projects, accounting for about 8% of savings. This results in fourteen firms that completed a retro-commissioning project in 2015.

A small number of allies delivered the majority of projects and savings to the program (Table 5-36). Six allies completed more than 80% of all retro-commissioning projects[36] from 2013 to 2015. Additionally, one ally (RSP1) completed almost 40% of all projects and about 20% of all savings. Two firms (RSP2 and RSP6) accounted for about 20% of projects and more than 40% of all savings. These two firms conducted healthcare projects exclusively.

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[35] As of 7/22/15 according to Ameren website "Approved Retro-commissioning Service Providers." https://q9u5x5a2.ssl.hwcdn.net/-/Media/Missouri-Site/Files/uefficiency/businessenergyefficiency/bizsavers/retro-commissioningApprovedList.pdf?la=en (Accessed on 11/19/15; no longer available as of 2/3/16.)

[36] One of these six allies no longer provides retro-commissioning or energy engineering services and is no longer a provider.

Table 5-36 Projects and Savings, by Provider, 2013 to 2015

*Provider***	*Specialization*	*Projects*		*2013-2015 Savings (MWh)**		
		Count	*Percent*	*Sum*	*Percent*	*Mean*
RSP1	Compressed air	24	39%	10,343	18%	431.0
RSP2	Building optimization	9	15%	16,032	28%	1,781.4
RSP3	Building optimization	7	11%	4,298	8%	614.1
RSP4	Building optimization	4	6%	1,661	3%	415.3
RSP5***	Building optimization	4	6%	679	1%	169.9
RSP6	Building optimization	3	5%	8,497	15%	2,832.3
NRSP1	Unknown	2	3%	2,866	5%	1,433.0
RSP8	Building optimization	2	3%	4,977	9%	2,488.6
RSP9	Building optimization	2	3%	2,039	4%	1,019.3
RSP10	Bldg. optim. and comp. air	1	2%	1,271	2%	1,270.8
NRSP2	Unknown	1	2%	899	2%	899.0
NRSP3	Unknown	1	2%	353	1%	353.1
RSP11	Building optimization	1	2%	1,624	3%	1,623.7
RSP12	Building optimization	1	2%	1,227	2%	1,227.0
Total		62	100%	56,767	100%	915.6

* Approximately 80% of savings were booked in 2015, which reflects the length of time needed to complete a retro-commissioning project.

** Approved RSPs are designated as RSP1-RSP12. Others are designated as NRSP1, NRSP2, and NRSP3.

***No longer providing retro-commissioning services

As part of the retro-commissioning evaluation, we conducted interviews with retro-commissioning service providers that completed projects in 2015. The next section summarizes the findings from those interviews.

5.8.2. Retro-Commissioning Service Provider (RSP) Interviews

Six RSPs had completed retro-commissioning projects by late October 2015, when the evaluation team began contacting RSPs for interviews, and in November, the team identified another seven RSPs expected to complete a 2015 project. With a goal of completing interviews with at least five RSPs, the team completed interviews with four of the six respondents identified in October, determined that one of the six no longer offered RCx services, and was unsuccessful reaching the sixth RSP after multiple attempts. The team completed an interview with a fifth RSP in January 2016. These five providers (RSP1, RSP3, RSP4, RSP6, and RSP12) represented a bit more than half (21 of 39) of all projects completed in 2015 and 43% of all savings delivered in 2015.

Three of these five firms conducted projects in at least two building types. Two (RSP1 and RSP4) did two building types, and one (RSP3) did four building types. Two (RSP6 and RSP12) worked in just one building type. (Table 5-37.)

Table 5-37 RSP Respondents' Work by Building Type

RSP	*2015 MWh Savings*	*Percentage of Savings by Building Type*					
		Education	*Entertain-ment*	*Industrial*	*Lodging*	*Health-care*	*Office*
RSP1	10,343	-	-	96%	-	-	4%
RSP3	4,298	36%	31%	-	31%	-	2%
RSP4	1,661	45%	-	-	-	-	55%
RSP6	8,497	-	-	-	-	100%	
RSP12	1,227	-	-	-	-	-	100%
Total	26,026	9%	5%	38%	5%	33%	10%

We asked these five RSPs about their experience with retro-commissioning, about the types of retro-commissioning work they did, their ability to identify opportunities for further savings, customer understanding of retro-commissioning, and how the Ameren Missouri program compares to other Retro-Commissioning Programs.

5.8.2.1. Experience with Retro-commissioning

Four of the five retro-commissioning providers suggested they and their firm had extensive experience doing retro-commissioning projects. All four reported having provided retro-commissioning services to customers before the BizSavers program existed, with two reporting having done so for about five years before the program started. They reported averaging about seven to ten projects per year.

The fifth respondent (RSP12) reported attempting to sell retro-commissioning projects in Ameren territory for several years but experienced difficulties in selling the concept to customers, typically property management firms. This respondent did not have experience with retro-commissioning services in other regions.

5.8.2.2. Services Provided

Respondent firms varied in the range of services they offered their clients. All used their own staff to conduct outreach, sell retro-commissioning projects to customers, prepare applications, conduct audits, and identify measures outside the scope of the Retro-Commissioning Program (measures that could be included in the standard and Custom Program). They differed mainly in how they handled installation work. Two had staff that completed installation work and three hired subcontractors or worked with the client's staff to oversee installation work. Additionally, three of the firms provided ongoing energy management services, such as continuous commissioning, beyond the retro-commissioning scope (Table 5-38).

Table 5-38 Services Provided by Retro-commissioning Respondents

RSP	*Outreach and Sales*	*Conduct Audit**	*Install Measures***	*Provide ongoing energy mgt. services*
RSP1	✓	✓	✓	
RSP3	✓	✓	✓	✓
RSP4	✓	✓		✓
RSP6	✓	✓		✓
RSP12	✓	✓		

* All those who reported providing audit services as part of retro-commissioning said that, as part of those audits, they also identify measures that fall outside the scope of retro-commissioning work.

** All those who reported installing low-cost/no-cost measures as part of the retro-commissioning project also said that they install measures that fall outside the retro-commissioning scope.

One of the respondents (RSP3) reported providing and managing subcontractors to implement all measures; the others did not report that service, but they reported working with their client to solicit bids for some of the work and with clients' staff, existing controls contractor, or subcontractors to implement some measures.

5.8.2.3. Targeting Retro-commissioning Projects

Respondents used a combination of cold-calls, word-of-mouth, and past experience with a customer to generate retro-commissioning work. They typically target specific types of customers. Four of the five providers target building owners, and one typically works with commercial property management firms. The four firms that target owners reported greater success selling retro-commissioning services than the firm that typically works with property managers.

Each of the four firms that target owners, target specific building types.

- RSP1, an air compressor optimization specialist, targeted industrial firms with at least 75hp compressors that operated for a minimum of 2,000 hours per year. Any firm with a smaller compressor that ran for less time results in "savings that are not worth the time." This provider contacts new customers for retro-commissioning services and re-contacts past customers, including past retro-commissioning customers because retro-commissioning "is a tune-up thing and folks fall off the wagon after a few years."
- RSP3 targets health care and office facilities. They target health care because healthcare facilities operate 24 hours a day and year round so even "minor changes" can result in "significant savings." RSP3 targets offices because they can typically

identify savings by turning off equipment that is running 24 hours when it should operate only during regular business hours.[37]

- RSP4 typically targets the healthcare, office, and education sectors in other states and in Missouri has successfully completed office and education buildings.[38]
- RSP6 served the healthcare sector in Missouri with retro-commissioning and also provides retro-commissioning to multiple sectors in other states

RSP12 typically provides utility consulting services to large commercial property management firms that run large office buildings and retail centers. This respondent reported difficulty getting his property manager clients to conduct retro-commissioning for two reasons. Firstly, decision-making is diffuse across multiple people and organizations, making it difficult to get final approval for a project.

> *"A few downtown [St. Louis] buildings… they have one representative for 20 different owners…so finding a decision maker can be challenging."*

Secondly, potential customers think they can provide retro-commissioning using existing staff.

> *"[One building I went to was] a 500,000 square foot downtown [St. Louis] building and tremendous opportunity for savings. We estimated [retro-commissioning project] payback less than a year. The owner said 'our engineer can do that'… it is ridiculous. This is common thing. A downtown Clayton office tower… they say they can do [retro-commissioning work] themselves… they think their personnel can do retro-commissioning work."*

RSP4 echoed the difficulty RSP12 noticed in working with property management firms. "[We work] directly with building owners…it is harder to get into property management firms… that is a harder sell [for retro-commissioning]… [property management firms] pass the [energy] costs onto the tenants."

5.8.2.4. Customer Understanding of Retro-commissioning

The previous process evaluation found that most of the interviewed retro-commissioning participants appeared to treat their retro-commissioning project much like a retrofit project, focusing on their internal decision to undertake capital improvements to reduce energy use. To shed light on that finding, in the current evaluation we asked RSPs how they think their clients view retro-commissioning as distinct from retrofit projects and what they tell their customers about the retro-commissioning process.

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[37] This respondent reported targeting healthcare but the program database did not show any healthcare projects for this RSP.

[38] This respondent is based in Illinois, across the river from St. Louis, and has done about 30 projects for Ameren Illinois and has just recently entered the Missouri market.

Responses varied among the RSPs. Out of the five respondents, two clearly indicated their clients understand the how retro-commissioning is distinct from retro-fit. One, the one that works with large hospital systems, noted that corporate-level contacts understood retro-commissioning and its value, but that facility-level contacts sometimes were skeptical. This may suggest possible value in working to get facility-level staff that have had good experience with retro-commissioning help sell the service to those at their organizations' other facilities (in organizations with multiple facilities).

One respondent indicated that it depends on the customer but suggested that those who "get it" are in the minority:

> *"It is harder to explain and harder to get them understand that we are helping them get buildings to operate together. It is more difficult because it is harder to feel and touch….*

Of the other two respondents, one did not comment and the other suggested his clients do not understand the basic ideas behind retro-commissioning.

When asked about what they tell people about the retro-commissioning process, one reported that they "explain it well … [that] it is a tune-up more than purchasing equipment." That respondent was one of the two who reported that clients "got" retro-commissioning. The others focused on what they told customers about incentives and energy savings but did not say anything about explaining the retro-commissioning process itself. We caution against reading too much into lack of detailed response. Still, the fact that, when asked specifically about what they tell customers about the process, most respondents did not refer to the retro-commissioning process (tuning up equipment, installing low-cost/no-cost measures, training facility staff on ongoing monitoring) may point to a place where more focused training of RSPs (in communicating exactly what retro-commissioning is) may pay off.

Note that findings from the participant interviews done for the current evaluation suggest that participants largely understood the retro-commissioning process and how it differs from a retrofit project, which differs from what the previous evaluation found (see Section 5.8.3). The participants interviewed for the current evaluation represented a larger range of customer types than those interviewed previously, who were largely industrial customers. It is not clear whether or not this accounts for the differences from the previous process evaluation.

5.8.2.5. Comparison with Programs in Other Jurisdictions

Of the three providers with Retro-Commissioning Program experience in other utility jurisdictions, all indicated the BizSavers program was similar to other programs, with the exception of how BizSavers incents the study cost. Currently, the Ameren program pays the retro-commissioning study cost at the conclusion of the project, based on the kWh savings that the project yields; the previous version of the program paid a percentage of the cost incurred to conduct the study. The previous approach provided customers with a greater assurance that they would not need to pay for a study that identified limited savings.

Two providers noted that the new incentive structure for studies makes the sale of a retro-commissioning project more difficult. One stated, “It makes it difficult to explain how much the customer may receive in incentives for the study. It is easier to explain a flat amount to a customer.” The third provider suggested that the current study incentive structure does not adequately offset the cost of a study compared to the 70% of the study cost another jurisdiction pays. This other jurisdiction pays the study incentive to the customer at the beginning of the project unlike the Ameren Missouri program.

5.8.2.6. Additional Comments

Throughout the interviews, respondents offered several comments and suggestions that went beyond the scripted interview topics. These comments and suggestions fell into three categories: coordinating with gas utilities in the delivery of the Retro-Commissioning Program; the effect of the suspension of the program after the current program cycle; and provision of a list of opt-out customers to help target their outreach.

Coordination with Gas Programs

One provider, with extensive experience conducting retro-commissioning projects in dual fuel utility territories, expressed interest in having Ameren Missouri partner with Laclede Gas to offer retro-commissioning incentives for both fuels. This respondent noted that the retro-commissioning process is extensive and time consuming. Reviewing electric and gas savings opportunities during the same customer visits by the retro-commissioning provider would yield efficiencies in program implementation and likely boost participation. This provider noted that identifying projects is far easier in dual fuel territories because the savings are more extensive than those in single-fuel areas. As evidence of this phenomenon, this respondent could not recall doing an electric only retro-commissioning project in dual fuel territory.

Program Suspension

All five respondents noted frustration with the lack of a consistent Retro-Commissioning Program (and other efficiency programs) in Missouri. According to these retro-commissioning providers, the discontinuation of Ameren Missouri’s current energy efficiency programs makes customers wary of participating and undermines efforts to drive future projects. In referring to the program disruption in 2012, one provider stated, “It took most of the first year of the current program to rebuild [trust with customers] and begin finding new energy saving opportunities for our customers.” Another provider indicated that the current program disruption likely will result in lost energy savings.

"customers don't want to sign up [for a] retro-commissioning study now and find out in three months that they could have gotten incentives. They are in business planning phases now. The last time the program came up for renewal… everyone stopped doing work until the new program came out."

List of Opt Outs

One provider indicated that knowing which Ameren customers opted out of the Energy Efficiency Investment Charge (EEIC) would be helpful so they would know not to spend time targeting their outreach to those customers.

5.8.3. Retro-Commissioning Participant Interviews

As of October 2015, nine customers had completed nine retro-commissioning projects and thirteen customers had thirteen projects in the "committed" phase – that is Ameren Missouri committed funds to the project anticipating completion by the end of November 2015. The team prioritized interviewing participants with completed project to understand all aspects of the project. After making at least five contact attempts to each one, evaluation staff were able to complete in-depth interviews with four of the nine customers that completed retro-commissioning projects. To complete the goal of five in-depth interviews, staff interviewed one of the thirteen participants with a committed project.

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 and provide program consistency.

5.8.3.1. Respondent Characteristics

Unlike the 2014 evaluation where RCx participants were mostly industrial customers doing compressed air projects, the 2015 respondents represented diverse types of facilities and industries (Table 5-39). In all cases, the respondent represented the building owner.

Table 5-39 Respondent Summary

Participant	*Building Type*	*Business Type*	*RCx Project Type*	*Square Footage*	*Employees at Project Site*	*Properties in Ameren Missouri Territory*
RCP2	Education/ research	Non-profit	Bldg. optimization	DK	400	3
RCP5*	Office	Property Manager	Bldg. optimization	154,000	340	100
RCP7	Manufacturing	Industrial	Compressed air	130,000	65	1
RCP9	Hospital	Healthcare	Bldg. optimization	2,000,000	>2,000	~100
RCP11	K-12 School	School Dist.	Bldg. optimization	147,000	750	33

* This respondent's firm was part owner of the building and full time manager of the building that received RCx services.

All five noted some type of engagement with managing their energy use beyond participating in efficiency programs. Regular monitoring of their energy usage was the most common practice, reported by four respondents (Table 5-40).

Table 5-40 Energy Practices and Policies

RCx Participant ID	*Monitor Energy Use Monthly**	*Prioritize EE Equipment in Purchasing Decisions*	*Installed Renewable Energy*
RCP2	✓	✓	
RCP5	✓		
RCP7			✓
RCP9	✓		
RCP11	✓	✓	✓

* RCP5 reported that their RSP had provided monthly energy monitoring services prior to the retro-commissioning project. RCP9 reported that they provide maintenance staff with energy management software.

5.8.3.2. Program Awareness and Involvement

All retro-commissioning participants reported some level of experience with Ameren Missouri programs in addition to their Retro-Commissioning Program work. All five participants did or were in the process of completing lighting projects, while two had completed an Ameren Missouri incented solar project and one had completed an HVAC projects in the past.

In 2014, RCx participants largely reported awareness of the RCx program from their RSP. In 2015, respondents reported a broader range of pathways that led to their program awareness. Three explicitly noted their RSP made them aware of the program, while one mentioned experience with Ameren Missouri's RCx program at a previous employer. The fifth respondent reported that he became aware of the program through a consultant who was advising his company about opting out of the EEIC charge (Table 5-41). According to this respondent, the consultant “did the math to see if it was in our best interest to participate in the [Ameren Missouri RCx program] and realized we should participate, not opt out.”

Table 5-41 Awareness of Retro-Commissioning Program

Respondent	*RCx Provider*	*Prior Employer*	*Contractor and Consultant*	*Prior Experience/ Knowledge of RCx*
RCP2	✓	✓		
RCP5	✓			
RCP7	✓			
RCP9			✓	✓
RCP11				✓

5.8.3.3. Feedback on Program Processes and the RSP’s Role

All respondents reported that both they and their RSP were involved in completing the application. All respondents reported that the process was relatively straightforward and were satisfied with the process and assistance they received from Ameren Missouri.

All respondents reported that the assistance they received from their RSP facilitated the process, three of whom explicitly stated that it would have been difficult without their RSP’s assistance. For example, RSP5 receiving building optimization services stated, “Once, I looked through [the applications and requirements] it looked like a lot so I was glad [our RSP] did much of the paperwork.” The industrial respondent, RCP7, noted that the RSP made the application process easy and indicated that “the easier it is for us the more chance [a project] is going to happen.” RCP11 noted that their provider had to take the lead in completing the application because the provider had to supply data that the customer would not be privy to, such as calculations completed during the study.

5.8.3.4. Project Decision Making

In the interviews for the prior evaluation, most participants appeared to treat retro-commissioning project much like a retrofit project, mainly noting that the projects arose from their internal decision to undertake capital improvements to reduce energy use. As a result of those responses, we revised the interview to include questions about their understanding of retro-commissioning. Participants in 2015 indicated they understood (1) the retro-commissioning process, (2) the long-term effects of RCx and (3) how an RCx project differs from a standard or custom retrofit project. We cannot exclude the possibility that the difference between 2014 and 2015 responses reflects that 2014 respondents were mostly industrial customers, while we were able to interview a range of customer types in 2015 (see Section 5.8.3.1).

The interviewer queried respondents about reasons for participating in the Retro-Commissioning Program. All five cited the desire for long-term cost savings, one of whom tied that motive to their organizational mission. Further, three of the five said they did the project to help them prioritize upgrade projects they had identified.

In most cases participants followed RSP recommendations resulting from the retro-commissioning study. The exceptions were as follows:

- RCP2 declined specific RSP recommendations because of technical requirements of the facility that the RSP was unfamiliar with.
- RCP9 could not afford to convert to all digital controls due to the expense. However, this organization plans to budget for digital controls conversions over the next few years.
- RCP11 noted several examples of suggested measures that fell outside of their six-year payback threshold, including the installation of VFDs on hot water pumps that had a 6.3-year payback.

5.8.3.5. Program Satisfaction and Suggestions for Improvement

Respondents generally reported high satisfaction with the program offerings, the service they received from their provider, and the program overall. All respondents reported willingness to participate in any future Ameren Missouri program and all noted receiving the incentive dollars they were anticipating. Respondents did not identify any problems with Ameren Missouri throughout the project process. In fact, one respondent expressed gratitude with program staff for being forgiving and “working with us” when they missed some deadlines over the course of the project.

Two respondents each made one suggestion for program improvement:

- Consistent with the program suggestions provided by interviewed RSPs, RCP11 suggested a guarantee that the cost of the RCx study would be covered by the program. He would have completed multiple RCx projects simultaneously had it been clear he would receive full reimbursement for the study cost.
- RCP2 suggested that Ameren Missouri cover sub-metering to better identify energy savings opportunities and to verify that energy savings persist after the RCx and measure installation. The installation of a meter “is not an energy saving device, but if you cannot measure [energy use accurately], you cannot improve [energy use].”

5.8.3.6. Comments about Program Discontinuation

Three participants expressed unhappiness with the on-again and off-again nature of the program renewal process between Ameren Missouri and the utility commission. These comments largely align with the feedback received from the RSPs in section 5.8.2.5.

RCP11 noted that even a brief disruption in the program results in long delays in project implementation. This respondent implied that the brief cancellation of the program in 2012 meant that his next RCx project did not start for almost two years. The delay was a result of waiting for program reinstatement, resubmitting the next RCx project into the capital budget planning cycle, and then conducting a Return for Qualifications (RFQ) process to identify a qualified RCx contractor.

RCP2 provided further illustration of the adverse effects of program interruption. According to this contact, after delays with the program approval in 2013, the program staff then rushed the program into the marketplace, and some of the documentation did not indicate there was a cap on incentives. To this contact, the inconsistent documentation was "a red flag" that the program was not ready for release. "Ameren was marketing the program before the program was approved."

RCP9 expressed some frustration having to get projects done by the end of November deadline and lack of clarity on what future Ameren Missouri programs will look like.

5.9. New Construction-Specific Feedback

This section summarizes project data specific to the New Construction Program and summarizes feedback from new construction trade allies and participants.

5.9.1. New Construction Project Analysis

Since 2013, Ameren Missouri began 126 new construction projects. Of those, 111 are completed, installed, or pending payment; of the remaining fifteen, six were discontinued and nine are on hold.

New construction projects most frequently occur in the education, industrial, office, warehouse, and healthcare sectors; and these projects take many months to complete. As can be seen in Table 5-42, over 70% of completed new construction projects occurred in these four sectors and more than 80% took more than six months to complete, averaging nearly 15 months from inception to completion.

Table 5-42 NC Project Characteristics

Characteristic	*Completed Projects (n=94)*
Building Type	
Education	20
Industrial	15
Office	13
Warehouse	10
Healthcare	10
Lodging	6
Retail	6
Grocery and Convenience	4
Faith-Based	3
Food & Beverage Service	2
Entertainment/Recreation	2
Automotive Services	1
Parking Garage	1
Gas Station	1
Time to Complete	
6 months or less	13
6 to 12 months	18
12 to 18 months	34
18 to 24 months	21
more than 24 months	8

Ameren Missouri paid, or is committed to paying, new construction customers almost $3 million for 43,021,898 kWh saved starting in 2013 and concluded by the end of 2015. For new construction projects, the kWh savings generally tracked the count of projects, with the notable exception of healthcare, making up 10% of the count but 18% of the savings (Figure 5-27).

Building Type	Projects		Savings		
	Count	%	Sum	%	Mean
Education	23	21%	9,117,225	21%	396,401
Healthcare	11	10%	7,924,222	18%	720,384
Office	14	13%	6,793,216	16%	485,230
Industrial	17	15%	6,779,625	16%	398,801
Warehouse	16	14%	5,218,998	12%	326,187
Retail	6	5%	3,189,893	7%	531,649
Lodging	7	6%	1,065,079	2%	152,154
Entertainment/Recreation	2	2%	772,203	2%	386,102
Grocery and Convenience	4	4%	642,874	1%	160,719
Parking Garage	2	2%	544,906	1%	272,453
Automotive Services	2	2%	325,463	1%	162,732
Food & Beverage Service	3	3%	301,344	1%	100,448
Gas Station	1	1%	183,357	0%	183,357
Faith-Based	3	3%	163,493	0%	54,498
Total	111	100%	43,021,898	100%	387,585

Figure 5-27 New Construction Projects and Savings by Building Type

Since the beginning of 2013, the average savings of new construction projects has decreased to one-fifth (20%) of the savings in the first two quarters (Table 5-43). Coupled with a slower decline of average incentives paid out, the cost per kWh saved by the New Construction Program has increased from 7.4 cents to 9.7 cents. The total number of projects peaked in the first two quarters of 2014, in which the program started nine more projects than in the next six quarters combined.

Table 5-43 Comparison of Savings and Incentives by Project Start Date

Project Start Date	Projects (n=111)	Percent	Average kWh Savings	Average Incentives	$ per kWh Saved
1/1/13 - 7/1/13	23	21%	520,613	$ 38,599	$ 0.074
7/1/13 - 1/1/14	29	26%	492,544	$ 34,769	$ 0.071
1/1/14 - 7/1/14	34	31%	313,132	$ 21,264	$ 0.068
7/1/14 - 1/1/15	9	8%	330,931	$ 24,191	$ 0.073
1/1/15 - 7/1/15	10	9%	250,415	$ 19,359	$ 0.077
7/1/15 - 1/1/16	6	5%	105,834	$ 10,244	$ 0.097

5.9.2. New Construction Trade Ally Interviews

The evaluation team conducted in-depth interviews with five trade allies who had completed at least one new construction project in 2015. The BizSavers database identified twenty-five trade ally firms that completed thirty-seven new construction projects for twenty-six customers, at twenty-seven sites from January through October 2015. The evaluation team sorted the twenty-five trade allies in descending order of cumulative New Construction Program electricity savings and called through the list until five trade allies completed interviews. The evaluation team completed interviews with five of these trade allies on November 4, 2015. The interviews covered program training, customer awareness, program satisfaction, and suggestions for improvement.

Interviews revealed that new construction trade allies were generally satisfied with the program, especially their interactions with program staff. However, trade allies were critical of the required energy savings calculations and modeling, noting that these requirements limit their ability to design qualifying projects.

5.9.2.1. Respondent Characteristics

Interviewed trade allies represented a variety of firm types (electrical contracting, architectural and design services, engineering, and energy services), firm sizes (one to two locations, with fewer than ten to about 1,000 employees), and locations and customer types served (Table 5-44).

Table 5-44 Respondent Characteristics

Respondent Company Services Offered	*Number of Locations*	*Approximate Number of Employees*	*Areas of Missouri Served*
Engineering and architecture	2	1,000	Statewide
Electrical contracting	2	160	Eastern
Engineering	1	45	Statewide
Engineering and architecture	1	9	Eastern and Central
Energy service company (ESCO)	1	8	Statewide

5.9.2.2. Program Training and Newsletters

New construction trade allies had limited experience with program training. Two of the five trade allies said they had personally attended some form of BizSavers training, with another saying their coworker had attended program training and described the training to him. Two of these trade allies – one who attended the training and one whose coworker described it – reported the training was valuable and conveniently located and timed, and agreed that the information presented was clear, appropriately detailed, and covered all relevant topics. The second trade ally who attended the training did not recall it well enough to speak these types of specifics.

Two trade allies said they were familiar with the BizSavers Solutions monthly electronic newsletter, one of whom said he “enjoyed them” and the other said that the newsletter does not contain useful information for trade allies (but may be useful for participants).

When asked about any other training or information that would be helpful, one trade ally reported wanting additional information on parking lot lighting upgrades.

5.9.2.3. Customer Program Awareness

Four of the five interviewed trade allies said their new construction clients were aware of the BizSavers new construction incentives before the trade allies had discussed the incentives with them. Two of those trade allies indicated that their clients' awareness of the BizSavers incentives was partial, with one explaining that the client was aware of some rebated measures but unaware of other relevant rebate opportunities.

Three of the trade allies provided suggestions for improving awareness of the new construction incentives, generally reinforcing the program's existing approach. Specifically, these trade allies suggested focusing outreach to the professionals that design and build buildings (e.g., designers, architects, engineers, electricians) and persons in senior corporate roles who are involved in the decision to build them.

5.9.2.4. Trade Ally Network (TAN) Membership and Co-Branding

Three of the five interviewed trade allies were members of the trade ally network (TAN). When asked about the impact of TAN membership on their business, one said it has been beneficial as it gives them more credibility; the other two said either that the TAN has had no negative or positive impact or they did not know what impact it had.

Two of the TAN members reported they were not using Ameren Missouri's logo for co-branding their services, both of whom said that no one from the BizSavers team had approached them about the marketing opportunity. One of these two TAN members said they do not do enough projects in Missouri to warrant co-branding their services and the other said they "just haven't done it yet." The third TAN member did not know whether or not his company used the Ameren Missouri logo.

5.9.2.5. Program Effects on New Construction Designs

All interviewed trade allies reported that the New Construction Program convinces project owners to incorporate energy efficient measures into the design of their buildings that they would not have otherwise incorporated. One respondent indicated that the program had influenced designs "greatly," causing that respondent to take energy efficiency into consideration "every time." However, the only specifics that respondents gave about how the program influenced the new construction design were that it influenced the selection of LEDs over other lighting types (three respondents) and decisions concerning HVAC and "maybe" envelope design (one respondent).

Four of the five respondents made it clear that they promote the incentives to their clients, one going so far as to report actively looking for incentives to suggest to clients. These responses suggested that, for these allies, promoting incentives is part of their business model. Three of the four indicated being motivated by their clients' interests – to reduce first costs or generate quick paybacks or long-term savings. The fourth, an

ESCO, suggested that doing so benefits the trade ally firm as well, allowing it to provide "a lot of value added work" when incentives are available.

When asked whether the program requirements had limited their designs of new construction projects, three trade allies reported that program requirements had somehow adversely affected the design process. All three reported that the savings calculations greatly exaggerate the time it takes them to complete their designs, although they did not specify whether that actually affected what they could include in the design.

Two respondents, however, did report that the technical analysis study (TAS) required for the Whole Building Performance (WBP) incentive had affected their designs. They explained that, in most projects, the WBP incentive is barely enough to cover the added cost of the TAS. As the cost of the TAS absorbs the bulk of the incentive and because customers do not want to commit to the TAS or custom incentive energy modeling before they know what the net cost of their project will be, the TAS makes it difficult to sell energy efficient designs through the program – which limits their designs. One of these trade allies pointed out that when he is unable to estimate the WBP incentive, clients perceive that his efforts to sell it is self-promoting: "Most people think I'm just trying to pad my pockets – so most will just do the standard stuff that we can easily figure out." One of these respondents said they are no longer going to recommend or participate in the program because of this issue.

Two of the five trade allies said the program requirements have not limited their new construction designs and did not report any other adverse impacts.

5.9.2.6. New Construction Projects Done Outside of the Program

To gauge potential for program expansion, the evaluation staff asked trade allies about new construction work done outside the program. Three of the five trade allies respectively reported doing two, eight, and "a lot" of new construction projects in Ameren Missouri territory during 2015 that did not apply for BizSavers incentives. The two who reported eight a "a lot" of such projects said they proposed qualifying equipment in "some" of those un-incented projects. The one who reported two projects reported not being involved in the design phase of those projects and so did not recommend qualifying equipment in either project.

The interviewer asked about factors that had prevented the inclusion of high-efficiency equipment in un-incented projects. The respondent with eight such jobs said the reason was that clients did not want to pay for the added cost of the TAS without first knowing what the incentive amount would be. The other respondent (who reported "a lot" of un-incented projects) said that lack of program awareness among some of the firm's project managers had prevented the inclusion of high-efficiency equipment. The third trade ally (who reported two un-incented jobs) declined to comment.

5.9.2.7. *Satisfaction with Program Experience*

Interviewed trade allies reported high satisfaction with most program elements, with all respondents giving ratings of 7 to 10 (on a 0-to-10 scale) on the program application process, the range of measures and products for which Ameren offers incentives, the quality of those measures and products that qualify for incentives, and their communication with program staff. Three of the five respondents gave similarly high ratings to the level of incentives offered and program rules and guidelines, while one respondent rated his satisfaction with these items as "1" and "2," respectively, and one did not rate his satisfaction on them.

All interviewed trade allies reported seeking assistance from program staff at some point in the course of their new construction projects, with respondents saying they sought assistance with general questions and design plans. All respondents said that program staff provided the assistance they needed and that there was no additional assistance that program staff should have provided.

Consistent with the above, the interviewed trade allies indicated that the best thing about the program was the ability to increase energy efficiency by either incenting or educating building owners or, in one case, the helpfulness and courteousness of program staff.

As noted in Section 5.9.2.5, above, the main area of concern for trade allies was around the requirements for calculating savings. Consistent with this, the one trade ally who gave low satisfaction ratings to any program elements said it was because the incentive amount is too little to justify the hassle and added cost related to energy modeling and the application process. When asked for suggestions for program improvements, two trade allies said that they need to be able to give project owners an estimated incentive amount before charging them for a TAS or custom incentive energy modeling, which they currently cannot do. Two trade allies suggested the program look to other similar programs for models – one noted simply that the program should simplify the required savings calculation methodologies to mirror other nonresidential energy efficiency rebate programs from utilities across the U.S., while another suggested that BizSavers should mirror a California utility's model of offering a 2% incentive to the design team.

5.9.3. New Construction Participant In-Depth Interviews

During Q4 2015, the evaluation team conducted seven in-depth interviews with new construction participants. Those seven respondents represented eleven projects and about one-third of all program savings.

As of November 2015, the BizSavers database showed twenty-six customers with 39 new construction projects that were completed in 2015, and another sixteen customers with projects that were designated as "committed" (11), "installed" (4), or in the "payment pending phase" (1). To get feedback from those who had experienced all phases of program participation, the evaluation team prioritized interviewing representatives of the twenty-six customers that had completed projects. The team was able to reach and interview six contacts with projects completed before November 3, 2015 and one contact with a project that was committed to be completed by November 30, 2015.

The 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 satisfied with the program, giving particular accolades to the program staff that assisted them throughout the process. However, as was shown in the 2014 evaluation, the earlier the program can be in touch with a new construction project, the more likely projects will maximize savings opportunities. Some findings suggest that greater promotion of the New Construction Program among standard and custom retrofit participants may be one way to generate greater program involvement in the early phases of new construction projects.

5.9.3.1. Respondent Characteristics

The small sample and population did not permit developing a statistically representative sample. However, we compared the respondents' company type to the population to determine whether there was evidence that the sample deviated from the population in some clear way. Both those in the sample and the population represented education, healthcare, industrial, retail, and warehouse end uses, which were the end-uses with the largest savings. Program savings largely resulted from the healthcare and education subsectors, and respondents represented buildings with savings largely in these two subsectors with notably smaller savings in the retail, warehouse, and industrial settings – thus, the interviewed respondents represented the subsectors that constituted 93% of program savings (Table 5-45).

Table 5-45 Comparison of Savings and Building Type in Sample and Population

Business Type	Sample			Population		
	Count	Savings (kWh)	%	Count	Savings (kWh)	%
Healthcare	1	4,425,445	57%	5	7,885,629	33%
Education	3	2,970,762	38%	9	6,072,230	26%
Retail	1	34,732	<1%	4	3,176,319	13%
Warehouse	1	206,532	3%	6	2,746,858	12%
Industrial	1	170,523	2%	5	2,210,874	9%
Entertainment/Recreation	-	-	0%	2	681,143	3%
Office	-	-	0%	5	483,542	2%
Automotive Services	-	-	0%	2	229,298	1%
Lodging	-	-	0%	1	192,906	1%
Faith-Based	-	-	0%	1	65,471	0%
Unknown	-	-	0%	2	9,045	0%
Total	7	7,807,994	100%	42	23,753,315	100%

Respondents were all owners or staff of the building owners. As Table 5-46 shows, respondents represented a range of business types and building sizes. Six of the seven respondents reported building new footprint projects while one was a major renovation to repurpose the building. All installed lighting, four installed HVAC, and two completed shell measures.

Table 5-46 Respondent Characteristics Summary

Resp. ID	Respondent Characteristics		Project Characteristics			
	Building End-Use Type	No. of Props. in Ameren MO	Project Type	Equipment Type	Sq. Ft	Number of Employees On-Site
NC10	Office/ Warehouse	1	New footprint	Lighting	118,000	35
NC16	Manufacturing/ office	1	New footprint	Lighting	22,500	55
NC38	Education/ office	1 lg. campus	Expansion	HVAC/ Shell/ Lighting	105,000	Up to ~500
NC12	Hospital	40	New footprint/ expansion	HVAC/ Shell/Lighting	240,000	Don’t know
NC39	Laboratory	1 lg. campus	New footprint	HVAC/ Lighting	215,000	Don’t know
NC23	Education	3	New footprint	Lighting	57,000	Up to ~330
NC20	Retail/ Event space	1	Redesign	Lighting	9,000	Up to ~450

5.9.3.2. *Program Awareness*

Respondents varied in how they became aware of the program. Three noted that an Ameren Missouri representative such as an account representative told them about the program, two indicated their past experience with efficiency programs triggered their interest in participation, and two noted their contractor or distributor alerted them to available incentives.

The degree of involvement in the project and the program also varied by customer. Almost all (6 of 7) respondents reported participating in Ameren Missouri programs in the past for everything from small lighting upgrades to chiller upgrades and solar panel installations, but only two of those respondents suggested they learned about the New Construction Program through their past program experience. Even in cases such as NC16 and NC20, who both reported high levels of past engagement with Ameren Missouri programs by installing solar panels and a large number of lights respectively, past participation did not lead to New Construction Program awareness (Table 5-47).

Table 5-47 Degree of Program Involvement

Resp. ID	*Building Type*	*Previously Used Ameren MO Programs*	*Source of NC Program Awareness*	*Program Involved in Design Phase*	*Project Characteristics (Type, Systems, Bldg. Size)*
NC10	Office/ Warehouse	No	Contractor	No	Footprint, lighting, medium
NC20	Retail/ Event space	Yes	Distributor	No	Redesign, lighting, small
NC16	Manufacturing/ Office	Yes	Ameren MO	No	Footprint, lighting, small
NC12	Hospital	Yes	Ameren MO	Yes	Footprint/expansion, multiple systems, medium
NC39	Laboratory	Yes	Ameren MO	Yes	Footprint, multiple systems, medium
NC38	Education/ Office	Yes	Past experience	Yes	Expansion, multiple systems, medium
NC23	Education	Yes	Past experience	No	Footprint, lighting, small

Readers should exercise caution in generalizing from this small sample. However, the fact that half of the interviewed respondents had past energy efficiency or renewable energy program experience and did not investigate program opportunities before or during the design phase of their projects suggests there is an opportunity to promote the New Construction Program (and perhaps other programs) whenever a customer engages with any efficiency or renewable energy program.

5.9.3.3. The Application Process

All respondents noted that program representatives were key players in submitting the application for incentives, and four of the seven noted a contractor or distributor played a key role in completing the application. Program representatives assisted with paperwork, answered questions, and generally helped ensure projects met all of the program requirements and timelines.

Evidence of the important role program staff played in participation came from respondents' lukewarm assessment of the application forms and their reports about the assistance they received from program staff on the application. While most reported the application was "straightforward," only two respondents rated the clarity of the application forms above the scale midpoint (where one equals not at all clear and five equals completely clear). Three respondents gave the midpoint rating, all of whom said the program staff helped them overcome the problems they experienced with the application forms – one reporting that she "could not have done" the project without assistance from the program representatives. A sixth respondent could not remember the forms because, to the best of his recollection, the program representative handled all paperwork. The remaining respondent was not involved with the application process.

5.9.3.4. Selection of the Incentive Path

New construction participants can receive incentives for relatively simple projects that involve basic lighting upgrades exclusively, similar to those available for existing buildings, to more complex projects that involve lighting, heating and cooling, appliances, the building shell, and energy modeling simulations. As past evaluations showed, the earlier that customers became involved in the program, the deeper the savings they were able to achieve through program incentives: all four of the respondents that completed lighting-only projects engaged with the program after the building design phase was complete, limiting how much incented work they could do.

Feedback from the seven participants interviewed for the current evaluation suggest that program involvement in the design phase is more likely to occur when Ameren Missouri staff generate program awareness and when the building owners have an institutional interest in energy efficiency. Of the three respondents who became aware of the program through the work of Ameren Missouri staff, two did projects that involved multiple systems. The one that did a lighting-only project said he wished he had involved Ameren in his project earlier so he could have planned and budgeted for other efficiency upgrades such as more efficient refrigeration.

Moreover, the three respondents that went beyond lighting-only measures – two from hospitals and one from a university – suggested they chose the more involved project type because of their long-term interest in energy savings and commitment to building above code. Two of them noted their projects achieved LEED standards, and the other suggested his new building was potentially LEED eligible but he was not interested in seeking actual certification.

Of the four respondents that engaged with the program after the building design and completed only lighting measures, two became aware of the program through a contractor or distributor that became involved in the project well after the design phase. Of the other two, one knew about the program through past experience and one became aware of it from an Ameren Missouri representative – those two did not explain why they did not engage the program during the design phase.

The above findings suggest that the types of trade allies that were involved in project design, the best time to incorporate efficiency into the building, did not appear to tell customers about new construction incentives. Again, the small sample argues for caution in drawing generalizations. However, these findings may underscore the importance of carrying out effective outreach with architects and other building design professionals.

5.9.3.5. Efficiency Drivers and Expectations

The factors driving the decision to install efficient equipment over baseline equipment varied across respondents and included corporate commitment (three respondents), contractor influence (three respondents), and prior positive experience with LED lighting (one respondent).

Three respondents reported opting not to install some program-recommended efficient equipment. Cost was a factor for two, while one each cited the difficulty of accommodating existing design, timeline issues, and lack of fit between the recommended equipment (lighting) and the specific building needs (Table 5-48).

Table 5-48 Summary of Recommended Equipment Not Installed

Resp. ID	*Building Type*	*Recommend but Not Installed*	*Cost Mentioned as a Factor?*	*Other Reason Not Installed*
NC10	Office/ Warehouse	Computer equipment	Yes	None
NC16	Manufacturing/ office	Refrigeration	Yes	Would have required too much work to accommodate existing design
NC39	Laboratory	Some lighting	No	Very specific lighting needs in lab and too tight a timeline to investigate efficient options

Respondents reported that the program did not disqualify any equipment and that the range of eligible equipment was generally adequate, with one exception. NC23 thought there were enough savings to provide incentives for going from HID to LED but reported that the program representatives said the savings associated with that switch were insufficient to provide incentives.

5.9.3.6. Satisfaction

All seven respondents rated their program satisfaction as high (at least 4 on a 1-to-5 scale, where 1 means not at all satisfied and 5 means very satisfied) across eight program elements, including the steps they took to complete the program, their interactions with program staff, the program overall, and Ameren Missouri in general. Overall satisfaction with the program was high even though the application forms were somewhat problematic for some respondents (See discussion in Section 0 about application form clarity).

Of five respondents that could compare their received incentive to their anticipated incentive amount, all reported that their incentives were at least as much as expected. (One respondent did not know what the promised incentive had been and another respondent had not yet seen the final incentive check.)

All respondents reported general satisfaction with the installed efficient equipment. One in particular reported "getting rave reviews" about lighting and comfort from the building occupants, and one noted that all future lighting work will be LEDs, like what he installed in his new building, because they use so little energy.

5.9.4. New Construction Participant Online Survey Respondents

Of the 843 respondents to the online participant survey (Section 5.4), 25 had completed new construction projects. The survey asked those respondents several questions that were specific to their program experience – specifically, which incentive options they were aware of, how well the range of incentive options fit their needs, and whether they had a clear sense of whom to go to for information about design team meetings.

Awareness of the range of incentive options reflected the types of new construction projects done in 2015. Twenty-one of the 25 respondents were aware of standard lighting incentives, which was more than double the number that were aware of the whole building performance incentives or standard non-lighting incentives (11 respondents each) and nearly double the number that were aware of the custom measure incentives.

Most respondents (19 of 25) reported that the range of incentive options fit their needs either "very much" or "completely." In addition, a large majority of respondents (20 of 25) said they had a clear sense of whom to go to for information about design team meetings.

The above findings suggest that new construction participants were satisfied with the program services, but they also further illustrate the program's challenges. The fact that the range of incentive options fit most respondents' needs despite the fact that most were not aware of the full range of options simply reflects the limited way in which many participants have used the New Construction Program so far.

6. Cost Effectiveness Evaluation

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

For each program, the evaluation team performed the following cost effectiveness tests: Total Resource Cost (TRC) test, Utility Cost test (UCT), Societal test and Participant test, as defined by the California Standard Practice Manual. Morgan Marketing Partners (MMP) completed the analysis utilizing DSMore software, the leading cost benefit analysis model in the country and the same model that was 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 correlates both price 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. Appendix N: Cost Effectiveness - Critical Technical Data provides additional information on the data sources test formulas, inputs, and methodology

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. The following table also summarizes the present values of the UCT net lifetime benefits (net avoided costs minus program costs). All programs pass the UCT and TRC tests.

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

Variable	*Portfolio*	*Custom*	*Standard*	*New Construction*	*RCx*
UCT	6.03	6.20	6.00	7.21	4.66
TRC	1.74	1.47	1.48	5.20	4.70
RIM	0.61	0.60	0.57	0.68	0.67
PCT	2.98	2.46	2.77	9.87	11.55
SCT	2.07	1.76	1.79	6.25	5.23
CCE - $/kWh	$0.0062	$0.0059	$0.0057	$0.0059	$0.0101
UCT Net Lifetime Benefits	$170,681,474	$98,507,036	$18,713,713	$19,087,827	$34,372,899

MMP performed the DSMore analysis at the individual measure level, which allows for an analysis by measure for all components of the program. Table 6-2, Table 6-3 and Table 6-4 provide measures that are underperforming or marginally performing with regards to their TRC values. Measures that had TRC values of one or less were included in the following tables as measures to monitor. The analysis did however result in more measures that did not pass the TRC test in 2015.

Many factors influence the cost effectiveness ratios each year. Although, Ameren Missouri decreased the avoided costs for electric production, avoided capacity and the avoided T&D rate in 2015, to align with the 2014 Integrated Resource plan, the cost effectiveness ratios are similar to prior years. One factor for the small change is some costs are relatively fixed, such as EM&V and Administration in relation to the benefits of electric kWh and kW, which significantly exceeded their targets. In addition, measures with a 15-year useful life, experience the escalated avoided capacity costs in the later years with the 2014 IRP in comparison to the 2013 cost data, which escalates in earlier years. Lastly, the final year of the 3-year program cycle did not have any incentive costs carried over to the forward year.

The evaluation team compared BizSavers incentive costs as recorded in the program tracking data to Ameren Missouri incentive costs as they appear in the general ledger, over the 3-year program cycle. The costs align relatively well, with a minor discrepancy that represents .0008% of total incentives costs, over the 3-year cycle. The 2015 discrepancy was greater, representing 6% of total 2015 incentive costs. Program implementation staff indicated the discrepancy was due to customers completing projects in one fiscal year but not being administratively complete until in the following program year.

Table 6-2 Custom Measures to Monitor

Measure	***End Use***	***TRC***
401210-Fan-VFD Fan - Large Air Handler	HVAC BUS	0.00
202310-Heat Pump-Between 11.25 and 20 ton - HP 135,000 - 240,000	HVAC BUS	0.02
801010-Industrial-Industrial Process Improvement	Process BUS	0.03
103650-LED-LED Replacing Neon	Lighting BUS	0.04
111010-Central Lghtg Ctl-Central Lighting Control	Lighting BUS	0.05
526110-Condenser-Efficient Condenser	Refrigeration BUS	0.11
203140-DX-Redesign	HVAC BUS	0.15
115030-Daylight Sensor-LED Fixture & Daylight Sensor Control - Exterior	Lighting BUS	0.24
116040-Lghtg Ctls-Dimming Control-Interior	Lighting BUS	0.28
103630-LED-Exterior LED replacing Linear Fluorescent	Lighting BUS	0.28
112060-Occupancy Sensor-Dimming	Lighting BUS	0.35

Measure	***End Use***	***TRC***
101030-T5-6 Lamp T5 High Bay high BF	Lighting BUS	0.37
513020-Air Compressor-Adding an Air Compressor to Aid Low Load Conditions	Air Comp BUS	0.38
103912-Lighting-LED Replacing 8ft 2-lamp T8 HO	Lighting BUS	0.43
103924-Lighting-LED-LED Replacing 2ft - 1 lamp T12 - F20	Lighting BUS	0.48
207840-Controls-Guest Room Energy Management, Electric Heating	HVAC BUS	0.49
102210-T8-T8 Exterior Lighting	Lighting BUS	0.51
102120-T8-4' T8 replacing 8' Fluorescent	Lighting BUS	0.51
801030-Industrial-Process-WWTP Dissolved Oxygen (DO) Aeration	Process BUS	0.53
513040-VSD Air Compressor-Install VSD Air Compressor for Trim	Air Comp BUS	0.54
103320-LED-2' LED Fixture Replacing Fluorescent	Lighting BUS	0.55
103310-LED-4' LED Tube replacing Fluorescent Fixture	Lighting BUS	0.56
101010-T5-4 Lamp T5 High Bay high BF	Lighting BUS	0.59
101040-T5-6 Lamp T5 High Bay med BF	Lighting BUS	0.64
204110-HVAC-Heat Recovery-NC	HVAC BUS	0.64
528070-Refrigeration-Controls-Defrost Controls	Refrigeration BUS	0.67
102140-T8-2' T8 Fluorescent replacing 2' Fluorescent	Lighting BUS	0.68
103030-LED-LED Replacing CFL	Lighting BUS	0.68
102313-Lighting-T8-T8 Replacing T12	Lighting BUS	0.69
103330-LED-Linear LED Replacing Incandescent/HID/Fluorescent	Lighting BUS	0.72
207430-Controls-Install Free Cooling Equipment-Controls	Cooling BUS	0.73
202610-HVAC-Heat Pump-Air Source	HVAC BUS	0.75
529050-Refrigeration-Process-Optimization	Refrigeration BUS	0.76
102316-Lighting-T8-T8 Replacing T12	Lighting BUS	0.76
102310-Lighting-T8-T8 Replacing T12	Lighting BUS	0.78
102250-Lighting-T8 Replacing 8ft - 2 lamp T12	Lighting BUS	0.79
103913-Lighting-LED Replacing 8ft 2-lamp T8 VHO	Lighting BUS	0.79
102335-Lighting-LED-LED Replacing T12	Lighting BUS	0.80
103914-Lighting-LED Replacing 8ft 2-lamp T12 F96	Lighting BUS	0.81
200110-Building Envelope - Reduce Infiltration	HVAC BUS	0.82
102327-Lighting-T8-T8 Replacing T12	Lighting BUS	0.82
116030-Lghtg Ctls-Dimming Control-Exterior	Lighting BUS	0.83
102315-Lighting-T8-T8 Replacing T12	Lighting BUS	0.83
101110-T5-T5 Replacing Incandescent	Lighting BUS	0.84
102331-Lighting-T8-T8 Replacing T12	Lighting BUS	0.86

Measure	End Use	TRC
103916-Lighting-LED Replacing 4ft - 2 lamp T12 - F40ES	Lighting BUS	0.90
103040-LED-LED Fixture Replacing HID Fixture <175 Watts	Lighting BUS	0.90
103923-Lighting-LED-LED Replacing 3ft - 1 lamp T12 - F30	Lighting BUS	0.91
103920-Lighting-LED Replacing 4ft - 3 lamp T8	Lighting BUS	0.91
103911-Lighting-LED Replacing 4ft 4-lamp T8	Lighting BUS	0.91
101190-T5-4' T5 replacing Fluorescent	Lighting BUS	0.93
528060-Controls-Refrigeration Condensesr Motors	Refrigeration BUS	0.99
102336-Lighting-LED-LED Replacing T12	Lighting BUS	0.99

Table 6-3 Standard Measures to Monitor

Measure	End Use	TRC
999140-ENERGY STAR Ice Machines 500 to 1000 lbs	Refrigeration BUS	0.60
999152-IT-ENERGY STAR 5.0 Desktop Computer	Office BUS	0.66
999114-Lighting-LED or ELD Exit Sign-Replacing CFL	Lighting BUS	0.67
999128-Refrigeration-Refrigerator Door-LED Lighting	Refrigeration BUS	0.73
999151-IT-Desktop Virtualization-Thin Client (2)	Office BUS	0.75
999141-ENERGY STAR Ice Machines more than 1000 lbs	Refrigeration BUS	0.75
999153-IT-PC Power Management Software-(Per Desktop PC To Be Managed)	Office BUS	0.80
999142-ENERGY STAR Steam Cookers 6 Pan - Electric	Cooking BUS	0.93
999115-Lghtg Ctls-Occ Sensor Fixture Mounted-Low Watt Fixture, >50 and <=200 Watts	Lighting BUS	0.96
999126-Refrigeration-Automatic Door Closers	Refrigeration BUS	0.98

Table 6-4 New Construction Measures to Monitor

Measure	Program	TRC
103030-LED-LED Replacing CFL	Lighting BUS	0.60
513010-Variable Speed Air Compressor-Replace Fixed Speed Air Compressor with Variable Speed	Air Comp BUS	0.71
999117-Lghtg Ctls-Occ Sensor Single Tech-Controlling Circuit 50 to 120 Watts	Lighting BUS	0.79
999116-Lghtg Ctls-Occ Sensor Fixture Mounted-High Watt Fixture, 200 to 500 watts	Lighting BUS	0.96

Program staff should monitor these measures 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.

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.

7.1. Impact Conclusions

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

- During 2015, the BizSavers Program had the highest participation and energy savings levels to date. Applicants submitted a uniquely large number of final applications during the last two months of the program year, immediately prior to the deadline for submission. This upturn in program activity may be associated with applicant and trade ally anticipation of cessation of program incentives.
- ADM engineers conducted post-installation site visits for seventy-eight projects implemented during 2015. They also performed eight pre-installation visits to determine the pre-implementation operating conditions for larger energy saving projects. The seventy-eight projects for which post-installation site visits were performed included measures implemented under the Standard, Custom, New Construction and Retro-Commissioning Programs, with seventeen of the seventy-eight projects receiving incentives through more than one program.
- For lighting controls, variation between ex ante and gross ex post energy savings persisted during 2015. As compared with previous program years, the program improved the ex ante savings assumptions by accounting for additional data collected from the application, resulting in gross realization rates, on average, being closer to 100%. The evaluation team observed high realization rates for control measures with an unbounded upper controlled wattage range. An example of this measure type is *Lighting Controls Occ Sensor Dual Tech Controlling Circuit >150 watts*. Therefore, a sensor controlling 300 watts has the same ex ante savings as a sensor controlling 151 watts, given identical operating hours.
- Also mentioned in prior year evaluation reports, ADM applies heating and cooling interaction factors to all custom and standard lighting projects, which has consistently resulted in a higher-than-average realization rate for lighting projects. While the TRM states that the unity value of 1.0 for HCIF may be

applied, ADM obtains the heating and cooling system information during site visits to support application of more accurate heating and cooling interaction factors, and applies these factors in calculation of energy savings of all lighting and lighting control measures.[39]

- ENERGY STAR® ice makers had low realization rates. The ex ante kWh savings was determined by the efficient ice maker capacity and matching TRM deemed savings. The evaluation team utilized the algorithm in the Ameren TRM, which accounts for base and efficient energy usage along with a 75% load factor. Also, the Commercial Kitchen Equipment Energy Star Calculator was referenced to estimate the baseline equipment efficiency, which was unknown. The efficient equipment usage was estimated based on the performance data sheet for the installed icemaker.

  The TRM deemed ice maker kWh savings value could not be replicated with the savings algorithm. It is likely that the baseline efficiency used in the deemed estimate is far too inefficient or the load factor may not have been applied.

- The program implementation contractor did not consistently document estimated peak kW impacts in the program tracking system. The implementation contractor allocated considerably greater efforts toward documenting estimated kWh energy savings, in comparison with that allocated toward documenting estimated peak kW impacts. This practice may be related to the implementation contractor's sense of the comparative importance of kWh and peak kW as program performance metrics.

- The evaluation team identified inconsistencies with the measure-level data field "Units." Measure-level "Units" are a key input to the cost effectiveness analysis; therefore, accuracy is important. The evaluation team identified inconsistencies when reviewing measure unit savings, as the quantity was often a value of one (1) with exceptionally high kWh savings. Although these values produce variation in the per unit measure savings, they did not affect the total project savings.

- Not all project documentation was readily available for evaluation review in the program tracking system, LM Captures. ADM was provided with login ID's to access all project data stored in LM captures, but ADM analysts made additional documentation requests for approximately one third of the sampled projects. In most cases, program staff was able to retrieve the documentation from a separate server. It was undetermined if the lack of supporting project documentation was a function of the storage capacity of the system or an internal

[39] See "Appendix L: Heating and Cooling Interactive Factors" for a presentation of the heating and cooling interaction factors developed and applied by ADM.

protocol that does not require all documentation to be uploaded to the program tracking system. One contributing factor may be the influx of program activity late in the program year and the focus of implementation resources on project review and not on administrative data entry tasks that facilitate evaluation.

- The overall portfolio of BizSavers Programs and each individual program is cost effective according to the TRC and UCT tests. The cost effectiveness analysis provides a list of custom, standard and new construction measures associated with a TRC test result less than one (Chapter 6.)
- Approximately 16% of the total program gross ex post kWh savings was associated with replacement of incandescent lighting with LEDs. Federal energy conservation regulations such as the EISA Act of 2007 established baselines for minimally efficient lighting and other equipment. The sell-through period for the rollout of the last incandescent lamp has occurred with the 40 watt lamp effective phaseout date of January 1, 2014. ADM evaluated all general illumination screw-in lamps from 310 to 2600 lumens with this federal regulation to determine the minimally efficient baseline that could have been purchased in the absence of the program.

7.2. Impact Recommendations

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

- To improve the ex ante savings calculation for lighting control measures the program implementer should consider the cost and benefits associated with collecting additional information. Exact controlled wattage and the existing lighting hours-of-use are two parameters that could further improve the realization rate of lighting control measures.
- ADM suggests that program staff apply heating and cooling interaction factors (HCIF) by building type, as mentioned 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, which are available in Appendix L: Heating and Cooling Interactive Factors.
- To improve the ex ante calculation for ENERGY STAR® ice machines, the program implementer should consider collecting information on the efficiency of the replaced ice machine and baseline data.

- To increase the accuracy of peak demand impacts, the implementation contractor should revise data collection and data entry protocols. The implementation contractor may develop kW savings estimation algorithms that account for applicant kWh savings and the end use of the installed measures. Additionally, the implementation contractor could require applicants to provide kW savings estimates for projects for which an energy model was created – energy models are often created by the applicant or trade ally for new construction and retro commissioning projects.
- The program implementer should consider revising implementation protocols to improve the accuracy of the measure-level “Unit” data field. The inconsistencies are easily identified, as the quantity of units is often a value of one (1) with conspicuously high kWh savings. These weighted values produce uncertainty in measure-level cost effectiveness testing.
- The program implementer should consider a solution to improve operational protocols or system technical enhancements that would ensure all project documentation is available in the program tracking system for evaluator review.
- To improve the ex ante savings estimates for screw-in general illumination lighting the program team should consider adjusting the baseline wattage as well as the lumen equivalence to align with the federal standard—EISA Act of 2007.

7.3. Regulator Research Questions – Process Findings and Recommendations

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 2015, 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?

- Findings from this evaluation point to several possible types of “market imperfections” or structural factors that may affect the ability of Ameren Missouri customers to undertake energy efficiency upgrades (on their own or through the BizSavers programs). The previous evaluation identified three of these: cost, lack of program awareness, and business size. This evaluation provided evidence that other factors may include geography and possibly the level of preparation of retro-commissioning service providers. Several of these factors are to some degree interrelated.

- Cost. The higher upfront cost of energy efficient equipment is a barrier; even when the equipment pays for itself in the long term, the first cost must compete with other priorities. Evidence includes the high NTG ratios for the BizSavers program and the interviews and surveys with trade allies and participants, which emphasized the importance of incentives in driving the efficiency upgrades.
- Awareness. Data from the trade ally survey suggests that about half of Ameren Missouri customers were unaware of the incentives *before the trade allies discussed them*. This suggests an awareness level of about 50% at the start of the 2015 program year, consistent with data from the previous (2014) evaluation's survey of nonparticipant customers. The degree to which the trade allies' efforts increased overall program awareness in the past program year depends on their increased reach into the market. Lack of awareness is a particular concern for the New Construction Program: of surveyed BizSavers participants that had not received the new construction incentives, 70% were not aware of those incentives. Although the program met its 2015 goals, lack of awareness may prevent future program expansion. Finally, evidence from retro-commissioning service providers (RSPs) suggests that awareness of the retro-commissioning incentives is lower in customer types that do not typically employ in-house facility managers.
- Business size. Businesses in the small rate class constitute a smaller percentage of program savings than their share of annual kWh usage. This holds true both for small accounts that are part of a larger aggregate of accounts (chains, franchises, and such) and those that are not part of a larger aggregate ("small businesses"). Surveyed trade allies tended to report that limited capital caused lower uptake of energy efficiency in small businesses.
- Geography. BizSavers projects and participants are disproportionately more from St. Louis and its suburbs than from more remote areas of the Ameren Missouri service territory, and the savings from projects in St. Louis and its suburbs are disproportionately higher than elsewhere. This may be at least partly due to the fact that customers in the smallest rate class – in particular, those that are not part of a larger aggregate – make up a higher percentage of accounts outside of St. Louis and its suburbs.
- Preparation of Retro-commissioning Service Providers. Finally, some evidence suggests that some RSPs may not provide customers with an adequate explanation of the purpose of retro-commissioning and of the processes that make it distinct from an equipment retrofit project. Customers that do not fully understand what the retro-commissioning process involves may be less likely to undertake a retro-commissioning project and may be less likely to realize the full potential savings of a

project. Further, the industrial segment appears to be dominated by an RSP that specializes in air compression, which may create a barrier to learning about building optimization.

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 previous evaluations, the range of business types in Ameren Missouri territory were well represented among standard and custom retrofit projects, suggesting that the program is effectively reaching the main segments of the target market. As noted above, small businesses constitute are somewhat under-represented in terms of savings.
- The current evaluation found evidence that awareness of the Retro-Commissioning Program may vary among business types, being greatest among those that typically employ in-house facility managers, such as hospitals, large hotels and casinos, and universities. Some evidence suggests that there may be greater awareness of the retro-commissioning compressed air option than the building optimization among industrial customers, resulting from that fact that one RSP that specializes in compressed air service serves a high share of the industrial market. Such findings do not necessarily suggest a need to alter the way the target market segment is defined, but rather to adjust some aspects of program delivery (see below).

Research Question 3: Do program measures reflect the diversity of end-use needs and available technologies for target segment?

- As previous evaluations found, participant and trade ally surveys showed satisfaction with the range of program-eligible equipment, delivery time for ordered equipment, and the quality of the equipment and the installation. The standard incentive application covered the equipment needs of most participants who used that option. Findings from the trade ally survey from this year’s evaluation suggest that T-12 lighting makes up more than one-third of tube lighting in Ameren Missouri service, which suggests that the program-eligible tube lighting types remain viable replacements options.
- Retro-commissioning participants continue to be highly satisfied with the services they received, the cost savings, and the performance of the program measures. Industrial customers, however, may not be completely aware of the full range of retro-commissioning options available to them because one RSP that specializes in compressed air service serves a high share of the industrial market.
- The interviewed new construction participants generally indicated that the range of program-eligible equipment met their needs, but this must be viewed in the context that the program reached most of these participants after the design phase, when their “equipment needs” largely consisted of lighting. In 2015, about 40% of New

Construction Program savings came from lighting measures. In a broader context, the ability of the New Construction Program to meet the diversity of end-use needs and available technologies is limited by the ability of program staff to become involved before building design takes place. On a related note, the interviewed new construction trade allies reported that the modeling requirements for doing custom measures in new construction projects took too long to fit within the construction timelines; earlier program involvement in new construction projects could reduce the time pressure that may limit savings from custom measures.

Research Question 4: Are communication and delivery channels/mechanisms appropriate for the target market segment?

- The BizSavers program exceeded savings goals for 2015. The program implementer reported using a wide range of marketing outreach channels and methods to reach end-use customers and service providers (e.g., contractors, vendors, and distributors). The implementer introduced some new outreach approaches in 2015, including conducting targeted outreach to decision makers representing customer account aggregates or "towers." Evidence suggests that this approach has been effective within St. Louis and suburbs but not as effective in outer areas. Findings indicate that program participants and trade allies are in general satisfied with information received from program staff. The evaluation team identified a few areas where enhanced program communication and/or delivery may help ensure continued program growth in future cycles.
- As indicated above, there is still evidence of low awareness of BizSavers incentives in general and of new construction incentives in particular. Even participants with past BizSavers program experience did not seek out new construction incentives prior to designing their building.
- There is some evidence that some RSPs may not provide detailed explanations of retro-commissioning to prospective customers. Retro-commissioning does not appear to be a core part of the business of many approved RSPs. One-third of the approved RSPs had not yet done any projects, and another third had done very little of the project work. Further, as noted above, the program may not be effective in providing information on building optimization to industrial customers that may get their information primarily from one RSP that specializes in air compression. The implementer's general outreach to trade allies does not encompass specific work with RSPs, which may limit the program's ability to ensure that RSPs are appropriately prepared to provide information on the range of retro-commissioning options and benefits.
- Despite a wide range of activities designed to improve the program's reach into small businesses, this sub-segment is still under-represented in program savings. Program staff reported plans for incorporating distribution of free direct-install

measures, which have been found to be a cost-effective method for achieving savings in the small business segment,[40,41,42] in future offerings.

- Implementer staff reported that the Ameren Missouri customer database does not identify the customer business or building type; therefore, the implementer cannot use customer data to support targeted marketing and outreach.

Research Question 5: Are there better ways to address market imperfections to increase adoption of each program measure?

- Any future program implementer should work to increase promotion of the new construction and retro-commissioning incentives to customers doing standard and custom retrofit projects. In particular, given that most retrofit participants planning new construction or major renovation projects are unaware of new construction incentives, increasing the awareness of those incentives and of the importance of involving the program staff early in the design phase could have a significant impact on savings. Things to consider may include providing incentives or other forms or recognition to retrofit contractors who refer customers to the New Construction or Retro-Commissioning Program as well as targeting customers that have submitted applications for retrofit incentives with direct marketing and outreach that focuses on new construction and retro-commissioning incentives.
- Any future program implementer should intensify outreach to architects and design engineers to improve New Construction Program uptake. Suggested activities include producing more case studies (based on recent projects) and fact sheets to provide information on design options (something that Lockheed did early in the program); providing seminars on specific design options and features; and offering recognition to “green leaders” in the architecture and design fields.
- Any future program implementer should work with RSPs to ensure that they are appropriately prepared and understand the value of fully explaining all aspects of retro-commissioning to prospective participants, focusing on equipment optimization and monitoring. It may be valuable to encourage and support RSPs that currently do not serve industrial customers to enter that segment.

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[40] 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.

[41] 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.

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

- Ameren Missouri and any future implementer should continue and expand outreach efforts in parts of the Ameren Missouri service territory outside of St. Louis and its suburbs, particularly to small businesses in those areas. The inclusion of free direct install of low-cost measures, to generate immediate cost-effective savings and generate interest in future projects, may help address the fact that small businesses outside of St. Louis and its suburbs are particularly under-represented in program savings.
- Ameren Missouri should consider adding customer type information to its customer database. This would be a large undertaking, but it would make it easier for programs to identify any under-served segments and improve reach into those segments. It also would improve assessments of program reach to various business and building types. Segmenting the nonresidential sector in the same way as CBECS would permit comparisons of Ameren Missouri customer segmentation with statewide and nationwide data.

Appendix A: Project-Level Analyses

Site R-6 and C-25

Executive Summary

R-6 and C-25 received retro-commissioning and custom incentives from Ameren Missouri for upgrading the existing building automation system and implementing HVAC controls on all of the HVAC units servings the casino and banquet center. The combined realization rate for these projects is 114%.

Project Description

The facility is comprised of three connected buildings: the casino, hotel, and banquet center. As part of two projects, the 14 rooftop units (RTUs) serving the casino and banquet center had their HVAC control systems updated in order to reduce annual energy consumption. The implemented control measures include: Night Setbacks (NS), Ventilation Reduction (VR), Economizer Optimization (Econ), Supply Air Temperature Reset (SAT Reset), and Single Zone Variable Air Volume (SZVAV) retrofit. The following tables provide a summary of the controls implemented on each RTU as well as the Expected savings:

Project 6751 Expected Savings by Measure

Roof Top Unit	*Measures*	*Expected kWh Savings*
RTU-1	*NS, VR, Econ, SAT Reset*	*260,525*
RTU-2	*NS, VR, SAT Reset*	*53,205*
RTU-4	*NS, VR*	*98,341*
RTU-5	*NS, SZVAV*	*87,493*
RTU-10	*NS, VR, SAT Reset, SZVAV*	*230,542*
Total	*-*	*730,106*

Project 8082 Expected Savings by Measure

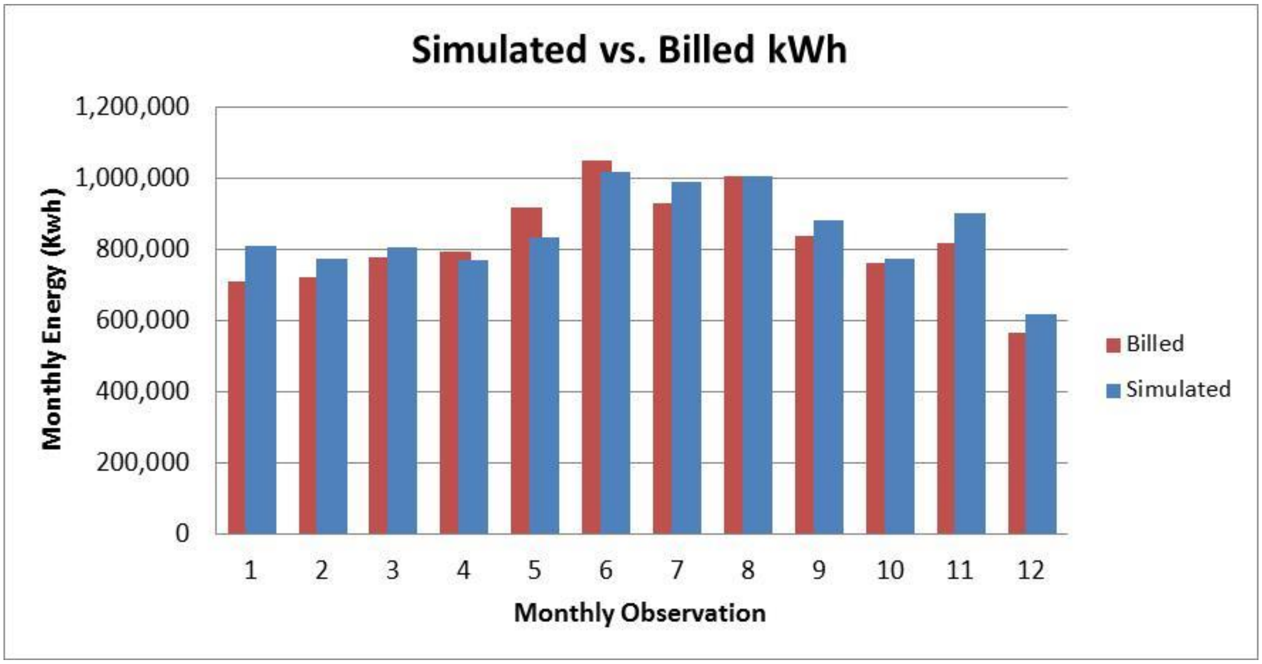
Roof Top Unit	*Measures*	*Expected kWh Savings*
RTU-3	*VR*	*19,052*
RTU-6 to 9	*VR*	*27,096*
RTU-11 & 12	*Controls*	*74,516*
RTU-1B & 2B	*NS*	*71,052*
Total	*-*	*191,715*

Measurement and Verification Effort

During the M&V visit, ADM staff verified the implementation of the new control strategies 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 computer to gather operational setpoints for the air and water side systems.

Energy savings for the implemented control strategies were determined through the construction of a site specific eQUEST model. Upon the completion of the initial baseline model, a custom weather file was created using 2014 NOAA weather data for the 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 baseline eQUEST model, an as-built model was created in which all the implemented control measures were modeled through the use of parametric runs. 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	992,805	992,805	0
Miscellaneous Equipment	3,157,424	3,157,424	0
Heating	880,430	415,054	465,376
Cooling	2,826,255	2,627,257	198,998
Pumps	130,045	87,901	42,144
Fans	2,269,263	1,923,361	345,902
Exterior Lighting	127,566	127,566	0
Total	**10,383,789**	**9,331,367**	**1,052,420**

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	
R-6 - Controls	RCx	730,106	842,967	115%	106.93
C-25 - Controls	Custom	191,715	209,453	109%	94.61
Total		921,821	1,052,420	114%	201.54

The combined project-level realization rate is 114%. The difference between realized and expected savings can be attributed to the ex ante calculations utilizing an engineering based equation to calculate the savings for each individual measure. The utilized methodology is compliant to the application; however, it does not account for the interactive effects between each measure. The ex post eQUEST simulations are able to account for the interactive effects between measures. The realized savings are more than the expected energy savings due to the interactive effects between each measure.

Site S-14 N-2

Executive Summary

S-14 N-2 received new construction and standard incentives from Ameren Missouri for lighting in the interior and exterior of their facility, installing occupancy sensors, and efficient computer installation. The realization rate for this project is 103%.

Project Description

The customer installed the following:

- (49) 4' 2LT8 fixtures in the canopy area
- (17) LED Pole fixtures
- (27) LED Downlight fixtures in the exterior
- (10) LED Double Head fixtures
- LED fixtures in the south tower area
- (234) Occupancy Sensors in the south tower area
- (255) Computers

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 90.1-1989).

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 interactive 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 interactive factor*

Efficient computer 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 computers*
W	= *Wattage of computer*
t	= *Hours on*

HCIF = *HVAC interactive 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' 2LT8	49	49	250	64	4,844	47,616	44,147	1.00	93%
MH to LED Pole	17	17	460	210	4,310	17,000	18,317	1.00	108%
Downlight to LED Downlight	27	27	75	18	4,310	6,155	6,632	1.00	108%
MH to LED Double Head	10	10	1,100	420	4,310	27,200	29,307	1.00	108%
LPD to LED	1	1	368,160	160,145	8,760	1,822,211	1,958,759	1.07	107%
LPD to LED	1	1	23,880	4,273	8,760	171,757	184,628	1.07	107%
Total						2,091,939	2,241,790		107%

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	134	120	8,760	6,132	61,640	45,240	1.07	73%
Controls	100	21	8,760	6,132	57,000	6,035	1.07	11%
Total					118,640	51,275		43%

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

Efficient Computer Savings Calculations

Measure	Quantity	kWh/yr baseline	kWh/yr as-built	Hours	Ex Ante kWh Savings	Ex Post kWh Savings	Heating Cooling Interaction Factor	Gross kWh Savings Realization Rate
Computer	255	156,087	30,068	8,760	137,955	126,018	1.07	91%
Total					137,955	126,018		91%

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 Installation	New Construction	2,091,939	2,241,790	107%	271.29
Lighting Controls	New Construction	118,640	51,275	43%	6.44
Efficient Computer	Standard	137,955	126,018	91%	14.39
Total		2,348,534	2,419,084	103%	292.12

The project-level realization rate is 104%. The higher lighting realization rate is due to the ex post hours of operation verified during the M&V site visit for the exterior fixtures (4,309 – 8,760), were greater than the lighting hours of operation used to perform the ex ante savings estimate (4,000). In addition, for the interior fixtures the ex post savings analysis included a heating and cooling interactive factor for gas heated/electric chiller conditioned hospital in Cape Girardeau (1.07), 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. The efficient computer realization rate is lower, as the ex post savings analysis accounted for the load from the added server required by the thin client computers, while the ex ante TRM based savings did not include the additional load.

Site C-4

Executive Summary

C-4 received custom incentives from Ameren Missouri for the installation of new high service water pumps with variable speed drives. The project-level realization rate is 102%.

Project Description

The customer installed a new pump house with four new high service pumps for the plant. The incentive only covered two of the four pumps due to redundancy for the plant. Typically, one 1500hp and one 2250hp pump will be used in operation.
The new pumps replaced the very old motors and pumps that were originally used for the plant. The new construction baseline was chosen due to the useful life of the old pumps.

Measurement and Verification Effort

ADM visited the facility and confirmed the installation of the new motors, pumps, and variable speed drives (VSDs or VFDs). During the site visit photos were taken of the new equipment nameplates and operational parameters of the motors running on VFDs. Pump flow, VFD speed, and power consumption trend data was requested from the plant.
Savings were calculated using the average daily plant water flow. This average value of approximately 29 MGD has been typical for the plant in the past and observed to be an approximate average moving forward. The new pump power was calculated using observed power consumption through on-site VFD control panel and flow meter. On-site findings showed one pump operating to provide about 17 MGD of water flow. This is due to the plant having issues with new pump operation and having new pumps out for repair. Typically, the plant was assumed to have two pumps running to provide the average plant flow. Energy savings were calculated with this assumption for the baseline and as-built case.

Results

Verified Gross Savings/Realization Rates

Measure Category	*Incentive*	*Gross kWh Savings*			*Gross Ex Post Peak kW Reduction*
		Ex Ante	*Ex Post*	*Realization Rate*	
New Pumps w/ VFDs	Custom	2,519,308	2,564,820	102%	-
Total		2,519,308	2,564,820	102%	-

The realization rate for the project is 102%. The ex ante and ex post savings estimates are similar. This is primarily due to similar methods used by both. The only differences are due to slightly different parameters in the calculation of average MCD, motor power, and the pump affinity exponent. The ex post analysis was limited due to the gaps pump trend data from the site SCADA system, as the pumps and drives were rotated frequently due to startup issues.

Site R-1

Executive Summary

R-1 received incentives from Ameren Missouri for a HVAC retro-commissioning project. The realization rate for this project is 83%.

Project Description

In order to reduce energy consumption throughout the building, a retro-commissioning study was performed and identified measures for implementation. The following measures were implemented:

- Replace broken pre-heat coil control valves
- Remove all three-way chilled water valves and replace with two-way valves
- Institute Trim and Respond secondary chilled water VFD control
- Upgrade air handling units from pneumatic controls to direct digital controls
- Install variable frequency drives
- Implement high efficiency sequence of operations
- Reset supply (and return) static air pressure set points
- Repair return/mixed/outside air damper operations
- Implement full economizer capability for all air handling units
- Implement unoccupied air handling unit setbacks

Measurement and Verification Effort

During the M&V visit, ADM staff verified that the RCx measures by reviewing equipment operation, installation, and documenting the control system changes in the building automation system (BAS).

ADM calculated the annual energy savings for the installed measures through the use of the supplied ex ante calculators. Each retrofitted air handler had a separate calculator that used hourly weather data, trended data, and site specific data to calculate the estimated annual energy use. Site specific data included equipment, building, and loads data. Trended data from each air handler included discharge air, return air, and mixed air temperatures, and unit flow rates. From this data, engineering equations were used to estimate the energy used by the air handler and associated building equipment required to heat and cool the spaces in the baseline and retrofit configurations. The energy savings are the difference between the calculated baseline and retrofit configuration’s energy use. Baseline and retrofit energy use is calculated using the equation below:

$$Building\ kW = Equip\ Sens\ Load + Lighing\ Sens\ Load + Fan\ Energy\ Total + CHW\ Cooling$$

Where:

Building kW = Total building end use energy
Equip Sense Load (kW) = Calculated equipment space load
Lighting Sense Load (kW) = Calculated lighting space load
Fan Energy Total (kW) = Sum of the supply, return, relief, and exhaust air handler fan energies
CHW Cooling (kW) = Calculated air handler chiller demand based on cooling coil load

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 Optimization	RCx	7,455,328	6,193,990	83%	-
Total		7,455,328	6,193,990	83%	-

The project level realization rate is 83%. The realization rate can be attributed to the ex ante analysis: using weather data from Bridgeport, CT, underestimating the building cooling loads, and assuming several air handlers brought in little to no outside air for the entire year in the baseline configuration. The ex ante analysis attributed savings for a baseline with little to no outside air.

The ex post analysis used TMY3 weather data in St Louis, MO. The ex ante calculations estimated that the peak building cooling load is 3.00 Btuh per square foot at 95^{o}F. However, the ex post calculations estimated the peak building cooling load is 28.66 Btuh per square foot at 98^{o}F. The ex post cooling load estimate is calculated using a DEER prototypical eQUEST Model of a Hospital using a TMY3 St. Louis weather file. The simulated peak building cooling load was divided by the prototypical model’s total floor area in square feet. The ex ante peak load wasn’t justified in the provided calculations.

Lastly, the ex post analysis does not attribute savings for a baseline with little to no outside air. The ex post analysis assumes that the baseline and as-built minimum damper positions are the same. The ex ante calculations were modified by increasing the baseline minimum outside air CFM fraction to equal the retrofit CFM fraction if it was less than the retrofit CFM fraction.

Site R-5

Executive Summary

R-5 received incentives from Ameren Missouri for a HVAC retro-commissioning project. The realization rate for this project is 68%.

Project Description

The customer implemented several measures as the result of a retro-commissioning study:

Measure Type	*Measure Description*
HVAC Optimization - Airside	1: Turn Off/Cycle Fans During Unoccupied Hours
Minimize Outside Air	2: Lock Out Outdoor Air During Unoccupied Hours
Demand Control Ventilation	3: Implement Demand Control Ventilation
HVAC Optimization - Airside	4: Resize the CFM of AHUS 11-14
HVAC Optimization - Airside	5: Convert AHUs 1-6 to Dedicated Outdoor Air Supply
HVAC Optimization - Waterside	6: Turn Off/Cycle Pumps During Unoccupied Hours
HVAC Optimization - Waterside	7: Turn Off/Cycle Chiller and Tower During Unoccupied Hours
HVAC Optimization - Airside	8: Newfound Items During Implementation

The above measures were implemented through repairing or replacing equipment and programming the energy management system (EMS). Part of the project involved bringing the building up to code ventilation. The outside air dampers were broken in a closed position. Thus, little to no outside air was being brought into the building.

Measurement and Verification Effort

ADM calculated annual energy savings associated with retro-commissioning through the use of a monthly pre/post billing data regression and engineering equations informed by on-site data collection.

The regression used interval metering data to compare the facility's monthly pre/post energy consumption to local weather. This was done in an effort to determine the effects that weather and the installed measures have on energy consumption. Through a sensitivity analysis, an overall R^2 of 0.89 was found for the regression. From the regression, the following equation was derived and used to calculate monthly energy consumption for the pre and post configurations:

$$kWh_{Monthly} = 141 \times CDD + 110 \times HDD + 191{,}179$$

Where:

$kWh_{Monthly}$ = *Monthly kWh consumption*

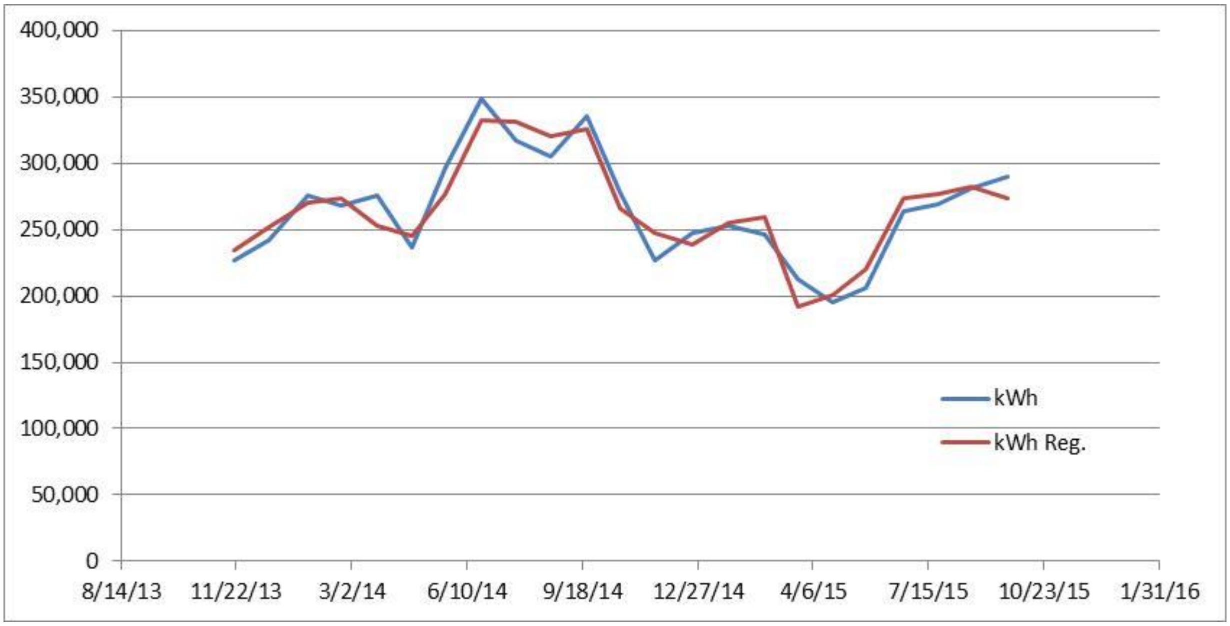
CDD = *Number of Cooling Degree Days for the month*

HDD = *Number of Heating Degree Days for the month*

Pre/Post = *Pre and post flag. 1 = Post, 0 = Pre*

The following plot compares the billed monthly kWh consumption of the building to the kWh calculated with the derived equation:

Billed vs. Regressed Monthly kWh



Annual energy savings for the installed measures were determined by using the derived equation to calculate the monthly pre/post energy consumption of the facility. Annual energy savings are the difference between baseline and as-built energy consumption for the building and can be seen in the following table:

Billing Regression Monthly kWh Savings

Month	*CDD*	*HDD*	*kWh*		
			Baseline	*As-Built*	*Savings*
1	34	666	269,201	213,032	56,169
2	58	456	249,388	193,218	56,169
3	249	178	245,879	189,710	56,169
4	405	57	254,601	198,431	56,169
5	598	11	276,946	220,777	56,169
6	955	0	326,168	269,999	56,169
7	1,112	0	348,334	292,164	56,169
8	1,010	0	333,912	277,743	56,169
9	755	0	297,837	241,668	56,169
10	343	60	246,293	190,123	56,169
11	135	243	236,873	180,703	56,169
12	14	582	257,068	200,899	56,169
Total			3,342,500	2,668,468	674,032

The billing regression method initially didn't capture all energy savings for the retro-commissioning project. Additional savings were realized from increasing outside air flow. The baseline system was found to not meet city building code requirements. The outside air dampers were broken in a closed position. Thus, little to no outside air was being brought into the building. After the building was brought up to code ventilation, outside air optimization measures (including DCV) were implemented. As a result, the total project savings do not appear in the billing data. The additional outside air conditioning requires additional energy, so the baseline was set to a minimum code compliant system.

Realized energy savings for the outside air optimization measures were calculated using engineering equations that were informed by on-site data collection including EMS trending data. The total energy usage of the code outside air, in kWh, was calculated and added to the billing regression savings. This accounts for the energy usage that the billing data didn't capture. The savings for the outside air optimization measures can be seen below:

Total Annual kWh Savings

Measure Type	*Description*	*kWh Savings*
2: Lock Out Outdoor Air During Unoccupied Hours 3: Implement Demand Control Ventilation	Outside Air Energy Savings	166,112
	Billing Regression Savings	674,032
	Total Savings	**840,144**

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 Optimization	Retro-Commissioning	1,227,000	840,144	68%	0
Total		1,227,000	840,144	68%	0

The project-level realization rate is 68%. The difference between realized and expected savings can be attributed to the ex ante calculations being based on engineering equations with assumed operational inputs. The ex post analysis uses a billing regression and post data informed engineering equations.

The billing regression uses pre and post retrofit utility billing data to calculate annual energy savings associated with the retro-commissioning. The regression accounts for the realized savings in the bills; however, not all of the retro-commissioning savings are realized in the billing data. This is because work was done to bring the building back up to code ventilation. In doing so, the increased outdoor air actually increased the billed usage. To account for this, the ex post analysis calculated savings for the outside air optimization measures using engineering calculations similar to the ex ante analysis. Those energy savings were added to the billing regression savings to account for the code ventilation improvements.

One difference in the ex post engineering calculations was the use of post trending data. The data were used to inform the engineering calculations with actual post conditions. Post trending data were also used to update the ex ante calculations.

Several ex ante assumptions resulted in overestimated savings. The ex ante analysis underestimated post runtime hours for air handling units and exhaust fans. The ex ante analysis also overestimated the amount of outside air that the system typically handles during periods where the building is not occupied. These items were also calculated separately for the kWh savings effect, and would have set the ex ante savings nearly equal to the ex post savings.

Site C-3 S-4

Executive Summary

C-3 S-4 received standard and custom incentives from Ameren Missouri for retrofitting lighting in the interior and exterior of their facility and installing occupancy sensors. In addition, custom incentives were also provided for building envelope sealing in several buildings, ductwork sealing in one building. The overall realization rate for this project is 111%.

Project Description

The customer retrofitted the following lighting with new lamps and/or fixtures:

- (7) 2' 2LT8 fixtures with (7) 2' 2LT8
- (55) 2' 4LT8 fixtures with (55) 2' 4LT8 fixtures
- (156) 3' 2LT8 fixtures with (156) 3' 2LT8 fixtures
- (139) 3' 2LT8 fixtures with (139) 3’ 2LT8 fixtures
- (70) 4' 1LT8 fixtures with (70) 4' 1LT8 fixtures
- (14) 4' 2LT8 fixtures with (14) 4' 2LT8 fixtures
- (2469) 4' 2LT8 fixtures with (2469) 4' 2LT8
- (603) 4' 2LT8 fixtures with (603) 4' 2LT8 fixtures
- (2) 4' 3LT8 fixtures with (2) 4' 3LT8 fixtures
- (81) 4' 3LT8 fixtures with (81) 4' 3LT8 fixtures
- (3115) 4' 3LT8 fixtures with (3115) 4' 3LT8
- (72) 4' 4LT8 fixtures with (72) 4' 4LT8 fixtures
- (8) 6' 2LT8 fixtures with (8) 6' 2LT8 fixtures
- (210) CFL fixtures with (261) LED fixtures
- (12) MH fixtures with (12) 4' 2LT5 fixtures
- (12) 2' 2LT8 fixtures with (12) 2' 2LT8 fixtures
- (1) 2' 3LT8 fixture with (1) 2' 3LT8 fixture
- (4) 2' 4LT8 fixtures with (4) 2' 4LT8 fixtures
- (2) 3' 2LT8 fixtures with (2) 3' 2LT8 fixtures
- (23) 4' 1LT8 fixtures with (23) 4' 1LT8 fixtures
- (4) 4' 2LT8 fixtures with (4) 4' 2LT8 fixtures
- (16) 4' 4LT8 fixtures with (16) 4' 4LT8 fixtures
- (10) 6' 4LT8 fixtures with (10) 6' 4LT8 fixtures
- (72) 8' 4LT8 fixtures with (72) 8' 4LT8 fixtures
- (4) 8' 6LT8 fixtures with (4) 8' 6LT8 fixtures
- (2) CFL Exit Sign with (2) LED Exit Sign
- (1) MH fixture with (1) LED Wall Pack fixture
- (2) MH fixtures with (2) LED Bollard fixtures
- (2) HID Wall Pack fixtures with (2) LED Wall Pack fixtures
- (1) MH fixture with (1) LED Flood fixture
- (15) MH fixtures with (15) LED Canopy fixtures
- (7) HPS fixtures with (7) LED Canopy fixtures
- (3) MV fixtures with (3) LED Wall Pack fixtures

- (4) MH fixtures with (4) LED Canopy fixtures
- (26) MH fixtures with (26) LED Wall Pack fixtures
- (17) MH fixtures with (17) LED Wall Pack fixtures
- (4) MH fixtures with (4) LED DSX fixtures
- (41) MH fixtures with (41) LED Flood fixtures
- (200) MH fixtures with (200) LED DSX fixtures
- (47) Incandescent fixtures with (47) LED fixtures
- (18) Incandescent fixtures with (18) LED Wall Mount fixtures
- (19) Incandescent fixtures with (19) LED fixtures
- (1) Incandescent fixture with (1) LED Wall Pack fixture
- (5) Incandescent fixtures with (5) LED Flood fixtures
- (1) Incandescent fixture with (1) LED Dusk to Dawn fixture
- (7) Incandescent fixtures with (7) LED fixtures
- (1210) 4' 2LT8 fixtures with (1210) 4' 2LT8 fixtures
- Installation of 376 Occupancy Sensors (high watt)
- Installation of 540 Occupancy Sensors (dual tech)
- Installation of 136 Occupancy Sensors (low watt)

The customer repaired seven leaking flex duct connectors in building 8. Fixing the leaks reduces the volumetric air flow rate, which allows the supply and return fan variable frequency drives (VFDs) to operate at a lower speed, consuming less energy as given by the fan affinity laws.

The customer also performed building envelope sealing at several buildings in the campus. This reduced the amount of air infiltration through cracks and other openings in the building envelope, thereby reducing mechanical cooling energy consumption. Following, is a summary of buildings affected, leaks identified, and associated claimed energy savings:

Building Envelope Sealing Summary

Building Number	Building Area (sqft.)	Qty. of Air Leakage (cfm)	Expected kWh Savings
1E	15,588	875	15,030
2	252,962	3,261	57,788
2D	16,008	880	15,135
2E	15,321	1,003	17,114
2F	24,853	249	4,413
3	347,145	4,474	79,278
3E	20,370	877	15,201
3F	18,502	833	18,567
4	380,167	5,072	89,857
4E	20,666	793	13,799
4F	25,000	852	14,874
5	1,013	249	2,515
6	30,754	910	15,945

Building Number	Building Area (sqft.)	Qty. of Air Leakage (cfm)	Expected kWh Savings
7	227,139	322	5,748
8	10,890	567	12,584
Total	1,406,378	21,217	377,848

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 90.1-1989).

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 interactive 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 interactive 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					
2' 2LT8 to 2' 2LT8	7	7	54	31	7,880	1,269	1,389	1.09	109%
2' 4LT8 to 2' 4LT8	55	55	58	37	7,880	9,101	9,965	1.09	109%
3' 2LT8 to 3' 2LT8	156	156	46	39	7,880	8,605	9,421	1.09	109%
3' 2LT8 to 3' 2LT8	139	139	46	38	7,880	8,763	9,594	1.09	109%
4' 1LT8 to 4' 1LT8	70	70	32	22	7,880	5,516	6,039	1.09	109%
4' 2LT8 to 4' 2LT8	14	14	62	42	7,880	2,206	2,416	1.09	109%
4' 2LT8 to 4' 2LT8	2,469	2,469	62	42	8,625	425,903	466,339	1.09	109%
4' 2LT8 to 4' 2LT8	603	603	62	41	7,880	99,784	109,250	1.09	109%
4' 3LT8 to 4' 3LT8	2	2	85	42	7,880	678	742	1.09	109%
4' 3LT8 to 4' 3LT8	81	81	85	63	7,880	14,042	15,374	1.09	109%
4' 3LT8 to 4' 3LT8	3,115	3,115	85	42	7,880	1,055,487	1,155,610	1.09	109%
4' 4LT8 to 4' 4LT8	72	72	114	48	7,880	37,446	40,998	1.09	109%
6' 2LT8 to 6' 2LT8	8	8	46	38	7,880	504	552	1.09	109%
CFL to LED	210	261	29	13	7,880	21,252	23,268	1.09	109%
MH to 4' 2LT5	12	12	295	179	8,625	12,006	13,146	1.09	109%
2' 2LT8 to 2' 2LT8	12	12	34	27	7,880	662	725	1.09	109%
2' 3LT8 to 2' 3LT8	1	1	47	40	7,880	55	60	1.09	109%
2' 4LT8 to 2' 4LT8	4	4	33	27	7,880	189	207	1.09	109%
3' 2LT8 to 3' 2LT8	2	2	46	39	7,880	110	121	1.09	109%
4' 1LT8 to 4' 1LT8	23	23	32	22	7,880	1,812	1,984	1.09	109%
4' 2LT8 to 4' 2LT8	4	4	62	42	7,880	630	690	1.09	109%
4' 4LT8 to 4' 4LT8	16	16	112	82	7,880	3,782	4,141	1.09	109%
6' 4LT8 to 6' 4LT8	10	10	92	76	7,880	1,261	1,380	1.09	109%
8' 4LT8 to 8' 4LT8	72	72	112	82	7,880	17,021	18,635	1.09	109%
8' 6LT8 to 8' 6LT8	4	4	170	82	7,880	2,774	3,037	1.09	109%
CFL Exit Sign to LED Exit Sign	2	2	18	3	8,760	259	288	1.09	111%
MH to LED Wall Pack	1	1	197	70	4,308	556	547	1.00	98%
MH to LED Bollard	2	2	95	60	4,308	307	302	1.00	98%
HID Wall Pack to LED Wall Pack	2	2	95	19	4,308	666	655	1.00	98%
MH to LED Flood	1	1	132	41	4,308	399	392	1.00	98%
MH to LED Canopy	15	15	132	41	4,308	5,979	5,880	1.00	98%
HPS to LED Canopy	7	7	173	41	4,308	4,047	3,980	1.00	98%
MV to LED Wall Pack	3	3	197	56	4,308	1,853	1,822	1.00	98%
MH to LED Canopy	4	4	132	41	4,308	1,594	1,568	1.00	98%
MH to LED Wall Pack	26	26	132	70	4,308	7,061	6,944	1.00	98%
MH to LED Wall Pack	17	17	210	70	4,308	10,424	10,253	1.00	98%
MH to LED DSX	4	4	210	143	4,308	1,174	1,155	1.00	98%
MH to LED Flood	41	41	295	79	4,308	38,789	38,151	1.00	98%
MH to LED DSX	200	200	295	106	4,308	165,564	162,838	1.00	98%
Incandescent to LED	47	47	75	11	7,880	23,001	25,994	1.09	113%
Incandescent to LED Wall Mount	18	18	90	15	4,308	5,913	5,816	1.00	98%

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	19	19	90	26	4,308	5,326	5,238	1.00	98%
Incandescent to LED Wall Pack	1	1	90	56	4,308	149	146	1.00	98%
Incandescent to LED Flood	5	5	476	110	4,308	8,022	7,890	1.00	98%
Incandescent to LED Dusk to Dawn	1	1	180	20	4,308	701	689	1.00	98%
Incandescent to LED	7	7	50	13	4,308	1,134	1,116	1.00	98%
4' 2LT8 to 4' 2LT8	1,210	1,210	62	42	7,880	190,696	208,785	1.09	109%
Total						2,204,472	2,385,534		108%

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	376	263.75	8,186	5,730	172,960	266,638	1.09	154%
Controls	540	468.90	8,126	5,688	307,800	675,825	1.09	220%
Controls	136	357	8,081	5,657	17,000	128,915	1.09	758%
Total					497,760.00	1,071,378		215%

During the M&V visit, ADM staff verified seven repaired leaking ducts, with many more that could be repaired. The openings in the flex ducts at the air handling unit (AHU) discharge were large, in some cases 1"x18". ADM reviewed the ex ante analysis, which used a TRANE Trace building simulation to determine energy savings, by adjusting fan horsepower downwards by 20%. A summary of the AHUs affected and their associated supply and return fan nominal horsepower input into the model is as follows:

TRANE Trace Model Adjustments for Duct Sealing Repairs

AHU I.D.	Baseline		After Leaks Repaired	
	SF hp	RF hp	SF hp	RF hp
AHU-1-1984	20	7.5	16	6
AHU-1B1	15	5	12	4
AHU-1B2	20	7.5	16	6
AHU-1C1	20	7.5	16	6
AHU-1C2	20	7.5	16	6
AHU-2D2	20	10	16	8
AHU-2A2	15	5	12	4

The ex ante analysis approach was considered sufficient. Since six of the seven AHUs affected had VFDs on both the supply and return fans, fixing the leaks result in the VFDs being able to reduce speed to maintain the same duct static pressure set point. ADM found that only seven of the twenty-three AHU ducts were repaired. A percentage of the total AHU fan horsepower was used to adjust the TRANE Trace savings.

During the M&V visit, ADM also spot checked several of the building envelope sealing measures performed. In addition, “before” and “after” photos of several of the leaks were obtained and reviewed. ADM also obtained a copy of the spreadsheet ex ante analysis, and performed a desk review. The analysis approach, referencing ASHRAE’s “Power Law Equation”[43], was used as a starting point for ADM’s calculation. An itemized record of sealing work performed at each building documenting total leakage area, in square feet, was provided as part of the project documentation. The following equation was then used to determine energy savings:

$$kWh_{savings} = \sum_{Bldg.} A_{leakage} \times F_{flow} \times F_{wind} \times \eta_{cooling} \times F_{weather}$$

Where:

$kWh_{savings}$	= *Annual energy savings*
$A_{leakage}$	= *Leakage area (sqft.)*
F_{flow}	= *Air leakage flow factor = 20 fpm/in wg*
F_{wind}	= *Air leakage wind factor,* $(\Delta P)^n$ *= 5.38 in wg*
$\eta_{cooling}$	= *Cooling efficiency (kW/ton)*
$F_{weather}$	= *Weather cooling season factor (ton-hr/cfm-yr)*

Savings only accrued during the summer months, since gas heating is used for all but one building affected by this measure. The one exception was a small building with electric resistance heating, with a building area comprising just 0.1% of the total of all buildings affected by this measure.

[43] 2009 ASHRAE Handbook- Fundamentals, pg. 16.14

Results

Verified Gross Savings/Realization Rates by Measure

Measure Category	*Incentive*	*kWh Savings*			*Realized Peak kW Reduction*
		Expected	*Realized*	*Realization Rate*	
Lighting Retrofit	Custom	2,169,098	2,347,370	108%	338.37
Lighting Retrofit	Standard	35,374	38,164	108%	4.35
Lighting Controls	Standard	497,760	1,071,378	215%	169.01
Building Envelope Sealing	Custom	377,848	60,189	16%	60.45
Ductwork Sealing	Custom	148,848	59,955	40%	20.95
Total		3,228,928	3,577,056	111%	593.13

The project-level realization rate is 111%.

The overall lighting retrofit project level realization rate is 108%. The following factors impacted the project gross realization rate:

- The ex post savings analysis of the interior lighting fixtures accounted for heating and cooling interactive effects. A factor applicable to gas heated/electric air conditioned large office facilities in St. Louis was applied to the lighting energy savings (1.09); the interior lighting fixture ex ante savings estimate did not account for heating and cooling interactive effects. The interior lighting fixtures realization rate was 109%.
- The ex post savings analysis of the exterior fixtures was premised upon hours of operation (4,308) slightly less than the hours of operation used to perform the ex ante estimation (4,380), resulting in a realized energy savings being slightly lower than expected. The ex post estimate of exterior fixture lighting operating hours was developed by referencing the Naval Observatory Sunrise/Sunset calendar. The exterior lighting fixture realization rate was 98%.
- The lighting controls ex ante energy savings estimate assumes a lesser impact on lighting hours than calculated by the ex post energy savings analysis. The lighting controls realization rate was 215%.

The building envelope resulted in a realization rate of 16%. This is due to the following factors:

- The summer indoor dry bulb temperature assumed in the ex ante model was 70F; whereas, ADM used a temperature of 75F, which was based on data collected during ADM's M&V efforts. This had a significant impact on the Weather Cooling Season Factor, essentially decreasing the total annual cooling load associated with a leaky building envelope. The enthalpy differential between outside air, being brought into compensate for leaks, and indoor air at 75F, was lower than that claimed for indoor air at 70F.

- The ex ante analysis assumed fan energy savings. Since all fans affected by this measure run 24/7, as verified during ADM's site visit, there should be no fan savings. There is just the aforementioned mechanical cooling (compressor) savings associated with tempering outside air.

The 40% realization rate for duct leak repairs is due to the ex ante analysis being premised upon 13 additional AHUs duct repairs serving Building 8, that did not have leak repairs performed.

Site N-1

Executive Summary

N-1 received new construction incentives from Ameren Missouri for the installation of efficient lighting and occupancy sensors, building envelope, heat recovery coils, economizer cooling equipment, and demand control ventilation. The realization rate for this project is 88%.

Project Description

The customer installed the following:

- (1,603) LED fixtures
- (184) Occupancy Sensors
- Efficient building envelope construction
- Free cooling Equipment/Controls
- Demand Control Ventilation

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 90.1-1989).

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 interactive 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 interactive 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 LED	579	579	132	49	6,570	381,238	345,458	1.09	91%
LPD to LED	255	255	80	30	6,570	101,039	92,030	1.09	91%
LPD to LED	33	33	80	30	6,570	13,076	11,910	1.09	91%
LPD to LED	15	15	103	38	6,570	7,604	6,926	1.09	91%
LPD to LED	3	3	97	36	6,570	1,441	1,312	1.09	91%
LPD to LED	50	50	192	71	6,570	51,150	43,138	1.09	84%
LPD to LED	30	30	192	71	6,570	28,417	25,883	1.09	91%
LPD to LED	1	1	146	54	6,570	720	656	1.09	91%
LPD to LED	1	1	291	108	6,570	1,441	1,312	1.09	91%
LPD to LED	1	1	461	171	6,570	2,281	2,078	1.09	91%
LPD to LED	1	1	486	180	6,570	2,401	2,187	1.09	91%
LPD to LED	1	1	583	216	6,570	2,882	2,625	1.09	91%
LPD to LED	2	2	777	288	6,570	7,684	6,999	1.09	91%
LPD to LED	2	2	909	337	6,570	8,992	8,190	1.09	91%
LPD to LED	1	1	1,117	414	6,570	5,523	5,031	1.09	91%
LPD to LED	2	2	1,263	468	6,570	12,487	11,374	1.09	91%
LPD to LED	37	37	133	49	6,570	24,385	22,211	1.09	91%
LPD to LED	61	61	133	49	6,570	40,202	36,618	1.09	91%
LPD to LED	95	95	78	29	6,570	35,207	33,478	1.09	95%
LPD to LED	16	16	78	29	6,570	6,190	5,638	1.09	91%
LPD to LED	23	23	85	32	6,570	9,666	8,804	1.09	91%
LPD to LED	133	133	127	47	6,570	83,573	76,122	1.09	91%
LPD to LED	4	4	111	41	6,570	2,202	2,006	1.09	91%
LPD to LED	37	37	153	57	6,570	27,988	25,493	1.09	91%
LPD to LED	11	11	162	60	6,570	8,805	8,020	1.09	91%
LPD to LED	23	23	189	70	6,570	21,479	19,564	1.09	91%
LPD to LED	14	14	162	60	6,570	11,207	10,207	1.09	91%
LPD to LED	4	4	2,246	833	6,570	44,426	40,465	1.09	91%
LPD to LED	1	1	460	170	6,570	2,273	2,071	1.09	91%
LPD to LED	5	5	613	227	6,570	15,155	13,804	1.09	91%
LPD to LED	4	4	766	284	6,570	15,155	13,804	1.09	91%
LPD to LED	14	14	766	284	6,570	53,044	48,315	1.09	91%
LPD to LED	4	4	1,073	398	6,570	21,218	19,326	1.09	91%
LPD to LED	1	1	1,226	454	6,570	6,062	5,522	1.09	91%
LPD to LED	18	18	85	32	6,570	7,564	6,890	1.09	91%
LPD to LED	43	43	143	53	6,570	30,404	27,694	1.09	91%
LPD to LED	78	78	143	53	6,570	55,152	50,235	1.09	91%
Total						1,149,735	1,043,396		91%

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

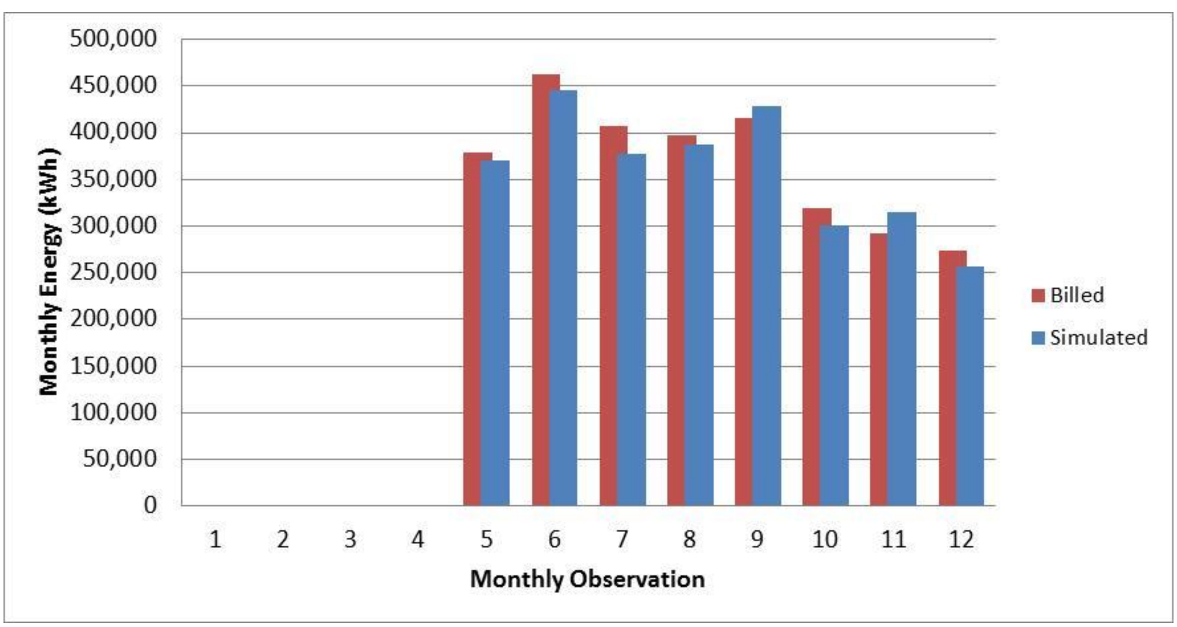
Lighting Controls Savings Calculations

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	34	104.41	6,570	4,599	15,640	7,623	1.09	49%
Controls	150	189.53	6,570	4,599	85,500	61,043	1.09	71%
Total					101,140	68,666		68%

During the M&V visit, ADM staff verified the installed measures and interviewed site contacts about the typical operation of the facility. ADM collected mechanical schedules, nameplate data, and details from the BMS to determine operation of the air and water-side HVAC systems.

Energy savings for the implemented control strategies were determined through the construction of a site-specific eQUEST model. Upon completion of the initial as-built model, a custom weather file was created using 2015 NOAA weather data for the St. Louis area. Using this weather file and billing data for the facility, ADM was able to ensure the model's energy load shape matched that of the bills. The building was completed in the summer of 2015. The results of this calibration effort can be seen below:

2015 Monthly kWh Calibration



Upon completion of the calibration for the as-built eQUEST model, a baseline model was created in which all the implemented control measures were removed through the use of parametric runs. Baseline and as-built models were then run using TMY3 weather data for the region. Typical year annual savings are the difference between the two models' annual consumption, as can be seen below:

As-Built Vs. Baseline Annual Energy Consumption

End-Use	*Baseline kWh*	*As-Built kWh*	*Annual kWh Savings*
Lighting	*775,111*	*775,111*	*0*
Miscellaneous Equipment	*982,525*	*982,525*	*0*
Heating	*2,166,403*	*1,344,399*	*822,004*
Cooling	*1,303,245*	*1,127,990*	*175,256*
Heat Rejection	*1,925*	*1,624*	*301*
Pumps	*153,129*	*153,920*	*-791*
Fans	*389,763*	*325,283*	*64,480*
Exterior Ltg	*31,892*	*31,892*	*0*
Total	**5,803,993**	**4,742,743**	**1,061,250**

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	1,149,735	1,043,396	91%	197.71
Lighting Controls	New Construction	101,140	68,666	68%	13.01
Windows , Roof	New Construction	205,317	70,604	34%	14.52
Heat Recovery Coils	New Construction	611,976	828,519	135%	-0.65
Free Cooling Equipment/Controls	New Construction	106,270	143,074	135%	0.00
Demand Control Ventilation	New Construction	300,652	19,053	6%	-0.06
Total		2,475,090	2,173,312	88%	224,54

The project-level realization rate is 89%. The lighting retrofit realization rate of 91% is due to the average ex post hours of operation verified during the M&V site visit (6,570), not accounting for the effect of lighting controls, being less than the lighting hours of operation used to perform the ex ante savings estimate (7,858). For the lighting controls, the ex ante estimation assumes a greater impact on lighting hours than was measures and verified during the M&V site visit. For non-lighting measures, the differences between realized and expected savings can be attributed to the ex ante calculations utilizing an uncalibrated energy simulation and a third party calculator. The utilized methodology did not account for the actual installed equipment nor building operations.

Site C-20 S-9

Executive Summary

C-20 S-9 received standard and custom incentives from Ameren Missouri for a major renovation, including: lighting, lighting controls, HVAC unit replacement, strip curtains, anti-sweat heater (ASH) controls, automatic door closers, electronically commutated motors (ECMs), and LED case lighting. The realization rate for this project is 96%.

Project Description

The customer installed the following lighting:

- (45) Incandescent Exit Sign fixtures with (45) LED Exit Sign fixtures
- LED redesign of the entire facility
- (41) Occupancy Sensors

The customer implemented the following Standard Non-Lighting measures:

Table 1. Standard Non-Lighting Measures

Measure	Qty.	Units
Strip Curtains	12	Doors
ASH Controls	67	Doors
Auto Door Closers	10	Door Closers
EC Motors	136	Motors
LED Case Lighting	90	Doors

The customer also replaced nine package rooftop air conditioning units (RTUs) with more efficient units, as a custom non-lighting measure. Following are details about the RTUs:

Table 2. Custom Non-Lighting Measures

Tag#	Service	Tons	As-built		TRM Baseline		Claimed Baseline
			EER	SEER	EER	SEER	EER
RTU-3	Kitchen	10	12		10.1		8.8
RTU-4	Stock/ Breakroom	10	12		10.1		8.8
RTU-5	Vestibule	7.5	12.5		10.1		8.9
RTU-6	Dining/ Front Restrooms	20	12		9.5		8.7
RTU-7	Bakery/ Bakery Prep	10	12		10.1		8.8
RTU-8	Team Members	3	12.5	17		13	13
RTU-9	Truck Dock/ Corridor	7.5	12.5		10.1		8.9
RTU-10	Mezzanine Offices	4	12.8	17		13	13
RTU-11	Mezzanine Offices	4	12.8	17		13	13

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 10/10/15 to 12/1/15) to monitor lighting operation. 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 90.1-1989).

Lighting retrofit energy savings are calculated as:

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

Where:

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

Lighting occupancy sensor energy savings are calculated as:

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

Where:

$kWh_{savings}$	*= Annual energy savings*
N	*= Number of occupancy sensors*
W	*= Wattage controlled by each occupancy sensor*
t	*= Lighting operating hours*
HCIF	*= HVAC interactive 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 Exit to LED Exit Sign	45	45	18	3	8,760	5,913	6,526	1.10	110%
A4 to A4	5	5	97	46	5,658	1,300	1,588	1.10	122%
A8 to A8	49	49	194	92	5,658	25,477	31,130	1.10	122%
B to B	38	38	95	45	5,658	9,664	11,808	1.10	122%
C to C	73	73	135	64	5,320	26,404	30,337	1.10	115%

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					
C1 to C1	10	10	135	64	5,658	3,617	4,419	1.10	122%
CL4 to CL4	63	63	116	55	6,285	19,583	26,582	1.10	136%
D to D	21	21	267	127	5,658	15,073	18,417	1.10	122%
E to E	16	16	61	29	5,658	2,622	3,204	1.10	122%
E1 to E1	6	6	95	45	5,658	1,526	1,864	1.10	122%
H to H	68	68	40	19	5,658	7,302	8,922	1.10	122%
I to I	30	30	95	45	5,658	7,630	9,322	1.10	122%
L4 to L4	5	5	97	46	5,658	1,300	1,588	1.10	122%
L8 to L8	110	110	194	92	5,658	57,194	69,883	1.10	122%
N4 to N4	4	4	91	43	5,658	972	1,188	1.10	122%
N8 to N8	44	44	179	85	5,047	21,137	23,041	1.10	109%
S1 to S1	5	5	27	13	5,658	367	449	1.10	122%
T to T	2	2	95	45	5,658	509	621	1.10	122%
U to U	6	6	105	50	5,658	1,695	2,072	1.10	122%
Total						209,286	252,962		121%

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	14	172.86	6,554	5,513	6,440	2,782	1.10	43%
Controls	10	172.80	4,745	3,520	5,700	2,337	1.10	41%
Controls	5	128	5,658	3,960	2,850	1,199	1.10	42%
Controls	12	247.92	4,895	4,542	6,840	1,159	1.10	17%
Total					21,830	7,478		34%

During the M&V visit, ADM staff verified measure implementation, collected data, and interviewed the site representative about facility operating characteristics.

ADM used the Ameren Missouri Technical Resource Manual (TRM), Illinois TRM, and Ohio TRM to estimate savings for all non-lighting measures. The Illinois TRM was only referenced for equivalent full load cooling hours (EFLCH) and the peak coincidence factor for the RTU replacement, since the Missouri TRM did not provide this data. The city used for EFLCH was Belleville, IL, which is only 17 miles from St. Louis, MO. ASHRAE 90.1-2007 (prevalent building code) was referenced for baseline RTU EER values for the capacity range >=65,000 and <135,000 Btu/hr, since values for this range were not provided in the Missouri TRM. The following table illustrates the TRM per unit deemed kWh savings and kW reduction values used by ADM to estimate savings for the standard non-lighting measures:

Table 3. TRM Deemed Savings Values

Measure	*Qty.*	*Units*	*kWh Savings per Unit*	*kW Reduction per Unit*
Strip Curtains	12	Doors	5,058	0.628
ASH Controls	67	Doors	1,367	0.079
Auto Door Closers	10	Door Closers	681	0.223
EC Motors	136	Motors	544	0.062
LED Case Lighting	90	Doors	429	0.041

The following TRM algorithm was used to estimate savings associated with the RTU replacements:

$$kWh_{savings} = \frac{BtuH}{1{,}000} \times \left(\frac{1}{EER_b} - \frac{1}{EER_q} \right) \times EFLCH$$

Where:

$kWh_{savings}$ = *Annual energy savings*

BtuH = *Nameplate cooling capacity in Btu/hr*

EER_b = *Efficiency rating of the baseline unit. For units <65,000 Btu/hr in capacity, SEER should be used.*

EER_q = *Efficiency rating of the installed unit. For units <65,000 Btu/hr in capacity, SEER should be used.*

EFLCH = *Equivalent Full Load Cooling Hours*

The TRM was referenced for RTU baseline efficiencies since data for the actual units removed were not available.

Results

Verified Gross Savings/Realization Rates by Measure

Measure Category	Incentive	kWh Savings			Realized Peak kW Reduction
		Gross Ex Ante kWh Savings	Gross Ex Post kWh Savings	Realization Rate	
Lighting Retrofit	Standard	5,913	6,526	110%	0.87
Lighting Retrofit	Custom	197,266	246,437	125%	50.04
Lighting Controls	Standard	21,830	7,478	34%	1.66
RTU Replacement	Custom	83,833	24,623	29%	15.00
Strip Curtains	Standard	60,696	60,696	100%	7.54
Anti-sweat Heater Controls	Standard	91,589	91,589	100%	5.29
Automatic Door Closers	Standard	6,810	6,810	100%	2.23
ECMs	Standard	73,984	73,984	100%	8.43
LED Case Lighting	Standard	38,610	38,610	100%	3.69
Total		580,531	556,752	96%	94.75

The project-level realization rate is 96%.

The following factors impacted the lighting retrofit realization rates:

- The ex post savings analysis of the interior lighting fixtures accounted for heating and cooling interactive effects. A factor applicable to gas heated/ electric air conditioned large retail facilities in St. Louis was applied to the lighting energy savings (1.10); the interior lighting fixture ex ante savings estimate did not account for heating and cooling interactive effects. This resulted in a realization rate of 110%.
- In addition, the ex post hours of operation verified during the M&V site visit for eighteen measures (ranging from 5,320 to 8,760) were greater than the lighting hours of operation used to perform the ex ante estimate (5,110 to 8,760). The realization rate of these measures averaged 125%.
- The lighting controls ex ante energy savings estimate assumes a greater impact on lighting hours than calculated by the ex post energy savings. The lighting controls realization rate was 34%.

The 29% realization rate associated with the RTU replacement is due to a few factors:

- The largest factor was the baseline EER and SEER values used in the ex ante analysis were significantly lower than those provided in the TRM. The source of the ex ante values is unknown. These differences are illustrated in Table 2 in the above “Project Description” section. Using less efficient baseline values results in larger savings.
- Claimed savings provided in calculations in the project documentation were significantly lower than those reported in the application (50,199 vs. 83,833 kWh). The realization rate would increase to 49% with this adjustment alone.

- The ex ante analysis used a RTU Comparison Calculator available on the Pacific Northwest National Laboratory website[44], while the ex post analysis used the TRM.

The 100% realization rates indicated for the other non-lighting measures were due to the ex post analysis following the same TRM savings methodology as ex ante.

[44] www.pnnl.gov/uac/

Site C-8

Executive Summary

C-8 received custom incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 98%.

Project Description

The customer retrofitted the following fixtures:

- (298) MH fixtures with (298) Induction High Bay fixtures in buildings S, B, F, & H

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:

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

Where:

$kWh_{savings}$ = *Annual energy savings*

N = *Number of fixtures*

W = *Wattage of each fixture*

t = *Lighting operating hours*

HCIF = *HVAC interactive 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 High Bay	298	298	1,080	507	8,597	1,495,805	1,468,026	1.00	98%
Total						1,495,805	1,468,026		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	1,495,805	1,468,026	98%	170.75
Total		1,495,805	1,468,026	98%	170.75

The project-level realization rate is 98%. The ex post operating hours verified during the M&V site visit (8,597) are less than the lighting operating hours used to perform the ex ante savings estimate (8,760) resulting in a slightly lower realization rate.

Site N-4

Executive Summary

N-4 received new construction incentives from Ameren Missouri for the installation of a Husky HyPet300 Injection Molder, a VFD compressor, a Eisbar DP 800/11 Dryer, and Frigel Hybrid cooler. The realization rate for this project is 129%.

Project Description

At the facility, G site (#2) received new equipment and was originally used for storage but expanded to production with multiple production lines. The company recently purchased the A site (#3) and will retrofit it for warehouse usage. The company added a 62,000 SF addition in the back of the G site. This addition will store resin and preform and have production equipment for the creation of preforms.

The injection molding machine is used to produce plastic packaging. The new model is "more energy efficient". This machine will be utilized 24hrs, 340 days per year.

The compressor is necessary to produce air pressure required for machine operation. The high efficiency compressor has a variable frequency drive to meet the required load. The lower efficiency compressor works with full capacity at all times. It will be utilized 24hrs, 340 days per year.

The material dryer uses machine generated heat to dry material (resin) and dehumidifying machine. It is a more efficient model which decreases electricity consumption required to keep appropriate levels of humidity for resin. It will be utilized 24hrs, 340 days per year.

Frigel hybrid cooler decreases the load on the Trane chiller. The Frigel Hybrid Cooler consumes less energy per unit than the Trane Chiller. It is also utilized in combination with heat exchanger to heat the production area. It will be utilized 24hrs, 340 days per year. Heating is only used 4-6 months of the year.

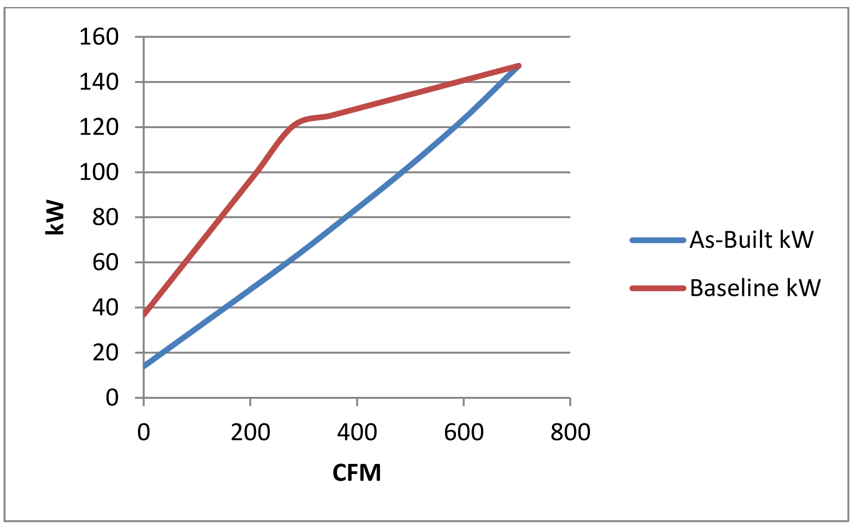
Measurement and Verification Effort

ADM visited the facility and confirmed the installation of the Husky HyPet300 Injection Molder, a VFD compressor, a Eisbar DP 800/11 Dryer, and Frigel Hybrid cooler. ADM received monitored kW data in 15 minute intervals from 8/1/2015 – 10/16/2015 for each machine.

For the Husky HyPet300 Injection Molder, ADM used monitored power data and recorded kg data to calculate the kWh/kg efficiency. The calculated kWh/kg efficiency is 0.72 kWh/kg. A baseline kWh/kg efficiency was calculated by finding the efficiency of a minimally efficient injection mold machine's ratings. It was found that the efficiency of a typical injection mold machine is 0.88 kWh/kg. Using the monitored power data, ADM calculated the corresponding kg using the as-built kWh/kg efficiency. Then the baseline kW was calculated using the baseline kWh/kg efficiency for each recorded data point. The data was used to calculate typical as-built and baseline kW profiles for each day of the week. The annual energy savings is the difference between the pre and post energy consumption extrapolated to an entire year.

For the VFD compressor, ADM used the monitored power data in conjunction with the as-built CAGI compressor curve to calculate the corresponding CFM output. Then ADM calculated the baseline kW using a compressor curve for a compressor with inlet modulating and blowdown for each recorded data point. The data was used to calculate typical as-built and baseline kW profiles for each day of the week. The annual energy savings is the difference between the pre and post energy consumption extrapolated to an entire year. The graph below illustrates the calculated compressor profiles of the as-built and baseline compressors:

Compressed Air kW Curves Pre/Post



For the Eisbar DP 800/11 Dryer, ADM used the as-built, spec sheet kWh/kg and the max monitored kW value in the monitoring period to calculate the baseline kWh/kg efficiency. ADM assumed the efficiency remained consistent from baseline to as-built with savings resulting in a drop in rated kW. Rated kW of the baseline was taken from a Piovan Dryer also used in the ex ante analysis. Using the monitored power data ADM calculated the corresponding kg using the as-built kWh/kg efficiency and then the baseline kW using the baseline kWh/kg efficiency for each recorded data point. The data was used to calculate typical as-built and baseline kW profiles for each day of the week. The annual energy savings is the difference between the pre and post energy consumption extrapolated to an entire year.

For the Frigel Hybrid cooler, ADM used monitored power data for the as-built cooler and chiller in conjunction with as-built equipment efficiencies to calculate total combined cooling tons for each recorded data point. Using the tons and chiller efficiency, a baseline chiller only kW was calculated for each recorded data point. The data was then used to calculate typical as-built and baseline kW profiles for each day of the week. The annual energy savings is the difference between the pre and post energy consumption extrapolated to an entire year.

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	
Husky HyPet300 Injection Molder	New Construction	187,680	170,108	91%	22
VFD compressor	New Construction	93,350	365,610	392%	47
Eisbar DP 800/11 Dryer	New Construction	274,176	316,493	115%	48
Frigel Hybrid cooler	New Construction	549,302	550,067	100%	59
Total		1,104,509	1,402,278	129%	177

The project level realization rate is 129%. The realization rate can be attributed to the ex ante analysis calculating savings for each machine as the difference between the as-built full load kW rating and assumed baseline full load kW rating. The difference was multiplied by estimated annual hours of operation. Using a full load kW ratings and estimated hours of operation method does not capture the full range of machine run hours and does not account for run times where the machine is operating with part load efficiencies where significant savings can be realized.

The ex post analysis calculated savings using as-built monitored kWh data, and the difference between known new equipment efficiencies and typical industry equipment efficiencies. This method captures the entire range of hours of operation and accounts for part load efficiencies to capture all the potential savings.

Site C-11

Executive Summary

C-11 received custom incentives from Ameren Missouri for installing a 300-kW Current-Fed Inverter High Frequency (CFI HF) solid state welder to replace an existing 400-kW vacuum tube welder. The realization rate for this project is 98%.

Project Description

The customer replaced a 400-kW-output welder that utilized vacuum tubes to control frequency. The installed 300-kW-output welder has solid-state controllers. The new welder is 81% efficient using transistors instead of 50% efficient with vacuum tubes. The expected annual savings of 546,875 kWh is based on both old and new welder running at 300-kW output power throughout the year.

Measurement and Verification Effort

During the M&V visit, ADM staff verified installation of 300-kW-output Thermatool Solid State HF Welder. On the day of ADM's visit, the facility was producing 0.113" pipe and the welder output power was 116 kW. The facility runs three shifts per day Monday through Friday and approximately 6 shifts per year on Saturdays. The welder doesn't stop during each shift change, but it does stop for 20 minutes during lunch breaks and for 10 minute breaks for the operator in each shift. The facility produces pipes in different wall thickness and the die has to be changed. Usually, the facility changes the die every 3 days, and the welder shuts off for 90 minutes during this time.

ADM used a similar calculation methodology as the ex ante savings calculation methodology while updating multiple parameters. The annual operating hours for the ex post increased from 4,219 hours to 5,632 hours because the ex ante utilization rate was only 75%. ADM verified that the welder runs 7.5 hours per shift; therefore, the utilization rate is 100% during work hours. The average welder output power was found to be 125 kW considering the facility produces pipes in various thicknesses throughout the year. See table below.

Output Power and Percent Annual Production Rates by Pipe Wall Thickness

Pipe Wall Thickness	*Output Power (kW)*	*% Annual Production*
greater than 0.125"	165	19%
between 0.100" to 0.125"	116	80%
between 0.057" to 0.100"	57	1%

The following equation was used to determine energy savings:

$$kWh_{savings} = W_{Power} \times \left(\eta_{baseline} - \eta_{new}\right) \times H_{annual}$$

Where:

$kWh_{savings}$	= *Annual energy savings*
W_{Power}	= *Annual average welder output power, 125 kW*
$\eta_{baseline}$	= *Vacuum welder efficiency, 50%*
η_{new}	= *Solid state welder efficiency, 81%*
H_{annual}	= *Annual welder operating hours, 5,632 hours*

Results

Verified Gross Savings/Realization Rates by Measure

Measure Category	*Incentive*	*kWh Savings*			*Realized Peak kW Reduction*
		Expected	*Realized*	*Realization Rate*	
Solid State Welder Upgrade	Custom	546,875	537,657	98%	95.46
Total		546,875	537,657	98%	95.46

The project-level realization rate is 98%. Although the realization rate is nearly 100%, there are differences in the factors between the ex ante and ex post analyses. ADM verified that the welder was running at 116 kW during the M&V visit, and the operator said the maximum output is at 165 kW. The ex ante analysis assumed the welder ran at 300 kW. While the ex ante analysis overestimated the power output, the realized welder operating hours were significantly higher than what was expected. ADM verified a utilization rate of 100% compared to the assumed 75%. Those differences offset each other, and the realized savings were close to the expected.

Site C-1

Executive Summary

C-1 received custom incentives from Ameren Missouri for upgrading the existing pneumatic building automation system with a Direct Digital Control (DDC) system. The realization rate for this project is 95%.

Project Description

C-1 replaced their existing pneumatic zone controls with a Direct Digital Control (DDC) system which serves (424) Fan Terminal Units (FTUs) and (173) Variable Air Volume (VAV) boxes. With the installation of the DDC system the following energy savings strategies were employed:

- Occupancy based scheduling for FTUs and VAVs,
- Wider unoccupied zone set points,
- Closing of zone box dampers during unoccupied periods, and
- FTU electric heaters will be shutoff during unoccupied periods.

An additional energy savings as a result of the removal of the (597) pneumatic controlled zone boxes is the compressed air system will have a reduced load thus consuming less energy.

Measurement and Verification Effort

ADM calculated the annual energy savings for the installation of the new DDC system through the use of a monthly pre/post billing data regression. The regression used interval metering data to compare the facility's monthly pre/post energy consumption to the local weather in an effort to determine the effects that weather and the installed measures have on energy consumption. Through a sensitivity analysis ADM determined that the Cooling Degree Day (CDD) base temperature was 68ºF and the Heating Degree Day (HDD) base temperature for the regression was 55ºF, this resulted in an overall R^2 of 0.89. From the regression the following equation was derived and used to calculate the monthly energy consumption for the pre and post configurations:

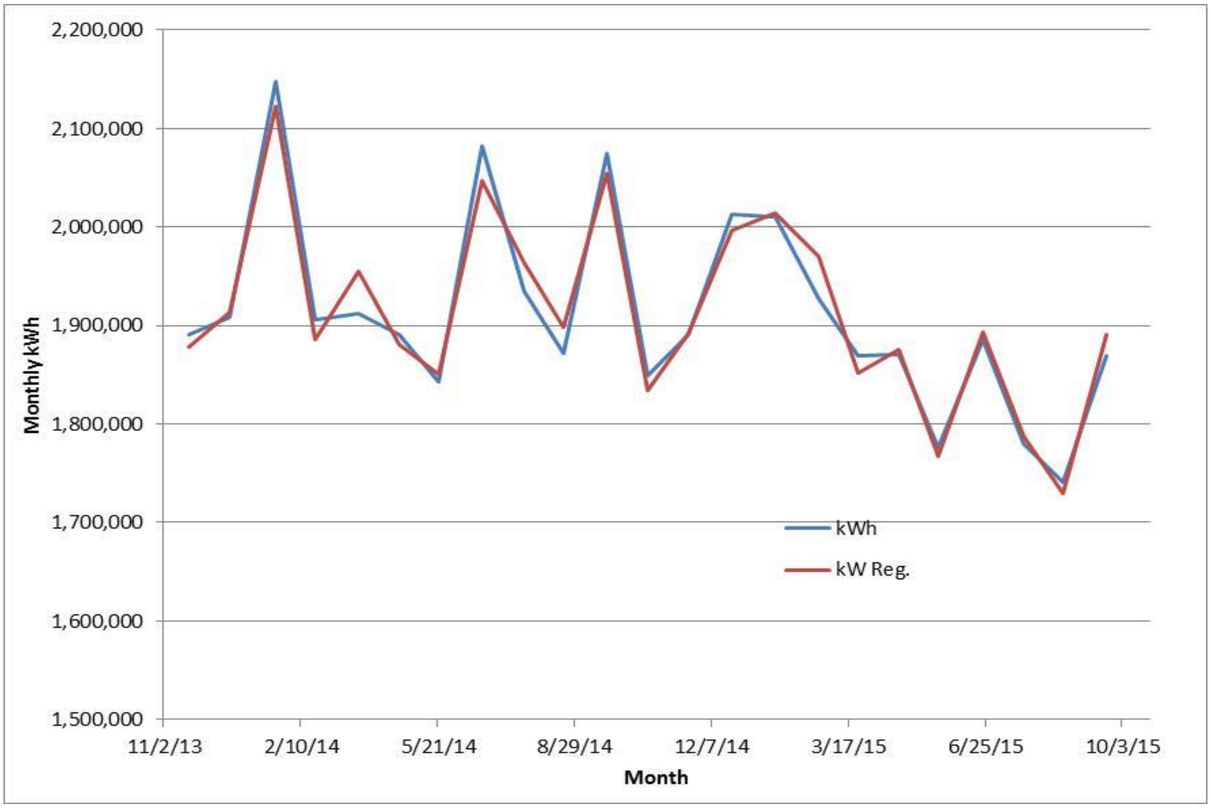
$$kWh_{Monthly} = 47{,}509 \times \#Days + 343 \times CDD + 88 \times HDD - 558 \times CDD_{post} - 927 \times HDD_{post} + 432{,}204$$

Where:

$kWh_{Monthly}$	*= Monthly kWh consumption*
#Days	*= Number of days in the month*
CDD	*= Number of Cooling Degree Days for the month*
HDD	*= Number of Heating Degree Days for the month*
CDD_{post}	*= Number of Cooling Degree Days for the month in the post period*
HDD_{post}	*= Number of Heating Degree Days for the month in the post period*

The following graph compares the actual monthly kWh consumption of the office building to the kWh calculated through the use of the derived equation:

Actual Vs. Regressed Monthly kWh



The annual energy savings for the installed measures were determined by using the above derived equation to calculate the monthly pre/post energy consumption of the facility for typical (TMY3) weather. The annual energy savings is the difference between the baseline and as-built energy consumption for the location and can be seen in the following table:

Monthly kWh Savings

Month	*# Days*	*CDD*	*HDD*	*kWh*		
				Baseline	*As-Built*	*Savings*
1	31	0.00	811.04	1,976,514	1,224,357	752,157
2	28	0.00	578.46	1,813,475	1,277,014	536,460
3	31	21.00	275.13	1,936,451	1,669,578	266,872
4	30	47.17	112.25	1,883,549	1,753,120	130,429
5	31	69.00	33.08	1,931,563	1,862,365	69,198
6	30	291.04	0.00	1,957,273	1,794,811	162,462
7	31	402.54	0.00	2,043,015	1,818,313	224,702
8	31	305.00	0.00	2,009,568	1,839,315	170,253
9	30	140.17	2.75	1,905,782	1,824,989	80,793
10	31	19.54	123.79	1,922,604	1,796,892	125,712
11	30	3.33	356.79	1,890,086	1,557,338	332,748
12	31	0.00	733.08	1,969,639	1,289,780	679,859
Total				23,239,519	19,707,874	3,531,645

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*	
Direct Digital Controls	Custom	3,707,600	3,531,645	95%	224.84
Total		3,707,600	3,531,645	95%	224.84

The project-level realization rate is 95%. The difference between ex ante savings and ex post savings can be attributed to the ex ante calculations being based on engineering equations with theoretical operational inputs. The ex post analysis used a billing regression, which used pre and post retrofit monthly utility billing to calculate the annual energy savings for the new DDC system.

Site C-22 S-19

Executive Summary

C-22 S-19 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 119%.

Project Description

The customer retrofitted the following fixtures:

- (119) MH fixtures with (112) 4' 4LT5HO fixtures
- (94) 4' 6LT5HO fixtures with (90) 4' 6LT5HO fixtures
- (6) 4' 4LT12 fixtures with (6) 4' 2LT8 fixtures in the breakroom 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. 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 90.1-1989).

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 interactive 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 interactive 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' 4LT5HO	119	112	461	232	7,425	243,705	234,503	1.09	96%
4' 6LT5HO to 4' 6LT5HO	94	90	358	358	7,505	12,086	11,755	1.09	97%
4' 4LT12 to 4' 2LT8	6	6	112	54	7,425	1,531	2,826	1.09	185%
Total						257,322	249,084		97%

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	177	278.27	7,425	5,197	53,100	120,002	1.09	226%
Total					53,100	120,002		226%

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	257,322	249,084	97%	44.87
Lighting Controls	Standard	53,100	120,002	226%	21.63
Total		310,422	369,086	119%	66.50

The project-level realization rate is 119%. The following factors impacted the project gross realization rate:

- The lighting retrofit had a slightly lower realization rate (97%). The ex post hours of operation verified during the M&V site visit for two measures (7,424 to 7,504), not accounting the effect of the lighting controls, are less than those used to perform the ex ante estimate (8,440).
- The lighting controls ex ante energy savings estimate assumes a lesser impact on the lighting hours than calculated by the ex post savings analysis. The lighting controls realization rate was 226%.

Site C-15 S-15

Executive Summary

C-15 S-15 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 95%.

Project Description

The customer retrofitted the following fixtures:

- (151) MH fixtures with (128) 4' 4LT5HO fixtures
- (24) 4' 6LT8 fixtures with (21) 4' 4LT5HO 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. 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 90.1-1989).

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 interactive 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 interactive 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' 4LT5HO	151	128	461	234	7,425	332,747	322,083	1.09	97%
4' 6LT8 to 4' 4LT5HO	24	21	219	234	7,745	4,861	2,897	1.09	60%
Total						337,608	324,980		96%

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	144	234	7,425	5,197	88,704	82,097	1.09	93%
Total					88,704	82,097		93%

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	337,608	324,980	96%	58.55
Lighting Controls	Standard	88,704	82,097	93%	14.80
Total		426,312	407,077	95%	73.35

The project-level realization rate is 95%. The following factors impacted the project gross realization rate:

- The ex post hours of operation verified during the M&V site visit (7,424 to 7,745), not accounting for the effect of lighting controls, are less than the hours of operation used to perform the ex ante estimate (8,440). The lighting retrofit realization rate is 96%.
- Aiding in the lighting realization rate was the ex post savings analysis accounting for heating and cooling interactive effects. A factor applicable to gas heated/ electric air conditioned light manufacturing facilities in St. Louis was applied to the lighting energy savings (1.09); the ex ante savings estimate did not account for heating and cooling interactive effects.

- The lighting controls ex ante savings estimation assumes a greater impact on lighting hours than calculated by the ex post energy savings analysis. The lighting controls realization rate was 93%.

Site R-2

Executive Summary

R-2 received incentives from Ameren Missouri for the retro-commissioning of three different buildings on their campus. The realization rate for this project is 111%.

Project Description

In order to reduce energy consumption throughout campus, the facility performed retro-commissioning study and identified measures for implementation. These buildings, which are 35% of the total campus building square feet, received retro-commissioning:

- Building 1 (379,259 SF)
- Building 2 (125,770 SF)
- Building 3 (376,939 SF)

The retro-commissioning portion of the project consisted of developing a Room Ventilation Schedule, AHU repairs, supply air temperature resets and static pressure resets.

- Non patient areas, reduced occupied air flow to ASHRAE standards
- Non patient areas, reduced unoccupied air flow to minimum at each VAV
- Simplified PID control loops with implementing single loop control theory
- Programmed supply air temperature reset using inputs from terminal devices
- Reset static pressure based on loads in zone spaces
- Repaired air handler dampers, actuators and control valves

Measurement and Verification Effort

During the M&V visit, ADM staff verified that the RCx measures by reviewing the operation of each air handler in the three buildings and documenting the control system changes in the existing Johnson Control (JCI) Metasys building automation system.

ADM calculated the annual energy savings for the installed measures through the use of a monthly pre/post trending data regression. The regression compared the monthly trending data to the local weather in an effort to determine the effects that weather has on the cooling system for both the pre and post conditions and accomplishes this with an R^2 of 0.976. From the regression the following equation was derived and used to calculate the monthly energy consumption for the pre and post configurations:

$$kWh_{Monthly} = 6{,}487 \times CDD - 621.6 \times HDD + 193{,}175 \times \#Days - 473{,}059 \times Pre\_Post + 1{,}340{,}532$$

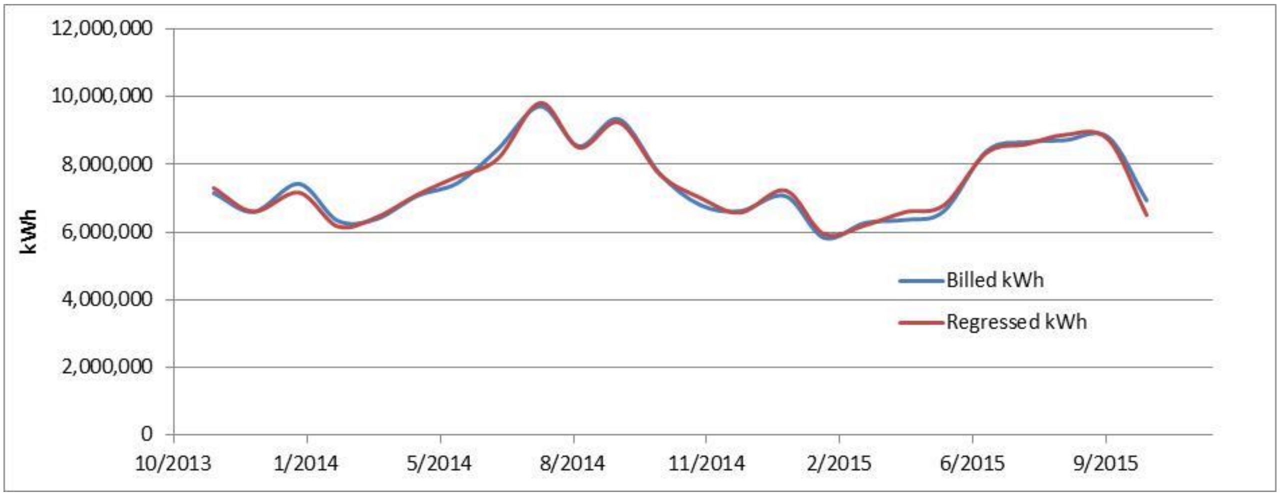
Where:

$kWh_{Monthly}$	= *Monthly kWh consumption*
CDD	= *Number of Cooling Degree Days for the month*

HDD	*= Number of Heating Degree Days for the month*
#Days	*= Number of days for the billing period*
Pre_Post	*= Binary value for pre/post monthly period (0=Pre, 1=Post)*

The following graph compares the monthly billed kWh to the kWh calculated through the use of the derived equation:

Trended Vs. Regressed Monthly kWh



The annual energy savings for the installed measures was determined by using the derived regression equation to calculate the monthly pre/post energy consumption of the facility. The annual energy savings is the difference between the baseline and as-built energy consumption for the location.

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	RCx	5,117,103	5,676,705	111%	648
Total		5,117,103	5,676,705	111%	648

The relatively high realization rate of 111% can be attributed to the ex ante regression analysis only including time series data during the baseline period. The ex ante analysis predicted the retrofit usage. The ex post regression model included 9 months of data after the retro-commissioning was completed. The ex post model also had a high R^2 value of 0.98 which represents the “goodness of fit”, where 1.0 is perfect.

Site C-9 S-18

Executive Summary

C-9 S-18 received standard and custom 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 across 5 buildings:

- (559) 2' 1LT8 fixtures with (559) 2' 1LT8 LBF fixtures
- (22) 2' 1LT8 fixtures with (22) 2' 1LT8 LBF fixtures
- (11) 2' 1LT8 fixtures with (11) 2' 1LT8 LBF fixtures
- (17) 3' 1LT8 fixtures with (17) 3' 1LT8 LBF fixtures
- (6) 3' 1LT8 fixtures with (6) 3' 1LT8 LBF fixtures
- (4) 3' 2LT8 fixtures with (4) 3' 2LT8 LBF fixtures
- (47) 3' 2LT8 fixtures with (47) 3' 2LT8 LBF fixtures
- (268) 4' 1LT8 fixtures with (268) 4' 1LT8 LBF fixtures
- (10) 4' 1LT8 fixtures with (10) 4' 1LT8 LBF fixtures
- (155) 4' 2LT8 fixtures with (155) 4' 2LT8 LBF fixtures
- (112) 4' 2LT8 fixtures with (112) 4' 2LT8 LBF fixtures
- (165) 4' 2LT8 fixtures with (165) 4' 2LT8 LBF fixtures
- (24) 4' 3LT8 fixtures with (24) 4' 3LT8 LBF fixtures
- (3) 4' 3LT8 fixtures with (3) 4' 3LT8 LBF fixtures
- (39) 4' 4KT8 fixtures with (39) 4' 4LT8 LBF fixtures
- (36) 2' 1LT8 fixtures with (36) 2' 1LT8 LBF fixtures
- (30) 4' 1LT8 fixtures with (30) 4' 1LT8 LBF fixtures
- (146) 4' 2LT8 fixtures with (146) 4' 2LT8 LBF fixtures
- (281) 4' 4LT8 fixtures with (281) 4' 4LT8 LBF fixtures
- (51) 4' 4LT8 fixtures with (51) 4' 4LT8 LBF fixtures
- (770) 2' 2LT8- U-tube fixtures with (770) 2' 3LT8 LBF fixtures
- (97) 2' 2LT8- U-tube fixtures with (97) 2' 3LT8 LBF fixtures
- (271) 2' 2LT8- U-tube fixtures with (271) 2' 3LT8 LBF fixtures
- (6) 4' 1LT8 fixtures with (6) 3' 1LT8 LBF fixtures
- (98) 2' 2LT8- U-tube fixtures with (98) 2' 3LT8 LBF fixtures
- (41) 4' 2LT8 fixtures with (41) 4' 2LT8 LBF fixtures
- (26) 2' 2LT8- U-tube fixtures with (26) 2' 3LT8 LBF fixtures
- (30) 2' 2LT8- U-tube fixtures with (30) 2' 3LT8 LBF fixtures
- (20) 2' 2LT8- U-tube fixtures with (20) 2' 3LT8 LBF fixtures
- (5) 4' 3LT8 fixtures with (5) 4' 3LT8 LBF fixtures
- (6) 2' 2LT8 fixtures with (6) 2' 2LT8 LBF fixtures
- (3) 2' 2LT8 fixtures with (3) 2' 2LT8 LBF fixtures
- (1214) 4' 3LT8 fixtures with (1214) 4' 3LT8 LBF fixtures
- (1) 3' 2LT8 fixture with (1) 3' 2LT8 LBF fixture
- (16) 3' 2LT8 fixtures with (16) 3' 2LT8 LBF fixtures

- (85) 4' 3LT8 fixtures with (85) 4' 3LT8 LBF fixtures
- (275) 4' 3LT8 fixtures with (275) 4' 3LT8 LBF fixtures
- (351) 4' 1LT8 fixtures with (351) 4' 1LT8 LBF fixtures
- (159) 4' 1LT8 fixtures with (159) 4' 1LT8 LBF fixtures
- (64) 4' 3LT8 fixtures with (64) 4' 3LT8 LBF fixtures
- (61) 4' 3LT8 fixtures with (61) 4' 3LT8 LBF fixtures
- (102) 4' 3LT8 fixtures with (102) 4' 3LT8 LBF fixtures
- (41) 4' 1LT8 fixtures with (41) 4' 1LT8 LBF fixtures
- (152) 4' 2LT8 fixtures with (152) 4' 2LT8 LBF fixtures
- (16) 4' 2LT8 fixtures with (16) 4' 2LT8 LBF fixtures
- (734) 4' 2LT8 fixtures with (734) 4' 2LT8 LBF fixtures
- (4) 4' 3LT8 fixtures with (4) 4' 3LT8 LBF fixtures
- (966) 4' 4LT8 fixtures with (966) 4' 4LT8 LBF fixtures
- (38) 4' 2LT8 fixtures with (38) 4' 2LT8 LBF fixtures
- (103) 4' 4LT8 fixtures with (103) 4' 4LT8 LBF fixtures
- (1636) 4' 2LT8 fixtures with (1636) 4' 2LT8 LBF fixtures
- (154) 4' 2LT8 fixtures with (154) 4' 2LT8 LBF fixtures
- (43) 4' 2LT8 fixtures with (43) 4' 2LT8 LBF fixtures
- (4) 4' 4LT8 fixtures with (4) 4' 4LT8 LBF fixtures in the
- (188) 4' 4LT8 fixtures with (188) 4' 4LT8 LBF fixtures
- (103) 2' 3LT8 fixtures with (103) 2' 3LT8 LBF fixtures
- (4) 2' 3LT8 fixtures with (4) 2' 3LT8 LBF fixtures
- (107) 4' 4LT8 fixtures with (107) 4' 4LT8 LBF fixtures
- (81) 4' 4LT8 fixtures with (81) 4' 4LT8 LBF fixtures
- (38) 4' 4LT8 fixtures with (38) 4' 4LT8 LBF fixtures
- (53) Incandescent fixtures with (53) LED fixtures
- (137) Incandescent fixtures with (137) LED fixtures
- (73) Incandescent fixtures with (73) 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 interactive 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					
2' 1LT8 to 2' 1LT8 LBF	559	559	18	16	2,668	3,430	3,736	1.09	109%
2' 1LT8 to 2' 1LT8 LBF	22	22	18	16	8,760	443	483	1.09	109%
2' 1LT8 to 2' 1LT8 LBF	11	11	18	16	5,814	147	160	1.09	109%
3' 1LT8 to 3' 1LT8 LBF	17	17	28	21	2,668	320	346	1.09	108%
3' 1LT8 to 3' 1LT8 LBF	6	6	28	21	8,760	368	401	1.09	109%
3' 2LT8 to 3' 2LT8 LBF	4	4	46	31	2,668	157	171	1.09	109%
3' 2LT8 to 3' 2LT8 LBF	47	47	46	31	5,814	4,017	4,376	1.09	109%
4' 1LT8 to 4' 1LT8 LBF	268	268	30	21	2,668	6,435	7,010	1.09	109%
4' 1LT8 to 4' 1LT8 LBF	10	10	30	21	5,814	523	570	1.09	109%
4' 2LT8 to 4' 2LT8 LBF	155	155	62	37	2,844	11,021	12,007	1.09	109%
4' 2LT8 to 4' 2LT8 LBF	112	112	62	37	2,668	7,470	8,137	1.09	109%
4' 2LT8 to 4' 2LT8 LBF	165	165	62	37	5,814	23,983	26,127	1.09	109%
4' 3LT8 to 4' 3LT8 LBF	24	24	85	57	2,668	1,793	1,953	1.09	109%
4' 3LT8 to 4' 3LT8 LBF	3	3	85	57	6,570	552	601	1.09	109%
4' 4KT8 to 4' 4LT8 LBF	39	39	112	74	2,668	3,954	4,307	1.09	109%
2' 1LT8 to 2' 1LT8 LBF	36	36	18	16	4,276	354	386	1.09	109%
4' 1LT8 to 4' 1LT8 LBF	30	30	30	21	2,844	768	837	1.09	109%
4' 2LT8 to 4' 2LT8 LBF	146	146	62	37	5,840	21,316	23,222	1.09	109%
4' 4LT8 to 4' 4LT8 LBF	281	281	112	74	4,380	46,770	50,951	1.09	109%
4' 4LT8 to 4' 4LT8 LBF	51	51	112	74	2,503	4,851	5,284	1.09	109%
2' 2LT8- U-tube to 2' 3LT8 LBF	770	770	59	34	4,276	83,959	91,460	1.09	109%
2' 2LT8- U-tube to 2' 3LT8 LBF	97	97	59	34	2,844	7,035	7,665	1.09	109%
2' 2LT8- U-tube to 2' 3LT8 LBF	271	271	59	34	8,760	60,536	65,948	1.09	109%
4' 1LT8 to 3' 1LT8 LBF	6	6	30	21	5,840	315	344	1.09	109%
2' 2LT8- U-tube to 2' 3LT8 LBF	98	98	59	34	3,574	8,931	9,730	1.09	109%
4' 2LT8 to 4' 2LT8 LBF	41	41	62	37	4,380	4,490	4,891	1.09	109%
2' 2LT8- U-tube to 2' 3LT8 LBF	26	26	59	34	5,840	3,872	4,218	1.09	109%
2' 2LT8- U-tube to 2' 3LT8 LBF	30	30	59	34	5,814	4,448	4,845	1.09	109%
2' 2LT8- U-tube to 2' 3LT8 LBF	20	20	59	34	2,503	1,277	1,391	1.09	109%
4' 3LT8 to 4' 3LT8 LBF	5	5	85	57	6,750	945	1,029	1.09	109%
2' 2LT8 to 2' 2LT8 LBF	6	6	33	23	4,276	251	274	1.09	109%
2' 2LT8 to 2' 2LT8 LBF	3	3	33	23	8,760	258	281	1.09	109%
4' 3LT8 to 4' 3LT8 LBF	1,214	1,214	85	57	4,276	145,350	158,334	1.09	109%
3' 2LT8 to 3' 2LT8 LBF	1	1	46	31	4,276	63	68	1.09	109%
3' 2LT8 to 3' 2LT8 LBF	16	16	46	31	8,760	2,060	2,245	1.09	109%
4' 3LT8 to 4' 3LT8 LBF	85	85	85	57	2,844	6,769	7,375	1.09	109%
4' 3LT8 to 4' 3LT8 LBF	275	275	85	57	8,760	67,452	73,483	1.09	109%

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' 1LT8 to 4' 1LT8 LBF	351	351	30	21	4,276	13,508	14,715	1.09	109%
4' 1LT8 to 4' 1LT8 LBF	159	159	30	21	8,760	12,536	13,656	1.09	109%
4' 3LT8 to 4' 3LT8 LBF	64	64	85	57	3,574	6,405	6,977	1.09	109%
4' 3LT8 to 4' 3LT8 LBF	61	61	85	57	5,840	9,975	10,867	1.09	109%
4' 3LT8 to 4' 3LT8 LBF	102	102	85	57	5,814	16,605	18,089	1.09	109%
4' 1LT8 to 4' 1LT8 LBF	41	41	30	21	5,840	2,155	2,348	1.09	109%
4' 2LT8 to 4' 2LT8 LBF	152	152	62	37	5,276	20,049	21,841	1.09	109%
4' 2LT8 to 4' 2LT8 LBF	16	16	62	37	6,570	2,628	2,863	1.09	109%
4' 2LT8 to 4' 2LT8 LBF	734	734	62	37	8,760	160,746	175,118	1.09	109%
4' 3LT8 to 4' 3LT8 LBF	4	4	85	57	2,503	280	305	1.09	109%
4' 4LT8 to 4' 4LT8 LBF	966	966	112	74	4,276	156,963	170,986	1.09	109%
4' 2LT8 to 4' 2LT8 LBF	38	38	62	37	3,574	3,395	3,699	1.09	109%
4' 4LT8 to 4' 4LT8 LBF	103	103	112	74	2,844	11,131	12,128	1.09	109%
4' 2LT8 to 4' 2LT8 LBF	1,636	1,636	62	37	4,276	174,888	190,512	1.09	109%
4' 2LT8 to 4' 2LT8 LBF	154	154	62	37	5,840	22,484	24,494	1.09	109%
4' 2LT8 to 4' 2LT8 LBF	43	43	62	37	2,503	2,691	2,931	1.09	109%
4' 4LT8 to 4' 4LT8 LBF	4	4	112	74	6,570	999	1,088	1.09	109%
4' 4LT8 to 4' 4LT8 LBF	188	188	112	74	8,760	62,581	68,177	1.09	109%
2' 3LT8 to 2' 3LT8 LBF	103	103	48	34	4,276	6,386	6,957	1.09	109%
2' 3LT8 to 2' 3LT8 LBF	4	4	48	34	2,844	165	180	1.09	109%
4' 4LT8 to 4' 4LT8 LBF	107	107	112	74	3,574	14,532	15,831	1.09	109%
4' 4LT8 to 4' 4LT8 LBF	81	81	112	74	5,840	17,976	19,583	1.09	109%
4' 4LT8 to 4' 4LT8 LBF	38	38	112	74	5,814	8,395	9,146	1.09	109%
Incandescent to LED	53	53	53	11	5,168	13,421	12,532	1.09	93%
Incandescent to LED	137	137	53	17	3,816	30,322	20,505	1.09	68%
Incandescent to LED	73	73	53	11	4,380	15,667	14,630	1.09	93%
Total						1,323,566	1,424,799		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	59,410	47,667	80%	13.87
Lighting Retrofit	Custom	1,264,156	1,377,132	109%	316.63
Total		1,323,566	1,424,799	108%	330.49

The project-level realization rate is 108%. The ex post savings analysis used previous site specific field work along with verifying hours of operation during the M&V site visit. The following factors impacted the project gross realization rate:

- The ex post savings analysis accounted for heating and cooling interactive effects. A factor applicable to gas heated/electric air-conditioned university facilities in St. Louis was applied to the lighting energy savings (1.09); the ex ante savings estimate did not account for heating and cooling interactive effects. The custom lighting retrofit realization rate was 109%.

- The three standard measures had a lower realization rate (80%) because the ex post savings analysis used the EISA 2007 federal standard baseline wattages, whereas the ex ante savings estimate used the actual baseline lamp wattages.

Site R-4

Executive Summary

R-4 received incentives from Ameren Missouri for a HVAC retro-commissioning project. The realization rate for this project is 86%.

Project Description

In order to reduce energy consumption throughout their campus, a retro-commissioning study was performed, and it identified measures for implementation. The following measures were implemented:

- Rebalance minimum air flow at VAV boxes,
- Repair economizers,
- Implement new occupancy schedules,
- Replace three way valves with new two way valves, and
- Change pumping distribution and scheduling.

Measurement and Verification Effort

During the M&V visit, ADM staff verified that the RCx measures by reviewing equipment operation and documenting the control system changes in the new building automation system (BAS).

ADM calculated the annual energy savings for the installed measures through the use of a monthly pre/post billing data regressions. The regressions compared the monthly billing data to the local weather in an effort to determine the effects that weather has on the building for both the pre and post conditions and accomplishes this with R^2s of 0.96 and 0.93. From the regression the following equations were derived and used to calculate the monthly energy consumption for the pre and post configurations:

$$kWh_{Monthly\_1} = 810 \times CDD + 72 \times HDD + 53{,}104 \times \#Days - 61{,}129 \times Pre\_Post - 43{,}891 \times Pre\_Post2 - 495{,}575$$

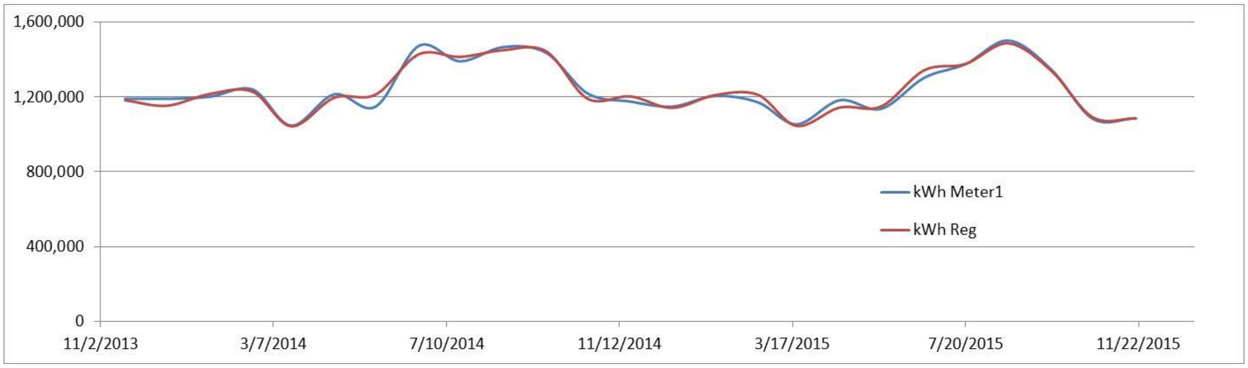
$$kWh_{Monthly\_2} = 54.5 \times CDD - 46 \times HDD + 4{,}653 \times \#Days - 14{,}800 \times Pre\_Post - 12{,}802 \times Pre_{Post2} + 29{,}867$$

Where:

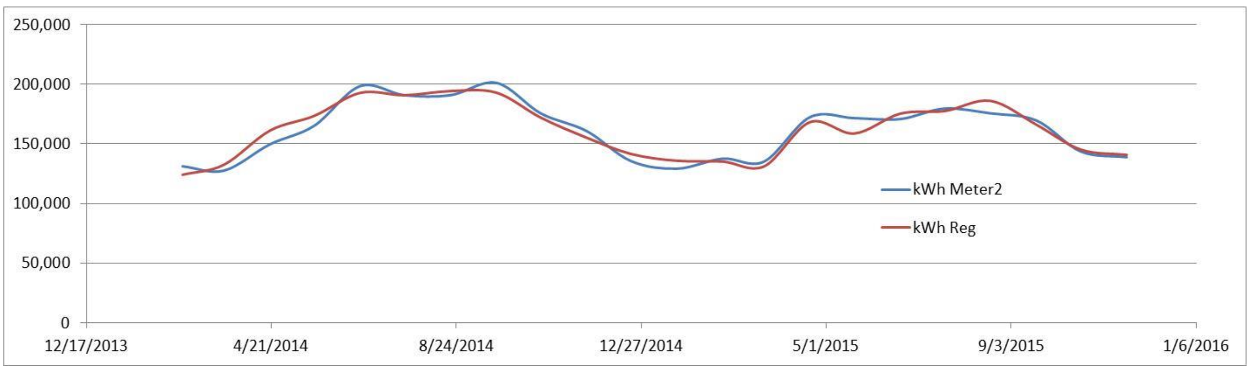
$kWh_{Monthly}$	*= Monthly kWh consumption*
CDD	*= Number of Cooling Degree Days for the month*
HDD	*= Number of Heating Degree Days for the month*
#Days	*= Number of days for the billing period*
Pre_Post for waterside measures	*= Binary value for pre/post monthly period (0=Pre, 1=Post)*
Pre_Post for airside measures	*= Binary value for pre/post monthly period (0=Pre, 1=Post)*

The following graphs compare the monthly billed kWh to the kWh calculated through the use of the derived equations:

Billed_1 vs. Regressed kWh Monthly_1



Billed_2 vs. Regressed kWh Monthly_2



The annual energy savings for the installed measures were determined by using the derived regression equations to calculate the monthly pre/post energy consumption of the facility. The annual energy savings is the difference between the baseline and as-built energy consumption for the facility. Two regression equations were used because there were two separate utility meters. A single regression was attempted to be made by combining the meters, but the results had more uncertainty.

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 Optimization	RCx	1,858,326	1,591,458	86%	182
Total		1,858,326	1,591,458	86%	182

The project level realization rate is 86%. The realization rate can be attributed to the ex ante analysis using a higher baseline energy use intensity (EUI). The ex ante analysis assumed 2013 billing data represented a typical year. The data wasn't normalized to typical weather for the baseline. The expected energy savings are not well-justified by the ex ante analysis. The ex ante analysis for the waterside measures were not provided. Another ex ante analysis was provided after installation that used a billing regression. The regression appeared to have errors with mixing kBtuh and kWh values for consumption data, and the statistics of the model were not provided.

The ex post regression models normalized the energy usage to typical weather. The ex post analysis accounted for actual post billing data to derive typical post usage. The ex post models also had high R^2 values of 0.96 and 0.92, which represent the “goodness of fit”, where 1.0 is perfect.

Site N-8

Executive Summary

N-8 received new construction incentives from Ameren Missouri for lighting in the exterior of their facility. The realization rate for this project is 112%.

Project Description

The customer retrofitted the following fixtures:

- (12) Canopy Fluorescent fixtures with (12) Canopy LED fixtures
- (123) MH Pole Light fixtures with (123) LED Pole Light 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 interactive 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*					
Canopy Fluorescent to Canopy LED	12	12	112	108	5,822	3,210	291	1.00	9%
MH Pole Light to LED Pole Light	123	123	456	157	4,308	138,561	158,425	1.00	114%
Total						141,771	158,716		112%

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	141,771	158,716	112%	1.60
Total		141,771	158,716	112%	1.60

The project-level realization rate is 112%. The following factors impacted the project gross realization rate:

- The ex post savings analysis hours of operation verified during the M&V site visit (4,308 to 8,760) averaged higher than the ex ante savings estimate (4,380).
- The pole lighting in the ex post savings analysis was adjusted to the installed heads (123) and wattage (157) whereas the ex ante savings estimate allowed for one fewer head (122) and a higher wattage (176).
- The canopy fixtures were also adjusted to the installed quantity (12) with a higher wattage, (108) whereas the ex ante savings estimate was premised upon a relatively higher quantity (15) and relatively lower wattage (78). The M&V site visit also confirmed that four of the canopy fixtures remained continuously on (8,760).

Site C-23

Executive Summary

C-23 received custom incentives from Ameren Missouri for installing variable frequency drives (VFDs) on refrigeration condenser fans. The realization rate for this project is 57%.

Project Description

The customer installed VFDs on 30 condenser fan motors that were originally operated with on/off staging controls at constant speed. Each of the 30 fans is powered by a 1.5 HP motor and serves a total of nine separate condensing units. There are two different types of condensers present at the facility, a two fan configuration with a total heat rejection of 153.5 MBH, and a four fan configuration with a total heat rejection of 307.0 MBH. The condensers serve a combination of walk in and reach in refrigeration coolers and freezers.

Measurement and Verification Effort

During the M&V visit, ADM staff performed a site interview and verified installation of the VFD's among a total of nine condenser units.

ADM evaluated the savings using prototypical eQUEST refrigeration models and area specific typical meteorological year (TMY3) weather data. Two baseline models with staged constant speed condenser fans were created; in which, one model's condensers were equipped with two fans while the other model's condensers were equipped with four fans. Another pair of models was created to represent the as-built condenser fan configurations which are equipped with VFDs, one representing condensers with two fans and the other model representing condensers with four fans.

Fan power for each of the models was entered using the Electric Input Ratio method, which allows for a normalized fan kW per Btu of heat rejection. Using the manufacturer specification sheets, ADM calculated that both the two and four fan condensing units have and fan EIR of 0.419. The models were then run using TMY3 weather data for the region, in which the savings between the corresponding models were normalized on a kWh per MBH condenser capacity.

From the eQUEST refrigeration simulations it was determined that the condensers with two fans have an annual savings of 64.66 kWh/MBH and the condensers with four fans have an annual savings of 58.81 kWh/MBH. The following table presents the savings for each of the nine condensers:

Individual Condenser Savings

Condenser	*Model #*	*MBH*	*kWh Savings*	*kW Reduction*
A	MXC-02K	153.5	9,926	0.30
B	MXC-02K	153.5	9,926	0.30
C	MXC-04K	328.4	19,314	0.65

Condenser	Model #	MBH	kWh Savings	kW Reduction
D	MXC-02K	153.5	9,926	0.30
E	MXC-04K	328.4	19,314	0.65
F	MXC-04K	328.4	19,314	0.65
G	MXC-04K	328.4	19,314	0.65
H	MXC-04K	328.4	19,314	0.65
I	MXC-04K	328.4	19,314	0.65
Total		2430.9	145,664	4.82

Peak savings were calculated using the eQUEST hourly outputs for typical meteorological year (TMY3) data for August 26th at 5:00PM.

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	Incentive	kWh Savings			Realized Peak kW Reduction
		Expected	Realized	Realization Rate	
Condenser VFD's	Custom	256,914	145,664	57%	6.44
Total	Custom	**256,914**	**145,664**	**57%**	**6.44**

The project-level realization rate is 57%. The low realization rate can be attributed to the ex ante analysis using an engineering based methodology that utilized an assumed pre/post load profile for each fan configuration. During the review of the ex ante calculations ADM determined that the load profile was generalized and was not informed by outside variables such as weather. ADM also determined through an additional calculation, that the claimed savings are more than the baseline motors could potentially use in an entire year. This was determined through the use of the following equation:

$$30\ motors * \frac{1.5HP}{motor} * \frac{.746kW}{HP} * \frac{1}{.95} motor\ efficiency * .8\ Load\ Factor * 8760\ hours = 247{,}641kWh\ annually$$

The ex ante savings value, is larger than the energy consumption during the baseline period.

Site N-3

Executive Summary

N-3 received new construction incentives from Ameren Missouri for several energy efficiency measures designed into their newly constructed Center. The realization rate for this project is 62%.

Project Description

N-3s new Center is a 126,000 square foot, 4-story care center that houses: doctors, nurses and staff performing telemedicine functions. The following above-code (ASHRAE 90.1-2007) energy efficiency measures were designed into the new Virtual Care Center:

Table 1. Energy Measures

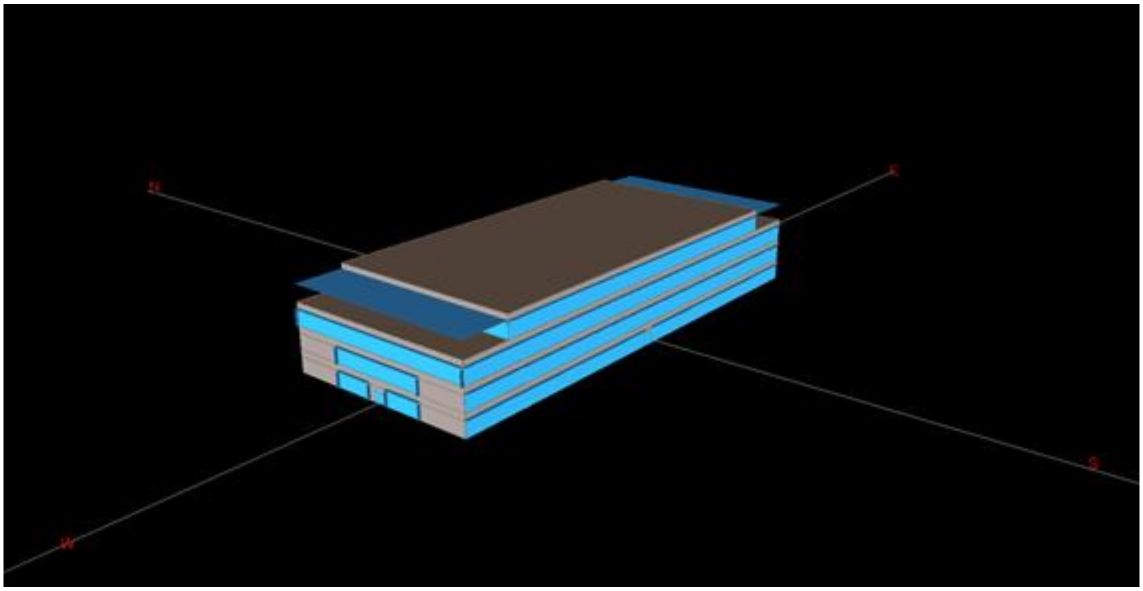
Measure	*Baseline*	*As-built*
Roof U-value (Btu/hr-sqft-F)	0.048	0.039
Lighting Power Density (W/sqft)	1.0	0.53
Energy Recovery Units	No	Yes
HVAC Cooling Type	VAV with Direct Expansion (DX) Coils	VAV with Chilled Water (CHW) Coils
HVAC VAV Fan Control	Forward Curved Fan with Inlet Guide Vanes	VFD
HW Pump Control	Constant Speed	VFD

Measurement and Verification Effort

During the M&V visit, ADM staff verified measure implementation, collected data, and interviewed the site representative about facility operating characteristics.

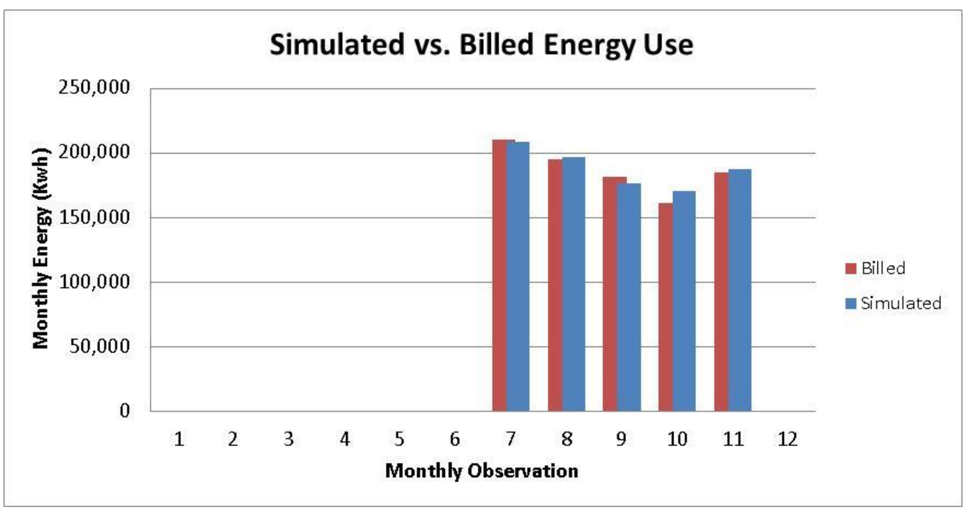
eQUEST whole building energy simulation software was used to determine energy savings, with the exception of the energy recovery units. An eQUEST model representing as-built conditions was first created:

Figure 1. Center eQUEST Model



A custom weather file for St. Louis, year 2015, was generated and used to calibrate the model, along with monthly utility billing data. The results of this calibration are as follows:

Figure 2. As-built Model Calibration Results



As indicated in the chart, only five months of billing data had accrued since the project's completion.

Once the model was calibrated, a baseline model was created using parametric runs to simulate the impact of the measures listed in Table 1. In addition, the custom weather file was replaced with Typical Meteorological Year 3 (TMY3) weather data for St. Louis.

Energy savings were then the difference in annual consumption of baseline and as-built models, as illustrated in the following table:

Table 2. Baseline and As-built End-use Electric Consumption

End-use	*kWh (x000)*	
	Baseline	*As-built*
Space Cool	1,187	957
Heat Rejection	0	0
Refrigeration	0	0
Space Heat	5	6
HP Supp.	0	0
Hot Water	0	0
Vent. Fans	294	106
Pumps & Aux.	16	38
Ext. Usage	0	0
Misc. Equip	563	563
Task Lights	0	0
Area Lights	1,107	587
Total	3,172	2,255

Savings for the heat recovery units were calculated outside the model, using AirXEstimator software[45], the same approach used in the ex ante analysis.

Results

Verified Gross Savings/Realization Rates By Measure

Measure Category	*Incentive*	*kWh Savings*			*Realized Peak kW Reduction*
		Expected	*Realized*	*Realization Rate*	
Lighting	New Construction	391,607	557,295	142%	63.62
Heat Recovery	New Construction	34,313	34,318	100%	34.10
Other HVAC & Envelope	New Construction	1,104,325	359,287	33%	65.05
Total		1,530,245	950,900	62%	162.77

The site-level realization rate is 62%.

The lighting realization rate of 142% is due to ADM including the third floor in the analysis; whereas, the ex ante analysis had excluded it due to that area not being fully occupied at the time of the post inspection. According to the site representative, the third floor was expected to be fully occupied by the end of 2015. Typical annual energy savings should include the lighting on the third floor.

Ex post and ex ante savings for the heat recovery units were the same, as the method employed in the ex ante analysis was considered sufficient by ADM.

[45] http://www.airxchange.com/resource-center-savings-calulator.htm

The “Other HVAC & Envelope” realization rate of 33% cannot be fully explained because only limited information for the ex ante DOE-2.2 baseline and as-built models was available. However, there were some inconsistencies observed during review of the DOE-2.2 reports provided. Claimed annual energy consumption for the ex ante as-built model was 198% of ADM’s calibrated as-built model, essentially twice as much. In addition, the ex ante baseline model appeared to use an incorrect HVAC cooling system type. Chilled water cooling was used, rather than direct expansion (DX) specified by ASHRAE 90.1-2007. Also, an all-electric heating system was modeled, instead of natural gas for hot water. An attempt was made by the applicant to compensate by subtracting natural gas consumption outputted by the as-built model, but it wasn’t justified in the documents.

Site C-31 S-20

Executive Summary

C-31 S-20 received standard and custom incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 89%.

Project Description

The customer retrofitted the following fixtures:

- (230) Incandescent lamps with (230) LED lamps
- (64) Incandescent lamps with (64) 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 interactive 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	230	230	25	7	8,760	36,266	39,670	1.09	109%
Incandescent to LED	64	64	72	13	8,760	48,776	36,182	1.09	74%
Total						85,042	75,851		89%

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	48,776	36,182	74%	5.53
Lighting Retrofit	Custom	36,266	39,670	109%	6.06
Total		85,042	75,851	89%	11.59

The project-level realization rate is 89%. The following factors impacted the project gross realization rate:

- The standard measures have a low realization rate (74%) because the ex post savings analysis used the EISA 2007 federal standard baseline wattages, whereas the ex ante savings estimate used the actual baseline lamp wattages.
- The custom measures have a higher realization rate (109%) due to the ex post analysis accounting for heating and cooling interactive effects. A factor applicable to gas heated/electric air conditioned light manufacturing facility in St. Louis was applied to the lighting energy savings (1.09); the ex ante savings estimate did not account for heating and cooling interactive effects.

Site C-21 S-33

Executive Summary

C-21 S-33 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 151%.

Project Description

The customer retrofitted the following fixtures:

- (11) MH fixtures with (11) LED fixtures
- (40) MH fixtures with (40) LED fixtures with Occupancy Sensors
- (194) MH fixtures with (194) LED fixtures
- (37) 8' 2LT12 fixtures with (37) LED fixtures
- (27) 4' 4LT5 fixtures with (27) LED fixtures
- (19) 4' 4LT5 fixtures with (19) LED 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 02/10/2015 to 03/19/2015) 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 interactive 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 interactive 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	11	11	461	91	6,013	78,499	24,473	1.00	157%
MH to LED	40	40	461	91	8,307		122,948	1.00	
MH to LED	194	194	210	89	6,013	97,652	141,152	1.00	145%
Lamp to LED	37	37	398	50	4,553	53,564	77,425	1.00	145%
4' 4LT5 to LED	27	27	236	89	6,013	16,511	23,866	1.00	145%
4' 4LT5 to LED	19	19	236	50	6,013	14,701	21,250	1.00	145%
Total						260,927	411,115		158%

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	40	91	8,307	6,943	15,480	4,965	1.00	32%
Total					15,480	4,965		32%

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	260,927	411,115	158%	62.10
Lighting Controls	Standard	15,480	4,965	32%	0.38
Total		276,407	416,080	151%	62.48

The project-level realization rate is 151%. The following factors impacted the project gross realization rate:

- The ex post analysis hours of operation verified during the M&V site visit (ranging from 6,013 to 8,307), not accounting for the effect of the lighting controls, are greater than the hours of operation used to perform the ex ante estimation (4,160). The lighting realization rate was 158%.
- The lighting controls ex ante energy savings estimate assumes a greater impact on lighting hours than calculated by the ex post energy savings analysis. The

applicant had 15,480 as the ex ante savings in the final application, while the database did not correspond but had 5,000 as the savings. The lighting controls realization rate was 32%.

Site C-13 S-28

Executive Summary

C-13 S-28 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 92%.

Project Description

The customer retrofitted the following fixtures:

- (38) MH fixtures with (38) LED fixtures with Occupancy Sensors
- (38) 8' 2LT12 fixtures with (38) LED fixtures
- (183) MH fixtures with (183) LED fixtures

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 4/23/15 to 5/14/15) 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 interactive 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 interactive 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	38	38	461	224	5,065	458,823	45,618	1.00	
MH to LED	183	183	461	224	8,614		373,596	1.00	
8' 2LT12 to LED	38	38	185	53	8,760	43,890	43,890	1.00	
Total						502,713	463,104		92%

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	38	224	5,065	3,092	17,480	16,794	1.00	96%
Total					17,480	16,794		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 Realization Rate	
Lighting Retrofit	Custom	502,713	463,104	92%	55.43
Lighting Controls	Standard	17,480	16,794	96%	2.03
Total		520,193	479,898	92%	57.46

The project level realization rate is 92%. The following factors impacted the project gross realization rate:

- For two of the light fixture measures the ex post savings analysis hours of operation verified during the M&V site visit (ranging from 5,065 to 8,614), not accounting for the effect of lighting controls, are less than the hours of operation used to perform the ex ante savings estimate (8,760). The overall lighting realization rate is 92%.
- The lighting controls ex ante energy savings estimate assumes a greater impact on lighting hours than calculated by the ex post energy savings analysis. The lighting controls realization rate is 96%.

Site N-10

Executive Summary

N-10 received new construction incentives from Ameren Missouri for retrofitting lighting in the exterior of their facility. The realization rate for this project is 121%.

Project Description

The customer retrofitted the following fixtures:

- (20) MH - Pole fixtures with (20) LED - Pole fixtures
- (6) MH - Wall Pack fixtures with (6) LED - Wall Pack 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 interactive 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 - Pole to LED - Pole	20	20	292	89	4,308	14,383	17,474	1.00	121%
MH - Wall Pack to LED - Wall Pack	6	6	218	63	4,308	3,300	4,009	1.00	121%
Total						17,683	21,483		121%

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	17,683	21,483	121%	0.10
Total		17,683	21,483	121%	0.10

The project-level realization rate is 121%. The following factors impacted the project gross realization rate:

- The ex post savings analysis hours of operation verified during the M&V site visit (4,308) were greater than the lighting hours of operation used to perform the ex ante savings estimate (3,546), resulting in a realized energy savings being higher than expected. The ex post estimate of lighting operating hours was developed by referencing the Naval Observatory Sunrise/Sunset calendar.
- The ex ante hours of operation were based on the actual building hours and not the non-daylighting hours for the exterior application.

Site C-26 S-32

Executive Summary

C-26 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 103%.

Project Description

The customer retrofitted the following fixtures:

- (3) 2' 2LT8 U-Tube fixtures with (3) LED Troffer fixtures
- (1) 2' 2LT8 U-Tube fixture with (1) LED Troffer fixture
- (1) 4' 4LT8 fixture with (1) LED Luminaire fixture
- (8) 4' 4LT9 fixtures with (8) LED Troffer fixtures
- (30) 4' 4LT10 fixtures with (30) LED Troffer fixtures
- (1) 4' 4LT11 fixture with (1) LED Luminaire fixture
- (2) 4' 4LT12 fixtures with (2) LED Troffer fixtures
- (4) 4' 4LT13 fixtures with (4) LED Troffer fixtures
- (1) MH fixture with (1) LED Area Light fixture
- (1) MH fixture with (1) LED Wall Pack fixture
- (3) MH fixtures with (3) LED Wall Pack fixtures
- (14) MH fixtures with (14) LED Canopy fixtures
- (3) MH fixtures with (3) LED Area Light fixtures
- (1) MH fixture with (1) LED Area Light fixture
- (2) Incandescent fixtures with (2) LED Lamp fixtures
- (13) Fluorescent Case Lighting fixtures with (13) 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 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 interactive 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					
2' 2LT8 U-Tube to LED Troffer	3	3	59	35	8,760	631	699	1.11	111%
2' 2LT8 U-Tube to LED Troffer	1	1	59	35	8,760	210	233	1.11	111%
4' 4LT8 to LED Luminaire	1	1	112	44	8,760	596	660	1.11	111%
4' 4LT8 to LED Troffer	8	8	112	44	8,760	4,765	5,278	1.11	111%
4' 4LT8 to LED Troffer	30	30	112	44	8,760	17,870	19,793	1.11	111%
4' 4LT8 to LED Luminaire	1	1	112	44	8,760	596	660	1.11	111%
4' 4LT8 to LED Troffer	2	2	112	44	8,760	1,191	1,320	1.11	111%
4' 4LT8 to LED Troffer	4	4	112	44	8,760	2,383	2,639	1.11	111%
MH to LED Area Light	1	1	1,080	168	4,308	3,995	3,929	1.00	98%
MH to LED Wall Pack	1	1	132	42	4,308	394	388	1.00	98%
MH to LED Wall Pack	3	3	132	42	4,308	1,183	1,163	1.00	98%
MH to LED Canopy	14	14	461	122	4,308	20,787	20,445	1.00	98%
MH to LED Area Light	3	3	461	168	4,308	3,850	3,787	1.00	98%
MH to LED Area Light	1	1	461	168	4,308	1,283	1,262	1.00	98%
Incandescent to LED Lamp	2	2	43	14	8,760	1,077	572	1.11	53%
Fluorescent Case Lighting to LED Case Lighting	13	13	45	25	8,760	5,577	5,442	1.25	98%
Total						66,388	68,268		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	1,077	572	53%	0.08
Lighting Retrofit	Custom	59,734	62,254	104%	4.42
Case Lighting Retrofit	Standard	5,577	5,442	98%	0.67
Total		66,388	68,268	103%	5.17

The project-level realization rate is 103%. The following factors impacted the project gross realization rate:

- The standard lighting measure had a lower realization rate (53%) because the ex post savings analysis used the EISA 2007 federal standard baseline wattages, whereas the ex ante savings estimate used the actual baseline lamp wattages.

- The interior lighting fixtures accounted for heating and cooling interactive effects. A factor applicable to gas heated/ electric air conditioned small retail facilities in St. Louis was applied to the lighting energy savings (1.11); the interior lighting fixture ex ante savings estimate did not account for heating and cooling interactive effects. The custom interior lighting fixtures realization rate was 111%.
- The ex post savings analysis of exterior fixtures was premised upon hours of operation (4,308) slightly less than the hours of operation used to perform the ex ante savings estimate (4,380), resulting in a realized energy savings being slightly lower than expected. The ex post estimate of exterior fixture lighting operating hours was developed by referencing the Naval Observatory Sunrise/Sunset calendar. The custom exterior lighting fixture realization rate was 98%.
- The case lighting measure was slightly lower than expected. The ex post savings analysis used the actual base and efficient wattages, case lighting heating and cooling interactive factor, and the hours of operation for the cases whereas the ex ante savings estimate used the TRM deemed savings factor. The case lighting realization rate was 98%.

Site C-27 S-34

Executive Summary

C-27 S-34 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:

- (14) MH fixtures with (7) LED Area Light fixtures
- (18) MH fixtures with (18) LED Canopy fixtures
- (3) MH fixtures with (3) LED Wall Pack fixtures
- (1) 2' 2L U-tube fixture with (1) LED Troffer fixture
- (1) 2' 2L U-tube fixture with (1) LED Troffer fixture
- (4) 4' 2LT12 fixtures with (4) LED Troffer fixtures
- (14) 4' 2LT12 fixtures with (14) LED Troffer fixtures
- (2) Incandescent fixtures with (2) LED Lamp fixtures
- (8) Fluorescent Case Lighting fixtures with (8) 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 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 interactive 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 Area Light	14	7	461	421	4,308	15,361	15,108	1.00	98%
MH to LED Canopy	18	18	461	122	4,308	26,727	26,287	1.00	98%
MH to LED Wall Pack	3	3	295	93	4,308	2,654	2,611	1.00	98%
2' 2L U-tube to LED Troffer	1	1	59	35	8,760	210	233	1.11	111%
2' 2L U-tube to LED Troffer	1	1	59	35	8,760	210	233	1.11	111%
4' 2LT12 to LED Troffer	4	4	82	44	8,760	1,332	1,475	1.11	111%
4' 2LT12 to LED Troffer	14	14	82	44	8,760	4,660	5,162	1.11	111%
Incandescent to LED Lamp	2	2	43	10	8,760	885	650	1.11	73%
Fluorescent Case Lighting to LED Case Lighting	8	8	59	23	8,760	3,432	3,168	1.26	92%
Total						55,471	54,926		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	885	650	73%	0.09
Lighting Retrofit	Custom	51,154	51,107	100%	1.37
Case Lighting	Standard	3,432	3,168	92%	0.39
Total		55,471	54,926	99%	1.84

The project-level realization rate is 99%. The following factors impacted the project gross realization rate:

- The standard interior lighting fixtures had a lower realization rate (73%). Because the ex post analysis used the EISA 2007 federal standard baseline wattages, whereas the ex ante savings estimate used the actual baseline lamp wattages.
- The ex post savings analysis of the interior lighting fixtures accounted for heating and cooling interactive effects. A factor applicable to gas heated/electric air conditioned small retail facilities in St. Louis (1.11); the interior lighting fixture ex ante savings estimate did not account for heating and cooling interactive effects. The custom interior lighting fixtures realization rate was 111%.
- The ex post savings analysis of the exterior fixtures was premised upon hours of operation (4,308) slightly less than the hours of operation used to perform the ex ante savings estimate (4,380), resulting in a realized energy savings being slightly lower than expected. The ex post estimate of exterior fixture lighting operating hours was developed by referencing the Naval Observatory

Sunrise/Sunset calendar. The custom exterior lighting fixture realization rate was 98%.

- The case lighting measure was slightly lower than expected. The ex post savings analysis used the actual base and efficient wattages, case lighting heating and cooling interactive factor, and the hours of operation for the cases whereas the ex ante savings estimate used the TRM deemed savings factor. The case lighting realization rate was 92%.

Site C-29 S-30

Executive Summary

C-29 S-30 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 93%.

Project Description

The customer retrofitted the following fixtures:

- (7) MH fixtures with (7) LED Canopy fixtures
- (2) MH fixtures with (2) LED Area Light fixtures
- (8) MH fixtures with (7) LED Area Light fixtures
- (3) MH fixtures with (3) LED Wall Pack fixtures
- (16) 4' 4LT8 fixtures with (16) LED Troffer fixtures
- (3) 4' 4LT8 fixtures with (3) LED Troffer fixtures
- (8) 4' 4LT8 fixtures with (8) LED Troffer fixtures
- (18) Fluorescent Case Lighting fixtures with (18) 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 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 interactive 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 Canopy	7	7	210	43	4,308	5,120	5,036	1.00	98%
MH to LED Area Light	2	2	461	168	4,308	2,567	2,524	1.00	98%
MH to LED Area Light	8	7	461	168	4,308	11,003	10,821	1.00	98%
MH to LED Wall Pack	3	3	461	134	4,308	4,297	4,226	1.00	98%
4' 4LT8 to LED Troffer	16	16	112	44	8,760	9,531	10,556	1.11	111%
4' 4LT8 to LED Troffer	3	3	112	44	8,760	1,787	1,979	1.11	111%
4' 4LT8 to LED Troffer	8	8	112	44	8,760	4,765	5,278	1.11	111%
Fluorescent Case Lighting to LED Case Lighting	18	18	53	21	8,760	10,725	6,467	1.28	60%
Total						50,391	46,888		93%

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	39,666	40,421	102%	2.57
Case Lighting Retrofit	Standard	10,725	6,467	60%	0.75
Total		50,391	46,888	93%	3.32

The project-level realization rate is 93%. The following factors impacted the project gross realization rate:

- The ex post savings analysis of the interior lighting fixtures accounted for heating and cooling interactive effects. A factor applicable to gas heated/electric air conditioned small retail facilities in St. Louis was applied to the lighting energy savings (1.11); the interior lighting fixture ex ante savings estimate did not account for heating and cooling interactive effects. The interior lighting fixtures realization rate was 111%.
- The ex post savings analysis of the exterior fixtures was premised upon hours of operation (4,308) slightly less than the hours of operation used to perform the ex ante savings estimate (4,380), resulting in a realized energy savings being slightly lower than expected. The ex post estimate of exterior fixture lighting operating hours was developed by referencing the Naval Observatory Sunrise/Sunset calendar. The exterior lighting fixture realization rate was 98%.
- The low realization rate for the case lighting measure (60%) results from the following:
    - The ex post savings analysis used the actual base and efficient wattages, case lighting heating and cooling interactive factor, and the hours of

operation for the cases whereas the ex ante savings estimate used the TRM deemed savings factor.

- The ex ante savings estimate for the number of doors (25) was higher than the actual number of doors verified during the M&V site visit (18).
- The application and invoice cited a higher number of case lamps (24) than were actually installed (22). The site contact confirmed that he returned the extra lamps.

Site S-2

Executive Summary

S-2 received standard incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 103%.

Project Description

The customer retrofitted the following fixtures:

- (228) Incandescent A lamps with LED lamps
- (675) Incandescent lamps with LED lamps
- (177) Incandescent Globes lamps with LED lamps
- (168) Incandescent A lamps with 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:

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

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
HCIF	= HVAC interactive 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*	*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	228	228	43	11	8,760	97,867	74,583	1.17	76%
Incandescent Down Light to LED	675	675	65	10	8,760	325,215	379,510	1.17	117%
Incandescent Globes to LED	177	177	40	5	8,760	55,043	64,233	1.17	117%
Incandescent to LED	168	168	53	14	8,760	89,772	66,978	1.17	75%
Total						567,897	585,305		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	567,897	585,305	103%	78.23
Total		567,897	585,305	103%	78.23

The project-level realization rate is 103%. The following factors impacted the project gross realization rate:

- The ex post savings analysis of the interior lighting fixtures accounted for heating and cooling interactive effects. A factor applicable to gas heated/electric air-conditioned hotel facilities in St. Louis was applied to the lighting energy savings (1.17); the interior lighting fixture ex ante savings estimate did not account for heating and cooling interactive effects.
- Two of the measures had a lower realization rate because the ex post savings analysis used the EISA 2007 federal standard baseline wattages (43 and 53), whereas the ex ante savings estimate used the actual baseline lamp wattages (60 and 75).

Site S-3

Executive Summary

S-3 received standard incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 37%.

Project Description

The customer retrofitted the following fixtures:

- (2521) Incandescent lamps with LED lamps
- (523) Halogen lamps with LED lamps
- (1388) Incandescent lamps with 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 interactive 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	2,521	2,521	43	10	1,145	315,125	111,114	1.17	35%
Halogen to LED	523	523	65	12	1,145	69,298	37,022	1.17	53%
Incandescent to LED	1,388	1,388	43	13	1,145	163,090	55,615	1.17	34%
Total						547,513	203,751		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	Standard	547,513	203,751	37%	0.00
Total		547,513	203,751	37%	0.00

The project-level realization rate is 37%. The following factors impacted the project gross realization rate:

- The ex post savings analysis was premised upon hours of operation (1,145) which is lower than the hours of operation used to perform the ex ante savings estimate (2,500), resulting in a realized energy savings lower than expected. The ex post estimate cites the DEER 2005 guest room lighting operation estimate. This average value has been corroborated through ADM's extensive fixture-level and circuit-level monitoring of guest room lighting operation.
- Two measures had an even lower realization rate (34% & 35%) because the ex post savings analysis used the EISA 2007 federal standard baseline wattages (43), whereas the ex ante savings estimate used the actual baseline lamp wattages (60).

Site C-24

Executive Summary

C-24 received custom 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 in the retail area:

- (99) HPS fixtures with (99) LED fixtures
- (230) HPS fixtures with (193) LED fixtures
- (18) HPS fixtures with (12) 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 interactive 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 LED	99	99	165	55	8,760	94,416	105,280	1.10	112%
HPS to LED	230	193	116	55	8,760	140,729	155,310	1.10	110%
HPS to LED	18	12	116	50	8,760	13,035	14,385	1.10	110%
Total						248,180	274,975		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	Custom	248,180	274,975	111%	36.57
Total		248,180	274,975	111%	36.57

The project-level realization rate is 111%. The following factors impacted the project gross realization rate:

- The ex post savings analysis accounted for heating and cooling interactive effects. A factor applicable to gas heated/electric air conditioned large retail facilities in St. Louis was applied to the lighting energy savings (1.10); the ex ante savings estimate did not account for heating and cooling interactive effects.
- The hours of operation for the project (8,760) were confirmed during the M&V site visit. The first measure had an ex ante savings estimate with lower hours of operation (8,670), resulting in this measure having a realization rate of 112%.

Site C-18

Executive Summary

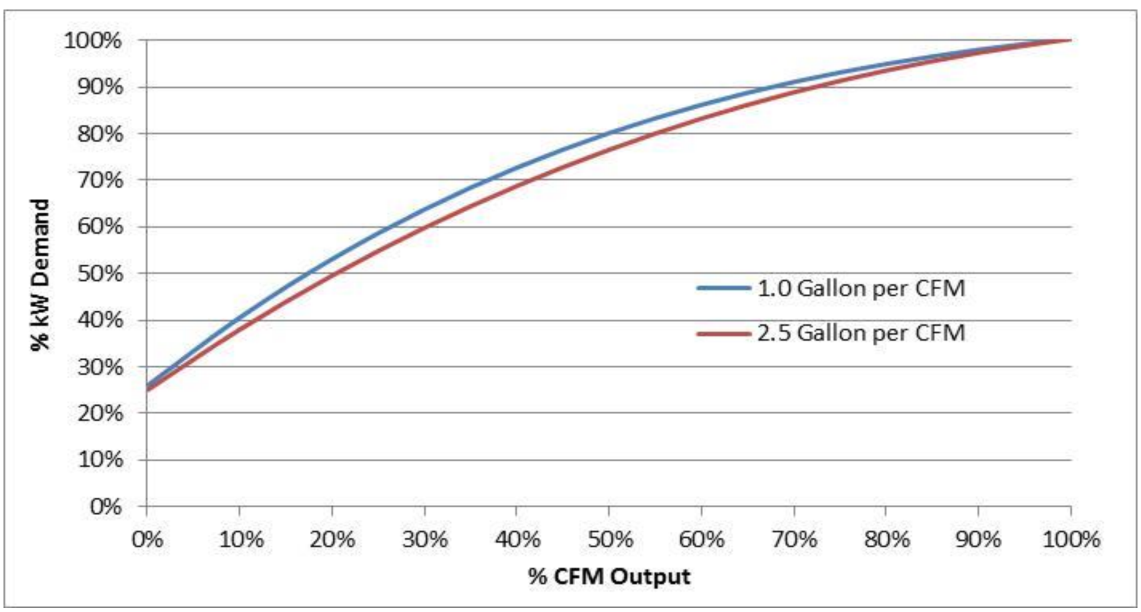
C-18, received custom incentives from Ameren Missouri for the replacement of a single large air compressor with two smaller compressors, installation of a 2,560-gallon receiver, and (7) zero loss drain valves. The project-level realization rate is 180%.

Project Description

The customer originally relied on a single 350 Hp Ingersoll Rand compressor with load/unload controls to provide compressed air to the facility. Through a compressed air study, it was found that the compressor typically operates below 65% of its total capacity. At this low operating point, the compressor is operating inefficiently, and as a solution, (2) Atlas Copco G160-125 compressors were installed. The two smaller compressors allow the system to load much more efficiently as a single compressor typically operates higher on its part load curve, while the second compressor is on stand-by and comes online in events of high demand.

In order to improve the overall efficiencies of the new Atlas Copco compressors with load/unload controls, an additional 2,560 gallons of air storage was added. The addition of the new storage tank brought the ratio of storage gallons per CFM of trim compressor output to 2.5 from 1.0. The graph below illustrates the impacts of the additional storage on the efficiency curve of a load/unload compressor:

Load/Unload Compressor Efficiency Curve



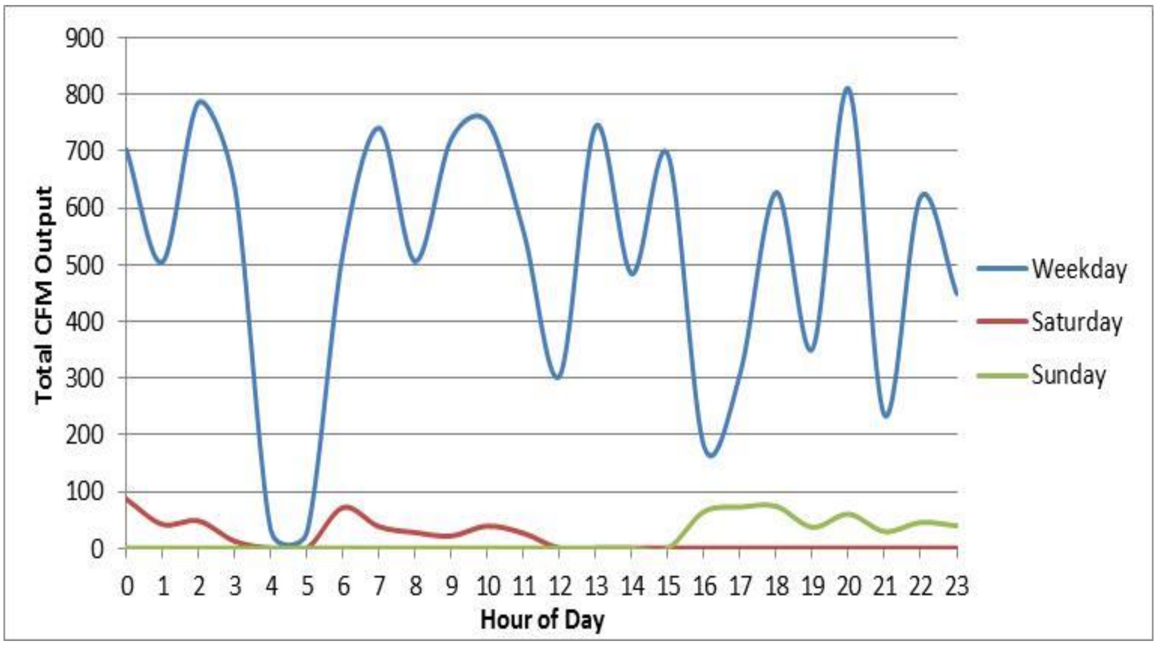
Originally the compressed air system relied on an array of (7) timer based drains to purge moisture from the system. These valves were replaced with zero loss drains valves and are estimated to save 3 CFM per drain valve for a total of 21 CFM.

Measurement and Verification Effort

ADM visited the facility and confirmed the installation of the air compressors, receiver, and zero loss drain valves. During the site visit power monitoring equipment was installed on each of the new Atlas Copco compressors. During the three week monitoring period, kW demand of the compressors was recorded at five minute intervals.

Using the monitored power data in conjunction with CAGI compressor curves, ADM calculated the corresponding CFM output of the compressors for each recorded data point. This data was then used to calculate the typical flow profiles for a weekday, Saturday, and Sunday. The graph below illustrates the calculated CFM profiles based on ADM's post installation monitoring data:

Weekly Compressed Air CFM Demand



Using the fore mentioned 2.5 gallon per CFM load/unload efficiency curve and the typical CFM flow schedule shown above, the corresponding energy usage for the baseline compressor was determined. The difference between the baseline compressor and as-built compressor usage extrapolated to an entire year is equal to the savings for the replacement of the pre-existing Ingersoll Rand compressor.

Savings for the installation of the air receiver was calculated using the calculated air flow profile in conjunction with the 1.0 and 2.5 gallon per CFM load/unload efficiency curves for the pre-existing Ingersoll Rand Compressor. The annual savings is equal to the difference between the baseline compressor usage with a 1.0 gallon per CFM load/unload efficiency curve and as-built compressor usage with a 2.5 gallon per CFM load/unload efficiency curve extrapolated to an entire year.

Annual energy savings for the installation of the zero loss drain valves was calculated by creating a second air flow profile in which an additional 21 CFM was added to each hour of the above air flow profile. Using the two flow profiles in conjunction with the 2.5

gallon per CFM load/unload efficiency curve, the annual energy consumption for both the pre and post zero loss drain valve installation was determined. The annual energy savings is the difference between the pre and post energy consumption extrapolated to an entire year.

Results

Verified Gross Savings/Realization Rates

Measure Category	Incentive	Gross kWh Savings			Gross Ex Post Peak kW Reduction
		Ex Ante	Ex Post	Realization Rate	
Compressor Replacement	Custom	275,036	486,308	177%	61.99
Air Storage	Custom	31,303	74,437	238%	8.25
Drain Valves	Custom	18,560	24,468	132%	3.75
Total		324,899	585,212	180%	73.99

The realization rate for the project is 180%. The difference between the ex ante and ex post savings can be attributed to the ex ante analysis using pre-implementation monitoring data for a limited period of six days, while ADM relied on three weeks of post-implementation monitoring data. During the initial air study, the facility was only operating five days per week with no operation on the weekends. During the M&V site visit, ADM was informed that the facility operates for a single shift on Saturday, and there has been an increase in production by approximately 10% since the initial air study.

Site C-16

Executive Summary

C-16 received custom 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 in the retail area:

- (263) 4' 4LT8 lamps with (263) LED lamps
- (45) 4' 3LT8 lamps with (45) LED lamps
- (258) 4' 4LT8 lamps with (258) LED lamps
- (5) 4' 3LT8 lamps with (5) LED lamps
- (42) 4' 4LT8 lamps with (42) LED lamps
- (46) 4' 3LT8 lamps with (46) LED lamps
- (117) 4' 2LT8 lamps with (117) LED lamps
- (168) 4' 1LT8 lamps with (168) LED lamps
- (42) 8' 2LT12 lamps with (42) LED lamps
- (33) 4' 2LT12 lamps with (33) 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 interactive 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' 4LT8 to LED	263	263	112	68	8,760	100,329	111,873	1.10	112%
4' 3LT8 to LED	45	45	85	51	8,760	13,403	14,791	1.10	110%
4' 4LT8 to LED	258	258	112	68	8,760	99,444	109,747	1.10	110%
4' 3LT8 to LED	5	5	85	51	8,760	1,489	1,643	1.10	110%
4' 4LT8 to LED	42	42	112	68	8,760	16,188	17,866	1.10	110%
4' 3LT8 to LED	46	46	85	51	8,760	13,701	15,120	1.10	110%
4' 2LT8 to LED	117	117	62	36	8,760	26,648	29,409	1.10	110%
4' 1LT8 to LED	168	168	30	19	8,760	16,188	17,866	1.10	110%
8' 2LT12 to LED	42	42	138	44	8,760	34,584	38,168	1.10	110%
4' 2LT12 to LED	33	33	82	36	8,760	13,298	14,675	1.10	110%
Total						335,272	371,158		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	Custom	335,272	371,158	111%	49.36
Total		335,272	371,158	111%	49.36

The project-level realization rate is 111%. The following factors impacted the project gross realization rate:

- The ex post savings analysis accounted for heating and cooling interactive effects. A factor applicable to gas heated/electric air conditioned large retail facilities in St. Louis was applied to the lighting energy savings (1.10); the ex ante savings estimate did not account for heating and cooling interactive effects.
- The hours of operation for the project (8,760) were confirmed during the M&V site visit. The first measure had an ex ante savings estimate with lower hours of operation (8,670), resulting in this measure having a realization rate of 112%.

Site C-19

Executive Summary

C-19 received custom incentives from Ameren Missouri for retrofitting lighting in the exterior of their facility. The realization rate for this project is 100%.

Project Description

The customer retrofitted the following fixtures:

- (280) HPS fixtures with (280) 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 interactive 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 LED	280	280	302	46	4,308	308,797	308,789	1.00	100%
Total						308,797	308,789		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	308,797	308,789	100%	3.08
Total		308,797	308,789	100%	3.08

The project-level realization rate is 100%, which indicates a highly accurate ex ante savings estimation.

Site S-27

Executive Summary

S-27 received standard 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:

- (50) Incandescent lamps with (50) 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 interactive 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	53	17	8,760	23,214	25,403	1.09	109%
Total						23,214	25,403		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	23,214	25,403	109%	2.59
Total		23,214	25,403	109%	2. 59

The project-level realization rate is 109%. The ex post savings analysis accounted for heating and cooling interactive effects. A factor applicable to gas heated/electric air conditioned nursing home facilities in St. Louis was applied to the lighting energy savings (1.09); the ex ante savings estimate did not account for heating and cooling interactive effects.

Site C-6

Executive Summary

C-6 received custom incentives from Ameren Missouri for retrofitting lighting in the exterior of their facility. The realization rate for this project is 100%.

Project Description

The customer retrofitted the following fixtures:

- (188) MH fixtures with (188) LED fixtures
- (1258) MH fixtures with (1258) LED fixtures
- (18) MH fixtures with (18) LED wall packs
- (161) MH fixtures with (161) LED fixtures
- (31) 4' 1LT12 fixtures with (31) LED fixtures
- (16) MH fixtures with (16) 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 interactive 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	188	188	461	211	4,308	205,860	202,470	1.00	98%
MH to LED	1,258	1,258	210	55	8,760	1,708,112	1,708,112	1.00	100%
MH to LED	18	18	461	211	4,308	19,710	19,385	1.00	98%

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	161	161	461	104	4,308	251,749	247,604	1.00	98%
4' 1LT12 to LED	31	31	82	12	8,760	19,009	19,009	1.00	100%
MH to LED	16	16	100	35	8,760	9,110	9,110	1.00	100%
Total						2,213,550	2,205,692		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	2,213,550	2,205,692	100%	202.88
Total		2,213,550	2,205,692	100%	202.88

The project-level realization rate is 100%, which indicates a highly accurate ex ante savings estimation.

Site R-3

Executive Summary

R-3 received incentives from Ameren Missouri for a HVAC retro-commissioning project. The realization rate for this project is 80%.

Project Description

In order to reduce energy consumption throughout the building, a retro-commissioning study was performed and identified measures for implementation. The following measures were implemented:

- Supply air static pressure reset
- Based on zone cooling demand
- Air handling unit occupied and unoccupied scheduling
- Terminal device occupied and unoccupied scheduling
- Repair return/mixed/outside air damper operations
- Implement single PID loop point of control

Measurement and Verification Effort

During the M&V visit, ADM staff verified that the RCx measures by reviewing equipment operation, installation, and documenting the control system changes in the building automation system (BAS).

ADM calculated the annual energy savings for the installed measures through the use of the supplied ex ante calculators. Each retrofitted air handler had a separate calculator that used hourly weather data, trended data, and site specific data to calculate their estimated annual energy use. Site specific data included equipment, building, and loads data. Trended data from each air handler included discharge air, return air, and mixed air temperatures, and unit flow rates. From this data, engineering equations were used to estimate the energy used by the air handler and associated building equipment required to heat and cool the spaces in the baseline and retrofit configurations. The savings is the difference between the calculated baseline and retrofit configuration's energy use. Baseline and retrofit energy use is calculated using the equation below:

$$Building\ kW = Equip\ Sens\ Load + Lighing\ Sens\ Load + Fan\ Energy\ Total + CHW\ Cooling$$

Where:

Building kW	= Total building end use energy
Equip Sense Load (kW)	= Calculated equipment space load
Lighting Sense Load (kW)	= Calculated lighting space load
Fan Energy Total (kW)	= Sum of the supply, return, relief, and exhaust air handler fan energies
CHW Cooling (kW)	= Calculated air handler chiller demand based on cooling coil load

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 Optimization	RCx	3,456,101	2,781,462	80%	-
Total		3,456,101	2,781,462	80%	-

The project level realization rate is 80%. The realization rate can be attributed to the ex ante analysis underestimating the building cooling loads and assuming several air handlers brought in little to no outside air for the entire year in the baseline configuration. The ex ante attributed savings for a baseline with little to no outside air.

The ex ante calculations estimate the peak building cooling load is 3.00 Btuh per square foot at 95ºF. However, the ex post calculations estimated the peak building cooling load is 28.66 Btuh per square foot at 98ºF. The ex post cooling load estimate is calculated using a DEER prototypical eQUEST Model of a Hospital using a TMY3 St. Louis weather file. The simulated peak building cooling load was divided by the prototypical model’s total floor area in square feet. The ex ante peak load wasn’t justified in the provided calculations.

Lastly, the ex post analysis does not attribute savings for a baseline with little to no outside air. The ex post analysis assumes that the baseline and as-built minimum damper positions are the same. The ex ante calculations were modified by increasing the baseline minimum outside air CFM fraction to equal the retrofit CFM fraction if it was less than the retrofit CFM fraction.

Site C-2

Executive Summary

C-2 received custom incentives from Ameren Missouri for retrofitting lighting in the exterior of their facility. The realization rate for this project is 100%.

Project Description

The customer retrofitted the following fixtures:

- (3021) MH fixtures with (3021) 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 interactive 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	3,021	3,021	132	30	8,760	2,699,324	2,699,324	1.00	100%
Total						2,699,324	2,699,324		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	2,699,324	2,699,324	100%	308.14
Total		2,699,324	2,699,324	100%	308.14

The project-level realization rate is 100%, which indicates a highly accurate ex ante savings estimation.

Site C-7

Executive Summary

C-7 received custom incentives from Ameren Missouri for retrofitting lighting in the exterior of their facility. The realization rate for this project is 100%.

Project Description

The customer retrofitted the following fixtures:

- (428) MH fixtures with (428) LED fixtures
- (61) MH fixtures with (61) 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*

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	428	428	1,080	285	4,311	1,463,118	1,465,799	1.00	100%
MH to LED	61	61	1,080	238	4,311	220,857	221,261	1.00	100%
Total						1,683,975	1,687,061		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	1,683,975	1,687,061	100%	16.83
Total		1,683,975	1,687,061	100%	16.83

The project-level realization rate is 100%, which indicates a highly accurate ex ante savings estimation.

Site S-17

Executive Summary

S-17 received standard incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 115%.

Project Description

The customer retrofitted the following fixtures in the nursing home area:

- (20) Incandescent fixtures with (20) LED fixtures
- (112) Incandescent fixtures with (112) 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 interactive 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*					
Incandescent to LED	20	20	70	17	8,760	9,286	10,161	1.09	109%
Incandescent to LED	112	112	70	14	8,760	51,999	60,124	1.09	116%
Total						61,285	70,286		115%

Results

Verified Gross Savings/Realization Rates by Measure

Measure Category	*Incentive*	*kWh Savings*			*Realized Peak kW Reduction*
		Expected	*Realized*	*Realization Rate*	
Lighting Retrofit	Standard	61,285	70,286	115%	10.56
Total		61,285	70,286	115%	10.56

The project-level realization rate is 115%. The following factors impacted the project gross realization rate:

- The ex post savings analysis accounted for heating and cooling interactive effects. A factor applicable to gas heated/electric air conditioned nursing home in St. Louis was applied to the lighting energy savings (1.09); the ex ante savings estimate did not account for heating and cooling interactive effects.
- The ex post savings analysis accounted for the installed wattage of the second measure(14) and was confirmed during the M&V site visit, which was lower than the ex ante savings estimate wattage (17), resulting in a higher realization rate (116%).

Site S-24

Executive Summary

S-24 received standard incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 106%.

Project Description

The customer retrofitted the following:

- (68) Incandescent lamps with (68) LED lamps
- (52) Incandescent lamps with (52) 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 interactive 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	68	68	43	9	5,762	17,160	15,112	1.12	88%
Incandescent to LED	52	52	53	7	5,762	11,721	15,408	1.12	131%
Total						28,881	30,520		106%

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	28,881	30,520	106%	6.38
Total		28,881	30,520	106%	6.38

The project-level realization rate is 106%. The ex post operating hours verified during the M&V site visit (5,762) are greater than the lighting operating hours used to perform the ex ante savings estimate (4,900). It appears that the ex ante savings estimate only provided approximately 39 minutes extra per day for cleanup and prep activities above the posted customer hours.

Site C-30

Executive Summary

C-30 received custom incentives from Ameren Missouri for retrofitting lighting in the exterior of their facility. The realization rate for this project is 99%.

Project Description

The customer retrofitted the following fixtures:

- (4) MH fixtures with (4) LED fixtures
- (9) HPS fixtures with (9) LED fixtures
- (12) MH fixtures with (12) LED fixtures
- (5) MH fixtures with (7) 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 interactive 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	4	4	461	120	4,307	5,958	5,875	1.00	99%
HPS to LED	9	9	302	120	4,307	7,155	7,055	1.00	99%
MH to LED	12	12	461	120	4,307	17,874	17,626	1.00	99%
MH to LED	5	7	461	155	4,307	5,329	5,255	1.00	99%
Total						36,316	35,811		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	Custom	36,316	35,811	99%	0.31
Total		36,316	35,811	99%	0.31

The project-level realization rate is 99%. The ex post savings analysis was premised upon hours of operation (4,307) slightly less than the hours of operation used to perform the ex ante savings estimate (4,368), resulting in a realized energy savings being slightly lower than expected.

Site S-29

Executive Summary

S-29 received standard incentives from Ameren Missouri for installing two ENERGY STAR® ice machines. The realization rate for this project is 37%.

Project Description

The customer installed two Manitowoc self-contained ENERGY STAR® ice machines.

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, nameplate information, and operating characteristics.

Ice machine energy savings are calculated based on Ameren Missouri TRM calculations:

$$\Delta kWh = \left(\frac{kwh\ base}{100lbs} - \frac{kwh\ eff}{100lbs}\right) * \frac{\frac{lbs}{24hrs}}{100lbs} * 365 * LF$$

Where:

$kWh_{savings}$	*= Annual energy savings*
$kWh_{base,\,per100lbs}$	*= Baseline[46] energy usage (kWh/100lbs)*
$kWh_{ee,\,per100lbs}$	*= Energy Efficient energy usage (kWh/100lbs)*
LF	*= Load Factor of ice maker representing time unit is making ice =0.75*
$\frac{\frac{lbs}{24hrs}}{100lbs}$	*= Harvest rate (lbs of ice made per day)*

The table shown below presents ex ante and ex post energy savings for the ENERGY STAR® ice machines installed under the project:

Ice Machine 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 Machine	2	1200	5.7	5.01	12,096	4,533	37%
Total					12,096	4,533	37%

[46] The baseline energy usage comes from Commercial Kitchen Equipment Energy Star Calculator

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	
Ice Maker	Standard	12,096	4,533	37%	1.38
Total		12,096	4,533	37%	1.38

The project-level realization rate is 37%. The ex ante analysis used deemed estimates from the Morgan Measure Libraries. The assumptions used to generate those estimates are unknown. The ex post analysis used the change in usage calculation found in the Ameren Missouri TRM. The equation is a more accurate estimate of savings due to the use of installed ice machine performance data.

Site S-25

Executive Summary

S-25 received standard incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 11%.

Project Description

The customer retrofitted the following fixtures:

- (224) Incandescent lamps with (224) 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 interactive 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	224	224	43	10	438	28,616	3,238	1.00	11%
Total						28,616	3,238		11%

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	28,616	3,238	11%	0.00
Total		28,616	3,238	11%	0.00

The project-level realization rate is 11%. The following factors impacted the project gross realization rate:

- The ex post savings analysis was premised upon hours of operation (438) which are lower than the hours of operation used to perform the ex ante estimate (2,555). The site contact confirmed that all of the lamps were installed in storage units and not in any hallways or offices as stated in the application. In addition, the site contact stated that a “yearly use of 5%” for the light fixtures in the storage units.
- The ex post savings analysis used the EISA 2007 federal standard baseline wattage (43), whereas the ex ante savings estimate used the actual baseline lamp wattage (60).

Site C-14

Executive Summary

C-14 received custom incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 102%.

Project Description

The customer retrofitted the following fixtures in the common area:

- (360) 4' 4LT12 fixtures with (360) 4' 2L LED fixtures
- (40) 4’ 4LT12 fixtures with (40) 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 interactive 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*					
4' 4LT12 to 4' 2L LED	360	360	164	49	8,760	402,960	388,840	1.07	
4' 4LT12 to 4' 2L LED	40	40	164	49	4,380		21,602	1.07	
Total						402,960	410,442		102%

Results

Verified Gross Savings/Realization Rates by Measure

Measure Category	*Incentive*	*kWh Savings*			*Realized Peak kW Reduction*
		Expected	*Realized*	*Realization Rate*	
Lighting Retrofit	Custom	402,960	410,442	102%	53.74
Total		402,960	410,442	102%	53.74

The project-level realization rate is 102%. The following factors impacted the project gross realization rate:

- The ex post savings analysis accounted for heating and cooling interactive effects. A factor applicable to gas heated/electric air conditioned non guestroom hotel facilities in St. Louis was applied to the lighting energy savings (1.07); the ex ante savings estimate did not account for heating and cooling interactive effects.
- The ex post savings analysis hours of operation for 40 of the fixtures (4,380) were less than the hours of operation used to perform the ex ante estimate (8,760).

Site	C-12

Executive Summary

C-12 received custom incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 102%.

Project Description

The customer retrofitted the following fixtures:

- (61) 4' 4LT12 fixtures with (60) LED fixtures
- (88) 4' 2LT12 fixtures with (88) LED fixtures
- (3) 4' 3LT8 fixtures with (3) LED fixtures
- (14) 4' 2LT12 fixtures with (14) LED fixtures
- (4) 4' 2LT12 fixtures with (4) LED fixtures
- (6) 4' 2LT12 fixtures with (6) LED fixtures
- (71) 4' 4LT12 fixtures with (71) LED fixtures
- (18) MH fixtures with (17) LED fixtures
- (8) 4' 2LT12 fixtures with (8) LED fixtures
- (148) 4' 2LT12 fixtures with (148) LED fixtures
- (4) 4' 2LT12 fixtures with (4) LED fixtures
- (3) 4' 2LT12 fixtures with (3) LED fixtures
- (5) 4' 2LT12 fixtures with (5) LED fixtures
- (49) 4' 2LT12 fixtures with (48) LED fixtures
- (18) 4' 2LT12 fixtures with (18) LED fixtures
- (1) MH fixture with (1) LED fixture
- (8) 4' 2LT12 fixtures with (8) LED fixtures
- (10) 4' 2LT12 fixtures with (10) LED fixtures
- (3) 4' 2LT12 fixtures with (3) LED fixtures
- (6) 4' 4LT12 fixtures with (6) LED fixtures
- (90) 4' 2LT12 fixtures with (90) LED fixtures
- (10) 4' 4LT12 fixtures with (10) LED fixtures
- (14) 8' 2LT12HO fixtures with (14) LED fixtures
- (2) 4' 2LT12 fixtures with (2) LED fixtures
- (9) 4' 4LT12 fixtures with (9) LED fixtures
- (7) 4' 2LT12 fixtures with (7) LED fixtures
- (2) 4' 2LT12 fixtures with (2) LED fixtures
- (33) 4' 4LT12 fixtures with (33) LED fixtures
- (1) 2' 2L U-tube T12 fixture with (1) LED fixture
- (38) 4' 2LT12 fixtures with (38) LED fixtures
- (3) 4' 4LT12 fixtures with (3) LED fixtures
- (8) 4' 2LT12 fixtures with (8) LED fixtures
- (9) 4' 2LT12 fixtures with (9) LED fixtures
- (7) 4' 2LT12 fixtures with (7) LED fixtures
- (2) 4' 4LT12 fixtures with (2) LED fixtures
- (8) 8' 2LT12HO fixtures with (8) LED fixtures
- (1) 8' 4LT12HO fixture with (1) LED fixture

- (29) 4' 4LT12 fixtures with (29) LED fixtures
- (15) MH fixtures with (15) LED fixtures
- (1) 8' 2LT12HO fixture with (1) LED fixture
- (5) 4' 4LT12 fixtures with (4) LED fixtures
- (22) 4' 2LT12 fixtures with (21) LED fixtures
- (9) 4' 2LT12 fixtures with (9) LED fixtures

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and placed photo-sensor loggers at the site (from 5/14/15 to 10/2/15) 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 interactive 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 LED	61	60	192	35	4,653	38,448	44,726	1.00	116%
4' 2LT12 to LED	88	88	96	35	4,653	21,472	24,978	1.00	116%
4' 3LT8 to LED	3	3	89	35	4,653	648	754	1.00	116%
4' 2LT12 to LED	14	14	96	35	4,653	3,416	3,974	1.00	116%
4' 2LT12 to LED	4	4	96	18	4,653	1,256	1,461	1.00	116%
4' 2LT12 to LED	6	6	96	47	8,760	2,575	2,575	1.00	100%
4' 4LT12 to LED	71	71	192	35	8,760	97,648	97,648	1.00	100%
MH to LED	18	17	188	47	8,760	22,645	22,645	1.00	100%
4' 2LT12 to LED	8	8	96	47	8,760	3,434	3,434	1.00	100%
4' 2LT12 to LED	148	148	96	47	8,760	63,528	63,528	1.00	100%
4' 2LT12 to LED	4	4	96	47	7,000	1,372	1,372	1.00	100%
4' 2LT12 to LED	3	3	96	47	8,760	1,288	1,288	1.00	100%
4' 2LT12 to LED	5	5	96	47	8,760	2,146	2,146	1.00	100%

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' 2LT12 to LED	49	48	96	47	8,760	21,444	21,444	1.00	100%
4' 2LT12 to LED	18	18	96	47	8,760	7,726	7,726	1.00	100%
MH to LED	1	1	188	47	8,760	1,235	1,235	1.00	100%
4' 2LT12 to LED	8	8	96	47	8,760	3,434	3,434	1.00	100%
4' 2LT12 to LED	10	10	96	47	8,760	4,292	4,292	1.00	100%
4' 2LT12 to LED	3	3	96	35	8,760	1,603	1,603	1.00	100%
4' 4LT12 to LED	6	6	112	35	8,760	4,047	4,047	1.00	100%
4' 2LT12 to LED	90	90	96	47	8,760	38,632	38,632	1.00	100%
4' 4LT12 to LED	10	10	192	47	8,760	12,702	12,702	1.00	100%
8' 2LT12HO to LED	14	14	144	90	8,760	6,623	6,623	1.00	100%
4' 2LT12 to LED	2	2	96	47	8,760	858	858	1.00	100%
4' 4LT12 to LED	9	9	192	47	8,760	11,432	11,432	1.00	100%
4' 2LT12 to LED	7	7	96	47	8,760	3,005	3,005	1.00	100%
4' 2LT12 to LED	2	2	96	47	8,760	858	858	1.00	100%
4' 4LT12 to LED	33	33	192	35	8,760	45,386	45,386	1.00	100%
2' 2L U-tube T12 to LED	1	1	96	35	8,760	534	534	1.00	100%
4' 2LT12 to LED	38	38	96	47	8,760	16,311	16,311	1.00	100%
4' 4LT12 to LED	3	3	192	47	8,760	3,811	3,811	1.00	100%
4' 2LT12 to LED	8	8	96	47	8,760	3,434	3,434	1.00	100%
4' 2LT12 to LED	9	9	96	35	8,760	4,809	4,809	1.00	100%
4' 2LT12 to LED	7	7	96	47	8,760	3,005	3,005	1.00	100%
4' 4LT12 to LED	2	2	192	47	8,760	2,540	2,540	1.00	100%
8' 2LT12HO to LED	8	8	144	90	8,760	3,784	3,784	1.00	100%
8' 4LT12HO to LED	1	1	288	90	8,760	1,734	1,734	1.00	100%
4' 4LT12 to LED	29	29	96	47	8,760	12,448	12,448	1.00	100%
MH to LED	15	15	288	47	8,760	31,667	31,667	1.00	100%
8' 2LT12HO to LED	1	1	264	90	8,760	1,524	1,524	1.00	100%
4' 4LT12 to LED	5	4	192	35	8,760	7,183	7,183	1.00	100%
4' 2LT12 to LED	22	21	96	47	8,760	9,855	9,855	1.00	100%
4' 2LT12 to LED	9	9	96	47	8,760	3,863	3,863	1.00	100%
Total						529,655	540,310		102%

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	529,655	540,310	102%	64.07
Total		529,655	540,310	102%	64.07

The project-level realization rate is 102%. The realization rate is high mainly because the ex post hours of operation verified during the M&V site visit for five measures (4,653) were higher than the lighting hours of operation used to perform the ex ante savings estimate (4,000).

Site S-10

Executive Summary

S-10 received standard incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 78%.

Project Description

The customer retrofitted the following fixtures:

- (600) Incandescent lamps with (600) 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 interactive 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*					
Incandescent to LED	600	600	43	10	8,760	261,600	202,962	1.17	78%
Total						261,600	202,962		78%

Results

Verified Gross Savings/Realization Rates by Measure

Measure Category	Incentive	kWh Savings			Realized Peak kW Reduction
		Expected	Realized	Realization Rate	
Lighting Retrofit	Standard	261,600	202,962	78%	25.9
Total		261,600	202,962	78%	25.9

The project-level realization rate is 78%. The realization rate is low because the minimally efficient lumen equivalent baseline lamp was used for the ex post savings analysis. This is based on the EISA 2007 federal regulation which increased the efficiency standards for incandescent general purpose lighting. In the lumen range of 750 to 1049, the maximum rated wattage for a replacement lamp is 43 watts. The ex ante savings estimate baseline wattage was 60 watts.

Site S-5 and S-6

Executive Summary

S-5 and S-6 received standard incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for these projects is 70%.

Project Description

The customer retrofitted the following:
S-5:

- (800) Incandescent lamps with (800) LED lamps

S-6:

- (800) Incandescent lamps with (800) 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 interactive 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*					
Incandescent to LED	800	800	60	11	8,760	343,392	240,442	1.07	70%
Incandescent to LED	800	800	60	11	8,760	343,392	240,442	1.07	70%
Total						686,784	480,884		70%

Results

Verified Gross Savings/Realization Rates by Measure

Project Number	Measure Category	Incentive	kWh Savings			Realized Peak kW Reduction
			Expected	Realized	Realization Rate	
S-5	Lighting Retrofit	Standard	343,392	240,442	70%	29.91
S-6	Lighting Retrofit	Standard	343,392	240,442	70%	29.91
	Total		686,784	480,884	70%	59.82

The project-level realization rate is 70%. The realization rate is low because the ex post savings analysis used the EISA 2007 federal standard baseline wattage for incandescent lamps, whereas the ex ante savings estimate used the actual baseline lamp wattage.

Site S-22

Executive Summary

S-22 received standard incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 113%.

Project Description

The customer retrofitted the following:

- (74) Incandescent lamps with (74) LED lamps
- (72) Halogen lamps with (72) 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 interactive 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	74	74	43	9	5,762	18,601	16,350	1.12	88%
Halogen to LED	72	72	53	7	5,762	16,229	21,334	1.12	131%
Total						34,830	37,684		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	34,830	37,684	108%	7.87
Total		34,830	37,684	108%	7.87

The project-level realization rate is 108%. The ex post operating hours verified during the M&V site visit (5,762) are greater than the lighting operating hours used to perform the ex ante savings estimate (4,900). It appears that the ex ante savings estimate only provided approximately 45 minutes extra per day for cleanup and prep activities above the posted customer hours.

Site C-33

Executive Summary

C-33 received custom incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 132%.

Project Description

The customer retrofitted the following fixtures:

- (15) 8’ 2 lamp T12s with LED lamps
- (30) 4’ 4 lamp T12s with LED lamps
- (29) 4’ 4 lamp T12s with LED lamps
- (15) 4’ 4 lamp T12s with 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 06/17/2015 to 09/03/2015) 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 interactive 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 LED	15	15	138	36	56	5,569	94	1.10	2%
4' 4LT12 to LED	30	30	164	36	4,040	7,987	17,142	1.10	215%
4' 4LT12 to LED	29	29	164	36	4,040	11,581	16,571	1.10	143%
4' 4LT12 to LED	15	15	164	36	1,512	2,995	3,208	1.10	107%
Total						28,132	37,015		132%

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	28,132	37,015	132%	10.57
Total		28,132	37,015	132%	10.57

The project-level realization rate is 132%. The following factors impacted the project gross realization rate:

- The ex post savings analysis hours of operation for two measures verified during the M&V site visit (4,040) were higher than the hours of operation used to perform the ex ante savings estimate (3,640).
- The ex post savings analysis accounted for heating and cooling interactive effects. A factor applicable to gas heated/electric air conditioned office facilities in Cape Girardeau was applied to the lighting energy savings (1.10); the ex ante savings estimate did not account for heating and cooling interactive effects.
- The ex post savings analysis has one measure with a low realization rate (2%) this is due to the room utilizing natural lighting. The M&V site visit confirmed that the light fixtures are rarely used.

Site C-38

Executive Summary

C-38 received custom incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 145%.

Project Description

The customer retrofitted the following fixtures:

- (30) 2' 2LT12 Utube fixtures with (19) 2x4 LED fixtures
- (9) 4' 4LT12 fixtures with (5) 2x4 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 interactive 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*					
2' 2LT12 Utube to 2x4 LED	30	19	82	57	5,710	5,998	8,708	1.11	145%
4' 4LT12 to 2x4 LED	9	5	164	57	5,710	5,188	7,531	1.11	145%
Total						11,186	16,239		145%

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	11,186	16,239	145%	3.22
Total		11,186	16,239	145%	3.22

The project-level realization rate is 145%. The following factors impacted the project gross realization rate:

- The ex post savings analysis hours of operation verified during the M&V site visit (5,709) were greater than the hours of operation used to perform the ex ante savings estimate (4,356), resulting in a realized energy savings higher than expected.
- The ex post savings analysis accounted for heating and cooling interactive effects. A factor applicable to gas heated/ electric air conditioned retail facilities in Cape Girardeau was applied to the lighting energy savings (1.110; the ex ante savings estimate did not account for heating and cooling interactive effects.

Site C-17 S-21

Executive Summary

C-17 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 118%.

Project Description

The customer retrofitted the following fixtures:

- (18) 8' 2LT12 fixtures with (18) 4' 4LT8 fixtures
- (6) MH fixtures with (6) 4' 6LT8 fixtures
- (50) MH fixtures with (50) 4' 6LT8 fixtures
- (91) HPS fixtures with (91) 4' 6LT8 fixtures
- (8) MH fixtures with (12) 4' 6LT8 fixtures
- (17) 8' 2LT12 fixtures with (17) 4' 4LT8 fixtures
- (46) 8' 2LT12 fixtures with (40) 4' 4LT8 fixtures
- (142) 8' 2LT12 fixtures with (142) 4' 4LT8 fixtures
- (14) 8' 2LT12 fixtures with (14) 4' 4LT8 fixtures
- Installation of (216) 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 6/19/15 to 9/21/15) 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 interactive 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 interactive 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	18	18	227	145	3,211	10,158	4,740	1.00	47%
MH to 4' 6LT8	6	6	461	218	5,856	10,034	8,538	1.00	85%
MH to 4' 6LT8	50	50	461	218	5,856	83,616	71,153	1.00	85%
HPS to 4' 6LT8	91	91	469	218	6,802	157,192	167,287	1.08	106%
MH to 4' 6LT8	8	12	461	218	6,811	7,378	7,302	1.00	99%
8' 2LT12 to 4' 4LT8	17	17	227	145	6,703	4,600	9,344	1.00	203%
8' 2LT12 to 4' 4LT8	46	40	227	145	5,243	16,247	24,337	1.00	150%
8' 2LT12 to 4' 4LT8	142	142	227	145	5,243	40,754	61,047	1.00	150%
8' 2LT12 to 4' 4LT8	14	14	227	145	2,355	1,894	2,703	1.00	143%
Total						331,873	356,451		107%

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	18	145	3,211	1,558	2,250	4,314	1.00	192%
Controls	56	218	5,856	3,466	16,800	29,184	1.00	174%
Controls	142	145	5,243	2,991	17,750	46,363	1.00	261%
Total					36,800	79,862		217%

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	331,873	356,451	107%	60.69
Lighting Controls	Standard	36,800	79,862	217%	11.72
Total		368,673	436,313	118%	72.41

The project-level realization rate is 118%. The following factors impacted the project gross realization rate:

- The ex post savings analysis hours of operation verified during the M&V site visit for four of the measures (ranging from 2,355 to 6,703), not accounting for the effect of lighting controls, are greater than the hours of operation used to perform the ex ante estimate (1,650 to 3,500).
- The ex post savings analysis accounted for heating and cooling interactive effects. A factor applicable to gas heated/electric air conditioned light manufacturing facilities in Kirksville was applied to the lighting energy savings (1.08); the ex ante savings estimate did not account for heating and cooling interactive effects.
- The lighting controls ex ante energy savings estimate assumes a lesser impact on the lighting hours than calculated by the ex post energy savings analysis. The lighting controls realization rate was 217%

Site S-31

Executive Summary

S-31 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:

- (14) Incandescent lamps with (14) LED lamps
- (3) Incandescent lamps with (3) 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 interactive 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	70	11	8,760	7,297	8,073	1.11	111%
Incandescent to LED	3	3	70	10	8,760	1,590	1,759	1.11	111%
Total						8,887	9,832		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	8,887	9,832	111%	1.45
Total		8,887	9,832	111%	1.45

The project-level realization rate is 111%. The realization rate is high because the ex post analysis included a heating and cooling interactive factor for gas heated/air conditioned hotel (non guestroom) in St. Louis (1.11), while the ex ante did not take into account heating and cooling interactive effects.

Site C-39

Executive Summary

C-39 received Custom Incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 215%.

Project Description

The customer retrofitted the following fixtures:

- (19) 8' 2 lamp T12s with LED lamps

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and placed photo-sensor loggers at the site (from 06/17/2015 to 09/03/2015) 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 interactive 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*	*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 LED	19	19	138	36	4,040	4,031	8,651	1.10	215%
Total						4,031	8,651		215%

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	4,031	8,651	215%	2.69
Total		4,031	8,651	215%	2.69

The project-level realization rate is 215%. The following factors impacted the project gross realization rate:

- The ex post savings analysis hours of operation verified during the M&V site visit (4,040) were higher than the hours of operation used to perform the ex ante savings estimate (2,080), resulting in a realized energy savings higher than expected.
- The ex post savings analysis accounted for heating and cooling interactive effects. A factor applicable to gas heated/electric air conditioned off ice in Cape Girardeau was applied to the lighting energy savings (1.10); the ex ante savings estimate did not account for heating and cooling interactive effects.

Site N-5

Executive Summary

N-5 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 103%.

Project Description

The customer installed the following fixtures in the interior of their facility:

- (1433) LED fixtures
- Installation of (63) Wall Occupancy Sensors
- Installation of (175) Ceiling 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 90.1-1989).

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 interactive 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 interactive 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 LED	210	210	90	35	6,570	75,960	83,167	1.09	109%
LPD to LED	13	13	90	35	8,760	4,702	6,865	1.09	146%
LPD to LED	183	183	106	41	6,570	78,211	85,632	1.09	109%
LPD to LED	72	72	106	41	8,760	30,772	44,922	1.09	146%
LPD to LED	62	62	10	4	6,570	2,585	2,830	1.09	109%
LPD to LED	168	168	91	35	6,570	61,293	67,109	1.09	109%
LPD to LED	5	5	91	35	6,570	1,824	1,997	1.09	109%
LPD to LED	60	60	91	35	8,760	21,890	31,957	1.09	146%
LPD to LED	64	64	91	35	6,570	23,350	25,565	1.09	109%
LPD to LED	2	2	91	35	8,760	730	1,065	1.09	146%
LPD to LED	64	64	112	43	6,570	29,007	31,759	1.09	109%
LPD to LED	302	302	112	43	6,570	136,877	149,864	1.09	109%
LPD to LED	22	22	28	11	6,570	2,523	2,762	1.09	109%
LPD to LED	24	24	277	107	6,570	26,769	29,309	1.09	109%
LPD to LED	12	12	277	107	8,760	13,384	19,539	1.09	146%
LPD to LED	11	11	21	8	6,570	917	1,004	1.09	109%
LPD to LED	52	52	98	38	6,570	20,598	22,552	1.09	109%
LPD to LED	23	23	98	38	8,760	9,111	13,300	1.09	146%
LPD to LED	2	2	10	10	6,570	208	-	1.09	0%
LPD to LED	12	12	23	9	6,570	1,126	1,233	1.09	109%
LPD to LED	5	5	10	10	6,570	521	-	1.09	0%
LPD to LED	31	31	3	3	8,760	808	149	1.09	18%
LPD to LED	34	34	2	2	8,760	884	(161)	1.09	-18%
Total						544,049	622,419		114%

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	63	39.63	6,570	4,599	24,381	5,388	1.09	22%
Controls	175	161.97	6,570	4,599	99,750	61,170	1.09	61%
Total					124,131	66,557		54%

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	544,049	622,419	114%	115.84
Lighting Controls	New Construction	124,131	66,557	54%	13.00
Total		668,180	688,977	103%	128.84

The project-level realization rate is 103%. The following factors impacted the project gross realization rate:

- The ex post savings analysis hours of operation verified during the M&V site visit (ranging from 6,570 to 8,760), not accounting for the effect of the lighting controls, were greater than the hours of operation used to perform the ex ante savings estimate (6,570), resulting in a realized energy savings higher than expected.
- The ex post savings analysis accounted for heating and cooling interactive effects. A factor applicable to gas heated/electric air conditioned large office facilities in St. Louis was applied to the lighting energy savings (1.09); the ex ante savings estimate did not account for heating and cooling effects.
- The lighting controls ex ante energy savings estimate assumes a greater impact on lighting hour than calculated by the ex post energy savings analysis. The lighting controls realization rate was 54%.

Site S-1

Executive Summary

S-1 received standard incentives for computer monitoring and power control. The realization rate for this project is 95%.

Project Description

In order to reduce energy consumption throughout the personal computers across many locations, the following was implemented:

- Monitor 12,721 computers with network software,
- Control computer and monitor power when inactive 15 minutes, and
- Add two additional servers to monitor computers.

Measurement and Verification Effort

During the M&V visit, ADM staff reviewed Standard measure by verifying the computer count at a sampled site, and verifying the power control policies programmed for all 12,721 computers on the network at other locations. Also, a one-time power measurement was taken for a desktop computer with CPU running and at rest.

ADM calculated the annual energy savings for the installed measures through the use of network logged data for the period before and after the power policies were enabled. The data was binned to weekend and weekday operations by computer type. From this data, engineering equations were used to estimate the energy usage by the computers from timestamped events for the computer and monitor operating modes. The savings are the difference between the calculated baseline and the retrofit energy usage. Baseline and retrofit energy usage are calculated using the equation below:

$$kWh = S_{new} + \sum_{i=1}^{17} \binom{n}{k} N_i \times (T_{CPUon} \times W_{CPUon} + T_{CPUsleep} \times W_{CPUsleep} + T_{CPUoff} \times W_{CPUoff} + T_{DISPoff} \times W_{DISPoff} + T_{DISPon} \times W_{DISPon})$$

And: $kWh_{savings=}\ kWh_{baseline} - kWh_{retrofit}$

Where:

$kWh_{savings}$ = *Annual energy savings*

S =*Additional network servers, kWh*

N_i = *Number of computers by type*

T_i = *time in computer power state*

W_i =*watts in computer state*

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	
IT, Computer Controls	Standard	1,017,680	964,559	95%	115
Total		1,017,680	964,559	95%	115

The project level realization rate is 95%. The realization rate can be attributed to ex ante estimation expecting full implementation of the power control policies. The parameters for the actual installation were less aggressive for the parameter of computer inactivity before implementing “sleep” mode. Also, the ex post analysis considered the network impact required to implement the computer control project, which included the loads for the two additional network servers.

Site N-9

Executive Summary

N-9 received new construction incentives from Ameren Missouri for retrofitting lighting in the interior and exterior of their facility. The realization rate for this project is 106%.

Project Description

The customer retrofitted the following fixtures:

- (1) HID fixture with (1) LED fixture
- (6) HID fixtures with (6) LED fixtures
- (14) LPD fixtures with (14) LED fixtures
- (3) LPD fixtures with (3) LED fixtures
- (30) LPD fixtures with (30) LED fixtures
- (12) LPD fixtures with (12) LED fixtures

Measurement and Verification Effort

During the M&V visit, ADM staff verified equipment installation, baseline and post-retrofit connected load, and placed photo-sensor loggers at the site (from 11/21/15 to 11/29/15) 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 interactive 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*					
HID to LED	1	1	95	26	4,309	297	297	1.00	100%
HID to LED	6	6	1,080	307	4,309	19,943	19,983	1.00	100%
LPD to LED	14	14	260	43	3,056	9,190	10,270	1.11	112%
LPD to LED	3	3	260	48	3,056	1,924	2,150	1.11	112%
LPD to LED	30	30	260	200	3,056	5,449	6,090	1.11	112%
LPD to LED	12	12	260	150	3,056	3,994	4,464	1.11	112%
Total						40,797	43,254		106%

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	40,797	43,254	106%	9.43
Total		40,797	43,254	106%	9.43

The project-level realization rate is 106%. The following factors impacted the project gross realization rate:

- The ex post savings analysis of the interior lighting fixtures accounted for heating and cooling interactive effects. A factor applicable to gas heated/electric air conditioned office facilities in St. Louis was applied to the lighting energy savings (1.11); the interior lighting fixture ex ante savings estimate did not account for heating and cooling interactive effects.
- The ex post savings analysis hours of operation for the interior lighting fixtures verified during the M&V site visit (3,056) was slightly higher than the hours of operation used to perform the ex ante savings estimate (3,024), resulting in a higher realized energy savings.

Site C-28

Executive Summary

C-28 received custom incentives from Ameren Missouri for retrofitting lighting in the exterior of their facility. The realization rate for this project is 99%.

Project Description

The customer retrofitted the following fixtures:

- (26) MH fixtures with (26) 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 interactive 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	26	26	461	95	4,308	41,566	40,998	1.00	99%
Total						41,566	40,998		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	Custom	41,566	40,998	99%	0.36
Total		41,566	40,998	99%	0.36

The project-level realization rate is 99%. The ex post savings analysis was premised upon hours of operation (4,308) slightly less than the hours of operation used to perform the ex ante savings estimate (4,368), resulting in a realized energy savings being slightly lower than expected. The ex post estimate of lighting operating hours was developed by referencing the Naval Observatory Sunrise/Sunset calendar.

Site S-11

Executive Summary

S-11 received standard incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 93%.

Project Description

The customer retrofitted the following fixtures:

- (200) Incandescent fixtures with (200) LED fixtures
- (190) Incandescent fixtures with (190) LED fixtures
- (240) Incandescent fixtures with (240) 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 interactive 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	200	200	35	6	8,760	50,808	56,209	1.11	111%
Incandescent to LED	190	190	40	5	8,760	58,254	64,446	1.11	111%
Incandescent to LED	240	240	43	7	8,760	112,478	84,894	1.11	75%
Total						221,540	205,549		93%

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	221,540	205,549	93%	30.31
Total		221,540	205,549	93%	30.31

The project-level realization rate is 93%. The following factors impacted the project gross realization rate:

- The ex post savings analysis accounted for heating and cooling interactive effects. A factor applicable to gas heated/electric air conditioned hotel facilities in St. Louis was applied to the lighting energy savings (1.11); the ex ante savings estimate did not account for heating and cooling interactive effects. The first two measures have a realization rate of 111%.
- The third measure has a lower realization rate (75%) because the ex post savings analysis used the EISA 2007 federal standard baseline wattage (43), whereas the ex ante savings estimate used the actual baseline lamp wattage (60).

Site N-6

Executive Summary

N-6 received new construction incentives from Ameren Missouri for lighting in the interior of their facility. The realization rate for this project is 94%.

Project Description

The customer retrofitted the following fixtures:

- (92) Lumen Equivalent MH fixtures with (92) 4' 6LT5HO 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 6/12/15 to 9/23/15) 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 interactive 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*					
Lumen Equivalent MH to 4' 6LT5HO	92	92	876	360	6,999	387,912	363,519	1.09	94%
Total						387,912	363,519		94%

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	387,912	363,519	94%	67.57
Total		387,912	363,519	94%	67.57

The project-level realization rate is 94%. The following factors impacted the project gross realization rate:

- The ex post analysis hours of operation verified during the M&V site visit (6,999) are less than the lighting hours of operation used to perform the ex ante savings estimate (8,170), resulting in a realized energy savings lower than expected.
- The ex post savings analysis accounted for heating and cooling interactive effects. A factor applicable to gas heated/electric air conditioned light manufacturing facilities in St. Louis was applied to the lighting energy savings (1.09); the ex ante savings estimate did not account for heating and cooling interactive effects.

Site C-10 S-23

Executive Summary

C-10 S-23 received custom and standard 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 111%.

Project Description

The customer retrofitted the following fixtures:

- (6) Incandescent lamps with (6) LED lamps
- (14) MH fixtures with (9) 4' 4LT5HO fixtures
- (12) MH fixtures with (16) 4' 4LT5 fixtures
- (2) MH fixtures with (2) 4' 4LT5HO fixtures
- (6) MH fixtures with (6) 4' 4LT5HO fixtures
- (33) MH fixtures with (29) 4' 4LT5HO fixtures
- (5) MH fixtures with (5) 4' 4LT5HO fixtures
- (3) 4' 2LT12 fixtures with (3) LED fixtures
- (5) 4' 2LT12 fixtures with (5) LED fixtures
- (8) MH fixtures with (8) 4' 4LT5HO fixtures
- (3) MH fixtures with (3) 4' 4LT5HO fixtures
- (2) MH fixtures with (2) 4' 4LT5HO fixtures
- (6) MH fixtures with (6) LED fixtures
- (45) MH fixtures with (45) 4' 4LT5 fixtures
- (22) MH fixtures with (22) 4' 4LT5 fixtures
- (37) MH fixtures with (31) 4' 4LT5 fixtures
- (12) MH fixtures with (12) 4' 4LT5HO fixtures
- (6) MH fixtures with (6) 4' 4LT5HO fixtures
- (58) MH fixtures with (58) 4' 4LT5HO fixtures
- (26) MH fixtures with (26) 4' 4LT5HO fixtures
- (13) MH fixtures with (13) 4' 4LT5HO fixtures
- (4) MH fixtures with (4) 4' 4LT5HO fixtures
- (2) MH fixtures with (2) 4' 4LT5HO fixtures
- (6) MH fixtures with (6) 4' 4LT5HO fixtures
- (77) MH fixtures with (77) LED Wall Pack fixtures
- (58) 4' 2LT12 fixtures with (58) LED fixtures
- (7) MH fixtures with (7) 4' 4LT8 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 photo-sensor loggers at the site (from 5/15/15 to 10/22/15) 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 interactive 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 interactive 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	6	6	65	14	4,000	1,224	1,339	1.09	109%
MH to 4' 4LT5HO	14	9	460	226	8,760	38,597	42,218	1.09	109%
MH to 4' 4LT5	12	16	460	145	8,760	28,032	30,663	1.09	109%
MH to 4' 4LT5HO	2	2	460	226	8,760	4,100	4,484	1.09	109%
MH to 4' 4LT5HO	6	6	460	226	4,000	5,616	6,143	1.09	109%
MH to 4' 4LT5HO	33	29	460	226	8,760	75,564	82,655	1.09	109%
MH to 4' 4LT5HO	5	5	460	226	4,000	4,680	5,119	1.09	109%
4' 2LT12 to LED	3	3	62	47	7,000	1,029	345	1.09	33%
4' 2LT12 to LED	5	5	62	47	5,000	1,225	410	1.09	33%
MH to 4' 4LT5HO	8	8	460	226	4,000	7,488	8,190	1.09	109%
MH to 4' 4LT5HO	3	3	460	226	8,760	6,150	6,727	1.09	109%

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' 4LT5HO	2	2	460	226	8,760	4,100	4,484	1.09	109%
MH to LED	6	6	460	90	8,760	19,447	21,272	1.09	109%
MH to 4' 4LT5	45	45	460	145	8,760	124,173	135,825	1.09	109%
MH to 4' 4LT5	22	22	460	145	8,760	60,707	66,404	1.09	109%
MH to 4' 4LT5	37	31	460	145	8,760	109,719	120,015	1.09	109%
MH to 4' 4LT5HO	12	12	460	226	8,760	24,598	26,906	1.09	109%
MH to 4' 4LT5HO	6	6	460	226	8,760	12,299	13,453	1.09	109%
MH to 4' 4LT5HO	58	58	460	226	8,760	118,891	130,048	1.09	109%
MH to 4' 4LT5HO	26	26	460	226	8,760	53,296	58,297	1.09	109%
MH to 4' 4LT5HO	13	13	460	226	8,760	26,648	29,149	1.09	109%
MH to 4' 4LT5HO	4	4	460	226	8,760	8,199	8,969	1.09	109%
MH to 4' 4LT5HO	2	2	460	226	8,760	4,100	4,484	1.09	109%
MH to 4' 4LT5HO	6	6	460	226	8,760	12,299	13,453	1.09	109%
MH to LED Wall Pack	77	77	288	38	4,308	83,738	82,927	1.00	99%
4' 2LT12 to LED	58	58	62	47	8,760	17,783	8,336	1.09	47%
MH to 4' 4LT8	7	7	461	145	8,760	19,377	21,195	1.09	109%
Total						873,079	933,511		107%

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	31	210.48	8,760	5,091	9,300	26,185	1.09	282%
Controls	23	138.70	8,760	5,091	6,900	12,801	1.09	186%
Controls	40	146.90	8,760	5,091	12,000	23,580	1.09	197%
Total					28,200	62,567		222%

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	1,224	1,339	109%	0.45
Lighting Retrofit	Custom	871,855	932,172	107%	134.15
Lighting Controls	Standard	28,200	62,567	222%	6.88
Total		901,279	996,078	111%	141.48

The project-level realization rate is 111%. The following factors impacted the project gross realization rate:

- The ex post savings analysis accounted for heating and cooling interactive effects. A factor applicable to gas heated/electric air conditioned industrial facilities in St. Louis was applied to the lighting energy savings (1.09); the ex ante savings estimate did not account for heating and cooling interactive effects.
- Three measures had lower realization rates (33% to 47%) because the ex post savings analysis used the EISA 2007 federal standard baseline lumen equivalent wattages, whereas the ex ante savings estimate used the actual baseline lamp wattages.
- The lighting controls ex ante energy savings estimate assumes a lesser impact on lighting hours than calculated by the ex post energy savings analysis. The lighting controls realization rate was 222%.

Site R-8

Executive Summary

R-8 received incentives from Ameren Missouri for HVAC retro-commissioning. The realization rate for this project is 95%.

Project Description

The facility is comprised of offices, conference rooms, a chapel, a museum, a café, and a radio station. As part of the retro-commissioning project, HVAC optimization measures were implemented. The following table provides a summary of the measures as well as expected savings:

Expected Savings by Measure

Measures	*Expected kWh Savings*
HVAC Optimization - Set Point Control	*275,269*
HVAC Optimization - Airside	*61,010*
HVAC Optimization - Waterside	*16,797*
Total	*353,076*

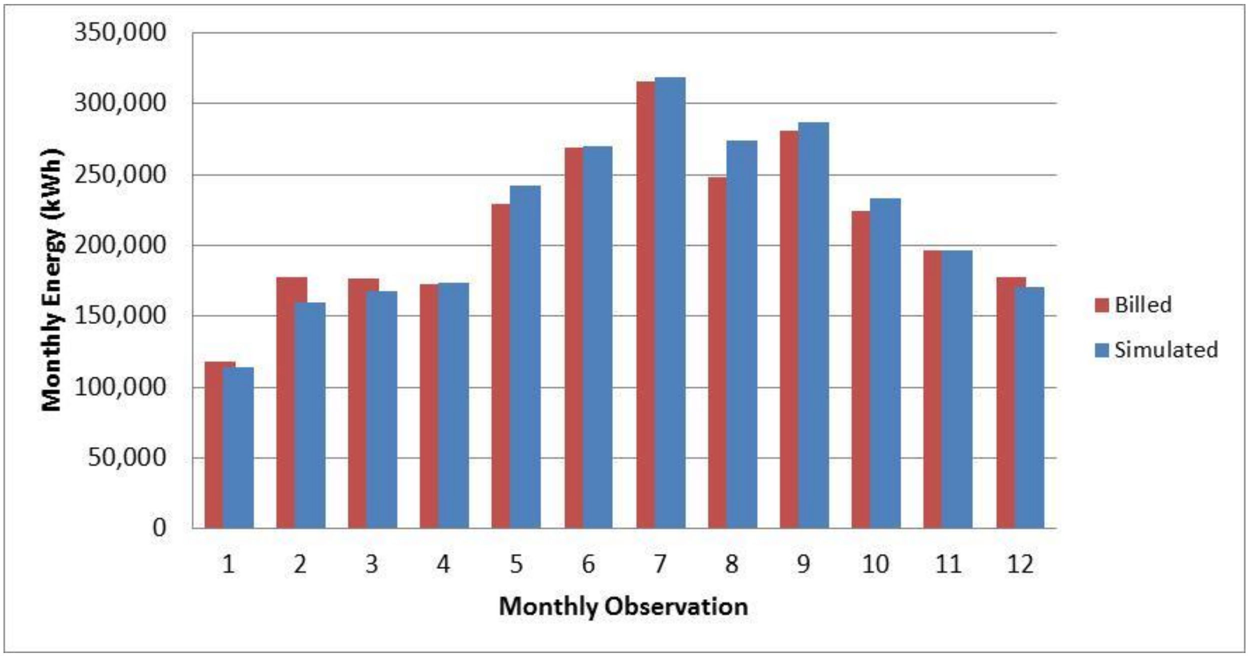
Set point control allowed for the air handling units (AHUs) to be turned off during periods when the building is not occupied. This also allowed for chilled water equipment to be turned off. The equipment ran continuously during the cooling season prior to retro-commissioning. Static pressure reset was also implemented on the airside equipment. Lastly, on the waterside, chilled water reset was programmed into the EMS.

Measurement and Verification Effort

During the M&V visit, ADM staff verified the installed measures and interviewed site contacts about typical facility operation. ADM collected mechanical schedules, nameplate data, and details in the BMS to better understand operation of the air and water-side systems.

Energy savings for the implemented control strategies were determined through the construction of a site-specific eQUEST model. Upon completion of the initial baseline 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 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 baseline eQUEST model, an as-built model was created in which all the implemented control measures were added through the use of parametric runs. Baseline and as-built models were then run using TMY3 weather data for the region. Typical year annual savings are the difference between the two models' annual consumption, as can be seen below:

As-Built Vs. Baseline Annual Energy Consumption

End-Use	Baseline kWh	As-Built kWh	Annual kWh Savings
Lighting	903,117	903,117	0
Miscellaneous Equipment	584,913	584,913	0
Heating	30,664	13,581	17,083
Cooling	768,539	552,552	215,987
Heat Rejection	0	0	0
Pumps	96,243	56,742	39,501
Fans	145,807	82,136	63,671
Exterior Ltg	153,079	153,079	0
Total	**2,682,362**	**2,346,120**	**336,242**

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 Optimization - Set Point Control	Retro-Commissioning	275,269	283,389	103%	0
HVAC Optimization - Airside	Retro-Commissioning	61,010	35,635	58%	0
HVAC Optimization - Waterside	Retro-Commissioning	16,797	17,217	103%	0
Total		353,076	336,242	95%	0

The project realization rate is 95%. Differences between realized and expected savings can be attributed to the ex ante calculations utilizing engineering equations based on assumed profiles and equipment energy usage. This methodology does not account for actual building operations and interactive effects.

Ex post calibrated simulations accounted for interactive effects and building operations. Specifically, the ex ante analysis utilized assumed fan efficiency, runtime hours, and kW for the airside static pressure reset measure. These assumptions resulted in overestimated savings for the measure because the AHU fans have variable frequency drives (VFDs). The fans use less energy than the ex ante analysis assumed.

Site C-5

Executive Summary

C-5 received custom incentives from Ameren Missouri for installing guest room energy management system (GREMS). The realization rate for this project is 68%.

Project Description

C-5 installed Verdant Energy Management system which is a type of guest room energy management system (GREMS) for the hospitality industry. A total of ten facilities are included in this project, and a total of 1,926 rooms are controlled by the new GREMS. With the installation of GREMS, the following energy savings strategies were employed:

- Occupancy based HVAC operation
- Temperature Setback
- Guest temperature limits

Measurement and Verification Effort

ADM calculated the annual energy savings for the installation of GREM using IPMVP Option A, key parameter measurement. During the M&V site visit, ADM collected key parameters including: trend data, one-time power measurement of HVAC units, and installed loggers to monitor temperature and amp readings for HVAC units.

ADM calculated the savings from this project as follows:

$$Annual\ Total\ kWh = Total\ Rooms\ \times kWh\ Savings\ per\ Room$$

Because every guest has unique characteristics of how they use energy in the hotel room and have different comfortable temperature, it is best to collect data from multiple rooms and derive average savings.

ADM calculated the average savings per guest room in following method:

$$kWh\ Savings\ per\ Room = Annual\ kWh_{Pre} - Annual\ kWh_{Post}$$
$$= \frac{Annual\ kW_{Post}}{Post/Pre} \times (1 - Post/Pre)$$

The annual kWh for the post installation was calculated using regression analysis. ADM used a daily average compressor and heater utilization data regression. The regression used the utilization data with the local weather in an effort to determine the effects that weather has on the average HVAC system utilization rate. ADM sampled three facilities and collected the daily average utilization rate for heating and cooling for over a 9 month period. ADM created the following regression equations:

$$Utilization\ Rate = A\ \times Temperature^2 + B \times Temperature + C$$

Where:

Utilization Rate	*= Cooling or heating utilization rate per day in percent*
A	*= 2nd order regression coefficient*
B	*= 1st order regression coefficient*

C = *Constant term in regression*

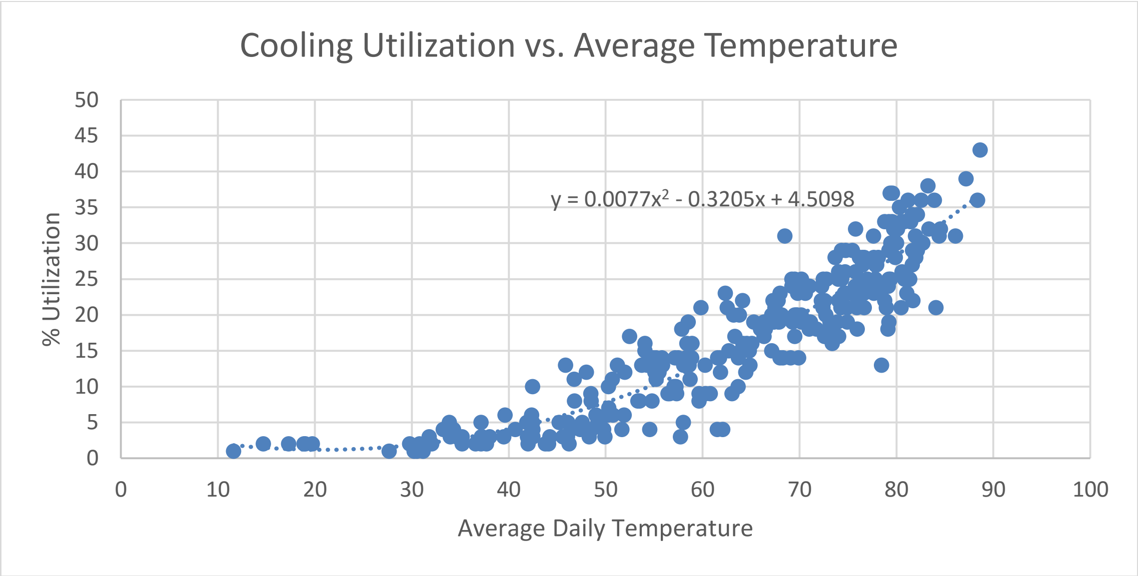
The following table shows the regression coefficient and coefficient of determination (R-square) value of three sample facilities:

Regression Coefficient from Three Sampled Facilities

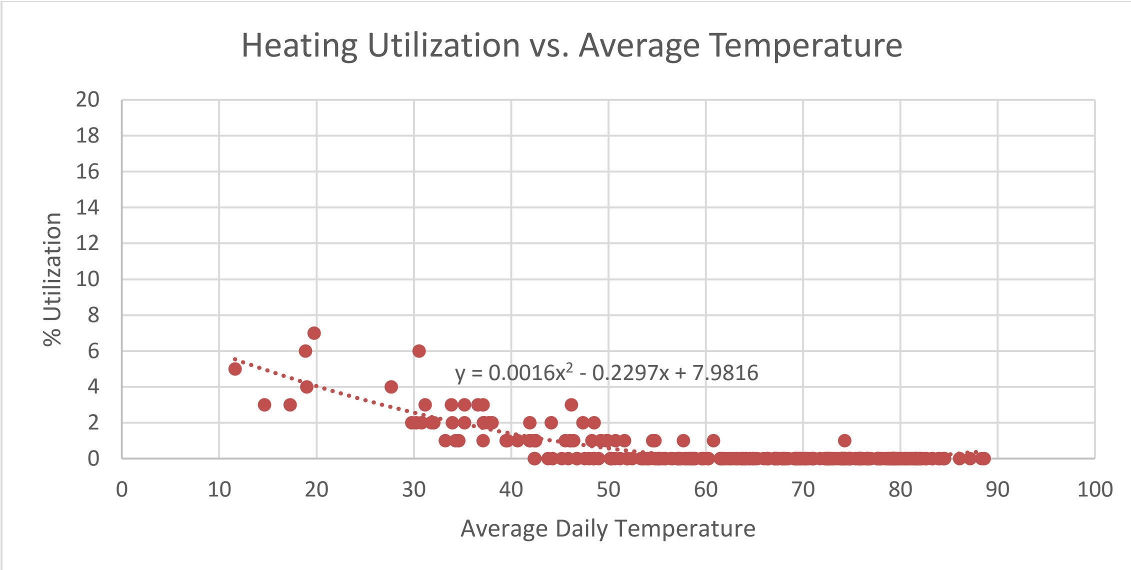
	Facility 1		*Facility 2*		*Facility 3*	
	Cooling	*Heating*	*Cooling*	*Heating*	*Cooling*	*Heating*
A	0.0131	0.0043	0.0077	0.0016	0.0092	0.0033
B	-0.6607	-0.6439	-0.3205	-0.2297	-0.5520	-0.4585
C	9.3966	23.8589	4.5098	7.9816	15.4768	15.9146
R^2	78.50%	74.47%	85.19%	74.79%	54.31%	66.72%

The R-square value isn't perfect because the HVAC usage is highly related to the outside temperature as well as guests' temperature set-points. The following graph visually represents strong correlation of HVAC utilization with outside temperature.

Cooling Utilization Rate vs. Daily Average Outdoor Temperature



Heating Utilization Rate vs. Daily Average Outdoor Temperature



By applying the regression to typical meteorological year version 3 (TMY3) of St. Louis Downtown Airport, which is the closest weather station to all three sampled facilities, ADM calculated the average annual operating hours for the heating and cooling systems using the following equation:

$$Annual\ Operating\ Hours = \left(\sum_{i=1}^{365} Utilization\ Rate_i\right) \times \frac{24}{100}$$

$$= \left(\sum_{i=1}^{365} A\ \times Temperature_i^2 + B \times Temperature_i + C\right) \times \frac{24}{100}$$

The following table summarizes the average annual operating hours of HVAC system in three sampled facilities:

Post Installation HVAC Operating Hours from Three Sampled Facilities

	Facility 1		*Facility 2*		*Facility 3*	
	Cooling	*Heating*	*Cooling*	*Heating*	*Cooling*	*Heating*
Operating Hours	1,569.98	244.24	1,180.02	68.62	1,460.00	137.71

Based on the facility data, ADM found the facility does not use very much heating.

The next step was to calculate the baseline operating hours. ADM used the pilot study data from the company to calculate the average ratio between pre and post operating hours for rented and vacant rooms. ADM used the following equation to calculate the pre and post ratio:

$$\frac{Post}{Pre} = Post/Pre_{Rented} \times Occupancy\ Rate + Post/Pre_{Vacant} \times (1 - Occupancy\ Rate)$$

Where:

Post/Pre = *The ratio between post and pre operating hours*

Post/Pre$_{Rented}$ *=The ratio between post and pre operating hours for rented rooms*

Post/Pre$_{Vacant}$ *=The ratio between post and pre operating hours for vacant rooms*

Occupancy Rate *=The facility occupancy rate, 73%*

The following table shows the comparison of average operating hours with and without GREMS. The pilot study data is the comparison of cooling and heating operation hours of 10 rooms with GREMS and 10 rooms without GREMS. The data starts from November 18, 2011 to December 16, 2012, it's over 1 year of data. After processing the pilot study data, ADM calculated Post/Pre ratio:

Difference in operating hours from the pilot study at Drury Inn St. Peters

Room	*Mode*	*no GREMS*	*GREMS*	*Post/Pre*	*Weighted Post/Pre Ratio*
Rented	Cooling	2,095.29	1,495.69	71%	55%
Vacant	Cooling	1,435.94	134.59	9%	
Rented	Heating	143.97	115.01	80%	62%
Vacant	*Heating*	*92.69*	*12.23*	*13%*	

ADM also calculated the baseline operating hours:

HVAC Operating Hours from Three Sampled Facilities

	Facility 1		*Facility 2*		*Facility 3*	
	Cooling	*Heating*	*Cooling*	*Heating*	*Cooling*	*Heating*
Post Operating Hours	1,569.98	244.24	1,180.02	68.62	1,460.00	137.71
Baseline Operating Hours	2,873.28	394.72	2,159.60	110.89	2,672.01	222.54

ADM used one time power measurements of HVAC system at three sampled facilities to calculate the savings per room per unit type:

HVAC Savings from Three Sampled Facilities

	Facility 1		*Facility 2*		*Facility 3*	
	Cooling	*Heating*	*Cooling*	*Heating*	*Cooling*	*Heating*
System Type	PTAC	Electric Resistance	PTAC	Electric Resistance	Water-source Heat Pump	Water-source Heat Pump
Watt/Unit	549	1,686	592	3,393	645	838
Post Operating Hours	1,569.98	244.24	1,180.02	68.62	1,460.00	137.71
Baseline Operating Hours	2,873.28	394.72	2,159.60	110.89	2,672.01	222.54
Baseline kWh	1,577.432	665.491	1,277.728	376.254	1,722.110	186.380
Post kWh	861.919	411.796	698.159	232.820	940.972	115.329
Savings	715.513	253.696	579.569	143.434	781.138	71.051

The average annual savings per room by system type is:

Average Annual kWh Savings by HVAC Type

	PTAC with Electrical Resistant Heating	*Water-source Heat Pumps with Gas Water Heater*
Average Annual kWh Savings per Room	846.11	852.19

Finally, ADM calculated the savings from all the facilities by applying the savings from above,

Total Annual kWh Savings per facility

Facility	*System Type*	*Verified Counts*	*Savings/Room*	*kWh*
4	PTACs – Electric Heating	163	846.11	137,915
5	Gas - Water Source HP	177	852.19	150,837
1	PTACs – Electric Heating	147	846.11	124,378
2	PTACs – Electric Heating	167	846.11	141,300
3	Gas - Water Source HP	187	852.19	159,359
6	FCUs – Electric Heating	277	846.11	234,371
7	Gas - Water Source HP	355	852.19	302,527
8	PTACs – Electric Heating	95	846.11	80,380
9	PTACs – Electric Heating	104	846.11	87,995
10	Gas - Water Source HP	254	852.19	216,456
TOTAL		1,926		1,635,519

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*	
GREMS	Custom	2,420,400	1,635,519	68%	0.00
Total		2,420,400	1,635,519	68%	0.00

The project-level realization rate is 68%. The difference between realized and expected savings can be attributed to the ex ante calculations being based on engineering equations with theoretical operational inputs. The ex post analysis used trended data from the GREMS and pre and post retrofit data from a pilot study to calculate the annual energy savings. Additionally, ADM verified the presence of 1,926 rooms with GREMS in ten facilities, whereas the ex ante savings analysis was premised upon the presence of 2,017 rooms with GREMs.

The ex ante savings estimated 1,200 kWh savings per year per room; where, ADM calculated 846 kWh for PTACs with electric resistant heating, and 852 kWh for water-sourced heat pumps. The main reason for the ex post energy savings being lower than expected is that ADM found guests prefer cooler room temperatures than hotter temperatures. In other words, despite the facility being located in heating heavy meteorological location (CDD of 1,552 and HDD of 4,781), guest rooms were observed to run more cooling than heating. Many hotels had electrical resistant heating, which has potential to consume significant amounts of energy, but guests were not running heating as much as cooling.

Because of the realized savings being significantly different than expected, ADM explored two other methods to calculate the energy savings for this project. TRM calculations and billing analysis were done; however, results from those analyses were not conclusive. During the TRM calculation, ADM attempted to recreate the deemed savings value of 1,112 kWh per room, but the equation in the TRM has an error that it doesn’t work out in units. It is missing parameters. In order to make the billing analysis accurate, daily occupancy rate information is crucial for a regression model, and without it, the statistical error is too large. The results are inconclusive because the hotels didn’t share detailed occupancy rates. After exploring other savings calculation methodologies, ADM concluded that the method used in the ex post analysis best defines the savings for this project.

Site C-36

Executive Summary

C-36 received custom incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 115%.

Project Description

The customer retrofitted the following fixtures:

- (213) 4' 1LT8 lamps with LED tube 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 interactive 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' 1LT8 to LED tube	213	213	30	16	5,293	15,238	17,584	1.11	115%
Total						15,238	17,584		115%

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	15,238	17,584	115%	3.73
Total		15,238	17,584	115%	3.73

The project-level realization rate is 115%. The following factors impacted the project gross realization rate:

- The ex post savings analysis hours of operation verified during the M&V site visit (5,292) were greater than the hours of operation used to perform the ex ante savings estimate (5,110). The ex ante used the posted store hours and did not account for opening and closing of the store by the employees.
- The ex post savings analysis accounted for the heating and cooling interactive effects. A factor applicable to gas heated/electric air conditioned retail facilities in Jefferson City was applied to the energy savings (1.11); the ex ante savings estimate did not account for heating and cooling interactive effects.

Site C-34

Executive Summary

C-34 received custom incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 115%.

Project Description

The customer retrofitted the following fixtures:

- (220) 4' 1LT8 lamps with LED tube 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 interactive 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' 1LT8 to LED tube	220	220	30	16	5,293	15,739	18,054	1.11	115%
Total						15,739	18,054		115%

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	15,739	18,054	115%	3.93
Total		15,739	18,054	115%	3.93

The project-level realization rate is 115%. The following factors impacted the project gross realization rate:

- The ex post savings analysis hours of operation verified during the M&V site visit (5,292) were greater than the hours of operation used to perform the ex ante savings estimate (5,110), resulting in a realized savings higher than expected. The ex ante used the posted store hours and did not account for the opening and closing of the store by the employees.
- The ex post savings analysis accounted for heating and cooling interactive effects. A factor applicable to gas heated/electric air conditioned retail facilities in St. Louis was applied to the lighting energy savings (1.11); the ex ante savings estimate did not account for heating and cooling interactive effects.

Site C-32

Executive Summary

C-32 received custom incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 115%.

Project Description

The customer retrofitted the following fixtures:

- (416) 4' 1LT8 lamps with LED tube 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 interactive 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' 1LT8 to LED tube	416	416	30	16	5,293	29,761	34,138	1.11	115%
Total						29,761	34,138		115%

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	29,761	34,138	115%	7.31
Total		29,761	34,138	115%	7.31

The project-level realization rate is 115%. The following factors impacted the project gross realization rate:

- The ex post savings analysis hours of operation verified during the M&V site visit (5,292) were greater than the hours of operation used to perform the ex ante savings estimate (5,110), resulting in a realized savings higher than expected. The ex ante used the posted store hours and did not account for the opening and closing of the store by the employees.
- The ex post savings analysis accounted for heating and cooling interactive effects. A factor applicable to gas heated/electric air conditioned retail facilities in Cape Girardeau was applied to the lighting energy savings (1.11); the ex ante savings estimate did not account for heating and cooling interactive effects.

Site C-37 S-37

Executive Summary

C-37 S-37 received standard and 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:

- (2) Incandescent fixtures with (2) LED fixtures
- (12) MH fixtures with (12) LED fixtures
- (1) MH fixture with (1) LED fixture
- (1) MH fixture with (1) LED- wall pack fixture

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 interactive 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	2	2	65	32	4,308	555	284	1.00	51%
MH to LED	12	12	295	107	4,308	9,701	9,719	1.00	100%
MH to LED	1	1	132	29	4,308	443	444	1.00	100%
MH to LED	1	1	461	41	4,308	1,806	1,809	1.00	100%
Total						12,505	12,256		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	Standard	555	284	51%	0.00
Lighting Retrofit	Custom	11,950	11,972	100%	0.12
Total		12,505	12,256	98%	0.12

The project-level realization rate is 98%. The following factors impacted the project gross realization rate:

- The standard measure quantity verified during the M&V site visit was adjusted in the ex post savings analysis (2) which was less than the quantity used during the ex ante savings estimate (3). The wattage also verified during the M&V site visit and through the specification sheets was adjusted in the ex post analysis (32) which was higher than the wattage used to perform the ex ante savings estimate (22). The realization rate for this measure was 51%.
- The custom measures were highly accurate with a realization rate of 100%.

Site C-35 S-35

Executive Summary

C-35 S-35 received standard and custom incentives from Ameren Missouri for retrofitting lighting in the exterior of their facility. The realization rate for this project is 79%.

Project Description

The customer retrofitted the following fixtures:

- (8) Incandescent lamps with (8) LED lamps
- (6) MH fixtures with (6) LED fixtures
- (4) MH fixtures with (4) LED fixtures
- (1) MH fixture with (1) LED fixture

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 interactive 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	8	8	72	10	5,460	3,931	2,708	1.00	69%
MH to LED	6	6	461	157	4,309	10,458	7,859	1.00	75%
MH to LED	4	4	295	41	4,309	4,558	4,378	1.00	96%
MH to LED	1	1	210	85	4,309	538	539	1.00	100%

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						19,485	15,483		79%

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	3,931	2,708	69%	0.49
Lighting Retrofit	Custom	15,554	12,775	82%	0.11
Total		19,485	15,483	79%	0.60

The project-level realization rate is 79%. The following factors impacted the project gross realization rate:

- The standard lighting measure had a lower realization rate (69%) because the ex post savings analysis used the EISA 2007 federal standard baseline wattage, whereas the ex ante savings estimate used the actual baseline lamp wattages.
- The M&V site visit verified the installed quantity of light pole heads with a total of (6), which is fewer than the quantity used to perform the ex ante savings estimate (8), resulting in a realized savings lower than expected (75%).

Site S-26

Executive Summary

S-26 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:

- (205) Incandescent Globe lamps with (205) LED Globe 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 interactive 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 Globe to LED Globe	205	205	40	7	3,415	23,453	25,948	1.11	111%
Total						23,453	25,948		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	23,453	25,948	111%	9.81
Total		23,453	25,948	111%	9.81

The project-level realization rate is 111%. The realization rate is high because the ex post analysis used a heating and cooling interactive factor for gas-heated/air conditioned hotel (non guestroom) in St. Louis (1.11), while the ex ante savings estimate did not take into account the heating and cooling interactive effects.

Site N-7

Executive Summary

N-7 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 163%.

Project Description

The customer installed the following:

- (184) LED fixtures
- (124) 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 90.1-1989).

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 interactive 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 interactive 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 LED	184	184	556	307	5,475	155,334	250,856	1.00	161%
Total						155,334	250,856		161%

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	124	307	5,475	3,833	37,500	62,506	1.00	167%
Total					37,500	62,506		167%

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	155,334	250,856	161%	45.82
Lighting Controls	New Construction	37,500	62,506	167%	11.42
Total		192,834	313,362	163%	57.24

The project-level realization rate is 163%. The following factors impacted the project gross realization rate:

- The ex post savings analysis hours of operation verified during the M&V site visit (5,475), not accounting for the effect of lighting controls, are greater than the hours of operation used to perform the ex ante savings estimate (3,369). The site is a distribution center working 15 hours, 7 days a week. The ex ante savings estimation of hours is more appropriate for an office location.
- The lighting controls ex ante savings estimate assumes a lesser impact on lighting hours than calculated by the ex post energy savings analysis.

Site S-13

Executive Summary

S-13 received standard incentives from Ameren Missouri for retrofitting lighting in the interior and exterior of their facility. The realization rate for this project is 179%.

Project Description

The customer retrofitted the following fixtures:

- (430) Incandescent lamps with (430) LED lamps in the garage lobby
- (190) Incandescent lamps with (190) LED lamps in the ballroom

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 interactive 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	430	430	90	9	8,760	152,555	305,111	1.00	200%
Incandescent to LED	190	190	65	10	4,380	46,187	51,096	1.11	111%
Total						198,742	356,207		179%

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	198,742	356,207	179%	49.90
Total		198,742	356,207	179%	49.90

The project-level realization rate is 179%. The following factors impacted the project gross realization rate:

- The ex post savings hours of operation for the first measure verified during the M&V site visit (8,760) were higher than the lighting hours of operation used to perform the ex ante savings estimate (4,380). This measure was installed in a parking garage where the fixtures are continuously on. This measure had a realization rate of 200%.
- The ex post savings analysis of the interior lighting fixtures accounted for heating and cooling interactive effects. A factor applicable to gas heated/ electric air conditioned non guestroom hotel facility in St. Louis was applied to the lighting energy savings (1.11); the interior lighting fixture ex ante savings estimate did not account for heating and cooling interactive effects. This measure had a realization rate of 111%.

Site S-7

Executive Summary

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:

- (896) Incandescent lamps with (896) LED lamps
- (652) Incandescent lamps with (652) 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 interactive 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	896	896	40	5	600	18,816	20,804	1.11	111%
Incandescent to LED	652	652	65	10	8,760	316,989	350,683	1.11	111%
Total						335,805	371,487		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	335,805	371,487	111%	51.71
Total		335,805	371,487	111%	51.71

The project-level realization rate is 111%. The ex post savings analysis of the interior lighting fixtures accounted for heating and cooling interactive effects. A factor applicable to gas heated/ electric air conditioned hotel facilities in St. Louis was applied to the lighting energy savings (1.11); the interior lighting fixture ex ante savings estimate did not account for heating and cooling interactive effects.

Site C-40 S-36

Executive Summary

S-36 received custom and standard incentives from Ameren Missouri for retrofitting lighting in the interior of their facility. The realization rate for this project is 93%.

Project Description

The customer retrofitted the following fixtures:

- (18) 4' 4LT12 fixtures with (18) LED fixtures
- (2) Incandescent lamps with (2) LED lamps
- (11) Incandescent lamps with (11) 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 11/17/15 to 12/10/15) 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 interactive 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 LED	18	18	112	45	2,642	3,480	3,511	1.11	101%
Incandescent to LED	2	2	60	11	2,642	574	290	1.11	50%
Incandescent to LED	11	11	75	10	2,642	2,279	2,108	1.11	93%
Total						6,333	5,909		93%

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	3,480	3,511	101%	1.35
Lighting Retrofit	Standard	2,853	2,398	84%	0.92
Total		6,333	5,909	93%	2.27

The project-level realization rate is 93%. The following factors impacted the project gross realization rate:

- The ex post savings analysis accounted for heating and cooling interactive effects. A factor applicable to gas heated/electric air conditioned small retail facilities in St. Louis was applied to the lighting energy savings (1.11); the ex ante savings estimate did not account for heating and cooling interactive effects.
- The ex post savings analysis hours of operation verified during the M&V site visit (2,642) were less than the lighting hours of operation used to perform the ex ante estimate (2,900), resulting in a realized energy savings lower than expected.
- The ex ante savings estimate for the second and third measures were based on the quantities the client actually purchased but not what was installed. The installed quantities verified during the M&V site visit (2 and 11) were less than the quantities used to develop the ex ante savings estimate (4 and 12).

Site S-16

Executive Summary

S-16 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:

- (224) Incandescent fixtures with (224) LED fixtures
- (105) Incandescent fixtures with (105) 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 interactive 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	224	224	50	10	6,000	54,432	60,213	1.11	111%
Incandescent to LED	105	105	50	10	2,080	8,845	9,785	1.11	111%
Total						63,277	69,999		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	63,277	69,999	111%	12.96
Total		63,277	69,999	111%	12.96

The project-level realization rate is 111%. The ex post savings analysis of the interior lighting fixtures accounted for heating and cooling interactive effects. A factor applicable to gas heated/ electric air conditioned non guestroom hotel facilities in St. Louis was applied to the lighting energy savings (1.11); the interior lighting fixture ex ante savings estimate did not account for heating and cooling interactive effects.

Site S-8

Executive Summary

S-8 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:

- (810) Incandescent lamps with (810) 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 interactive 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	810	810	50	7	8,760	308,659	341,467	1.11	111%
Total						308,659	341,467		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	308,659	341,467	111%	50.35
Total		308,659	341,467	111%	50.35

The project-level realization rate is 111%. The ex post savings analysis of the interior lighting fixtures accounted for heating and cooling interactive effects. A factor applicable to gas heated/ electric air conditioned non guestroom hotel facilities in St. Louis was applied to the lighting energy savings (1.11); the interior lighting fixture ex ante savings estimate did not account for heating and cooling interactive effects.

Site R-7

Executive Summary

R-7 received incentives from Ameren Missouri for a retro-commissioning project. The project-level realization is 84%.

Project Description

The facility is comprised of common areas and dorm rooms. The customer implemented several measures as the result of a retro-commissioning study:

Measure Type	*Measure Description*
HVAC Optimization - Controls	Resize Lower Level And First Floor Ventilation
HVAC Optimization - Controls	Resize Lower-Level And First Floor Air Flow
HVAC Optimization - Controls	Reduce Residential Exhaust And Supply Air
Kitchen - Refrigeration	Kitchen Refrigeration Turn Down

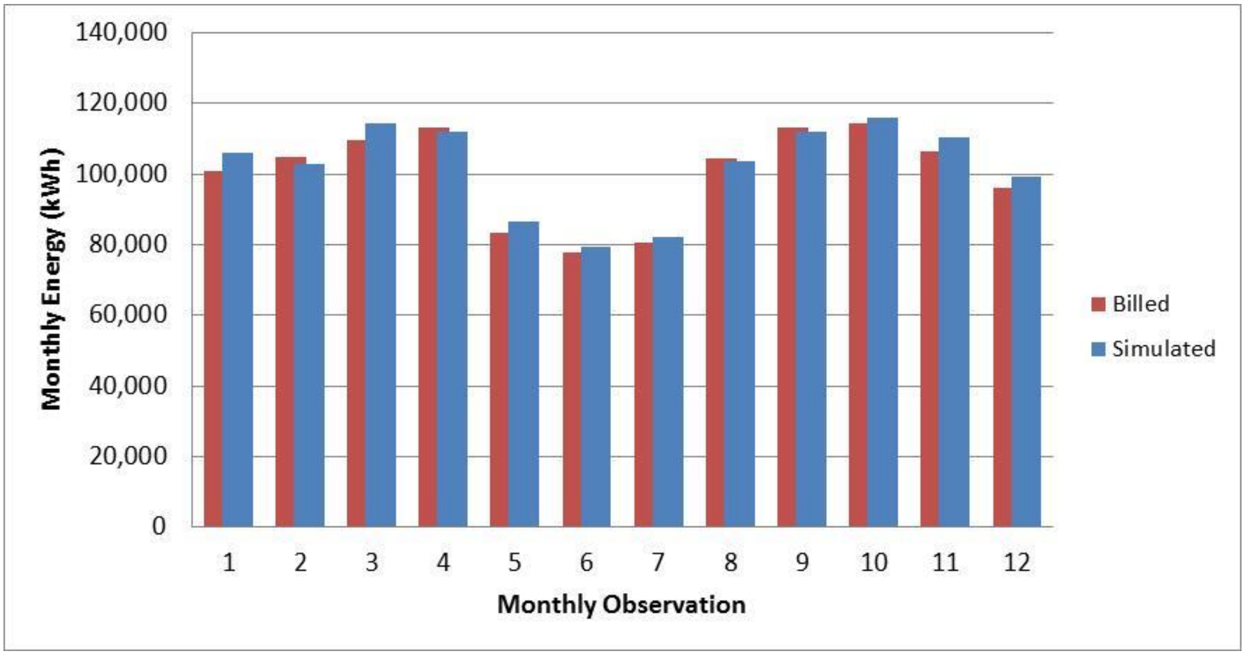
The above measures were implemented through installing variable speed drives (VSDs), programming the energy management system (EMS), and turning off equipment. Four air handling units were affected: AHU-4, AHU-5, AHU-10, and AHU-11. AHUs 10 & 11 had new VSDs installed, so that the flows could be adjusted. AHU-4 & 5 had functioning VSDs, but changes were made so that the speeds could be reduced. Lastly, the kitchen equipment is now being shut down during the summer and during school breaks.

Measurement and Verification Effort

During the M&V visit, ADM staff verified the installed measures and interviewed site contacts about the typical operation of the facility. ADM collected mechanical schedules, nameplate data, and details from the EMS to better understand operation of the air and water-side systems.

Energy savings for the implemented control strategies were determined through the construction of a site-specific eQUEST model. Upon completion of the initial baseline model, a custom weather file was created using 2014 & 2015 NOAA weather data for the St. Louis area. Using this weather file and billing data for the facility, ADM was able to ensure the model's energy load shape matched that of the bills. The retro-commissioning was completed in November, 2015. The results of the calibration are below:

2014 & 2015 Monthly kWh Calibration



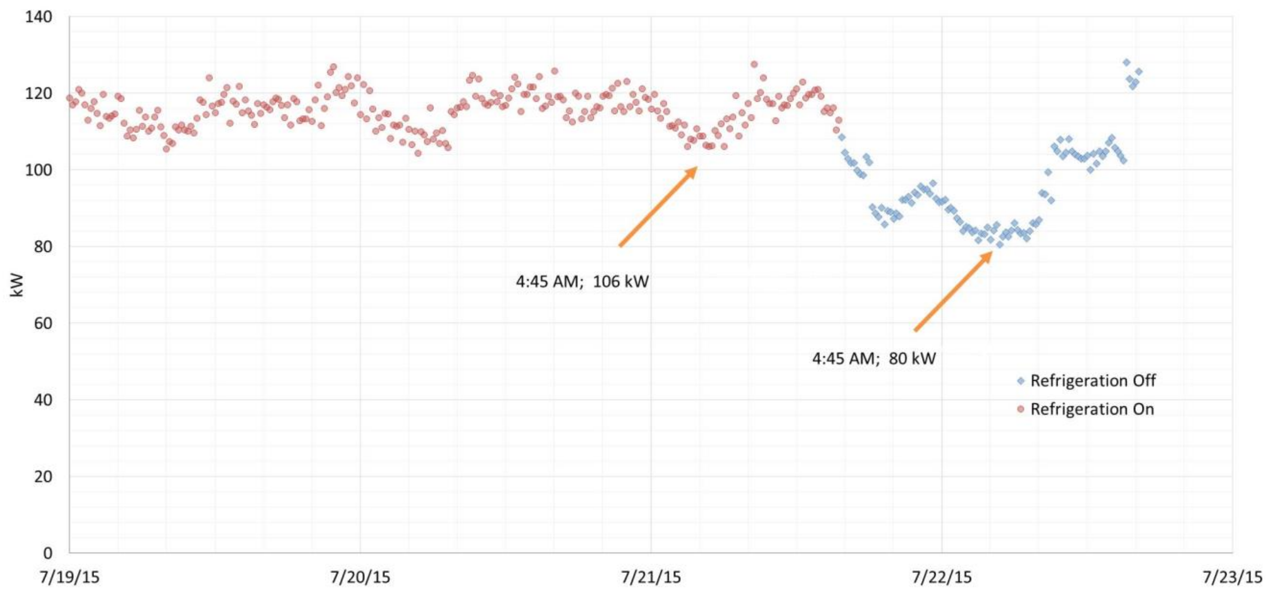
Upon completion of the calibration for the baseline eQUEST model, an as-built model was created in which all the implemented control measures were added through the use of parametric runs. Baseline and as-built models were then run using TMY3 weather data for the region. Typical year annual savings are the difference between the two models' annual consumption, as can be seen below:

As-Built Vs. Baseline Annual Energy Consumption

End-Use	Baseline kWh	As-Built kWh	Annual kWh Savings
Lighting	321,879	321,879	0
Miscellaneous Equipment	180,676	180,676	0
Heating	2,129	2,096	33
Cooling	347,971	271,804	76,167
Pumps	43,642	43,331	311
Fans	685,352	497,234	188,118
Total	**1,581,649**	**1,317,020**	**264,629**

Energy savings for the kitchen refrigeration turn down were calculated through the use of pre and post trending data. The energy savings were determined by taking the difference between pre and post minimum kW values and multiplying the values by the total hours per year that the equipment will be off. The minimum values show the baseline usage for the refrigeration equipment:

Kitchen Shut Down Energy Usage



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 – Optimization	RCx	326,100	264,629	81%	30.54
Kitchen – Refrigeration	RCx	53,700	52,632	98%	17.04
Total		379,800	317,261	84%	47.58

The combined project-level realization rate is 84%. For HVAC optimization measures, the differences between realized and expected savings can be attributed to the ex ante calculations utilizing engineering equations and operational assumptions. This methodology does not account for the actual building operations or interactive effects.

Ex post calibrated simulations are able to account for the actual operations and interactive effects. The new minimum fan flows were input into the parametric runs of the energy simulation, and the speeds/flows vary above the minimum. The ex ante analysis assumed the minimum flows were the typical usage for the fans. Thus, the ex post fan usage is higher, realizing less savings than expected.

For the kitchen refrigeration measure, the savings are slightly different due to a rounding error in the ex ante analysis.

Site S-12

Executive Summary

S-12 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:

- (540) Incandescent lamps with (540) 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 interactive 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	540	540	50	7	8,760	205,772	227,645	1.11	111%
Total						205,772	227,645		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	205,772	227,645	111%	33.57
Total		205,772	227,645	111%	33.57

The project-level realization rate is 111%. The ex post savings analysis of the interior lighting fixtures accounted for heating and cooling interactive effects. A factor applicable to gas heated/ electric air conditioned non guestroom hotel facilities in St. Louis was applied to the lighting energy savings (1.11); the interior lighting fixture ex ante savings estimate did not account for heating and cooling interactive effects.

Appendix B: Program Staff Interview Guide

Roles & Responsibilities

[All]

Q1. Let's start with a bit about you. Can you please confirm your current job title? [*Insert job title here for confirmation*]

Q2. Have your job title or responsibilities regarding the BizSavers program changed since last year? If so, how?

Q3. About how much of your time is devoted to the Ameren Missouri BizSavers program?

Q4. Of the four BizSavers programs – Standard, Custom, Retro-Commissioning, New Construction – which, if any, do your job responsibilities *not* cover?

[Q5 and Q6]

Q5. What changes have there been, if any, in staffing, people's responsibilities, or the overall reporting structure since last year?

Q6. Are there any other planned changes in staffing, responsibilities, or reporting structure? If so, what are they?

Marketing and Outreach

Now, I'd like to hear about the current status of marketing activities for the program.

[Q7]

Q7. Overall, what's your perspective about how well the program's marketing and outreach strategies have been working this past year?

[Probe about: Activities specific to each strategies? How M&O effectiveness differs by: Program, Participant type, and TA type?]

[Q8]

Q8. Have Lockheed Martin's program marketing and outreach efforts in the past year met your expectations?

a. What are they doing well?

b. In what ways, if any, do they fall short of expectations?

I'd like to follow up on some topics that came up in last year's staff interviews.

Q9. Can you update me on outreach efforts in outlying areas, including any role that key account reps and customer service agents are playing?

[Previously reported CSAs may do program presentations to customers, with BD coordination.]

Q10. First, can you update me on the use of video case studies, social media, media kits, and so forth?

[Probe to clarify what exactly media kits are and their relationship to case studies.]

Q11. How about the plan to inform the 98,000 customers with email addresses about the online application form – how did that go?

[Probe about any feedback received.]

Q12. How about the idea of putting a button on e-bills to link customers to information on saving energy – has that been done?

["Start Saving Energy Now." Probe about any feedback received.]

Q13. Can you update me on the effort to identify customer "towers" and how that is working?

["Towers" are large (> 2M kWh) customers with many locations – e.g., McD, schools, airport. Probe about other possible usage - e.g., compressed air companies and the customers they service (from Kelley interview).]

Q14. Can you update me on outreach targeted to specific business types?

[K-12, hospitality, gov, food service equipment. Probe about targeting parts of service territory with high density of targeted biz types.]

Q15. Any updates on efforts to reach small and medium-sized businesses?

[Probe about efforts to work with TAs to target small biz.]

Q16. What new developments have there been, if any, in program collateral?

Q17. What changes, if any, have been made to the *BizSavers Solutions* electronic newsletters?

[Find out who it is sent to and how often. Previously, one staff person mentioned they wanted to include savings tips, but Ameren MO wants only info on incented measures.]

Q18. What changes have been made to the program website, if any, in the past year? How are those working out?

Q19. Can you fill me in on the “4 simple steps” campaign?

[Probe about: why limited to one event (Archdiocese Energy Summit), whether they can see an effect in terms of projects moving to next step.]

Q20. And can you tell me about the “set the pace” events?

[Probes about what they were, how they worked, outcomes.]

Q21. What other changes have been made, or are planned, for marketing and outreach during 2015?

[Probe about reason for changes, how the efforts are going.]

Q22. Finally, what challenges, if any, do you see to expanding market penetration?

Q23. [If any challenges:] What could the program do to overcome those challenges? What is preventing the program from implementing these changes?

Program Progress

[Q24-Q27]

Q24. How is the program doing relative to its goals?

[Probe about savings goals, project completions, and pipeline.]

Q25. How is the program doing in terms of the balance between lighting and non-lighting projects?

Q26. [If balance could improve:] What might the program do to improve the balance between lighting and non-lighting projects?

Q27. What measures been added or modified in the past year, if any?

[Probe about reasons and uptake. Were these new prescriptive measures?]

Program Changes

[Q28-Q29]

Q28. One of the findings from last year’s process evaluation was that RCx participants didn’t seem to differentiate between the RCx program and a retrofit program. What has been done, if anything, to make sure that RSPs communicate the optimization aspect of RCx to participants?

Q29. Another finding from last year’s process evaluation was that the program became involved in most NC projects after the building design phase, limiting the influence on measures. What, if anything, has been done to get the program involved in the design phase?

[Q30]

Q30. What additional energy-efficiency-related training has Ameren/Lockheed provided to program staff in the past year, if any?

[One of the recommendations from last year was to provide Ameren and Lockheed staff with training in basic architecture and design engineering concepts so that they can discuss energy efficiency with architects and design engineers.]

Trade Allies & Other Service Providers

[Q31-Q39]

I'd also like to get an update on how the program is working with trade allies and other program partners.

Q31. Can you give me an update on trade ally recruitment?

[Probe about: Getting TAs from bordering TANS, the TA taskforce, and recruiting at conferences and through DOE FEMP.]

Q32. What kinds of barriers are you seeing to TAN recruitment?

[Probe about: Awareness of the requirement to re-join the TAN after the bridge year, insurance requirements, and the application process. Specific firms or TA types they are having difficulty reaching – what they might do next.]

Q33. What changes have you made, if any, to the program's efforts to keep TAs informed?

[Probe about training, events, and newsletters. They send one newsletter to all TAs; one goes only to TAN members.]

Q34. Can you tell me a little about the money-savings deals and "4 simple steps" campaigns?

[Probe about purpose and goals; how they track success (e.g., could they tell that campaigns increased number of applications?)]

Q35. What changes have there been, if any, in the TAN tier ranking system, including any changes in members' ranks?

[Last year, found that some TAs might lose status but interviews suggested this was minimal.]

Q36. [If any changes:] What has been the effect of those changes?

Q37. How are things going with encouraging trade allies to use co-branded marketing materials?

Q38. How are things going with the Distributor Partnership Program?

[Probe about uptake with large distributors such as Grainger – it was low last time.]

Q39. What other changes, if any, are planned for outreach to, and interaction with, trade allies and other service providers?

[Probe about types of TA, including RSPs and NC.]

Communication

[All – time allowing]

Next I'd like to hear briefly about how communication processes are working between and within staff at Ameren Missouri and Lockheed.

Q40. How has communication been *among [Ameren/Lockheed]* staff regarding the BizSavers program?

[Probe about any changes in frequency or type of meeting.]

Q41. [If issues identified] What are they? Do you have any suggested solutions?

Q42. And how has communication been *between Ameren and Lockheed* staff?

[Probe about: Any changes in frequency or type of meeting, monthly meetings/webinars with KARs and CSAs, reports to CSAs about projects in their territory – how proactive is LM on that? How well is Ameren keeping LM informed on key accounts? LM presentations to Ameren (last year, one staff member reported a presentation was still in "draft" form).]

Q43. [If issues identified] What are they? Do you have any suggested solutions?

[Q44]

Q44. Can you give me an update on the "10 most wanted" campaign?

Probe about new "most wanted" customer, how many captured, CSA assistance.

[DESCRIPTION OF 10 MOST WANTED, FROM 2014 REPORT: 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.]

Tracking & Reporting

Next, I'd also like to hear about tracking and reporting.

[Q45]

Q45. How well is the current tracking and reporting process working to meet your needs?

[Probe about additional reports or information that would be useful.]

[Q46-Q49]

Q46. We learned earlier this year about the effort to identify customer “towers” in the database. How is that effort coming?

[Probe about how, exactly, they do it – do they have a new db field to identify each unique tower? (Note: the marketing use of towers is addressed in a separate question.)]

Q47. Have you developed a way to track applications that result from the Distributor Partnership Program?

[Probe about online applications. (They leave information about online application at DPP sites.)]

Q48. What other tracking and reporting changes were made, if any, during late 2014 or 2015? How have those worked out?

Q49. What changes have been made, if any, to QA/QC procedures?

Conclusion

[All]

Q50. Is there anything that you would like to see changed in program offerings in the future?

Q51. Is there anything else about the program that we have not discussed that you feel should be mentioned?

Q52. 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

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

2C. Please rank the usefulness of the three sections of the seminar – please identify only one section as “most useful” by assigning the number 1 to it, identify only one as “second most useful” by assigning the number 2 to it, and identify only one as ”least useful” by assigning the number 3 to it. [Don’t know allowed]

Section 1: BizSavers program overview by SH
Section 2: BizSavers incentives and Trade Ally Network by JK
Section 3: Application tips and the importance of energy efficiency by AQ

2D. How satisfied were you with...

*(Please select **one** response per row.)*

	Very dissatisfied	Somewhat dissatisfied	Neither satisfied nor dissatisfied	Somewhat satisfied	Very satisfied	Don’t know
a. SH’s section discussing “BizSavers incentives and the Trade Ally Network”	1	2	3	4	5	
b. JK’s section discussing “BizSavers incentives and the Trade Ally Network”	1	2	3	4	5	
c. AQs section discussing	1	2	3	4	5	

“Application tips and the importance of energy efficiency”	

Overall, how do you rate this event?

	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. 1.	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]

6A. What additional resources or information would you like from the BizSavers program?

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]

2. 1.	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]

3. 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.)*

4. 1. Architect	5. 11. Industrial services
6. 2. Developer or builder	7. 12. IT or data center services
8. 3. Distributor	9. 13. Manufacturer
10. 4. E	11. 14. Manufacturer's rep
12. 5. Energy Auditor/Modeler	13. 15. Mechanical contractor
14. 6. Engineering	15. 16. National account services
16. 7. ESCO (Energy Service company)	17. 17. Refrigeration services
18. 8. Financial services	19. 18. Retro-commissioning agent
20. 9. Full service engineering	21. 19. Sales Engineering
22. 10. HVAC distributor	23. 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]

24.	2. No	3. Not sure

13. [IF Q12=1 (TAN MEMBERS)]**:** How long have you been part of the Trade Ally Network?

25.	1. Less than six months
26.	2. Between six months and one year
27.	3. Between one year and two years
28.	4. More than two years
29.	5. Don't know
30.	6. Not applicable - my company is not part of the Trade Ally Network

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?

    31. Facilities Manager
    32. Energy Manager
    33. Other facilities management/maintenance position
    34. Chief Financial Officer
    35. Other financial/administrative position
    36. Proprietor/Owner
    37. President/CEO
    38. Manager
    39. 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 in survey]

3. How did you learn about Ameren Missouri's incentives for efficient equipment or upgrades? (Select all that apply)

    1. From a Trade Ally/contractor/service provider
    2. From an architect, engineer or energy consultant
    3. From an equipment vendor or building contractor
    4. From an Ameren Missouri Account Representative
    5. From a BizSavers Program representative
    6. From a search engine (Google, Yahoo, Bing)
    7. At an event/trade show
    8. Received an email blast or electronic newsletter
    9. Received an informational brochure
    10. From a program sponsored webinar
    11. From mobile advertising
    12. From Ameren Missouri's website
    13. TV / radio ad's sponsored by Ameren Missouri
    14. Friends or colleagues
    15. Through past experience with the program
    16. 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 Q 7 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 1	2	3	4	Completely 5	Don't 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 1	2	3	4	Completely 5	Don't 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

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. Online Fast Track Application
    2. Downloadable Fast Track Application
    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. Online
    5. Other – please specify: ____
    88. Don't know

18. Thinking back to the application process, please rate the clarity of information 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

[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, if at all, did each of the following 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. 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?

    40. No
    41. 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

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

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

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

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 BizSaversProgram, 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.) (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.) (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

7.3.1. 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

[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. Please list any other properties that could benefit from energy efficient electric or gas equipment upgrades which may qualify for an incentive. Please provide company name, contact person, and phone number and/or email address. _____ [OPEN-ENDED RESPONSE]

71. 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.)Less than 5,000

    1. 5,001 to 10,000
    2. 10,001 to 20,000
    3. 20,001 to 50,000
    4. 50,001 to 75,000
    5. 75,001 to 100,000
    6. 100,001 to 250,000
    7. 250,001 to 500,000
    8. 500,001 to 1,000,000
    9. More than 1,000,000
    88. Not sure

72. How can the BizSavers Program implementation team provide you with better service? _____ [OPEN-ENDED RESPONSE]

Appendix E: TA Semi-Structured Interview Guide

Screening [ASK ALL]

First, I need to ask a couple of questions to see if you are eligible for this survey.

Let's start with a few questions about your company.

I3. Just to confirm, my information indicates that you have worked on Ameren Missouri equipment replacement projects in existing buildings and that you are [IF TAN_MEMBER= "YES" READ "a member of the Ameren Missouri Trade Ally Network"; IF TAN_MEMBER= "NO" READ "NOT a member of the Ameren Missouri Trade Ally Network"]. Is that correct? [AS NEEDED: Members are featured on Ameren Missouri's web site and can use the Network logo in marketing.]

RESPONDENT IS A MEMBER OF AMEREN MISSOURI TAN

() YES

() NO

Firmographics

Let's start with a few questions about your company.

Q1. How many business locations do you have? [# OR DK]

Q2. How many employees work at all of your locations? Your best estimate is fine. [# OR DK]

[DISPLAY Q3 IF I3=1]

Q3. Which of the following areas do you serve? [SELECT ALL]

- ☐ St. Louis Metro
- ☐ Outer St. Louis suburbs (Arnold, Festus, Hillsboro, St. Peters, O'Fallon, Washington, Union, Park Hills, Bonne Terre, Troy, Potosi)
- ☐ North or Central Missouri (Kirksville, Excelsior Springs, Moberly, Jefferson City, Lake of the Ozarks)
- ☐ Southeastern Missouri (Cape Girardeau, Hayti, Caruthersville)
- ☐ [Do not read] Statewide
- ☐ [Do not read] Don't know

Training

Now let's talk a bit about any information or training you've received about the BizSavers programs.

[ALL]

Q4. Have you attended any public events that Ameren Missouri has held to educate contractors and customers about the BizSavers programs, such as workshops, seminars, and trade show appearances? [SELECT ONE]

- ☐ Yes ➔ How many of these have you attended in the past year?
- ☐ No, but someone else at the firm has
- ☐ No (and nobody else specified)
- ☐ Don't know

[DISPLAY Q5 TO Q7 IF Q4 = 'YES']

Q5. Thinking of all the information you've received at these events, how much do you disagree or agree with these statements? Please answer on a scale of 0 to 10, with 0 being "don't agree at all" and 10 being "strongly agree."

[FOR EACH ITEM, 0-10 SCALE WITH DK AND REF RESPONSES; RANDOMIZED PRESENTATION]

1. The information presented was clear
2. The correct level of detail was presented
3. All relevant topics were covered
4. The time was convenient
5. The length of time was appropriate
6. The location was convenient

Q6. And on a scale of 0 to 10, where 0 is "not at all" and 10 is "extremely well," how well did the information and training you've received cover the following topics?

[FOR EACH ITEM, 0-10 SCALE WITH DK AND REF RESPONSES; RANDOMIZED PRESENTATION EXCEPT F]

1. General application requirements
2. Qualifying equipment
3. Calculating retrofit savings and incentives
4. M&V requirements
5. How to sell the benefits of energy efficiency
6. Were there any other topics?-specify: ______________

Q7. Are you aware that the program offers a monthly electronic newsletter for contractors and customers? [SELECT ONE]

[*IF NEEDED: The newsletter is called BizSavers Solutions*]

- ☐ Yes
- ☐ No
- ☐ Don't know

[DISPLAY Q8 IF Q7 = 'YES']

Q8. Do you receive the program's monthly electronic newsletter? [SELECT ONE]

- ☐ Yes
- ☐ No
- ☐ Don't know

[DISPLAY Q9 IF Q8 = 'YES']

Q9. How useful is the newsletter? Please answer on a scale of 0 to 10, with 0 being "not at all useful" and 10 being "extremely useful." [0-10 SCALE WITH DK AND REF]

[DISPLAY Q10 TO ALL]

Q10. Did you hear about Ameren Missouri's money-saving deals challenge that was in effect from July through September this year? [SELECT ONE]

[*If no or not sure, say: Ameren Missouri advertised that challenge in the BizSavers newsletter – the 10 companies that completed the greatest number of BizSavers projects from July through September would be given the opportunity to advertise a money-saving deal on the BizSavers website. Do you recall hearing about that challenge?*]

- ☐ Yes – no prompt
- ☐ Yes – after prompt
- ☐ No
- ☐ Don't know\
- ☐ Not aware of current challenge but aware of previous challenge(s)
- ☐ Other: ______

[DISPLAY Q11 IF Q10 = 'YES' OR 'NOT AWARE']

Q11. How much influence, if any, did the challenge have on your efforts to sell program-qualified upgrades? Please answer on a scale of 0 to 10, with 0 being "no influence" and 10 being "great influence." [0-10 SCALE WITH DK AND REF]

Q12. What additional information or training, if any, would you like to get from Ameren Missouri? [OPEN END]

[NOTE TO INTEVIEWER: Probe about specific program processes, technologies, rules, etc.]

Marketing and Customer Program Awareness

Now let's talk about your customers a bit.

For my next questions, even if you've done other types of jobs, I'd like you to focus on your customers with equipment replacement projects in existing buildings.

Q13. First, what are the main business or building types that you work with? [SELECT ALL]

[NOTE TO INTEVIEWER: Read list as necessary; select all that apply]

- ☐ Office buildings
- ☐ Lodging (hotels/motels)
- ☐ Retail (non-food)
- ☐ Religious organizations
- ☐ Restaurants, including fast-food
- ☐ Industrial/manufacturing plants
- ☐ Schools, colleges, or universities
- ☐ Health care/hospitals
- ☐ Grocery and convenience stores
- ☐ All other
- ☐ Other, specify___________________

Q14. If you were to divide your customers into building owners, property management firms, and businesses that lease space from others, about what percentage would be in each group? Your best guess is fine.

[*Read list items*]

- ☐ Answered
  - Building owners [%]
  - Property management firms [%]
  - Businesses that lease space [%]
- ☐ Don't know

[*NOTE TO INTERVIEWER: If needed, say: I'm talking about the people* <u>*you*</u> *deal with as customers. For example, property management firms represent building owners, but I'd like to separate out the building owners that you deal directly with from the property management firms that represent building owners.*]

Q15. And of your customers that are building owners, about what percentage own buildings with a total of less than 200,000 square feet? Your best guess is fine. [% OR DK]

From here on, any time I refer to the Ameren Missouri business incentives, I'll use the name BizSavers, and keep in mind that I am referring specifically to Ameren <u>Missouri</u> programs.

Q16. Of your customers who applied for BizSaver incentives, about what percentage were aware that those incentives were available before you mentioned it to them? [SELECT ONE]

- ☐ None (0%)
- ☐ 1% to 25%
- ☐ 26% to 50%
- ☐ 51% to 75%
- ☐ 76% to 99%
- ☐ All (100%)

- ☐ Don’t know
- ☐ Other: ______

[DISPLAY Q17 IF SELECTED >1 RESPONSE TO Q13]

Q17. In which types of businesses, if any, is awareness of BizSavers incentives lowest? [OPEN END]

[DISPLAY Q18 IF I3 = ‘YES’]

Q18. Is your firm using Ameren Missouri’s logo for co-branding your services? [SELECT ONE]

- ☐ Yes
- ☐ No
- ☐ Don’t know

[DISPLAY Q19 AND Q20 IF Q18 <> YES AND I3 = ‘YES’]

Q19. Has anyone from Ameren Missouri or the BizSavers program staff talked to anyone in your firm about co-branding? [SELECT ONE]

- ☐ Yes
- ☐ No
- ☐ Don’t know

Q20. What additional information or assistance might encourage your firm to use Ameren Missouri’s logo for co-branding your services? [OPEN END]

Promotion of EE and BizSavers, Including Related Barriers

Now I’d like to hear how you have been marketing BizSavers incentives to clients in the past year – both those who <u>have and have not</u> applied for or received Ameren Missouri BizSavers incentives. Again, even if you’ve done other types of jobs, I’d like you to focus on your equipment replacement projects in existing buildings.

Q21. In about what percentage of those jobs did you propose equipment that could have qualified for BizSavers incentives? [% OR DK]

[NOTE TO INTERVIEWER: We want to know what percentage of jobs proposed to customers included equipment that was efficient enough to qualify, regardless of whether or not the client applied for incentives. Use text box to explain if respondent says answer “depends” on factor like customer or project type.]

[DISPLAY Q22 IF Q21 < 100% OR = DK]

Q22. In your experience, what types of businesses, if any, are <u>less</u> likely than others to agree to the incentive-qualifying equipment you proposed? [OPEN END OR DK]

Q23. Has any client of yours opted <u>not</u> to install high-efficiency equipment because applying for Ameren Missouri incentives was too burdensome?

- ☐ Yes
- ☐ No
- ☐ Don't know

[DISPLAY Q24 AND Q25 IF Q23 = YES]

Q24. In the past year, about how many clients of yours opted <u>not</u> to install high-efficiency equipment because the process of applying for Ameren Missouri incentives was too burdensome? [OPEN END OR DK]

Q25. For which types of businesses, if any, did this occur most frequently? [OPEN END OR DK]

Q26. As a service to clients, have you ever offered a discount on incentive-qualifying equipment in lieu of applying for BizSavers incentives?

- ☐ Yes
- ☐ No
- ☐ Don't know

[DISPLAY Q27 IF Q26 = YES]

Q27. In the past year, about how many of your clients installed incentive-qualifying equipment that you discounted in lieu of applying for BizSavers incentives?

[NOTE TO INTERVIEWER: If asked why we are asking this, say: "Ameren Missouri would like to know how many customers are doing energy efficient upgrades outside of the BizSavers programs." If asked why specifically we are asking about discounts offered in lieu of incentives, say: "This would be an indication that the BizSavers program is influencing the energy savings."]

Q28. Have the program rules for calculating energy savings ever limited the equipment you'd like your client to consider?

- ☐ Yes
- ☐ No
- ☐ Don't know

[DISPLAY Q29 IF Q28 = YES]

Q29. What equipment was it and how did the program rules for calculating energy savings limit the equipment choices? [OPEN END]

[DISPLAY Q30 IF LGT = YES]

Q30. About what percentage of all tube lighting in the Ameren Missouri service territory would you estimate is T12? [OPEN END OR DK]

Interactions with Program Staff (All Respondents, Except as Noted)

Now thinking about all of your incentive related jobs, I'd like to hear about your interactions with Ameren Missouri or Lockheed Martin staff who run the programs.

[ALL]

Q31. What types of assistance did you seek, if any, from program staff during the process of completing applications and getting your proposed projects approved? [SELECT ALL]

[*Do not read list. Also record any assistance the respondent reports that a coworker or customer sought.*]

Type of Assistance	1. Self	2. Coworker	3. Customer
Co-branding (logo) rules	☐	☐	☐
General program information	☐	☐	☐
Questions about how to fill out incentive application	☐	☐	☐
Check on status of incentive application	☐	☐	☐
Questions about the Trade Ally Network application	☐	☐	☐
Check on status of Trade Ally Network application	☐	☐	☐
Other, specify	☐	☐	☐
None	☐	☐	☐
Don't know	☐	☐	☐

[DISPLAY Q32 IF Q31.1 <> NONE AND Q31.1 <> DK]

Q32. Were program staff able to give you the assistance you were looking for?

- ☐ Yes
- ☐ No
- ☐ Don't know

[DISPLAY Q33 IF Q32 = NO OR DK]

Q33. What additional assistance would you have liked? [OPEN END]

Satisfaction (All Respondents, Except as Noted)

Except for a couple of closing remarks, we'll close with a few satisfaction questions to get an idea of your overall experience with program processes.

[ALL]

Q34. On a scale of 0 to 10 where 0 means "not at all satisfied" and 10 means "extremely satisfied," please rate how satisfied you are with . . .

[0-10 SCALE WITH DK, REF, AND NA]

a. … the program application process
b. … the range of measures and products for which Ameren offers incentives
c. … the quality of those measures and products that qualify for incentives
d. … the communication with program staff
e. … the level of incentives offered
f. … program rules and guidelines

[DISPLAY Q35 IF Q34.a < 7]

Q35. What about the application process were you dissatisfied with? [OPEN END]

[DISPLAY Q36 IF Q34.b < 7]

Q36. What about the range of measures and products were you dissatisfied with? [OPEN END]

[DISPLAY Q37 IF Q34.c < 7]

Q37. What about the quality of measures and products were you dissatisfied with? [OPEN END]

[DISPLAY Q38 IF Q34.f < 7]

Q38. What about the program rules and guidelines were you dissatisfied with? [OPEN END]

Conclusion (All, Except as Noted)

[ALL]

Q39. What would you say is the best thing about the BizSavers programs you have worked with?

- ☐ Association with the utility and the program offers credibility to the benefits of a project
- ☐ Increasing awareness of/interest in energy efficiency
- ☐ Working with program staff
- ☐ Increased sales
- ☐ Other – specify: [OPEN END]
- ☐ Nothing
- ☐ Don't know

Q40. What about the programs would you most like to see changed?

- ☐ Increasing awareness of/interest in energy efficiency
- ☐ Increased incentive amounts
- ☐ More standard incentives
- ☐ Simplify/shorten program process (process too complicated/takes too long)
- ☐ Other – specify: ____
- ☐ Nothing
- ☐ Don't know

Q41. Do you have any other comments or thoughts about the program that you think would be useful for Ameren Missouri to hear? [OPEN END]

Thank you for taking the time to talk.

[IF LGT=YES] This year, Ameren Missouri has asked us to try to assess the amount of energy efficient lighting products that have been sold without BizSavers incentives. It would help out a great deal if you would agree to take a brief online survey at your convenience. May I send you a link to that survey? It will take about 5 to 10 minutes and, again, it will provide very valuable information to Ameren Missouri.

- ☐ Yes
- ☐ No

[IF YES] And what email address shall we send that to?

Email address: [OPEN END]

Okay. Thank you for agreeing to take that brief survey. We'll send it to you in the next few days.

[IF LGT<>YES] Would it be alright for me to contact you via phone or email for any needed clarifications?

- ☐ Yes
- ☐ No

Email address: [OPEN END]

Direct number [if other than the one we have]: [OPEN END]

Appendix F: Non-participant Spillover Methodology

The evaluation team developed an innovative approach to estimating the *BizSavers* program's lighting-related spillover savings – that is, savings from un-incented sales of high-efficiency lighting equipment that resulted from direct or indirect program influence. The approach built upon, but goes beyond, a common method of assessing spillover savings in which surveyed trade allies estimate program-influenced sales of un-incented energy efficient measures.[47] The remainder of this section describes the typical approaches to assessing spillover and the limitations of those approaches and then describes the current approach.

Spillover assessments typically distinguish between participant and nonparticipant spillover. Participant spillover generally occurs when a program participant's experience with the program leads them to install additional measures; it typically is assessed by surveying program participants about program-influenced, un-incented upgrades.

Nonparticipant spillover occurs when program nonparticipants install measures either because of direct program influence (e.g., marketing, discussions with program staff) or because a program-influenced trade ally convinced them to carry out the upgrade. Nonparticipant spillover may be assessed two ways: 1) by surveying nonparticipants about program-influenced but un-incented upgrades; or 2) by surveying trade allies about their sales of program-influenced, un-incented equipment to program nonparticipants.

One limitation common to all of the typical survey approaches – participant, nonparticipant, and trade ally – is that they do not fully take into account the various channels through which a program may exert direct and indirect influence through the interactions of the program, distributors, installation contractors, and end-users. Figure F-1 illustrates these various channels. For example, program-influenced distributors making equipment recommendations in sales to end-users represent one channel; program-influenced distributors making equipment recommendations to contractors, who make recommendations to end-users is another channel; and program-influenced

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[47] See, for example:
Tetra Tech (2011). *National Grid, NSTAR, Western Massachusetts Electric Company, Unitil, and Cape Light Compact 2010 Commercial and Industrial Electric Programs Free-ridership and Spillover Study: Final Report*. Accessed on December 22, 2015 from: http://ma-eeac.org/wordpress/wp-content/uploads/Electric-PAs-Cross-Cutting-CI-Free-ridership-and-Spillover-Field-Study-Final-Report.pdf.
Navigant Consulting (2014). *Final Annual Report to the Pennsylvania Public Utility Commission for the Period June 2013 through May 2014, Program Year 5*. For Pennsylvania Act 129 of 2008 Energy Efficiency and Conservation Plan. Accessed on December 29, 2015 from: https://www.peco.com/CustomerService/RatesandPricing/RateInformation/Documents/PDF/New%20Filings/PECO%20Act%20129%20PY5%20Annual%20Report%20Fin%2011%2014%202014.pdf.

contractors who do not get recommendations from distributors but who make recommendations to end-users is yet a third channel.

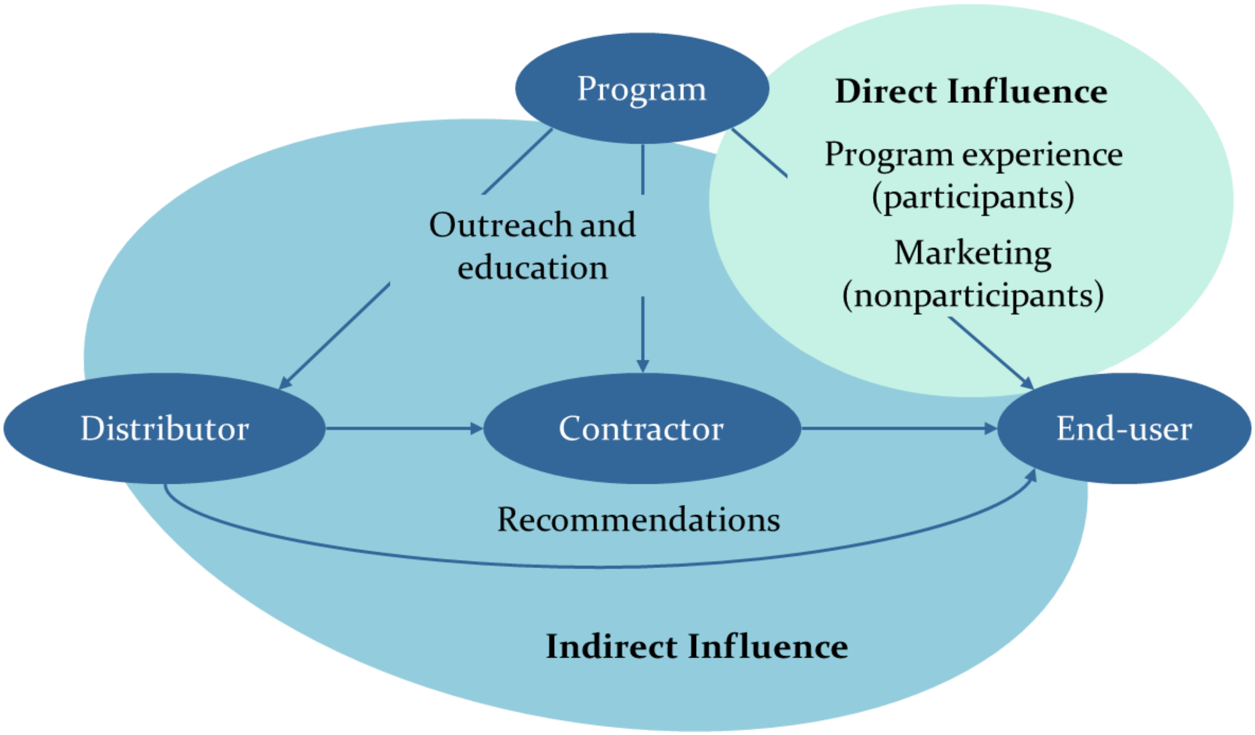

Figure F-1 Channels of Program Influence

While participant and nonparticipant surveys can assess direct program influence on end-users, they cannot fully assess the program's *indirect* influence through trade allies, as they do not assess the program's influence on the trade allies.

The failure to take account of the various roles of distributors and installation contractors has even greater implications for trade ally surveys. Such surveys may include both distributors and installation contractors. Assessing program-influenced sales both from distributors, who sell to end-users as well as to contractors, and from contractors, who buy from distributors to sell to end-users, creates the risk of double-counting equipment that installation contractors buy from distributors and sell to end-users. In addition, in the typical approach, each surveyed trade ally provides a single estimate of the program's influence on un-incented sales of high-efficiency equipment. This ignores the multiple possible paths of influence shown in the above figure, each of which may represent a different degree of program influence. Thus, such an approach oversimplifies the assessment of program influence.

Finally, the typical approach assumes that surveyed trade allies can accurately estimate the proportion of their sales that went to nonparticipants. Trade allies may have a sense of the proportion of sales that did or did not receive incentives, but their un-incented sales may be to participants (participant spillover) as well as to nonparticipants – and there is no reason to expect that a trade ally would reliably estimate the proportion of un-incented sales that went to each group.

Current Approach: The Five Scenarios

The current approach's innovation is that it identifies multiple scenarios representing all possible combinations of program influence on distributors, distributor influence on contractors or end-users, and contractor influence on end-users.

Table F-2 shows the five identified scenarios and the influence channels associated with each. Each scenario is defined based on: 1) whether the distributor sold equipment directly to an end-user (scenarios 1 and 2) or sold to a contractor (scenarios 3, 4, and 5); and 2) whether the sales in question involved equipment recommendations. Program direct influence on the end-user may occur in all scenarios. That also is the *only* possible influence in scenarios 2 and 5, as there are no equipment recommendations made to the end-user in those scenarios. Note that in scenario 5, it does not matter whether or not the distributor recommended equipment to the contractor, since the contractor did not recommend equipment to the end-user, so the distributor's recommendation could not influence the end-user.

As detailed below, the evaluation team used data from online surveys of distributors and contractors as well as from the program database to estimate the total sales of un-incented high-efficiency equipment in each of the above scenarios and to estimate the mean program indirect influence via distributors and contractors. The team used data from previous participant and nonparticipant surveys to estimate program direct influence on end-users.

Description of Survey

The evaluation team designed separate online survey instruments for distributors and installation contractors. Both surveys asked respondents to select the types of high-efficiency lighting they sold within Ameren Missouri service territory from the list identified in Table F-1.

Table F-1 Types of High Efficiency Lighting

Lighting Type	
LED linear tube	LED exit signs
LED exterior wall pack	T5 high bay 150-400 watt
LED high bay	T5 or T8 tube
LED screw-in	Ceramic metal halide
LED screw-in reflectors	Induction exterior fixture
LED refrigerated case	CFL screw-in

Table F-2 Five Scenarios of Equipment Sales and Recommendations

Scenario	Sales Channel	Equipment Recommendations			Possible Influence Channels
		Distributor to End-user	Distributor to Contractor	Contractor to End-user	
1	Distributor sells to end-user	Yes	n/a	n/a	(1.1) Program ⇨* end-user (1.2) Program ⇨ distributor ⇨ end-user
2		No	n/a	n/a	(2.1) Program ⇨ end-user
3	Distributor sells to contractor, who sells to end-user	n/a	Yes	Yes	(3.1) Program ⇨ end-user (3.2) Program ⇨ distributor ⇨ contractor ⇨ end-user (3.3) Program ⇨ contractor ⇨ end-user
4		n/a	No	Yes	(4.1) Program ⇨ end-user (4.2) Program ⇨ contractor ⇨ end-user
5		n/a	Yes or No	No	(5.1) Program ⇨ end-user
*⇨ = “influences”					

Analysts aggregated the program-eligible lighting types into 39 typical categories of efficient lighting that varied by wattage. For each lighting type selected, the survey asked respondents how many units of various specific measures they sold within Ameren Missouri service territory. For example, the “LED linear tube” measure type included the measures “LED 4’ linear tube, 1600-1800 lumens, 17-19 watt” and “LED 4’ liner tube, 1801-2200 lumens, 20-22 wall."

The surveys then asked questions designed to allocate the total reported sales to the five scenarios identified above. The distributor survey asked what percentage of total sales (by measure type) went to contractors versus to end-users. Both surveys asked about the percentages of sales in which the respondent made equipment recommendations – the distributor survey asked this separately about contractor and end-user sales, while the contractor survey asked this only about end-user sales.

Both surveys asked respondents to report the percentage of end-user sales for which the customers reported they would apply for *BizSavers* incentives, which provides an estimate of the percentage of un-incented sales.[48] Section 0, below, describes how the evaluation team allocated the distributors’ and contractors’ estimated un-incented sales to the five scenarios.

48 As described in the next subsection, the evaluation team also used a second method and data source to estimate the amount of un-incented sales and used the results that provided the more conservative estimate of un-incented sales.

Finally, both surveys asked respondents to rate the program's influence on their recommendations and the contractor survey asked respondents to rate the influence of distributor recommendations on their recommendations to end-user customers; both surveys used a 1-5 scale. Both surveys assessed the respondents' influence on their end-user customers by asking what percentage of their recommendations the customers accepted.

Sampling and Data Collection Methodology

The target population for the spillover survey was any lighting distributors and contractors doing business in the Ameren Missouri service territory. On the assumption that most of the distributors and contractors with significant lighting work in the Ameren Missouri service territory had done at least one *BizSavers* project, we defined the survey frame as any firm that had done any *BizSavers* projects from 2013 through 2015 (the current program cycle).

From the *BizSavers* database, the evaluation team identified approximately 350 firms with any lighting projects since 2013. The evaluation team used "business type" information from the database to classify all members of the Ameren Missouri Trade Ally Network (TAN) into distributors (those who primarily sold, but did not install, equipment) and installation contractors. The team classified non-TAN firms based on information on the firms' websites, as confirmed in the survey. About one-third of the lighting firms were distributors and two-thirds were contractors.

The evaluation team conducted the spillover surveys at the same general time as, but separately from, a process evaluation survey of trade allies conducted by telephone. The evaluation team used the following approach to allocate the sample frame between the two research activities:

- The team initially allocated trade allies with 2015 projects to the survey frame for the process evaluation. The interviewer for the process survey asked each survey respondent, as well as each trade ally that refused to take the process survey, to agree to complete the online spillover survey. The evaluation team sent an email invitation with a survey link to those who agreed to take the spillover survey.
- The evaluation team also sent email invitations to complete the online survey to: 1) all distributors and contractors with 2015 projects that the phone interviewer could not or did not reach by the time the process survey was completed; and 2) all distributors and contractors with projects in 2013 or 2014 but not 2015.

The email invitation to complete the online survey explained the purpose of the survey. The invitation provided contact information for key evaluation team and Ameren Missouri staff. The team sent up to three weekly follow-up emails to all recipients of the email survey invitation (including those process survey respondents who agreed to complete the online survey).

After three weeks in the field, the evaluation team also place calls to forty large distributors and contractors that had not completed the survey to encourage survey completion.

The above efforts resulted in the completion of the online surveys by thirty-three distributors and twenty-nine contractors. Together, those sixty-two respondents represented 50% of the 2015 *BizSavers* lighting savings. For reasons explained below, this approach does not seek to extrapolate from sample results to the greater population of trade allies.

Estimation of Total and Un-Incented Savings

The evaluation team first developed a kWh savings value for each of the thirty-nine lighting measure categories. The kWh savings algorithm is summarized below:

$$\text{kWh Savings} = \text{Watts}_{(\text{base})} - \text{Watts}_{(\text{efficient})} / 1000 \text{ X Annual Hours of Use}$$

The baseline wattage for each set was based on commercially available nominally efficient wattages. The evaluation team utilized the Energy Independence and Security Act (EISA) of 2007 to determine nominally efficient baselines. This included Section 321 for replacing incandescent general service lamps. The rollout of replacement guidelines in the wattage ranges of 40 watts to 100 watts was considered fully implemented, with the most recent rollout of 310-749 lumen lamps (40 watts) as of January 1, 2014. In addition, Section 322 guidelines were used for the replacement of reflector lamps. Section 324 guidelines guided estimations for the replacement of HID fixtures and lamps. To determine the baseline wattage of liner fluorescent lamps the evaluation team used the 2009 Department of Energy regulations. The program incentivized T12 replacement lighting at both the lumen equivalent and the actual T12 during a special incentive offer. The methodology utilized the more efficient baseline for the linear fluorescent typical lighting categories in the survey.

The team based the efficient wattage for each lighting category on either the wattage of the actual offered measure or the midpoint wattage when a range was provided. The evaluation team based annual hours of use for all interior lighting was based on the Ameren TRM weighted building hours, at 5,202 annual hours. Exterior hours were based on the annual non-daylight hours for central Missouri.

The evaluation team could then estimate the total energy savings that resulted from each survey respondent’s sales of high-efficiency lighting. If a respondent reported selling a particular type of high-efficiency lighting but did not report the number of units sold, the team assigned zero savings to that lighting type for that respondent.

The team then subtracted each respondent's incented savings from total savings to generate an estimate of un-incented savings. The team had two sources for each respondent's estimate of incented savings: 1) the respondent's total savings multiplied by the respondent's estimated percentage of sales for which the customer applied for *BizSavers* incentives; and 2) the incented lighting savings for projects the respondent's firm had done, as tracked in the program database. To be conservative, the evaluation team used the source that produced the *lower* estimate of un-incented savings for each respondent. In the case of respondents that did not report sales of a given lighting type but the program database showed incented savings for that lighting type, the evaluation team assigned zero un-incented savings, rather than a negative number, to that lighting type.

The program implementer had already identified participant spillover savings associated with completed *BizSavers* projects ("project-level spillover") and recorded those savings in the program database. The evaluation team identified the project-level spillover savings for each surveyed distributor and contractor, and subtracted those savings from that distributor or contractor's total un-incented savings produced by the above method to produce a net un-incented sales value for each survey respondent.

The team then allocated the savings from the net un-incented sales to the five scenarios – distributor sales to end-users to scenarios 1 and 2, and contractor sales to scenarios 3, 4, and 5 (Table F-3). The distribution of the distributor sales between scenarios 1 and 2 and of the contractor sales among scenarios 3 to 5 depended on the percentage of sales that involved recommendations.

Table F-3 Allocation of Savings from Un-incented Sales to the Five Scenarios

<table>
<tr><th>Scenario</th><th colspan="5">How Un-Incented Sales Are Calculated by Scenario</th></tr>
<tr><td>1</td><td rowspan="2">Distributor un-incented sales to end-users</td><td>X</td><td colspan="3">Percentage in which distributor recommended equipment</td></tr>
<tr><td>2</td><td>X</td><td colspan="3">Percentage in which distributor did not recommend equipment</td></tr>
<tr><td>3</td><td rowspan="3">Contractor un-incented sales*</td><td>X</td><td>Percentage in which distributor recommended equipment</td><td>X</td><td>Percentage in which contractor recommended equipment</td></tr>
<tr><td>4</td><td>X</td><td>Percentage in which distributor did not recommend equipment</td><td>X</td><td>Percentage in which contractor recommended equipment</td></tr>
<tr><td>5</td><td>X</td><td colspan="3">Percentage of sales in which contractor did not recommend equipment**</td></tr>
</table>

*All contractor sales are to end-users.
**In this scenario, it does not matter whether or not the distributor recommended equipment, since the contractor did not recommend equipment, and therefore any distributor recommendations did not get passed on to the end-user.

None of the scenarios includes the distributors' reported sales to contractors. That is because all distributor sales to contractors also represent contractor sales to end-users.

Since this approach already counts the contractors' reported sales to end-users, adding distributor sales to contractors would double-count those sales.

Calculation of Program Indirect Influence on End-Users

For each scenario, the team used the survey data to calculate mean program *indirect* influence through the various influence channels, as follows:

- Distributors and contractors rated the program's influence on their recommendations, using a 1-5 scale, where 1 means "no influence" and 5 means "great influence." The evaluation team converted the scaled responses to 0%, 25%, 50%, 75%, and 100%, respectively.
- Contractors rated the influence of distributor recommendations on their own recommendations, using the same a 1-5 scale, and the evaluation team similarly converted the scaled responses to 0% to 100%.
- The evaluation team used the respondents' (distributors and contractors) reported percentage of accepted recommendations to end-user customers as the indicator of their influence on end-users.

For any given influence channel, the mean program *indirect* influence value is the product of the mean influence values for each "link" in that channel. For example, program-influenced distributors that make equipment recommendations to end-users represent one channel (designated as *program* ⇨ *distributor* ⇨ *end-user*). For that channel, the mean program direct influence is the product of the program's mean influence on the distributors and the distributors' mean influence on the end-users. With this method, the evaluation team could calculate a single mean program indirect influence value for each influence channel.

Calculation of Program Direct Influence on End-Users

Recall that the current approach does not try to distinguish between un-incented sales to program participants versus nonparticipants. The approach instead uses a weighted average of the assessed program influence on energy efficiency upgrades undertaken by participants and nonparticipants from previous participant and nonparticipant surveys.

Of the 488 2015 *BizSavers* participants who completed the participant survey during Q1-Q3 2015, 34 reported un-incented efficiency upgrades. Those 34 respondents reported the program's influence on those upgrades on a 1-5 scale, from "unimportant" to "very important." As with the distributor and contractors' influence ratings, the evaluation team converted those scores to 0% to 100%.

The evaluation team did not conduct a nonparticipant survey in 2015, but did so in 2014 and so used data from that survey as a proxy for 2015. In that survey, 27 respondents reported on the influence of Ameren Missouri's energy efficiency marketing on the decision to undertake efficiency upgrades. Again, respondents rated influence on a 1-5 scale, which the evaluators converted to scores from 0% to 100%.

Not surprisingly, the participant survey yielded a higher mean program influence score (73.4%) than did the nonparticipant survey (14.8%). To provide the weights for the two scores, the evaluation team estimated the participant and nonparticipant shares of the total sales of un-incented high-efficiency equipment, using data from the distributor and contractor survey and an independent estimate of the *participant* spillover rate. The estimates used the following formulas:

(1): $x = y + z$

(2): $x = q + r$

(3): $r = y - (y * s) = y * (1 - s)$

Where x = total sales, y = participant sales, z = nonparticipant sales,
q = un-incented sales, r = incented sales, and
s = participant spillover rate.

Formulas (1) and (2) simply show that total sales are the sum of participant and nonparticipant sales, which are the sum of un-incented and incented sales. Formula (3) shows that the incented proportion of sales is equal to the total of participant sales minus the spillover (or un-incented) portion of participant sales.

The evaluation team calculated the savings-weighted mean percentages of incented (r) and un-incented sales (q) from the distributor and contractor surveys, yielding values of $r = .694$ and $q = .306$.

The evaluation team separately estimated a participant spillover savings rate of .015 based on the savings from un-incented equipment installed as part of incented projects, which the program implementer tracked in the program database. This level is consistent with spillover levels found in other evaluations of nonresidential programs.[49] (As explained further below, the evaluation team subtracted all separately tracked spillover savings from the total determined through the current approach.)

Substituting the values of r and s into Formula (3), above, and solving for y:

$$.694 = y * (1-.015) = y * .895$$

$$y = .694 / .895 = .705$$

Thus, participant sales represent 70.5%, and nonparticipant sales represent 29.5% of un-incented high-efficiency sales. The evaluation team used those values with the

[49] For example, Tetra Tech (2011), *op. cit.*

participant and nonparticipant influence values to produce a weighted mean value for program direct influence on end-users:

$$(.734 * .705) + (.148 * .295) = .561, \text{ or } 56\%$$

Results: Calculation of Maximum Program Influence in Each Scenario

For each scenario, the team multiplied the total savings from un-incented measures by the influence value for that scenario to yield the estimated savings from program-influenced un-incented sales. As

Table F-2 showed, however, scenarios 1, 3, and 4 each have multiple possible channels of influence, each possibly having different influence values.

For each of scenarios 1, 3, and 4, then, the evaluation team used the *maximum* influence value from that scenario's various influence channels. For example, if the influence value for *program* ⇨ *contractor* ⇨ *end-user* is greater than for either *program* ⇨ *end-user* or *program* ⇨ *distributor* ⇨ *contractor* ⇨ *end-user*, then that is the value for scenario 3. Table F-3 illustrates this, showing the evaluation team's computed spillover savings for the five spillover scenarios and the total across the five scenarios.

Summing the spillover savings for the five scenarios produced a total spillover savings value for the surveyed distributors and contractors of 12,061,250 kWh.

As noted above, the evaluation team did not attempt to extrapolate the sample results to the population of trade allies. This is because the distributor- and contractor- reported sales data were highly skewed, which, combined with relatively small samples, produced large relative errors around the mean savings values, which would have produced population estimates with low precision. Nevertheless, since the estimated sample savings total from the current method itself relied on estimated mean influence levels, the evaluation team constructed confidence intervals around the sample total. The variances for the influence levels were small, producing a precision of ± 2.4%, at 90% confidence, for the total savings value. Thus, the evaluation team has 90% confidence that the sampled distributors and contractors represent at least 11,777,137 kWh of lighting-related spillover savings, assuming that they provided unbiased estimates of total sales and influence. The team was able to determine that the 2015 *BizSavers* projects associated with the surveyed distributors and contractors represented 50% of the total 2015 *BizSavers* lighting-related savings. Thus, the spillover savings calculated in the current method likely represent a large portion of the total program-induced, lighting-related spillover.

Because the data collected was reflective of 2014 sales estimations, the evaluation team determined is analytically appropriate to develop a deemed spillover rate that would be applied to the 2015 gross lighting ex ante kWh savings. The evaluation team used the lower bound spillover savings estimation (11,510,886 kWh) divided by 2014 gross lighting ex ante (94,681,369 kWh) to calculate a 12.2% non-participant spillover rate. When applied to the 2015 gross lighting ex ante kWh the result is 21,968,006 kWh in non-participant lighting kWh spillover savings attributed to the BizSavers Program in 2015.

Impact of Missing Data

Of the thirty-three distributors and twenty-nine contractors surveyed, five (15%) and eight (28%), respectively, did not report the number of units sold of at least one type of high-efficiency lighting they sold within Ameren Missouri service territory. For specific lighting types, the percentage of respondents that did not report the number of units sold (out of the number that reported selling the lighting type) varied from 0% to 6% for distributors and 0% to 25% for contractors. Across all respondents and lighting types, the overall missing data rates were 3% for distributors and 12% for contractors.

Those respondents with missing “units sold” data tended to report lower sales of other lighting types, compared to respondents that had no missing data. Therefore, the impact of the missing data on the sales estimate was less than the missing data percentage. To estimate the impact of missing data, the evaluation team interpolated each missing value in the following manger:

- The team first calculated the mean savings for each lighting type, across all the respondents who reported sales for that lighting type. Each of these means is called a *lighting-type mean*.
- The team then calculated each respondent’s *total savings* as a percentage of the total of the *lighting-type means* for which that respondent reported sales. Thus, for example, if a respondent reported selling all lighting types except ceramic metal halides and induction exterior fixtures, then the team calculated that respondent’s total savings as a percentage of the *lighting-type means* for all but those two lighting types. Each of these percentages is called the respondent’s *savings percentage*.
- Finally, for each missing response, the team multiplied the respondent’s *savings percentage* by the appropriate *lighting-type mean*.

Thus, each missing response is interpolated based on the mean value of non-missing responses for that lighting type, adjusted based on how the respondent’s savings for reported measures compares with the mean savings reported by other respondents for those same measures.

Using this approach, the evaluation team estimated that the missing unit sales data reduced the total estimate of distributor savings by about 0.5% and total estimate of contractor savings by about 6%.

Table F-4 Five Scenarios of Equipment Sales and Recommendations

Scenario		Total Un-Incented Savings (kWh)	…Times Maximum Of…			Relative bounds at 90% confidence	Program-Influenced Un-Incented Savings (kWh) – Min 90%
1	Distributor recommends and sells to end-user	6,837,910	Program ⇨ end-user*	56%	= 85%	7%	5,409,412
			Program ⇨ distributor (96%) X distributor ⇨ end-user (88%)	85%			
2	Distributor sells to end-user without recommendation	772,213	Program ⇨ end-user	56%	= 56%	5%	410,906
3	Distributor recommends and sells to contractor, who recommends and sells to end-user	6,775,447	Program ⇨ end-user	56%	= 62%	9%	3,851,196
			Program ⇨ distributor (96%) X distributor ⇨ contractor (86%) X contractor ⇨ end-user (73%)	60%			
			Program ⇨ contractor (85%) X contractor ⇨ end-user (73%)	62%			
4	Distributor sells to contractor without recommendation, who recommends and sells to end-user	1,815,142	Program ⇨ end-user =	56%	= 62%	9%	1,031,735
			Program ⇨ contractor (85%) X contractor ⇨ end-user (73%)	62%			
5	Distributor sells to contractor**, who sells to end-user without recommendation	841,848	Program ⇨ end-user	56%	= 56%	5%	447,960
	Total	17,042,561				5%	11,510,886

*Read as "value of program influence on end-user."

**With or without recommendation

Appendix G: TA Spillover Survey – Contractor Version

Thank you for agreeing to take this brief survey. The first few questions are to assess how much high-efficient lighting you have sold and installed in the past year in Ameren Missouri's service territory. The questions after that concern your recommendations to your customers.

If you have any questions, please feel free to call Ryan Bliss at Research Into Action, at 503, 287-9136, or email him at ryan.bliss@researchintoaction.com

Q42. Which of the following types of equipment did you sell or install within the Ameren Missouri service territory in 2014 – including both those that did and did not receive BizSavers incentives? [50]

- [] LED Linear Tube
- [] LED exterior wall pack
- [] LED High Bay
- [] LED Screw-in
- [] LED Screw-in Reflectors
- [] LED Refrigerated Case - Linear Tubes
- [] LED Exit Signs
- [] T5 High bay 150 - 400 Watt
- [] T5 or T8 tube
- [] Ceramic Metal Halide
- [] Induction Exterior Fixture
- [] CFL Screw-in

[50] If we can establish a reasonable minimum criterion, we can phrase the question as, "For which of the following types of lighting did you sell at least X units within the Ameren Missouri service territory in 2014?

Q43. How many of the following specific types of lighting did you sell or install within the Ameren Missouri service territory in 2014?

[PROGRAMMER: Display only the specific lighting measures that are associated with lighting types selected in Q42, as shown in column 1 of the table.]

DISPLAY IF SELECTED IN Q42	SPECIFIC LIGHTING MEASURE	# Sold or installed
LED Linear Tube	LED 4' linear tube, 1600-1800 lumens, 17 - 19 watt	
	LED 4' linear tube, 1801-2200 lumens, 20 - 22 watt	
LED exterior wall pack	LED exterior wall pack or pole, <50 watts	
	LED exterior wall pack or pole, 50 to 100 watts	
	LED exterior wall pack or pole, >100 watts	
LED High Bay	LED High Bay, <100 watts	
	LED High Bay,100 to 300 watts	
	LED High Bay, >300 watts	
	LED Decorative, less than 10 watts	
LED Screw-in	LED Screw-in omnidirectional 310-749 lumens, (40 w equivalent) 4 - 5 watts	
	LED Screw-in omnidirectional 750-1049 lumens, (60 w equivalent) 6 - 8 watts	
	LED Screw-in omnidirectional 1050-1489 lumens, (75 w equivalent) 9 - 13 watts	
	LED Screw-in omnidirectional 1490-2600 lumens, (100 w equivalent) 16 - 20 watts	
LED Screw-in Reflectors	LED Screw-in Reflector ,420-524 lumens (40 - 50 w equivalent), 9 watts	
	LED Screw-in Reflector 561-726 lumens, (51 -66w equivalent), 12 watts	
	LED Screw-in Reflector, 837-1063 lumens (67 - 85 w equivalent), 15 watts	

	LED Screw-in Reflector 1204-1610 lumens (86 - 115 w equivalent) , 18 watts	
	LED Screw-in Reflector 1682-2248 lumens (116 - 155 w equivalent), 26 watts	
	LED Screw-in Reflector 2340-3075 lumens (156 - 205 w equivalent), 35 watts	
LED Refrigerated Case - Linear Tubes	LED Refrigerated Case linear tube, center tube, 48-72", 1600 lumens	
	LED Refrigerated Case linear tube-end door tube, 48-72", 800 lumens	
LED Exit Signs	LED Exit sign	
T5 High bay 150 - 400 Watt	T5 High bay 4' 3L T5 fixture(250 MH equivalent) 150 - 200 watts	
	T5 High bay 4' 4L T5 fixture (400 MH equivalent) 200-300 watts	
	T5 High bay 4' 6L T5 fixture (400 MH equivalent) 300-400 watts	
T5 or T8	T5 Lamp 4' T5 (2800 -3200 lumens) 28-36 watts	
	T5 Lamp 4' T5 (4300-5000 lumens) 49 - 54 watts	
	T8 Lamp 4' T8 (2200 - 2500 lumens) 25 watt	
	T8 Lamp 4' T8 (2500-2700 lumens) 28 W	
	T8 Fixture 4' 2L T8 Troffer 25-28 watt lamps	
	T8 Fixture 4' 3L T8 Troffer 25-28 watt lamps	
	T8 Fixture 4' 4L T8 Troffer 25-28 watt lamps	
Ceramic Metal Halide	Ceramic metal halide, 70-100 watts	
	Ceramic metal halide, 140-160 watts	
Induction Exterior Fixture	Induction Exterior fixture, 100 - 300 watts	

CFL Screw-in	CFL Screw-in omnidirectional 310-749 lumens, (40 w equivalent) 9 - 13 watts	
	CFL Screw-in omnidirectional 750-1049 lumens, (60 w equivalent)13 - 15 watts	
	CFL Screw-in omnidirectional 1050-1489 lumens, (75 w equivalent) 18 - 25 watts	
	CFL Screw-in omnidirectional 1490-2600 lumens, (100 w equivalent) 26 - 30 watts	

Q44. Thinking about the lighting jobs you have done, about what percent of the time did the vendor that sold you the equipment make an equipment recommendation? (As opposed to times when you did not request a recommendation and the vendor did not offer one.)

[PROGRAMMER: Offer two options: enter exact % value or provide OE response]

Q45. And when you do a lighting job, about what percentage of the time do you recommend equipment to your customer? (As opposed to times when your customer does not request a recommendation and you do not offer one.)

[PROGRAMMER: Offer two options: enter exact % value or provide OE response]

Q46. And when you recommend equipment for a lighting job, about what percentage of your recommendations do your customers accept, on average?

[PROGRAMMER: Offer two options: enter exact % value or provide OE response]

Q47. Of your sales of each of the following equipment types to businesses or other end-users in Ameren Missouri service territory, about what percentage of the time did your customer apply for BizSavers incentives?

[PROGRAMMER NOTE: Display only the types of lighting selected in Q42.]

Lighting Type	Percentage of customers that applied for BizSavers incentives
LED Linear Tube	[%]
LED exterior wall pack	[%]
LED High Bay	[%]
LED Screw-in	[%]
LED Screw-in Reflectors	[%]
LED Refrigerated Case - Linear Tubes	[%]
LED Exit Signs	[%]
T5 High bay 150 - 400 Watt	[%]
T5 or T8 tube	[%]
Ceramic Metal Halide	[%]
Induction Exterior Fixture	[%]
CFL Screw-in	[%]

Q48. Please rate the degree to which vendor recommendations, when given, have influenced the equipment recommendations you have made to your customers. Please use a scale from 1, meaning is “no influence,” to 5, meaning “great influence.”

[PROGRAMMER NOTE: Insert 1-5 scale with “Not sure” option]

Q49. Please rate the degree to which the BizSavers program has influenced the equipment recommendations you have made to your customers. Please use a scale from 1, meaning is “no influence,” to 5, meaning “great influence.”

(You may consider any way in which the program may have influenced your recommendations, such as by making you aware of the incentives for equipment or by providing you information on the advantages of specific types of equipment.)

[PROGRAMMER NOTE: Insert 1-5 scale with “Not sure” option]

Q50. Why did you provide that rating? [OPEN-END RESPONSE]

Appendix H: TA Spillover Survey – Vendor Version

Thank you for agreeing to take this brief survey. The first few questions are to assess how much high-efficient lighting you have sold in the past year in Ameren Missouri's service territory to contractors and to end-users. The questions after that concern your recommendations to your customers.

If you have any questions, please feel free to call or email Ryan Bliss at Research Into Action, at 503, 287-9136, or email him at ryan.bliss@researchintoaction.com .

Q51. Which of the following types of lighting did you sell within the Ameren Missouri service territory in 2014?[51]

[] LED Linear Tube

[] LED exterior wall pack

[] LED High Bay

[] LED Screw-in

[] LED Screw-in Reflectors

[] LED Refrigerated Case - Linear Tubes

[] LED Exit Signs

[] T5 High bay 150 - 400 Watt

[] T5 or T8 tube

[] Ceramic Metal Halide

[] Induction Exterior Fixture

[] CFL Screw-in

Q52. How many of the following specific types of lighting did you sell within the Ameren Missouri service territory in 2014?

[PROGRAMMER: Display only the specific lighting measures that are associated

[51] If we can establish a reasonable minimum criterion, we can phrase the question as, "For which of the following types of lighting did you sell at least X units within the Ameren Missouri service territory in 2014?

with lighting types selected in Q51, as shown in column 1 of the table.]

DISPLAY IF SELETED IN Q51	SPECIFIC LIGHTING MEASURE	# SOLD
LED Linear Tube	LED 4' linear tube, 1600-1800 lumens, 17 - 19 watt	
	LED 4' linear tube, 1801-2200 lumens, 20 - 22 watt	
LED exterior wall pack	LED exterior wall pack or pole, <50 watts	
	LED exterior wall pack or pole, 50 to 100 watts	
	LED exterior wall pack or pole, >100 watts	
LED High Bay	LED High Bay, <100 watts	
	LED High Bay,100 to 300 watts	
	LED High Bay, >300 watts	
	LED Decorative, less than 10 watts	
LED Screw-in	LED Screw-in omnidirectional 310-749 lumens, (40 w equivalent) 4 - 5 watts	
	LED Screw-in omnidirectional 750-1049 lumens, (60 w equivalent) 6 - 8 watts	
	LED Screw-in omnidirectional 1050-1489 lumens, (75 w equivalent) 9 - 13 watts	
	LED Screw-in omnidirectional 1490-2600 lumens, (100 w equivalent) 16 - 20 watts	
LED Screw-in Reflectors	LED Screw-in Reflector ,420-524 lumens (40 - 50 w equivalent), 9 watts	
	LED Screw-in Reflector 561-726 lumens, (51 -66w equivalent), 12 watts	
	LED Screw-in Reflector, 837-1063 lumens (67 - 85 w equivalent), 15 watts	

	LED Screw-in Reflector 1204-1610 lumens (86 - 115 w equivalent) , 18 watts	
	LED Screw-in Reflector 1682-2248 lumens (116 - 155 w equivalent), 26 watts	
	LED Screw-in Reflector 2340-3075 lumens (156 - 205 w equivalent), 35 watts	
LED Refrigerated Case - Linear Tubes	LED Refrigerated Case linear tube, center tube, 48-72", 1600 lumens	
	LED Refrigerated Case linear tube-end door tube, 48-72", 800 lumens	
LED Exit Signs	LED Exit sign	
T5 High bay 150 - 400 Watt	T5 High bay 4' 3L T5 fixture(250 MH equivalent) 150 - 200 watts	
	T5 High bay 4' 4L T5 fixture (400 MH equivalent) 200-300 watts	
	T5 High bay 4' 6L T5 fixture (400 MH equivalent) 300-400 watts	
T5 or T8	T5 Lamp 4' T5 (2800 -3200 lumens) 28-36 watts	
	T5 Lamp 4' T5 (4300-5000 lumens) 49 - 54 watts	
	T8 Lamp 4' T8 (2200 - 2500 lumens) 25 watt	
	T8 Lamp 4' T8 (2500-2700 lumens) 28 W	
	T8 Fixture 4' 2L T8 Troffer 25-28 watt lamps	
	T8 Fixture 4' 3L T8 Troffer 25-28 watt lamps	
	T8 Fixture 4' 4L T8 Troffer 25-28 watt lamps	
Ceramic Metal Halide	Ceramic metal halide, 70-100 watts	
	Ceramic metal halide, 140-160 watts	
Induction Exterior	Induction Exterior fixture, 100 - 300 watts	

Fixture		
CFL Screw-in	CFL Screw-in omnidirectional 310-749 lumens, (40 w equivalent) 9 - 13 watts	
	CFL Screw-in omnidirectional 750-1049 lumens, (60 w equivalent)13 - 15 watts	
	CFL Screw-in omnidirectional 1050-1489 lumens, (75 w equivalent) 18 - 25 watts	
	CFL Screw-in omnidirectional 1490-2600 lumens, (100 w equivalent) 26 - 30 watts	

Q53. For each of the following equipment types, about what percentage of your sales in Ameren Missouri service territory was to contractors and what percentage was to end-users?

[PROGRAMMER: Display only the types of lighting selected in Q51.]

Lighting Type	Percentage sold to contractors	Percentage sold to end-users
LED Linear Tube	[%]	[%]
LED exterior wall pack	[%]	[%]
LED High Bay	[%]	[%]
LED Screw-in	[%]	[%]
LED Screw-in Reflectors	[%]	[%]
LED Refrigerated Case - Linear Tubes	[%]	[%]
LED Exit Signs	[%]	[%]
T5 High bay 150 - 400 Watt	[%]	[%]
T5 or T8 tube	[%]	[%]
Ceramic Metal Halide	[%]	[%]
Induction Exterior Fixture	[%]	[%]
CFL Screw-in	[%]	[%]

The next couple of questions are about your sales of lighting equipment to contractors.

Q54. And of your sales of each of the following equipment types to contractors in Ameren Missouri service territory, about what percentage of the time did the contractor indicate that they or their customer would apply for BizSavers incentives?[52]

[PROGRAMMER NOTE: Display only the types of lighting selected in Q51.]

Lighting Type	Percentage of contractors that indicated customer would apply for BizSavers incentives
LED Linear Tube	[%]
LED exterior wall pack	[%]
LED High Bay	[%]
LED Screw-in	[%]
LED Screw-in Reflectors	[%]
LED Refrigerated Case - Linear Tubes	[%]
LED Exit Signs	[%]
T5 High bay 150 - 400 Watt	[%]
T5 or T8 tube	[%]
Ceramic Metal Halide	[%]
Induction Exterior Fixture	[%]
CFL Screw-in	[%]

Q55. When you make a sale of lighting equipment to contractors, about what percentage of the time do you recommend equipment that you think would work for their job? (As opposed to times when the contractor did not request a recommendation and you did not offer one.)

[PROGRAMMER: Offer two options: enter exact % value or provide OE response]

Q56. And when you recommend equipment to contractors for a lighting job, about what percentage of your recommendations do they accept, on average?

[PROGRAMMER: Offer two options: enter exact % value or provide OE response]

The next couple of questions are about your sales of lighting equipment to businesses or other end-users.

[52] This question possibly could be omitted. It is possible that it would not provide reliable information on the % of jobs that receive incentives, as contractors may not tell vendors whether or not the customer will apply for incentives. We will have two other sources of information on incented vs. non-incented sales: 1) the database tracks incented sales, so we can subtract those from the estimated total sales from vendor responses; and 2) we will ask contractors what % of their jobs with customers have incentive applications.

Q57. Of your sales of each of the following equipment types to businesses or other end-users in Ameren Missouri service territory, about what percentage of the time did the customer indicate that they would apply for BizSavers incentives?

[PROGRAMMER NOTE: Display only the types of lighting selected in Q51.]

Lighting Type	Percentage of contractors that indicated customer would apply for BizSavers incentives
LED Linear Tube	[%]
LED exterior wall pack	[%]
LED High Bay	[%]
LED Screw-in	[%]
LED Screw-in Reflectors	[%]
LED Refrigerated Case - Linear Tubes	[%]
LED Exit Signs	[%]
T5 High bay 150 - 400 Watt	[%]
T5 or T8 tube	[%]
Ceramic Metal Halide	[%]
Induction Exterior Fixture	[%]
CFL Screw-in	[%]

Q58. And when you make a sale of lighting equipment directly to businesses or other end-users, about what percentage of the time do you recommend equipment that you think would work for their job? (As opposed to times when the customer did not request a recommendation and you did not offer one.)

[PROGRAMMER NOTE: Offer two options: enter exact % value or provide OE response]

Q59. And when you recommend equipment to a customer for a lighting job, about what percentage of your recommendations do your customers accept, on average?

[PROGRAMMER: Offer two options: enter exact % value or provide OE response]

Q60. Please rate the degree to which the BizSavers program has influenced the equipment recommendations you have made to contractors or end-user customers. Please use a scale from 1, meaning “no influence,” to 5, meaning “great influence.”

(You may consider any way in which the program may have influenced your recommendations, such as by making you aware of the incentives for equipment or by providing you information on the advantages of specific types of equipment.)

[PROGRAMMER NOTE: Insert 1-5 scale with “Not sure” option]

Q61. Why did you provide that rating? [OPEN-END RESPONSE

Appendix I: TA Semi Structured Interview Guide - NC

Let's start with a few questions about your company.

Q1. How many business locations do you have? []

Q2. How many employees work at all of your locations? Your best estimate is fine. []
Q3. What areas of Missouri do you serve? []

Training (All Respondents)

I'd like to hear a bit about any information or training you've received from Ameren Missouri or BizSavers about the energy efficiency programs.

Q4. Ameren Missouri has held public events to educate contractors and customers about the BizSavers programs. These include workshops, seminars, and appearances at trade shows. Have you attended this type of informational meeting? If so, how many? []
[ASK Q5 TO Q6 IF Q4 = 'YES']

Q5. How valuable, if at all, was the information you've received at these events? []

[AS NEEDED, PROBE ABOUT:]

a. Clarity of information
b. Level of detail presented
c. Topics covered (application requirements, equipment, calculating savings and incentives, M&V requirements, selling benefits of EE)

Q6. How was the timing and location of these events? []

[IF NEEDED: BY TIMING, WE MEAN THE SCHEDULED TIME OF THE EVENT AND/OR THE DURATION OF THE EVENT]
Q7. How useful is the program's *BizSavers Solutions* monthly electronic newsletter to you? [If not useful, why not?] []

[IF NEEDED, PROBE ABOUT AWARENESS OF THE NEWSLETTER]
Q8. What additional information or training, if any, would you like? []

[Probe about specific program processes, technologies, rules, etc.]

Marketing and Customer Program Awareness

Now let's talk about your customers a bit, again focusing on those that have done new construction projects.

Q9. First, what are the main business or building types that you work with? []

Q10. According to the project database, you have done [INSERT] new construction projects that applied for Ameren Missouri incentives this year. Is that correct? []

Q11. For how many of those projects was your client aware that those incentives were available before you mentioned it to them? []

Q12. What would you suggest that Ameren Missouri do to increase your customers' awareness of BizSavers incentives? [OPEN END]

[ASK Q18 IF MEMBER OF TAN

How, if at all, has being a member of the Ameren Missouri Trade Ally Network affected your business? []

Q13. Is your firm using Ameren Missouri's logo for co-branding your services? [If not: why not?] []

[PROBE ABOUT:

- WHETHER ANYONE FROM AMEREN/BIZSAVERS SPOKE TO THEM ABOUT IT
- WHAT IT WOULD TAKE TO GET THEM TO DO IT]

Q14. In what ways, if any, has working with the BizSavers New Construction Program affected the design of your new construction projects? []

Q15. In what ways, if any, has working with the BizSavers New Construction Program limited the design of your new construction projects? []

[PROBE ABOUT RULES FOR CALCULATING BASELINE AND INCENTIVES]

Q16. About how many new construction jobs did you do in 2015 that *did not* apply for BizSavers incentives? []

Q17. In how many of those jobs did you propose high-efficiency equipment – that is, equipment that could have qualified for BizSavers incentives? []

Q18. In those cases, what, if anything, has prevented you from being able to include high-efficiency equipment in your designs? []

['CLIENT DECISION' IS NOT AN ACCEPTABLE ANSWER! PROBE ABOUT CLIENTS' REASONS FOR DECIDING NOT TO INCLUDE]

Interactions with Program Staff (All Respondents, Except as Noted)

Now thinking about all of your incentive related jobs, I'd like to hear about your interactions with Ameren Missouri or Lockheed Martin staff who run the programs.

Q19. On a scale of 0 to 10 where 0 means "not at all satisfied" and 10 means "extremely satisfied," please rate how satisfied you are with . . .

[PROGRAMMER: 0-10 scale with 'DK,' 'REF,' and 'NA' options]

[INTERVIEWER: 'NA' is only if the question could not apply to them because they have no basis on which to answer, for example: they had no role in the program application process, had no communication with program staff or never looked at program rules and guidelines. If they say something does not apply to them, ask why and then determine whether it is a true 'NA' or really a 'DK'. ('No opinion' = 'DK')]

g. … the program application process
h. … the range of measures and products for which Ameren offers incentives
i. … the quality of those measures and products that qualify for incentives
j. … the communication with program staff
k. … the level of incentives offered
l. … program rules and guidelines

[ASK Q35 TO Q38 IF APPLICABLE PART OF Q34 < 7]

Q20. What about the application process were you dissatisfied with? []
Q21. What about the range of measures and products were you dissatisfied with? []
Q22. What about the quality of measures and products were you dissatisfied with? []
Q23. What about the program rules and guidelines were you dissatisfied with? []

[ASK Q24 TO Q26 IF NOT ADDRESSED]

Q24. What types of assistance did you seek, if any, from program staff? []
Q25. Were program staff able to give you the assistance you were looking for? []
Q26. What additional assistance would you have liked? []

Conclusion (All, Except as Noted)

Q27. What would you say is the best thing about the BizSavers programs you have worked with? []
Q28. What about the programs would you most like to see changed? []
Q29. Do you have any other comments or thoughts about the program that you think would be useful for Ameren Missouri to hear? []

Thank you for taking the time to talk.

Appendix J: TA Semi Structured Interview Guide - RCx

Introduction and Background

Let's start with a few questions about your company.

[ASK ALL]

Q30. What services does your firm provide? *[Probes: audits, installation of retrofits, commissioning, retro-commissioning, energy management, …]*

[ASK ALL]

Q31. What type of retrocommissioning services do you specialize in?

a. Building optimization
b. Compressed air
c. Refrigeration
d. Other, specify: _________

[ASK ALL]

Q32. How long has your firm provided retrocommissioning services?

[ASK ALL]

Q33. About how many RCx projects do you do per year that receive Ameren Missouri incentives? How many do you do without Ameren Missouri incentives?

Customer Firmographics

I have a few questions about your RCx customers.

[ASK ALL]

Q34. First, what are the main business or building types that you work with on RCx projects?

[ASK ALL]

Q35. What is the ownership structure of your RCx customers? Are the buildings typically managed by a property management firm, owned by your customers, or in space leased by your customer?

[ASK ALL]

Q36. What size, in square feet, are the properties you serve with RCx?

Typical project

[ASK ALL]

Q37. Please briefly describe what happens during each phase of an RCx project from your first contact with a customer to project completion. Please include your role and who you interact with on the client side.

[ASK ALL]

Q38. How do RCx customers get RCx-suggested items installed? [*If needed: Does your firm provide installation and commissioning services for an RCx project? Do you work with subcontractors to do the work or is that up to the customer?]*

[ASK ALL]

Q39. From the perspective of your client, how does the RCx program differ, if at all, from any other energy efficiency upgrade project?

Customer Awareness of RCx

[ASK ALL]

Q40. How do you typically market your RCx services to customers? [*If needed: Do customers ask you for the service or do you bring the service up to your customers, or something else?*]

[ASK ALL]

Q41. Before a project starts, what do you tell customers about the RCx process?

[ASK ALL]

Q42. What do you tell customers about the RCx incentives?

▪

[ASK ALL]

Q43. Which customers do you typically market the RCx incentives to? Are there certain types of customers that are better candidates for RCx than others? How are they better candidates?

[ASK ALL]

Q44. What would you suggest, if anything, that Ameren Missouri do to increase your customers' awareness of BizSavers incentives?

▪

[ASK ALL]

Q45. What have you heard from your RCx customers about the RCx program through Ameren? Do you see any barriers to participation? If so what are the barriers?

RCx Program Comparisons

[ASK ALL]

Q46. Do you provide RCx services in locations other than Ameren Missouri territory? If so, how do the services you provide differ, if at all, between those in Ameren Missouri territory and other utility territories?

Q47. Are there additional equipment types or services that should be covered by the Ameren RCx program? What are they and why should they be covered?

Training

I'd like to hear a bit about any information or training you've received from Ameren Missouri or BizSavers about the RCx program.

[ASK ALL]

Q48. What training, if any, about the Ameren RCx program did you receive from Ameren Missouri? Training could include on-site visits from Ameren staff, phone calls with staff. Etc.

[ASK IF Q48 = Received some type of training]

Q49. How was the training you received? Were your questions answered effectively? Can you give me an example of what you asked and how it was resolved?

[ASK ALL]

Q50. What additional information or training about the RCx program, if any, would you like? *[Probe about specific program processes, technologies, rules, etc.]*

[ASK ALL]

Q51. What services, if any, do you provide customers with services through other Ameren programs?

Conclusion

[ASK ALL]

Q52. What are the strengths of the RCx program offered by Ameren Missouri?

[ASK ALL]

Q53. What are the challenges of the RCx program offered by Ameren Missouri?

[ASK ALL]

Q54. Do you have any other comments or thoughts about the program that you think would be useful for Ameren Missouri to hear?

Thank you for taking the time to talk. Would it be alright for me to contact you via phone or email for any needed clarifications?

Appendix K: Near Participant In-depth Interview Guide

Screening

[ASK ALL]

S1. Before we go any further, I understand that you started a project located at [ADDRESS] in [CITY] where you anticipated receiving financial incentives from Ameren Missouri. What is the current status of the project located at [ADDRESS] in [CITY]? [RECORD OPEN-END RESPONSE AND CODE (options 2-6) BASED ON RESPONSE]

1. [OPEN-ENDED RESPONSE]

[Code Open – End into one of these categories]

2. Project is in process [END INTERVIEW]
3. Project is completed [END INTERVIEW]
4. Project stopped by Ameren [END INTERVIEW]
5. Project stopped due to lack of funds
6. Project stopped because of contractor problems
7. Does not confirm project at that location

[*Do not read:*]

96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[STATE IF S1 =2, 3, OR 4]

Thank you for your time today. We are only speaking with people that have not and do not plan to complete their project in the short term. Therefore, I will not need to take up any more of your time. Thanks.

[IF S1 ≠ 2, 3, OR 4 CONDUCT INTERVIEW]

Firm and Project Descriptors

First, I'd like to get a bit of background on your role and the project or projects that you were looking into doing. All my questions will refer only to the project or projects that that you were looking into Ameren Missouri for incentives for and to the properties where you were planning to do those projects.

[ASK ALL]
Q53. Can you please tell me your title or role?

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know
99. Refused

[ASK ALL]
Q54. What type of building is located at [ADDRESS] in [CITY]? [*If needed: Is it an office, manufacturing facility, school, etc.*]

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know
99. Refused

[ASK ALL]
Q55. Do you own, lease, or rent the facility at those locations?

[SINGLE RESPONSE]

1. Own
2. Lease
3. Mix of own/lease/rent:- explain _____

[*Do not read:*]

98. Don't know
99. Refused

[ASK ALL]
Q56. Ameren Missouri offers two ways to get incentives for equipment upgrades. One is the Standard incentive, which provides fixed incentives for common, proven energy efficient measures. The other is the Custom path, for non-standard efficiency measures, where the incentive is based on the estimated energy savings, which must be calculated specifically for each project. Which of those project type were you thinking about?

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know
99. Refused

Awareness and Application

[ASK ALL]
Q57. Please tell me how your firm came to apply for Ameren Missouri BizSavers incentives, including how the discussion got started and who played what role in the decision. [*Probe about: How they became aware of the incentives. Who initiated discussion - program rep, vendor, energy auditor, etc. Role that*

vendors/retailers, contractors, auditors, etc. played and how that affected decision]

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know
99. Refused

[ASK ALL]

Q58. Including yourself, who all was involved in completing the application for BizSavers incentives? What was each person's involvement?

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know
99. Refused

[ASK ALL]

Q59. Please describe the application paperwork you completed. [*Probe about: Version of form - Excel spreadsheet, PDF version, a paper version, or other format. Method of submitting - email, fax, mail, other. Where they got form - website, program rep, trade ally, etc*.]

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know
99. Refused

[ASK ALL]

Q60. And how was your experience with the application paperwork?

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know
99. Refused

[ASK ALL]

Q61. What suggestions, if any, do you have for streamlining the application forms or the approval process?

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know
99. Refused

Experience with processes, requirements and staff

[ASK ALL]

Q62. Please summarize the application processes and steps your firm went through before deciding not to continue with the process. [*In other words, how far in the application process were they? What requirements had they completed?*]

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know
99. Refused

[ASK ALL]

Q63. Overall, how was your experience with the Ameren Missouri BizSavers program's processes and requirements? [*Probes: What aspects of participation [application, documentation requirements, etc., if any, did you find surprising? What aspects, if any, did you find challenging?*]

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know
99. Refused

[ASK ALL]

Q64. On a scale of 1 to 5, where 1 means "not at all satisfied" and 5 means "very satisfied," please rate your satisfaction with the following aspects of the program: [*Interviewer: prompt with responses for each, do not read 97-99]*

[MATRIX QUESTION]

	NOT AT ALL SATISFIED 1	2	3	4	VERY SATISFIED 5	DK	NA	REASON NA
The steps you had to take to get through the program								
The range of equipment that qualifies for incentives								
The quality of your interactions with program staff								
The amount of documentation you were required to provide								
Any inspections the program carried out at your work site								
The program, overall								
Ameren Missouri								

[INTERVIEWER: "NA" applies only if the question is not applicable to the project (e.g., no documentation was required). It does not apply just because the respondent is not familiar with the issue (e.g., the respondent did not supply the documentation). In the latter case, record response as "DK."]

[ASK ALL]
Q65. And why did you decide not to continue with the process?

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know
99. Refused

[ASK ALL]
Q66. Did you discuss your reasons with anyone from the program? If so, how did program staff respond to your concerns?

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know
99. Refused

[ASK ALL]
Q67. In addition to the incentives you were investigating, what other Ameren Missouri incentives for commercial buildings are you aware of?

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know
99. Refused

[IF DID NOT CONSIDER CUSTOM INCENTIVE PATH]
Q68. Are you aware that incentives are available for equipment that doesn’t qualify for the Standard path, through the Custom incentive path?

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know
99. Refused

[IF DID NOT CONSIDER STANDARD INCENTIVE PATH]
Q69. Are you aware that incentives are available for certain lighting and non-lighting equipment through the Standard incentive path?

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know
99. Refused

[IF AWARE OF OTHER INCENTIVES]
Q70. Have you applied for any of those incentives we have been talking about?

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know
99. Refused

[ASK ALL]
Q71. In what ways could the program be improved? [*Probe about: Equipment selection that qualified for incentives.*]

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know
99. Refused

Spillover

[ASK ALL]
Q72. 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 from Ameren Missouri?

[SINGLE RESPONSE]

1. Yes
2. No

[*Do not read:*]

96. Other, please specify: [OPEN-ENDED RESPONSE]
97. Not applicable
98. Don't know
99. Refused

[ASK IF Q72 = 1 “YES”]]
Q73. What energy efficient equipment did you purchase? Specify equipment

[MULTIPLE RESPONSE]

1. Lighting
2. HVAC
3. Motors/controls
4. Shell

[*Do not read:*]

96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[ASK IF Q72 = 1“YES”]
Q74. How important was your experience with the program to your decision to implement the additional energy efficiency measures?

[SINGLE RESPONSE]

1. Very important

2. Somewhat important
3. Neither important or unimportant
4. Somewhat important
5. Unimportant

[*Do not read:*]

96. Other, please specify: [OPEN-ENDED RESPONSE]
97. Not applicable
98. Don't know
99. Refused

[ASK IF Q72 = 1 “YES”]

Q75. How important was your past participation in any programs offered by Ameren Missouri to your decision to implement the additional energy efficiency measures?

[SINGLE RESPONSE]

1. Very important
2. Somewhat important
3. Neither important or unimportant
4. Somewhat important
5. Unimportant

[*Do not read:*]

96. Other, please specify: [OPEN-ENDED RESPONSE]
97. Not applicable
98. Don't know
99. Refused

[ASK IF Q72 =2 “NO”]

Q76. Why didn’t you apply for or receive incentives for those items?

[SINGLE RESPONSE]

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

[*Do not read:*]

96. Other, please specify: [OPEN-ENDED RESPONSE]
97. Not applicable
98. Don't know
99. Refused

Firmographics and Energy Practices

I'd like to learn a little more about your firm so we can know can better understand the market that the BizSavers program serves.

[ASK ALL]
Q77. How many separate locations does your organization own or lease for its own use in Ameren Missouri territory?

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know
99. Refused

[ASK ALL]
Q78. In how many of these locations would the BizSavers incentive program be applicable?

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know
99. Refused

[ASK ALL]
Q79. Will your firm consider applying for Ameren Missouri incentives in the future?

[SINGLE RESPONSE]

1. Yes
2. No

[*Do not read:*]

98. Don't know
99. Refused

[ASK IF Q79 =2 "NO"]
Q80. Why not?

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know
99. Refused

[ASK IF Q79 =1 "YES"]
Q81. Which types of Ameren Missouri incentives do you expect to apply for in the future? *(Probe to code)*

[MULTIPLE RESPONSE]

1. Existing Buildings (Standard or Custom) Lighting
2. Existing Buildings non-lighting (specify measure)
3. New Construction
4. Retro-commissioning

[*Do not read:*]

96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[ASK ALL]

Q82. How many square feet of indoor space is the property or properties I was asking about? [*IF NEEDED: I mean, at any of the properties for which you began, but did not complete, an application for Ameren Missouri incentives.]*

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know
99. Refused

[ASK ALL]

Q83. How many employees do you have at that property/those properties

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know
99. Refused

[ASK ALL]

Q84. What, if anything, does your company do to monitor or manage energy use in buildings it occupies?

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know
99. Refused

That is all the questions I have. As I review and analyze your responses, would it be alright if I contacted you again if needed to clarify a response? Thanks again. Good bye

Appendix L: Heating and Cooling Interactive 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

Appendix M: Update to 2014 EM&V Recommendations

Throughout the 2015 program year, the evaluation team followed up with program staff and monitored the program tracking system, LM Captures, to monitor how the program responded to past EM&V recommendations. The following section provides an update regarding the program's response.

EM&V Recommendation: 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.[1] Continued adherence to the TRM deemed values is likely to result in continued high variability of gross realization rates for this measure.

- Program Response: The recommendation was partially addressed in 2015. Additional control measures were added to the application. Full implementation would include the addition of controlled wattage.

EM&V recommendation: ADM suggested, in the 2013 and 2014 year-end report 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.

- Program Response: The recommendation was not addressed. The application of HCIFs was not implemented during the 2014 program year. Although, the inclusion of this factor will improve the estimation of savings, the program is compliant with the direction of the 2012 TRM which assumes the IF factor to have a value of 1.0 for the first three year program implementation. Ameren has asked for, and received, the HCIF table developed by ADM from modeled building types and HVAC systems, in May of 2015.

EM&V Recommendation: 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

- Program Response: The recommendation was addressed. Compressed air measures were added to the pre-installation monitoring thresholds for notification by LM.

EM&V Recommendation: 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.

- Program Response: The recommendation was not addressed.

EM&V Recommendation: 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

- Program Response: The recommendation was not addressed. The special incentive period ended as planned in April 2015.

EM&V Recommendation: 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.

- Program Response: The recommendation was partially addressed. Lockheed staff did not describe any new revisions to the application or application instructions after mid-2014 (which were described in the 2014 year-end report), but contacts reported g holding training sessions: 1) a web-based TA Orientation with an explanation of the program, the various types of incentives and a Custom Application walk-through session, starting in October 2014, which all new TA applicants are required to take within 60 days after approval; 2) regularly-scheduled Open House or “Workshop” sessions, started in May 2015, offering all network Trade Allies and even non-network TAs an opportunity for a 1-on-1 training and/or Q&A session to with Lockheed Business Development staff. Registration in the workshops is limited to 20 to facilitate the personal-touch aspect.

EM&V Recommendation: 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.

- Program Response: The recommendation was addressed. 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.

EM&V Recommendation: 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.

- Program Response: The recommendation was partially addressed. The Lockheed Program Lead for new construction reported that Lockheed is developing relationships with architects and designers around Missouri and noted that many of the Lockheed staff are LEED certified, which suggests a basic understanding of architecture and design engineering concepts. Contacts did not describe any additional efforts to increase awareness of the new construction or Retro-Commissioning Programs or 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.

EM&V Recommendation: 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.

- Program Response: Data collection did not inform to what degree the program reviewed such material with RSPs in 2015.

Appendix N: 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. First, the same analysis tool was used, DSMore. Second, MMP obtained the economic and financial assumptions used for developing the model 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 = $23.60/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.
- Cost Escalation Rate = 3%

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 model assumptions 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. MMP based measure lifetime assumptions 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 2015 Ameren Missouri spending data. This is the actual spending for 2015 broken down into implementation (contractor costs), incentives and administration (other portfolio costs), as shown in

Program	*EM&V*	*Education and Outreach*	*Portfolio Admin*	*Data Tracking*	*Total*
Custom	$548,207	$9,980	$553,710	$55,034	$1,166,931
Standard	$191,290	$3,482	$193,211	$19,204	$407,187
New Construction	$104,145	$1,896	$105,190	$10,455	$221,686
Retro-Commissioning	$106,227	$1,934	$107,293	$10,664	$226,118
Portfolio	$949,869	$17,293	$959,403	$95,357	$2,021,921

. MMP applied these numbers 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 best practice regarding how to allocate certain expenses Ameren Missouri incurred during 2015 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:

- The evaluation team fully allocated all EM&V, portfolio administration, and data tracking costs incurred during 2015 to the programs for the purposes of testing program cost effectiveness during the 2015 program year. In other words, all program-level benefits and costs summate to the portfolio level benefits and costs.
- Table N-1 presents Ameren Missouri's 2015 actual program costs. 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.
- The evaluation team allocated EM&V, Education and Outreach, Portfolio Administration and Data Tracking costs 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 N- N-2 and Table N-3 below provide additional details regarding the apportionment factor and allocation values.

Table N-1 Ameren Missouri Spending Data 2015 (expressed in 2015 dollars)

C&I EE PROGRAM COSTS (2015)	*Contractor Costs*	*Incentive Costs*	*Marketing Costs*	*Total Costs*
Prescriptive	$2,606,895	$3,535,038	$0	$6,141,933
Custom	$6,401,315	$10,591,749	$0	$16,993,064
Retro-commissioning	$1,180,012	$3,278,696	$0	$4,458,708
New Construction	$895,811	$1,851,661	$0	$2,747,472

Business - Other				$0
Total C&I Program Costs	$11,084,033	$19,257,143	$0	$30,341,176
OTHER PORTFOLIO COSTS (2015)				
EM&V	$949,869	$0	$0	$949,869
Education and Outreach	$17,293	$0	$0	$17,293
Portfolio Admin	$834,615	$0	$124,788	$959,403
Data Tracking	$95,357	$0	$0	$95,357
Total C&I Other Portfolio Costs	$1,897,133	$0	$124,788	$2,021,921

Table N-2 Net Benefit Apportionment Factors (expressed in 2013 dollars)

Program	*NPV of UCT Benefits*	*Apportionment Factor*
Custom	$ 98,507,036	57.71%
Standard	$ 18,713,713	10.96%
New Construction	$ 19,087,827	11.18%
Retro-Commissioning	$ 34,372,899	20.14%
Total	$ 170,681,474	100%

Table N-3 Other Cost Allocation Values Apportioned (expressed in 2015 dollars)

Program	*EM&V*	*Education and Outreach*	*Portfolio Admin*	*Data Tracking*	*Total*
Custom	$548,207	$9,980	$553,710	$55,034	$1,166,931
Standard	$191,290	$3,482	$193,211	$19,204	$407,187
New Construction	$104,145	$1,896	$105,190	$10,455	$221,686
Retro-Commissioning	$106,227	$1,934	$107,293	$10,664	$226,118
Portfolio	$949,869	$17,293	$959,403	$95,357	$2,021,921

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 N-1 below is a summary of benefit and cost inputs for each cost test performed.

Table N-1 Summary of Benefits and Costs Included in each Cost Effectiveness Test[53]

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

[53] 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 evaluation team presents the majority of costs and savings 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 evaluation team presents the participant borne costs, as applied to the Participant Cost Test (PCT), 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

Table N-2 summarizes the key financial benefit and cost inputs for the portfolio level Utility Costs Test (UCT). Ameren Missouri's avoided cost of energy is $170.7 million (energy savings). Incentives and overhead totaled $28.3 million, which yields a benefit-cost ratio of 6.03. The UCT results show that the energy saved is approximately six times greater than the portfolio costs, from the utility perspective.

Table N-2 Utility Cost Test (UCT) Inputs and Results - Portfolio Level

UCT Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production	$107,978,493	
Avoided Electric Capacity	$47,547,505	
Avoided T&D Electric	$15,155,477	
Incentives		$16,304,570
Implementation Costs		$1,767,676
EM&V, Admin, Data Tracking		$10,221,374
Total	$170,681,474	$28,293,619
UCT Benefit - Cost Ratio	6.03	

The TRC test results, shown in Table N-3, reflect the BizSavers Program impacts on all customers in the Ameren Missouri service territory, participants and non-participants. The participant measure costs and overhead make up the total portfolio costs of $98 million. The benefits consist of the utility's total avoided costs of $170.7 million, which yields a benefit-cost ratio of 1.74.

Table N-3 Total Resource Cost Test (TRC) Inputs and Results - Portfolio Level

TRC Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production	$107,978,493	
Avoided Electric Capacity	$47,547,505	
Avoided T&D Electric	$15,155,477	
Participation Costs (net)		$86,000,530
Implementation Costs		$1,767,676
EM&V, Admin, Data Tracking		$10,221,374
Total	$170,681,474	$97,989,580
TRC Benefit - Cost Ratio	1.74	

The portfolio level RIM test reflects the program impacts on utility rates. Table N-4 summarizes key inputs for the RIM test. The net benefits include the avoided utility costs of $170.7 million, and the costs of $279.4 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 .61. 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.[54]

Table N-4 Ratepayer Impact Measure Test (RIM) Inputs and Results - Portfolio Level

RIM Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production	$107,978,493	
Avoided Electric Capacity	$47,547,505	
Avoided T&D Electric	$15,155,477	
Incentives		$16,304,570
Implementation Costs		$1,767,676
EM&V, Admin, Data Tracking		$10,221,374
Lost Revenues		$251,107,044
Total	$170,681,474	$279,400,663
RIM Benefit - Cost Ratio	0.61	

Table N-5 summarizes the key financial inputs to the portfolio level PCT, which reflects the program impacts on the participants. The portfolio level benefits include the program incentives and energy bill savings, which total $268.9 million. The costs include gross participant costs, totaling $95.8 million and yielding a benefit-cost ratio of 2.98. The participants' energy bill savings are nearly three times the costs.

[54] 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 N-5 Participant Cost Test (PCT) Inputs and Results – Portfolio Level

PCT Calculations		
Category	*Benefits*	*Costs*
Bill Savings (Gross)	$268,904,666	
Incentives	$16,304,570	
Participant Cost (Gross)		$95,758,123
Total	$268,904,666	$95,758,123
PCT Benefit - Cost Ratio	2.98	

The portfolio level SCT reflects the program impacts on society; the key financial inputs are displayed in Table N-6. The net benefits include the avoided utility costs of $219.1 million and the costs of $105.6 million. The financial data for the SCT test yields a benefit-cost ratio of 2.07.

Table N-6 Societal Cost Test (SCT) Inputs and Results - Portfolio Level

SCT Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production	$151,122,915.80	
Avoided Electric Capacity	$47,547,505.07	
Avoided T&D Electric	$20,420,764.56	
Participation Costs (net)		$92,723,167.02
Implementation Costs		$1,905,854.70
EM&V, Admin, Data Tracking		$11,020,375.39
Total	$219,091,185	$105,649,397.11
SCT Benefit - Cost Ratio	2.07	

BizSavers Custom Program Cost Test Inputs and Results

The evaluation team performed cost tests 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 effectiveness perspective.

Table N-7 summarizes the key financial benefit and cost inputs for the Custom Program UCT. The Custom Program attained $98.5 million in energy savings from avoided utility costs. Incentives, overhead and other program costs totaled $15.9 million, which yields a benefit-cost ratio of 6.20. The UCT results show that the energy saved is approximately six times greater than the program costs, from the utility perspective.

Table N-7 Utility Cost Test (UCT) Inputs and Results – Custom Program

UCT Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production	$63,409,056	
Avoided Electric Capacity	$26,680,234	
Avoided T&D Electric	$8,417,746	
Incentives		$9,259,896
Implementation		$1,020,196
EM&V, Admin, Data Tracking		$5,596,385
Total	$98,507,036	$15,876,477
UCT Benefit - Cost Ratio	6.20	

The TRC test results, shown in Table N-8, 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 $67.1 million. The benefits consist of the utility's total avoided costs of $98.5 million, which yields a benefit-cost ratio of 1.47. The results show that the Custom Program benefits are almost one and a half times the program costs.

Table N-8 Total Resource Cost Test (TRC) Inputs and Results - Custom Program

TRC Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production	$63,409,056	
Avoided Electric Capacity	$26,680,234	
Avoided T&D Electric	$8,417,746	
Participation Costs (net)		$60,442,821
Implementation		$1,020,196
EM&V, Admin, Data Tracking		$5,596,385
Total	$98,507,036	$67,059,403
TRC Benefit - Cost Ratio	1.47	

The Custom Program RIM test reflects the program impacts on utility rates. Table N-9 summarizes key inputs for the RIM test. The net benefits include the avoided utility costs of $98.5 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 $163.5 million. The financial data for the RIM test yields a benefit-cost ratio of .60. The ratio suggests that rates have potential to increase over time.

Table N-9 Ratepayer Impact Measure Test (RIM) Inputs and Results - Custom Program

RIM Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production Avoided Electric Capacity Avoided T&D Electric	$63,409,056 $26,680,234 $8,417,746	
Incentives Implementation EM&V, Admin, Data Tracking Lost Revenues		$9,259,896 $1,020,196 $5,596,385 $147,632,262
Total	$98,507,036	$163,508,739
RIM Benefit - Cost Ratio	0.60	

The Custom Program PCT reflects the program impacts on the participants; Table N-10 summarizes the key financial inputs. The portfolio level benefits include the program incentives and energy bill savings, which total $159.5 million. The costs include measure incentives and gross participant costs; totaling $68.7 million and yielding a benefit-cost ratio of 2.46. The results indicate that participants' energy bill savings are two and a half times the costs.

Table N-10 Participant Cost Test (PCT) Inputs and Results – Custom Program

PCT Calculations		
Category	*Benefits*	*Costs*
Bill Savings Incentives	$159,477,591 $9,259,896	
Participant Cost (Gross)		$68,674,095
Total	$159,477,591	$68,674,095
PCT Benefit - Cost Ratio	2.46	

The portfolio level SCT reflects the program impacts on society; Table N-11 summarizes the key financial inputs. The net benefits include the avoided utility costs of $127.1 million and the costs of $72.3 million. The financial data for the SCT test yields a benefit-cost ratio of 1.76.

Table N-11 Societal Cost Test (SCT) Inputs and Results – Custom Program

SCT Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production	$89,034,714.93	
Avoided Electric Capacity	$26,680,233.71	
Avoided T&D Electric	$11,372,152.58	
Participation Costs (net)		$65,167,619
Implementation Costs		$1,099,944
EM&V, Admin, Data Tracking		$6,033,853
Total	$127,087,101	$72,301,417
SCT Benefit - Cost Ratio	1.76	

BizSavers Standard Cost Test Inputs and Results

Table N-12 provides the key financial benefit and cost inputs for the Standard Program UCT. The Custom Program attained $34.4 million in energy savings from avoided utility costs. Incentives and overhead totaled $5.7 million, which yields a benefit-cost ratio of 6.00. The UCT results show that the energy saved is approximately six times greater than the program costs, from the utility perspective.

Table N-12 Utility Cost Test (UCT) Inputs and Results – Standard Program

UCT Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production	$23,410,912	
Avoided Electric Capacity	$8,363,970	
Avoided T&D Electric	$2,598,018	
Incentives		$3,090,526
Implementation Costs		$355,986
EM&V, Admin, Data Tracking		$2,279,093
Total	$34,372,899	$5,725,605
UCT Benefit - Cost Ratio	6.00	

The TRC test results, shown in Table N-13, 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 $23.3 million. The benefits consist of the utility's total avoided costs of $34.3 million, which yields a benefit-cost ratio of 1.48. The results show that the standard program benefits are approximately one and a half times greater than the costs.

Table N-13 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	$23,410,912 $8,363,970 $2,598,018	
Participant Cost (Net) Implementation Costs EM&V, Admin, Data Tracking		$20,635,958 $355,986 $2,279,093
Total	$34,372,899	$23,271,037
TRC Benefit - Cost Ratio	1.48	

The standard program RIM test reflects the program impacts on utility rates. .

Table *N-14* summarizes the key inputs for the RIM test. The net benefits include the avoided utility costs of $34.4 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 $60.2 million. The financial data for the RIM test yields a benefit-cost ratio of .57. The ratio suggests that rates have potential to increase over time.

Table N-14 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	$23,410,912 $8,363,970 $2,598,018	
Incentives Implementation Costs EM&V, Admin, Data Tracking Lost Revenues		$3,090,526 $355,986 $2,279,093 $54,494,085
Total	$34,372,899	$60,219,689
RIM Benefit - Cost Ratio	0.57	

The standard program PCT reflects the program impacts on the participants; Table N-15 displays the key financial inputs. The standard program benefits include the program incentives and energy bill savings, which total $57.3 million. The costs include gross participant costs; totaling $21.8 million and yielding a benefit-cost ratio of 2.77. The results indicate that participants' energy bill savings are more than two and a half times the costs.

Table N-15 Participant Cost Test (PCT) Inputs and Results – Standard Program

PCT Calculations		
Category	*Benefits*	*Costs*
Bill Savings	$57,322,601	
Incentives	$3,090,526	
Participant Cost (Gross)		$21,801,545
Total	$57,322,601	$21,801,545
PCT Benefit - Cost Ratio	2.77	

Table N-16 summarizes the Standard Program SCT test results. The net benefits include the avoided utility costs of $44.8 million and the costs of $25.1 million. The financial data for the SCT test yields a benefit-cost ratio of 1.79.

Table N-16 Societal Cost Test (SCT) Inputs and Results – Standard Program

SCT Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production	$32,937,558.85	
Avoided Electric Capacity	$8,363,969.51	
Avoided T&D Electric	$3,539,171.43	
Participation Costs (net)		$22,249,065.42
Implementation Costs		$383,812.90
EM&V, Admin, Data Tracking		$2,457,248.84
Total	$44,840,700	$25,090,127.15
SCT Benefit - Cost Ratio	1.79	

BizSavers New Construction Cost Test Inputs and Results

Table N-17 provides the key financial benefit and cost inputs for the New Construction Program UCT. The New Construction Program attained $18.7 million in energy savings from avoided utility costs. Incentives and overhead totaled $2.6 million, which yields a benefit-cost ratio of 7.21. The UCT results show that the energy saved is approximately seven times greater than the program costs, from the utility perspective.

Table N-17 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	$10,836,118 $6,075,630 $1,801,965	
Incentives Implementation EM&C, Admin, Data Tracking		$1,618,825 $193,810 $783,168
Total	$18,713,713	$2,595,803
UCT Benefit - Cost Ratio	7.21	

The TRC test results, shown Table N-18 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 $3.6 million. The benefits consist of the utility's total avoided costs of $18.7 million, which yields a benefit-cost ratio of 5.20. The results show that the New Construction Program costs are more than five times as much as the benefits (energy savings.)

Table N-18 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	$10,836,118 $6,075,630 $1,801,965	
Participant Costs (net) Implementation EM&V, Admin, Data Tracking		$2,621,207 $193,810 $783,168
Total	$18,713,713	$3,598,185
TRC Benefit - Cost Ratio	5.20	

The New Construction Program RIM test reflects the program impacts on utility rates. Table N-19 summarizes the key inputs for the RIM test. The net benefits include the avoided utility costs of $18.7 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 $27.3 million. The financial data for the RIM test yields a benefit-cost ratio of 0.68. The ratio suggests that rates have potential to increase over time.

Table N-19 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	$10,836,118 $6,075,630 $1,801,965	
Incentives Implementation EM&V, Admin, Data Tracking Lost Revenues		$1,618,825 $193,810 $783,168 $24,744,380
Total	$18,713,713	$27,340,182
RIM Benefit - Cost Ratio	0.68	

The New Construction Program PCT reflects the program impacts on the participants; Table N-20 summarizes the key financial inputs. The New Construction Program benefits include the program incentives and energy bill savings, which total $27.5 million. The costs include measure incentives and gross participant costs, totaling $2.9 million and yielding a benefit-cost ratio of 9.87. The results indicate that participants' energy bill savings are approximately two times the costs.

Table N-20 Participant Cost Test (PCT) Inputs and Results – New Construction Program

PCT Calculations		
Category	*Benefits*	*Costs*
Bill Savings Incentives	$27,476,175 $1,618,825	
Participant Cost (Gross)		$2,947,160
Total	$27,476,175	$2,947,160
PCT Benefit - Cost Ratio	9.87	

Table N-21 summarizes the New Construction Program SCT test results. The net benefits include the avoided utility costs of $24.2 million and the costs of $3.9 million. The financial data for the SCT test yields a benefit-cost ratio of 6.25.

Table N-21 Societal Cost Test (SCT) Inputs and Results – New Construction Program

SCT Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production Avoided Electric Capacity Avoided T&D Electric	$15,649,890.83 $6,075,629.81 $2,523,965.30	
Participation Costs (net) Implementation Costs EM&V, Admin, Data Tracking		$2,826,105.81 $208,960.09 $844,387.81
Total	$24,249,486	$3,879,453.71
SCT Benefit - Cost Ratio	6.25	

BizSavers Retro-Commissioning Cost Test Inputs and Results

Table *N-22* summarizes key financial benefit and cost inputs for the Retro-Commissioning Program UCT. The Retro-Commissioning Program attained $19.1 million in energy savings from avoided utility costs. Incentives and overhead totaled $4.1 million, which yields a benefit-cost ratio of 4.66. The UCT results show that the energy saved is approximately four times greater than the program costs, from the utility perspective.

Table N-22 Utility Cost Test (UCT) Inputs and Results – Retro-Commissioning Program

UCT Calculations		
Category	*Benefits*	*Costs*
Avoided Electric Production Avoided Electric Capacity Avoided T&D Electric	$10,322,407 $6,427,672 $2,337,748	
Incentives Implementation EM&V, Admin, Data Tracking		$2,335,323 $197,685 $1,562,728
Total	$19,087,827	$4,095,735
UCT Benefit - Cost Ratio	4.66	

The TRC test results, shown Table N-23 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 $4.1 million. The benefits consist of the utility's total avoided costs of $19.1 million, which yields a benefit-cost ratio of 4.70 The results show that the Retro-Commissioning Program benefits are more than four and a half times as much as the costs.

Table N-23 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	$10,322,407 $6,427,672 $2,337,748	
Participant Costs (net) Implementation EM&V, Admin, Data Tracking		$2,300,543 $197,685 $1,562,728
Total	$19,087,827	$4,060,956
TRC Benefit - Cost Ratio	4.70	

The Retro-Commissioning Program RIM test reflects the program impacts on utility rates. Table N-24 summarizes key inputs for the RIM test. The net benefits include the avoided utility costs of $19.1 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 $28.3 million. The financial data for the RIM test yields a benefit-cost ratio of 0.67. The ratio suggests that rates have potential to increase over time.

Table N-24 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	$10,322,407 $6,427,672 $2,337,748	
Incentives Implementation EM&V, Admin, Data Tracking Lost Revenues		$2,335,323 $197,685 $1,562,728 $24,236,317
Total	$19,087,827	$28,332,052
RIM Benefit - Cost Ratio	0.67	

The Retro-Commissioning Program PCT reflects the program impacts on the participants; Table N-25 displays the key financial inputs. The New Construction Program benefits include the program incentives and energy bill savings, which total $24.6 million. The costs include gross participant costs totaling $2.3 million and yielding a benefit-cost ratio of 11.55. The results indicate that participants' energy bill savings are approximately eleven and one half times the costs.

Table N-25 Participant Cost Test (PCT) Inputs and Results – Retro-Commissioning Program

PCT Calculations		
Category	*Benefits*	*Costs*
Bill Savings Incentives	$24,628,298 $2,335,323	
Participant Cost (Gross)		$2,335,323
Total	$24,628,298	$2,335,323
PCT Benefit - Cost Ratio	11.55	

Table N-26 summarizes the Retro-Commissioning Program SCT test. The net benefits include the avoided utility costs of $22.9 million and the costs of $4.4 million. The financial data for the SCT test yields a benefit-cost ratio of 5.23.

Table N-26 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	$13,500,751.18 $6,427,672.04 $2,985,475.25	
Participation Costs (net) Implementation Costs EM&V, Admin, Data Tracking		$2,480,376.24 $213,137.51 $1,684,885.50
Total	$22,913,898	$4,378,399.24
SCT Benefit - Cost Ratio	5.23	

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 N-27 provides the data inputs used by the evaluation team to develop the BizSavers CCE figures.

Table N-27 BizSavers CCE Inputs and Results

Program	*Lifetime Savings kWh*	*NPV Program Costs*	*CCE $/kWh*
Custom	2,673,991,263	$15,876,477	$0.0059
Standard	1,004,701,168	$5,725,605	$0.0057
RCx	404,669,516	$4,095,735	$0.0101
NC	443,703,390	$2,595,803	$0.0059
Portfolio	4,527,065,337	$28,293,619	$0.0062

Appendix O: 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.