CommunitySavers Program Evaluation Report

March 2017 – February 2018

Prepared For:

Ameren Missouri

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1. Executive Summary

This report presents the results of the impact, process, and cost effectiveness evaluations of the CommunitySavers Program implemented during program year 2017 (PY2017), which occurred during March 2017 – February 2018. ADM Associates performed the evaluation, measurement and verification of the program. The primary evaluation activities include the following:

- The evaluation team collected data for the evaluation through review of program materials, on-site inspections, and interviews with Ameren Missouri staff members, ICF International (ICF) staff members, and participating customers.
- The evaluation team performed site visits with customers recruited through a participant survey.
- Analysts performed ex post gross kWh energy savings calculations for each implemented measure. Ex post saving calculations incorporated in-service rates developed through data collected during on-site visits.
- Participating property manager or owner surveys provided insight into the participants experience and level of satisfaction with the program.
- Surveys of tenants provided information on satisfaction with the installed measures and the installation process.

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 CommunitySavers EM&V Data Collection Efforts

*Data Source**	*Method*	*Dates*	*Research Objective*	*Analysis Type*
Program staff (3), Ameren Missouri (1), ICF (2)	In-depth interview	February 2018 to March 2018	Program function; communication; tracking and reporting; quality control	Qualitative
Database analysis	Database review	January 2018 to April 2018	Number of projects; project type and details; data quality	Quantitative
Participants (32)	Online/Telephone Survey	November 2017 to March 2018	Program experiences; satisfaction with program	Quantitative and qualitative

*Data Source**	*Method*	*Dates*	*Research Objective*	*Analysis Type*
Tenant (83)	Mail	November 2017 to December 2017	Site visit recruitment; program experiences; satisfaction with program	Quantitative and qualitative
Post-install site visit (28 units)	On-site M&V	January to February 2017	Verify baseline operating conditions	Quantitative and qualitative

* Sample sizes in parentheses

Table 1-2 provides a summary of the evaluated energy savings of the CommunitySavers PY2017 Program. The table displays the ex ante kWh, ex post gross kWh, and ex post net kWh savings as compared with the PY2017 energy savings goal. The net-to-gross (NTG) ratio for the CommunitySavers Program is estimated to be 1.0, in line with common practice for estimation of low-income program net savings.[1] During this period, the program gross and ex post net energy savings totaled 7,334,784 kWh.

Table 1-2 Summary of kWh Savings for CommunitySavers Program

PY2017 kWh Savings Targets	*Ex Ante kWh Savings*	*2017 Ameren Missouri TRM kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*	*Ex Post Net kWh Savings*	*Estimated Net-to-Gross Ratio*	*Percent of Goal Achieved*
5,013,210	5,585,775	5,002,647	7,334,784	131%	7,334,784	100%	146%
Note: Ex ante kWh are savings as reported in the program tracking data. 2017 Ameren Missouri TRM savings are savings based on applying the per unit savings values from the 2017 Ameren Missouri TRM.							

Table 1-3 summarizes the kW savings of the program. The program gross and ex post net savings totaled 2,059.25 kW.

[1] See Violette and Rathbun, Chapter 17: Estimating Net Savings: Common Practices. The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures, available electronically at https://www.energy.gov/sites/prod/files/2015/01/f19/UMPChapter17-Estimating-Net-Savings.pdf, p. 50.

Table 1-3 Summary of kW Savings for CommunitySavers Program

PY2017 kW Savings Targets	*Ex Ante kW Savings*	*2017 Ameren Missouri TRM kW Savings*	*Ex Post Gross kW Savings*	*Gross kW Savings Realization Rate*	*Ex Post Net kW Savings*	*Estimated Net-to-Gross Ratio*	*Percent of Goal Achieved*
1,155.00	1,349.56	1,365.50	2,059.25	153%	2,059.25	100%	178%

The following section summarizes findings and recommendations that resulted from the evaluation activities. They are organized to present impact and process findings separately.

1.1. Impact Conclusions

Below is a list of conclusions associated with the impact analyses.

- The overall program kWh gross realization rate was 131%, with variable measure-level gross realization rates. The sources of the differences between ex ante savings and ex post energy savings are discussed in Section 3.2. Overall, much of the difference between ex ante and ex post energy savings is associated with the use of fully deemed ex ante measure energy savings values that do not account for measure-specific characteristics which were accounted for in the ex post energy savings analysis.
- Ex post net energy savings achieved 146% of the energy savings goal. The total ex post net energy savings for PY2017 totaled 7,334,784 kWh. This amount is more than triple the ex post net energy savings realized during PY2016 (2,349,841 kWh).

  An increase in common area lighting projects was a significant factor in the increase in program energy savings as compared with PY2016. Common area lighting accounted for less than 1% of program ex ante energy savings in PY2016 and accounted for 20.2% of ex ante energy savings in PY2017. Implementation and Ameren Missouri staff attributed the increase in energy savings to three factors: 1) a legislative change that allowed properties that receive the Low-Income Housing Tax Credit (LIHTC) to receive common area incentives; 2) a heightened focus on building the common area project pipeline as a recruitment activity distinct from that of developing direct install projects, and 3) the inclusion of exterior lighting measures that operated during fewer than 24 hours a day. Additionally, the implementation contractor added an additional project manager to focus on common area projects.

- The measure names applied to some common area lamps did not clearly map to Ameren Missouri TRM savings.
- Program lighting tracking data generally provided fairly limited information regarding the lighting projects and did not include information such as space type, lamp wattages, and heating and cooling system types.

1.2. Impact Recommendations

Based on the above conclusions, the evaluation team offers the following impact recommendations.

- Clarify measure naming conventions for business lighting measures. Review the measure name descriptions in the data to ensure that categories map to Ameren Missouri TRM measures. This should help with the assignment of savings values that are consistent with the Ameren Missouri TRM.
- Track additional data on lighting measures. Ideally, program tracking data for lighting projects would include data on lamp type, lamp wattage, number of lamps, and space type for the lamps.

1.3. Regulator Research Questions – Process Conclusions and Recommendations

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?

- Multiple market imperfections were identified that may prevent low-income multifamily property owners from investing in energy efficiency improvements either through the CommunitySavers Program or outside of it. The identified market imperfections are: cost, geography, lack of property staff resources, and split incentives.
- Cost. The cost of energy efficient equipment is a barrier to completing efficiency improvements through the program and outside of it. Program staff that work with multifamily property owners and managers noted that cost is a barrier to efficiency improvements in the properties managed. As an example, staff noted that cost of envelope improvements such as windows is high in comparison with the incremental cost covered by the incentive. This sentiment was echoed by six out of 32 survey respondents as well.
- Geography. Analysis of the program activity in comparison with the location of multifamily properties, lower income customers, and subsidized multifamily properties

found that program activity was disproportionately concentrated in St. Louis and its surrounding suburbs.

- Insufficient Property Staff. Multifamily property operators may not have staff available to implement efficiency measures. As was the case in PY2016, one survey respondent stated that they did not have the staff available to implement efficiency improvements at the property.[2] Additionally a program staff member suggested that in some cases properties that complete direct install projects are not willing to immediately initiate a common area project because their staff need to refocus on other priorities. CommunitySavers is designed to minimize the time required by property managers and owners through the assistance provided by the account manager who will assist with program paperwork and the scheduling of the work completed.
- Split Incentives: One form of split incentives in multifamily properties occurs when the tenant pays the cost of the electricity use, but the owner is responsible for choices that affect how efficiently the equipment and building utilizes electricity. This issue is most likely to occur for equipment and building characteristics that affect tenant energy use. The program addresses the barrier to efficiency resulting from the split incentives between owners and occupants by providing the direct install measures and HVAC tune-ups at no cost to the building operator or the tenant.

Research Question 2: Is target market segment appropriately defined, or does it need further subdivision or merging with other segments?

- The target market is appropriately defined. The program targets subsidized multifamily properties and properties with tenants residing in non-subsidized housing with an income of at or below 200% federal poverty level.
- Because providing services to the low-income multifamily market requires a sufficiently specialized set of outreach and project implementation processes, maintaining the focus on this market with dedicated staff resources to serving is preferable to merging with resources serving other markets.

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

- The program offers measures that cover all major multifamily in-unit end-use needs: lighting, appliances, space cooling and heating, and water heating. Additionally, the Standard and SBDI incentives available for common areas cover lighting, commercial refrigeration and kitchen equipment, and pool pumps. Building envelope and other improvements are eligible for Custom incentives.

[2] Prior evaluations of CommunitySavers also identified staffing issues as a barrier to program participation. Ameren Missouri Low Income and Process Evaluation: Program Year 2015.

- Participant survey respondents did not identify any additional measures that should be included in the program. Seventy-eight percent of participant survey respondents aware of the common area incentives stated that these incentives completely met their needs for efficiency improvements. One respondent indicated that the windows and doors were not addressed – these measures are covered in the building audit and are incentivized through the custom incentive component but may not have been addressed because they are cost prohibitive. Another respondent indicated that not all of the common area lighting was replaced, but it was unclear if the respondent did not want to pursue the replacement of that lighting or if it was not covered through the program. Additionally, 84% of property managers indicated satisfaction with the equipment installed through the program.

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

- The communication and delivery channels are appropriate to the target market segment. Staff used a variety of approaches to promote the program incentives including direct outreach to property managers and owners, working with community groups and apartment associations, and working with Ameren Missouri trade allies to promote the program incentives.
- Staff stated that during PY2017 they were involved in the St. Louis Apartment Association and attended multiple events during the year, that they continued their association with the Tower Grove Neighborhood Association, and that they attended an application workshop hosted by the Missouri Housing Development Corporation and provided information about the program to developers and property management companies. Staff also continued their direct outreach to multifamily property owners and managers. Repeated contact with property managers and owners is important for this market segment because this segment is typically viewed as unresponsive and difficult to reach and staff continued to engage in this activity.[3]
- Staff engaged with the Missouri Housing Development Corporation and attended PACE meetings during PY2017. Staff noted that they have provided information to property managers on PACE financing but that there was little interest in it.
- Staff engaged in outreach to trade allies during PY2017 and reported that they received project referrals from the trade allies. Staff emphasized the importance of outreach to HVAC contractors, in particular, because they may be contacted by property managers or owners in the event that their HVAC equipment fails.

[3] Energy Efficiency for All (2015). Program design guide: Energy efficiency programs in multifamily affordable housing. Energy Efficiency for All Project.

- Implementation staff noted that during PY2017 they focused on building a pipeline of common area projects distinct from the pipeline of direct install projects. This was contrasted with the approach used in PY2016 that focused on direct install projects as a first step in the participation process. Additionally, the program implementation contactor increased staffing such that there are separate program staff members focused on managing the direct install and the common area components.
- Two case studies were developed in PY2017 featuring complexes that implemented lighting, HVAC, appliance, and water heating improvements.
- Among those participants that had not received common area incentives at the time of the survey, the share of participant survey respondents who reported that they were aware of common area incentives from 15% in PY2016 to 83% in PY2017. Additionally, 67% of respondents aware of the common area incentives reported that they were somewhat or very likely to complete a common area project at the property.

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

- Continued engagement with PACE may provide additional opportunities to finance higher cost measures with longer measure lives. Reviewed literature indicates that the inability of property managers and PACE administrators to estimate project energy savings may be a factor that limits PACE participation. The program should consider identifying itself as a potential resource for property managers and PACE administrators for estimation of project energy savings.
- Provide links to PACE and other financing opportunities on the program website along with brief information about the key benefits of PACE financing (included in a tax assessment, transferable in the even the property is sold) to increase awareness of the opportunities.

2. Introduction

This report presents the results of the impact and process evaluations of the CommunitySavers Program. This program is available to owners and managers of low-income multifamily properties that receive electrical service from Ameren Missouri. This report presents results for activity during PY2017.

2.1. Program Description

The CommunitySavers Program provides financial incentives and services to encourage comprehensive energy efficiency improvements in income-eligible multifamily properties. The program uses a “one-stop shop” model through which a dedicated account manager provides a variety of services to assist property managers and owners with the identification of energy efficiency opportunities and completion of application materials, guidance on development of project proposals for bidding, and provision of communication materials for distribution to tenants.

Multifamily properties with three or more units that receive electric service under Ameren Missouri Service Classification of Residential or Non-Residential (excluding lighting classifications) and that meet the tenant income qualifications are eligible. Income eligibility is established by meeting one of the following requirements:

- Reside in federally-subsidized housing units and fall within that programs’ income guidelines (U.S. Department of Housing and Urban Development (HUD), U.S. Department of Agriculture (USDA), and/or Public Housing Authorities). Receive the State Low-Income Housing Tax Credit (LIHTC).
- Reside in non-subsidized housing with an income at 200% of poverty level or below.

Properties with a mix of qualifying and non-qualifying tenants are eligible for incentives for the entire building if at least 51% of tenants meet the income requirements. If fewer than 51% of the tenants meet the income requirements, the building may receive common area and in-unit upgrades if the owner or manager verifies that comparable efficiency improvements have been made in all non-qualifying units.

The program provides the following type of incentives:

- Direct installation of measures at no cost to the property owner or tenant. The direct install measures include:
    - ENERGY STAR room air conditioners;
    - ENERGY STAR refrigerators;
    - LED lamps;
    - Low flow faucet aerators and showerheads, and pipe insulation;

- HVAC Maintenance and tune-ups;
- Programmable thermostats; and
- Dirty filter alarms.

- Small Business Direct Install (SBDI) incentives for common area lighting;
- HVAC system replacement incentive for properties with dwelling units with a residential account 1(M) service rating. Incentives are 25% higher than for non-qualifying residential customers; and
- Custom/standard incentives for common areas. The incentives provided are 25% higher than those offered for non-qualifying non-residential customers.

2.2. Program Trends in PY2017

Figure 2-1 summarizes ex ante savings from March 2017 through February 2018. The total ex ante savings for the CommunitySavers program was 5,359,046 kWh for the program year, with a range between zero and 1,466,649 kWh and an average monthly savings of 44,658 kWh. The highest month for savings occurred in March 2017, followed by February 2018.

Figure 2-1 Ex Ante Savings by Qualification/Processing Date

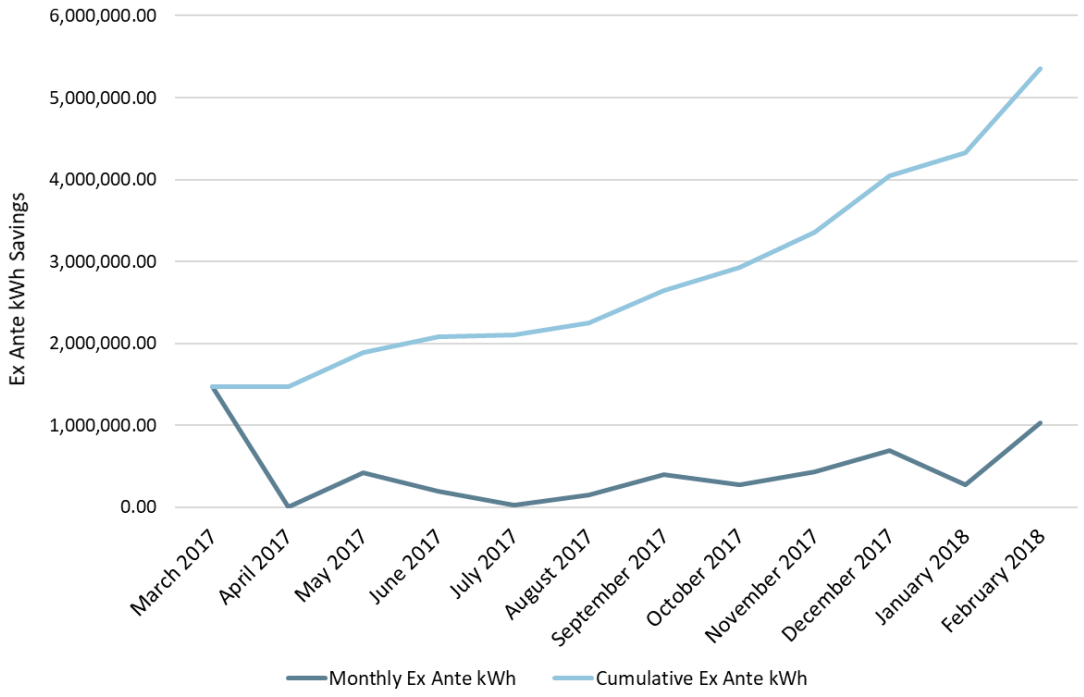


Figure 2-2 summarizes ex ante savings by program component. In comparison to PY2016, the share of program savings that resulted from common area measures (i.e., MFLI- Standard Prescriptive and MFLI Small Business Direct Install measures)

accounted for a significantly larger share of ex ante savings (up from approximately 1% to 31%).

As shown, over half (57%) of all program savings resulted from the MFLI direct install measures. The refrigerant recharge component of the HVAC tune-ups accounted for the largest portion of the overall savings within MFLI direct install at 15%, followed by low flow showerheads (13%), and programmable thermostats (11%).

MFLI Small Business Direct Install accounted for 19% of overall savings. Exterior LED replacing HID accounted for the largest portion of savings within MFLI Small Business at 25%. MFLI Standard Prescriptive accounted for 13% of overall savings, with LED 12-20 watt A-Line lamp replacing incandescent 75-100 watts accounted for the largest overall savings within this program at 28%.

MFLI Refrigerators and MFLI Heating and Cooling Component accounted for 11.8% and 0.3% of program savings, respectively.

Figure 2-2 Ex Ante Savings by Program Component

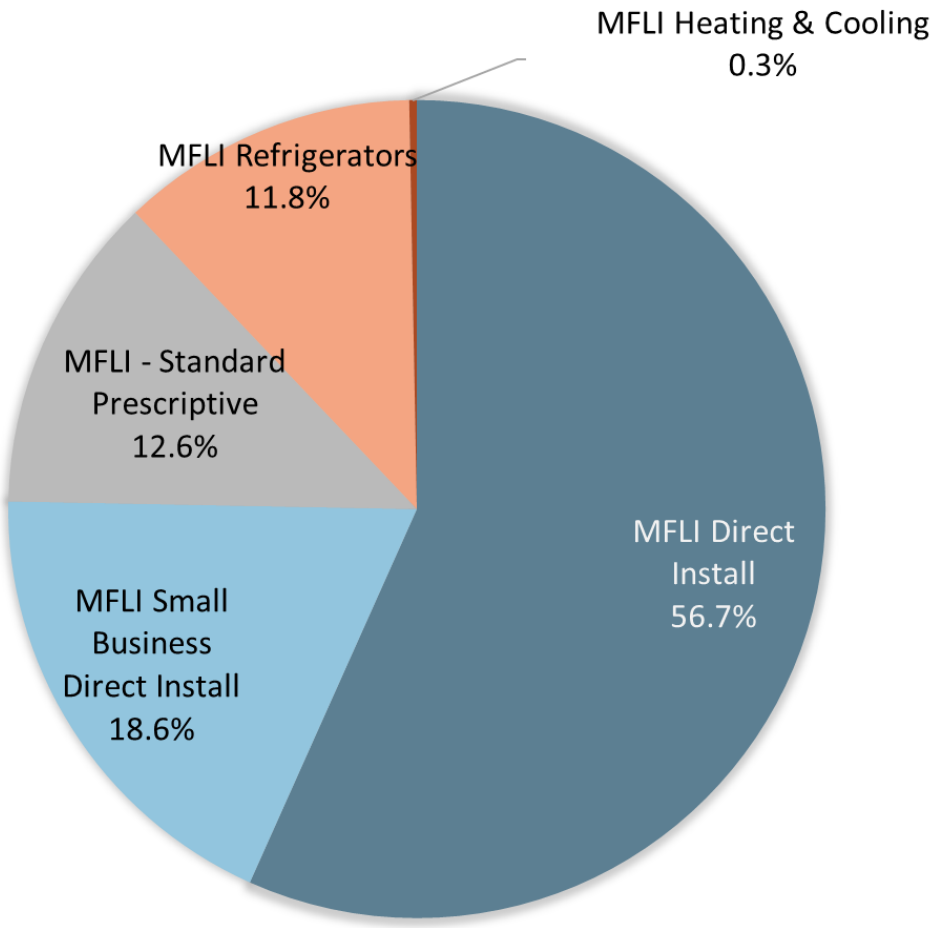


Figure 2-3 summarize ex ante savings by end use among all residential programs (MFLI direct install, MFLI Heating and Cooling, and MFLI Refrigerators). The largest share of savings for residential programs is from HVAC, followed by lighting, then water heating, then refrigeration and cooling.

Figure 2-3 Ex Ante Savings by End Use for Residential Measures

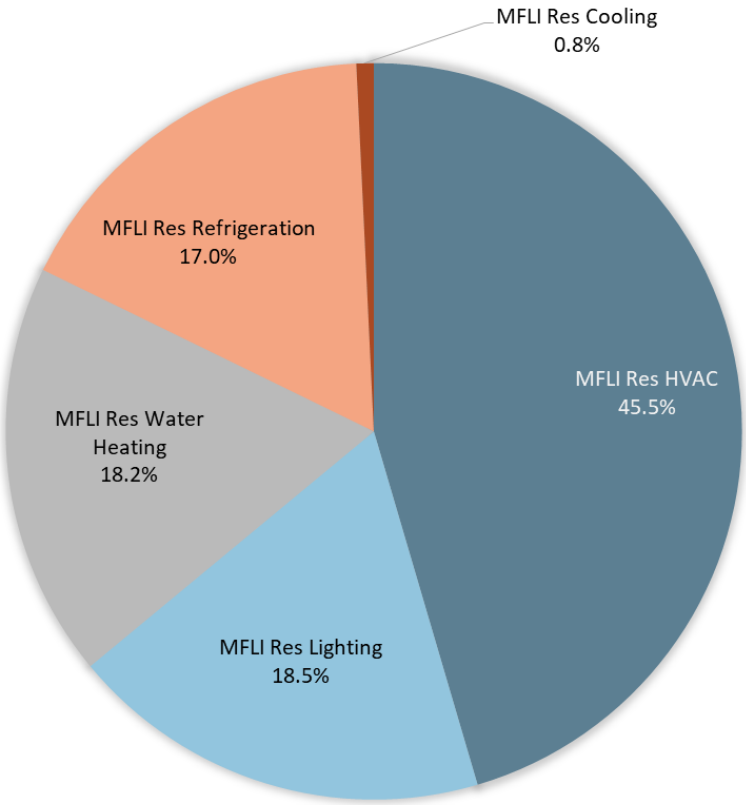
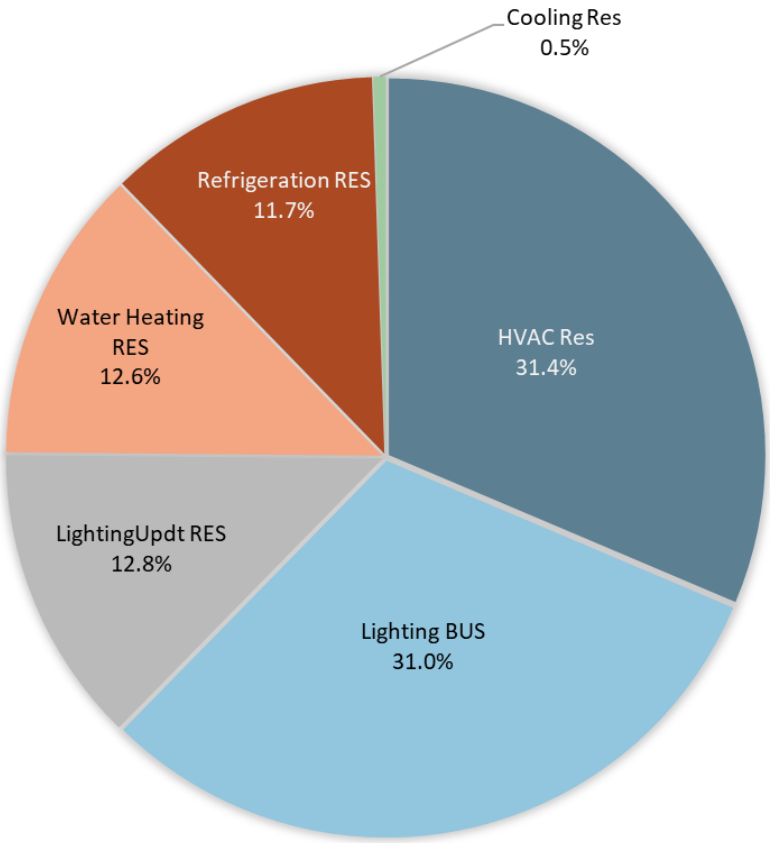


Figure 2-4 summarizes energy savings by end-use. Almost one-third (31.4%) of gross ex ante savings resulted from HVAC measures (HVAC replacements, tune-ups/refrigerant recharge, programmable thermostats, and dirty filter whistles). Another 31.0% of gross ex ante savings came from common area (business program) lighting measures.

Figure 2-4 Ex Ante Savings by End-Use



2.3. Organization of Report

This report on the impact and process evaluation of the program for the period March 2017 through February 2018 is as follows:

- Chapter 3 presents and discusses the methods used for and the results obtained from estimating ex post net gross savings.
- Chapter 4 presents and discusses the methods used for and results obtained from the process evaluation.
- Chapter 5 presents and discusses the methods used for and results obtained from the cost effectiveness evaluation.
- Chapter 6 presents evaluation conclusions and recommendations.
- Appendix A: ICF Program Manager Interview Guide
- Appendix B: Ameren Missouri Program Manager Interview Guide
- Appendix C: Property Manager / Owner Survey
- Appendix D: Tenant Survey

- Appendix E: PACE Literature Review
- Appendix F: Cost Effectiveness - Critical Technical Data
- Appendix G: Glossary of Terms

3. Estimation of Ex Post Gross and Net Savings

This chapter explains the estimation of gross and ex post net kWh savings and gross and ex post net peak kW savings for PY2017 program participants from measures installed at their properties. ADM performed impact analyses in accordance with evaluation requirement 4 CSR 240-22.070 (8). Section 3.1 describes the methodology used for estimating ex post gross kWh savings. Section 3.2 presents the results of the effort to estimate gross savings.

The net-to-gross (NTG) ratio for the CommunitySavers Program is estimated to be 1.0, in line with common practice for estimation of low-income program net savings.[4] As such, the net energy and demand reduction impacts are equal to the gross energy and demand reduction impacts.

3.1. Methodology for Estimating Ex Post Gross Savings

The methodology used to estimate ex post gross kWh savings is described in this section. The primary data used in the analysis was information collected through site visits performed in tenant units.

3.1.1. Post-Installation Site Visits

ADM collected data used for the evaluation of program ex post savings through site visits. Data collected during these visits included:

- Verification of installed measures;
- Verification that measures were properly installed;
- Assessment of baseline conditions (e.g., flow rates of existing faucets); and
- Collection of information on programmable thermostat set points.

Tenants were recruited for post-installation site visits through a mail survey. In total, 28 site visits were performed. In-service rates used to develop ex post gross savings were adjusted based on findings from the site visits as discussed in the following sections describing the approach to analyzing savings from program measures.

[4] See Violette and Rathbun, Chapter 17: Estimating Net Savings: Common Practices. The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures, available electronically at http://www.nrel.gov/docs/fy14osti/62678.pdf, p. 50.

3.1.2. Procedures for Estimating Energy Savings from Measures Implemented through the Program

The approach ADM employed to determine ex post gross energy saving impacts depended on the measure. The following sections summarize the approach used to estimate ex post kWh savings for the following measure types:

- LED Lighting Replacement;
- Refrigerator Recycling and Replacement;
- Low-Flow Showerhead Addition;
- Low-Flow Faucet Aerator Addition;
- Hot Water Pipe Insulation Addition;
- Programmable Thermostat Addition;
- Filter Alarm Addition;
- HVAC Replacement; and
- HVAC Tune-Ups.

3.1.2.1. Method for Analyzing Savings from LED Lighting Measures

Electric energy savings from LED lighting measures were calculated as follows:

$$\Delta kWh_{Total} = \frac{Watts_{Base} - Watts_{EE}}{1000} * Hours * ISR * Quantity * HCIF$$

Where,

W_{Base} = Input wattage of the existing or baseline system [W]

W_{EE} = Actual Wattage of LED fixture purchased/ installed [W]

HCIF = Heating and cooling interaction factor hours

Hours = Average hours of use per year [hr]

Quantity = Number of units claimed

ISR = In Service Rate, the percentage of units rebated that are actively in service

1000 = Conversion factor [W/kW]

Table 3-1 summarizes the equation parameters for the energy savings associated with the implementation of LED lighting measures and their reference sources. The parameter values were determined from the following sources:

- Residential baseline and efficient equipment wattages were derived from the Ameren Missouri Technical Reference Manual (Ameren Missouri TRM) and program data, respectively;
- Commercial baseline and efficient equipment wattages were derived from a combination of program documentation and the Ameren Missouri TRM;
- Residential and commercial reference cities, as well as heating and cooling types of program facilities, used to determine measure HCIF values, were derived from program tracking data and program building applications;
- Hours of use were based on program tracking data referencing the installation location, hours of use collected by the implementation contractor during interview with staff, as well as site visits and internet searches to determine living unit type (senior housing vs. family housing);
- The ISR value was derived from ADM site visit data; and
- Quantity values of measures were sourced from program tracking data.

Table 3-1 LED Lighting Energy Savings Calculation Inputs

Parameter	*Value*	*Unit*	*Source*
$Watts_{Base}$	Varies	W	See Table 3-3
$Watts_{EE}$	Varies	W	Program Data; Project Documentation
$ISR_{Residential}$	97%	-	Site Visits
$ISR_{Commercial}$	100%	-	Quantities verified through documentation review
Quantity	Varies	-	Program Data; Project Documentation
Hours	Varies	hr	See Table 3-2
HCIF	Varies	-	ADM

Table 3-2 summarizes the hours of use applied in the calculation of lighting savings.

Table 3-2 Lighting Hours of Use

Parameter	*Value*	*Source*
In-Unit Senior Building	365	Cadmus PY5 metering study[1]
In-Unit Family Building	694	Cadmus PY5 metering study[1]
In-Unit, Unknown Type	530	Cadmus PY5 metering study[1]
Common Area	6,541 or Site Specific Reported Hours	ADM Site Visits/Program tracking data
Exterior	4,322	U.S. Naval Observatory dusk to dawn hours for St. Louis[2]
LED Exit Signs	8,760	Ameren MO TRM

1. Ameren Missouri Low Income and Process Evaluation: Program Year 2014, p.26
2. http://aa.usno.navy.mil/data/docs/RS_OneDay.php

Table 3-3 summarizes the baseline and efficient wattages used in the calculation of residential lighting savings. The baseline wattages were based on wattages of the efficient lamps installed.

Table 3-3 Residential Lighting Baseline Wattages

Category Name	*Lumens*	*WattsBase*	*WattsEE*	*WattsBase Source*	*Per Unit Gross Ex Post kWh Savings*
LED 12W DIMMABLE E26	1100	53	11	Ameren MO TRM	35
LED 15W FLOOD PAR30	800	55	14	Ameren MO TRM	28
LED 18W FLOOD PAR 38	1200	70	17	Ameren MO TRM	237
LED 6-8W GLOBE G25	500	29	8	Ameren MO TRM	13
LED 9-10.5W DOWNLIGHT E26	800	43	9	Ameren MO TRM	20

Table 3-4 summarizes the baseline and efficient wattages used to estimate exit sign energy savings. Project documentation did not note the wattages of the exit signs; ADM referenced the Ameren Missouri TRM as a source for the efficient wattages.

Table 3-4 LED Exit Signs

Category Name	*WattsBase*	*WattsEE*	*WattsBase Source*
LED Exit Signs	30	3	Ameren MO TRM

For common area lighting projects, ADM referenced either program tracking data or the Illinois Technical Reference Manual (TRM) to develop baseline wattages for the lamp replacements. Baseline lamp characteristics tracked in program data were referenced for lamps HID lamps replaced with LED lamps.

Table 3-5 summarizes the baseline and efficient wattages used to estimate commercial lighting savings. Project documentation and program tracking data was referenced to

identify measure characteristics such as the efficient lamp type, wattage, and lumens. This information was used in conjunction with the Illinois TRM to source the baseline wattage used in the calculation of energy savings. The efficient lamp wattage was the wattage of the installed lamps.

It should be noted that most of the baseline wattages shown in the table below are based on baselines that reflect the energy efficiency standards stemming from the Energy Independence and Security Act of 2007 (EISA).

Project documentation did not note the wattages of the exit signs; ADM referenced the Ameren Missouri TRM as a source for the efficient wattages.

Table 3-5 Commercial Lighting Baseline Wattages

Category Name	*Efficient Measure*	*WattsBase*	*WattsBase Source*[5]
Linear	LED 4' Linear Replacement Lamp	33.6	IL TRM
Linear	LED 2' Linear Replacement Lamp	19.4	IL TRM
Omnidirectional Bulbs	Omnidirectional 250 - 309 lumens	25	IL TRM
Omnidirectional Bulbs	Omnidirectional 310 - 749 lumens	29	IL TRM
Omnidirectional Bulbs	Omnidirectional 750 - 1049 lumens	43	IL TRM
Omnidirectional Bulbs	Omnidirectional 1050 - 1489 lumens	53	IL TRM
Omnidirectional Bulbs	Omnidirectional 1490 - 2600 lumens	72	IL TRM
Omnidirectional Bulbs	Omnidirectional 2601 - 2999 lumens	150	IL TRM
Omnidirectional Bulbs	Omnidirectional 3000 – 5279 lumens	200	IL TRM
Omnidirectional Bulbs	Omnidirectional 5280 - 6209 lumens	300	IL TRM
Directional	PAR 740 – 849 lumens	45	IL TRM
Directional	PAR 850 – 1179 lumens	50	IL TRM
Directional	PAR 1180 – 1419 lumens	65	IL TRM
Directional	BR30/40 525 – 714 lumens	50	IL TRM
Directional	BR30/40 715 – 937 lumens	65	IL TRM
Decorative	Globe/Candelabra 300-499 lumens	40	IL TRM
Decorative	Globe/Candelabra 500 + lumens	60	IL TRM

ADM referenced the heating and cooling interactive factors presented in Table 3-6 below.

Table 3-6 Heating and Cooling Interactive Factors by Reference City

Location	*Cooling*	*Heating*	*HCIFkWh*
Cape Girardeau	AC	Gas Furnace	1.072
Cape Girardeau	AC	Electric Resistance	0.735
Cape Girardeau	Heat Pump	Heat Pump	0.877
Jefferson City	AC	Gas Furnace	1.087
Jefferson City	AC	Electric Resistance	0.759

[5] For all lamps aside from PAR lamps, version Illinois Statewide TRM v6.0 was used. For PAR lamps, v3.0 was used.

Location	*Cooling*	*Heating*	*HCIFkWh*
Jefferson City	Heat Pump	Heat Pump	0.890
Kirksville	AC	Gas Furnace	1.049
Kirksville	AC	Electric Resistance	0.658
Kirksville	Heat Pump	Heat Pump	0.794
St. Louis	AC	Gas Furnace	1.083
St. Louis	AC	Electric Resistance	0.746
St. Louis	Heat Pump	Heat Pump	0.878
Cape Girardeau	Unknown	Unknown	1.000
Jefferson City	Unknown	Unknown	1.000
Kirksville	Unknown	Unknown	1.000
St. Louis	Unknown	Unknown	1.000

3.1.2.2. Method for Analyzing Savings from Refrigerator Recycling and Replacement Measures

Electric energy savings from refrigerator recycling and replacement measures were calculated as follows:

$$\Delta kWh_{Total} = \Delta kWh_{Base} - \Delta kWh_{EE}$$

For electric energy savings associated with the recycling of baseline refrigerators, with known specifications[6]:

$$\Delta kWh_{Base} = [0.5822 + (Age * 0.0269) + (Pre - 1990 * 1.0548) + (Size * 0.0673) + (Side - by - Side * 1.0706) + (Single - door * -1.9767) + (Primary\ Usage * 0.6046)] * Days * Part\ Use\ Factor * ISR * Quantity$$

Where,

Age = Age of retired unit

Pre-1990 = 1 if manufactured pre-1990, else 0

Size = capacity of retired unit [ft^3]

Side-by-side = 1 if side-by-side, else 0

Single-door = 1 if single-door, else 0

Primary Usage = 1 if unit was primary unit, else 0

[6] The full equation also includes terms for interactions between HDD and CDD days and an unconditioned space dummy variable, where the dummy variable is coded as 1 if the unit is installed in an unconditioned space, and 0 means it was installed in conditioned space. Because all of the program units were removed from tenant units, ADM assumed all were installed in a conditioned space and dropped these terms from the equation.

Days = Days per year [day/yr]

Part Use Factor = factor used to account for those units that are not running throughout the entire year

ISR = In Service Rate, In Service Rate, the percentage of units rebated that are actively in service

Quantity = Number of units claimed

For electric energy savings associated with the recycling of baseline refrigerators, with unknown specifications:

$$\Delta kWh_{Base} = UEC_{Base} * Part\ Use\ Factor * Quantity * ISR$$

Where,

UEC_{Base} = Deemed Unit Energy Consumption [kWh/quantity]

Part Use Factor = factor used to account for those units that are not running throughout the entire year

ISR = In Service Rate, In Service Rate, the percentage of units rebated that are actively in service

Quantity = Number of units claimed

For electric energy savings associated with the implementation of efficient refrigerator measures:

$$\Delta kWh_{EE} = UEC_{EE} * ISR * Quantity$$

Where,

UEC_{EE} = Deemed Unit Energy Consumption [kWh/quantity] = 1,181

ISR = In Service Rate, the percentage of units rebated that are actively in service

Quantity = Number of units claimed

Table 3-7 summarizes the equation parameters for the energy savings associated with the implementation of efficient refrigerator measures and their reference sources.

Table 3-7 Refrigerator Energy Savings Calculation Inputs

Parameter	*Value*	*Unit*	*Source*
Age	Varies	yr	Program Data
Pre-1990	Varies (0 or 1)	-	Program Data
Size	Varies	ft^3	Program Data
Side-by-Side	Varies (0 or 1)	-	Program Data
Single-Door	Varies (0 or 1)	-	Program Data
Primary Usage	1	-	Program Data
Days/ Year	365	day/yr	-
Part Use Factor	1	-	Program Data
ISR	100%	-	ADM Site Visit
UEC_{EE}	Varies	kWh/unit	Program Data, ENERGY STAR
Quantity	Varies	-	Program Data

3.1.2.3. Method for Analyzing Savings from Low-Flow Showerhead Measures

Electric energy savings of low-flow showerheads were calculated as follows:

$$\Delta kWh_{Total} = \left(\frac{People * ShowerTime * Days * \%Days * \Delta GPM * (T_{Shower} - T_{In}) * C_P * Den}{3{,}413 * RE * Showerheads}\right) * Quantity * ISR$$

Where,

People = Number of people taking showers [people/household]

Showerheads = Number of showerheads installed per home

ShowerTime = The average shower duration [min/shower]

ΔGPM = Difference in gallons per minute between the base showerhead and the new showerhead [gal/min]

Days = Number of days per year [days/year]

%Days = Number of showers taken per person, per day

T_{Shower} = Average water temperature at the showerhead [°F]

T_{in} = Average inlet water temperature [°F]

C_P = Specific heat capacity [BTU/lb-°F]

Den = Water density [lb/gal]

3,413 = Btu to kWh [BTU/kWh]

RE = Recovery Efficiency of the electric hot water heater

ISR = In Service Rate, the percentage of units rebated that are actively in service

Quantity = Number of units claimed

Table 3-8 summarizes the equation parameters for the energy savings associated with the implementation of low-flow showerhead measures and their reference sources. The choice of parameter values was based on the following factors:

- Except for ΔGPM deemed values were sourced from the Ameren Missouri TRM;
- ΔGPM was based on ADM site visit data;
- ISR values were based on ADM site visit data; and
- Quantity of measures were sourced from program tracking data.

Table 3-8 Low-Flow Showerhead Energy Savings Calculation Inputs

Parameter	*Value*	*Unit*	*Source*
People	Varies	people/household	Program Data
Shower Time	8.66	min/ shower	Secondary source cited in PY6 Evaluation
Days	365	Days/ year	
%Days	0.66	Showers/person/day	Secondary source cited in PY6 Evaluation
ΔGPM	1	gal/min	ADM Site Visit
T_{Shower}	105	°F	Secondary source cited in PY6 Evaluation
T_{In}	61.3	°F	Ameren MO TRM
C_P	1.00	BTU/lb-°F	
Den	8.33	lb/gal	
BTU to kWh	3,413	BTU/kWh	
RE	0.98	-	Cadmus PY3 site visits
Showerheads	1	Showerheads/household	PY7 program data
ISR	94%	-	ADM Site Visit
Quantity	Varies	-	Source Data: Quantity

3.1.2.4. Method for Analyzing Savings from Faucet Aerator Measures

Electric energy savings of faucet aerators were calculated as follows:

$$\Delta kWh_{Total} = \frac{((People * FaucetTime * Days * \Delta GPM * (T\_Shower - T\_in) * C\_P * Den)}{(3413 * RE * Faucets)} * ISR * Quantity$$

Where,

ΔGPM =Difference in gallons per minute between the base faucet aerator and the new faucet aerator [gal/min]

People = Number of people per household [people/ household]

Den = Water density [lb/gal]

Days =Number of days per year [days/ year]

ISR = In Service Rate, the percentage of units rebated that are actively in service

Quantity = Number of units claimed

Faucets = Number of faucets installed per household [faucet/household]

FaucetTime = Average duration of faucet use [min/faucet use]

C_P *= Specific heat capacity of water [Btu/lb-°F]*

T_{Faucet} *= Average water temperature out of the faucet [°F]*

T_{In} *= Averate inlet water temperature [°F]*

$RE_{Electric}$ *= Recovery efficiency of electric water heater*

3,413 = Converts Btu to kWh [Btu/kWh]

Table 3-9 summarizes the equation parameters for the energy savings associated with the implementation of low-flow faucet aerator measures and their reference sources. The choice of parameter values was based on the following factors:

- Except for ΔGPM deemed values were sourced from the Ameren Missouri TRM;
- ΔGPM were based on ADM site visit data;
- ISR values were based on ADM site visit data; and
- Quantity of measures were sourced from program tracking data.

Table 3-9 Faucet Aerator Energy Savings Calculation Inputs

Parameter	*Value*	*Unit*	*Source*
People	Varies	People/ household	Program Data
Faucet Time	3.7	min/day	Cadmus PY3 metering study
Days	365	days/year	
ΔGPM	0.7	gal/min	Site visit data
T_{Faucet}	80	°F	Site visit data PY7 program data, IL-TRM
T_{In}	61.3	°F	Secondary source cited in PY6 Evaluation
BTU to kWh	3,413.00	BTU/kWh	
RE	98.00%	-	Cadmus PY3 site visits5
Faucets	1.8	Faucets/household	PY7 program data
Den	8.33	lb/gal	
C_P	1	BTU/ lb-°F	
ISR	98%	-	ADM Site Visit
Quantity	Varies	-	Source Data: Quantity

3.1.2.5. Method for Analyzing Savings from Hot Water Pipe Insulation Measures

Electric energy savings of Hot Water pipe insulation were calculated as follows,

$$\Delta kWh = \left(\frac{\left(\frac{C_{Base}}{R_{Base}} - \frac{C_{EE}}{R_{EE}} \right) * L * \Delta T * Hours}{\eta DHW_{Elec} * 3{,}412} \right) * ISR * Quantity$$

Where,

C_{Base} = Circumference of uninsulated pipe [ft]

R_{Base} = Thermal resistance coefficient of uninsulated pipe [hr-°F-ft^2/ Btu]

C_{EE} = Circumference of insulated pipe [ft]

R_{EE} = Thermal resistance coefficient of insulated pipe [hr-F-ft^2/Btu]

L = Length of pipe from water heating source covered by pipe wrap [ft]

ΔT = Average temperature difference between supplied water and outside air [°F]

Hours = Average hours of use per year [hr]

ηDHW_{Elec} = Recovery efficiency of electric hot water heater

Conversion factor from Btu to kWh = 3,412 [Btu/kWh]

ISR = In Service Rate, the percentage of units rebated that are actively in service

Quantity = Number of claimed units

Table 3-10 summarizes the equation parameters for the energy savings associated with the implementation of hot water pipe insulation measures and their reference sources. The parameter values were derived from the following sources:

- Except for the R_{EE} value, deemed parameter values were sourced from the 2017 MO TRM;
- R_{EE} value was based on ADM site visit data;
- ISR value was based on ADM site visit data; and
- Quantity of measures were sourced from program tracking data.

Table 3-10 Pipe Insulation Energy Savings Calculation Inputs

Parameter	*Value*	*Unit*	*Source*
C_{Base}	0.14451	ft	Ameren MO TRM
R_{Base}	1	(hr-°F-ft^2)/Btu	Ameren MO TRM
C_{EE}	0.40631	ft	Ameren MO TRM
R_{EE}	3.6	(hr-°F-ft^2)/Btu	ADM Site Visit
L	1	ft	Ameren MO TRM
ΔT	58.9	°F	Supply temperature: 125 °F; Groundwater temperature: 55 °F (https://dnr.mo.gov/geology/geosrv/wellhd/heatpump.htm)
Hours	8,766	hr	Ameren MO TRM
ηDHW_{Elec}	0.98	-	Ameren MO TRM
Conversion Factor	3,412	Btu/kWh	Ameren MO TRM
ISR	0.93	-	ADM Site Visit
Quantity	Varies	-	Program Data

3.1.2.6. Method for Analyzing Savings from Programmable Thermostat Measures

Electric energy savings of programmable thermostats installed on central air conditioning units were calculated as follows:

$$\Delta kWh_{CAC\_Total} = \frac{FLH_{Cool} * Capacity_{Cooling} * \left(\frac{1}{SEER_{CAC}}\right)}{1000} * SB_{Degrees} * SF * EF * ISR * Quantity$$

Electric energy savings of programmable thermostats installed on air source heat pump tune-ups were calculated as follows:

$$\Delta kWh_{ASHP\ (and\ Elec_{Resist})\_Total} = \left(\left(\frac{FLH_{Cool} * Capacity_{Cooling} * \left(\frac{1}{SEER_{CAC}}\right)}{1000} * SB_{Degrees} * SF * EF\right) + \left(\frac{FLH_{Heat} * Capacity_{Heating} * \left(\frac{1}{HSPF_{ASHP}}\right)}{1000} * SB_{Degrees} * SF * EF\right)\right) * ISR * Quantity$$

Where,

FLH_{Cool} = Full load cooling hours

$FLH_{Cool\text{-}stat}$ = Full load cooling hours with setback schedule

$Capacity_{Cooling}$ = Cooling capacity of system in BTU/hr (1 ton = 12,000 BTU/hr)

$SEER_{CAC}$ = SEER efficiency of central air conditioner

$SEER_{ASHP}$ = SEER efficiency of air source heat pump

$HSPF_{ASHP}$ = Heating Season Performance Factor of system

FLH_{Heat} = Full load heating hours

$FLH_{Heat\text{-}stat}$ = Full load heating hours with setback schedule

$Capacity_{Heating}$ = Heating capacity of system in BTU/hr (1 ton = 12,000 BTU/hr)

$SB_{Degrees}$ = weighted sum of setback degrees to comfort temperature

SF = Savings factors from ENERGY STAR calculator

EF = Efficiency ratio

Quantity = Number of units claimed

ISR = In Service Rate, the percentage of units rebated that are actively in service

Table 3-11 summarizes the equation parameters for the energy savings associated with the implementation of programmable thermostat measures and their reference sources. The parameter values were derived from the following sources:

- Except for capacity and SB values, deemed parameter values referenced the Ameren Missouri TRM;
- Air conditioner model numbers and specifications used to determine $Capacity_{Cooling}$ and $Capacity_{Heating}$, were from Ameren Missouri;
- $SB_{Degrees}$ values for heating and cooling were derived from ADM site visit data;
- ISR value was based on ADM site visit data; and
- Quantity of measures were sourced from program tracking data.

Table 3-11 Programmable Thermostat Energy Savings Calculation Inputs

Parameter	*Value*	*Units*	*Source*
$Capacity_{Cooling}$	Varies	Btu/hr	Program Data
$Capacity_{Heating}$	Varies	Btu/hr	Program Data
$SEER_{CAC}$	10	W/hr	Ameren MO TRM
$SEER_{ASHP}$	10	W/hr	Ameren MO TRM
$SB_{Degrees\text{-}heat}$	2.1	°F	2017 site visit thermostat schedule data
$SB_{Degrees\text{-}Cool}$	2.9	°F	2017 site visit thermostat schedule data
SF_{Heat}	0.03	%/degree	ENERGY STAR CALCULATOR
SF_{Cool}	0.06	%/degree	ENERGY STAR CALCULATOR
ISR	100%	-	ADM Site Visit and Survey data
$HSPF_{ASHP}$	7	Btu/W-hr	Ameren MO TRM
$HSPF_{ElectricResistance}$	3.41	Btu/W-hr	http://www.gearypacific.com/docs/46%20-%20What%20is%20the%20HSPF%20of%20a%20Heat%20Pump.pdf
$EFLH_{Cool\text{-}Springfield}$	1178	hours	ENERGY STAR Air source heat pump calculator; EPA 2002
$EFLH_{Cool\text{-}St\text{-}Louis}$	1215	hours	ENERGY STAR Air source heat pump calculator; EPA 2002
$EFLH\_{}_{Heat\text{-}Springfield}$	1997	hours	ENERGY STAR Air source heat pump calculator; EPA 2002
$EFLH_{Heat\ St\text{-}Louis}$	2009	hours	ENERGY STAR Air source heat pump calculator; EPA 2002

3.1.2.7. Method for Analyzing Savings from Filter Alarm Measures

Electric energy savings of filter alarms were calculated as follows,

$$\Delta\text{kWh}_{\text{Total}} = \left(\frac{\Delta kWh_{Heat}}{yr} + \frac{\Delta kWh_{Cool}}{yr}\right) * \text{Quantity}$$

$$kWh\ Heating\ Savings = kW_{motor} * \ FLH_{heat} * EI * ISR$$

$$kWh\ Cooling\ Savings = kW_{motor} * \ FLH_{cool} * EI * ISR$$

Where,

kW_{motor} = Average motor full load electric demand

FLH_{heat} = Full load heating hours

FLH_{cool} = Full load cooling hours

EI = Efficiency improvement

ISR = In-service rate

Quantity = Number of units claimed

Table 3-12 summarizes the equation parameters for the energy savings associated with the implementation of filter alarm measures and their reference sources. The parameter values are derived from the following sources:

- The EI deemed value and motor kW referenced the Ameren Missouri TRM;
- Effective full load hours referenced a 2002 EPA report;
- ISR value was based on ADM site visit data; and
- Quantity of measures were sourced from program tracking data.

Table 3-12 Filter Alarm Energy Savings Calculation Inputs

Parameter	*Value*	*Unit*	*Source*
kW_Motor	0.5	kW	Ameren MO TRM
$FLH_{Heat\text{-}St.\ Louis}$	2009	hr/yr	Ameren MO TRM
$FLH_{Cool\text{-}St.\ Louis}$	1215	hr/yr	Ameren MO TRM
EI	15%	-	Ameren MO TRM
ISR	58%	-	ADM Site Visit

3.1.2.8. Method for Analyzing Savings from HVAC Measures

Electric energy savings of early replacement central air conditioners were calculated as follows:

$$\Delta kWh_{CAC\_Total} = \left(\frac{FLH_{Cool} * \frac{BTU}{hr} * \left(\frac{1}{SEER_{Exist}} - \frac{1}{SEER_{EE}} \right)}{1000} \right) * ISR * Quantity$$

Where,

FLH_{Cool} = Full load cooling hours [hr]

Capacity = Size of new equipment in [Btu/hr]

$SEER_{Exist}$ = Seasonal Energy Efficiency Ratio of existing unit [kBtu/kWh]

$SEER_{EE}$ = Seasonal Energy Efficiency Ratio of ENERGY STAR unit [kBTU/kWh]

ISR = In-service rate

Quantity = Number of units claimed

Table 3-13 summarizes the equation parameters for the energy savings associated with the implementation of central air conditioner measures and their reference sources. The parameter values were derived from the following sources:

- Deemed parameter values referenced the Ameren Missouri TRM;
- $SEER_{EE}$ values were sourced from program tracking data;
- ISR value was based on ADM site visit data; and
- Quantity of measures were sourced from program tracking data.

Table 3-13 Central Air Conditioner Replacement Energy Savings Calculation Inputs

Parameter	*Value*	*Unit*	*Source*
Capacity	Varies	Btu/hr	Program Data
$SEER_{Exist}$ or $SEER_{Base}$	Varies	kBtu/kWh	Ameren MO TRM
$SEER_{EE}$	Varies	kBtu/kWh	Program Data
ISR_{AC}	100%	-	ADM Site Visit
$FLH_{Heat\text{-}St.\ Louis}$	2009	hr/yr	Ameren MO TRM
$FLH_{Cool\text{-}St.\ Louis}$	1215	hr/yr	Ameren MO TRM

Electric energy savings of early replacement room air conditioners were calculated as follows:

$$\Delta kWh = \left(\frac{FLH * \frac{Btu}{H}}{EER_{Exist} * 1000} - \left(\%replaced * \frac{FLH * \frac{Btu}{H}}{EER_{New-base} * 1000} \right) \right) * ISR * Quantity$$

Where,

FL*H = Full load hours of room air conditioning unit*

Btu/H = Full load hours of room air conditioning unit

EER_{Exist} *= Efficiency of recycled unit*

%replaced = Percentage of units dropped off that are replaced

$EER_{New\text{-}Base}$ *= Efficiency of efficient unit*

ISR = In-service rate

Quantity = Number of units claimed

Table 3-14 summarizes the equation parameters for the energy savings associated with the implementation of room air conditioner measures and their reference sources. The parameter values were derived from the following sources:

- Except for %replaced value, deemed parameter values referenced the Ameren Missouri TRM;
- %replaced value based on ADM site visit data;

- ISR value was based on ADM site visit data; and
- Quantity of measures were sourced from program tracking data.

Table 3-14 Room Air Conditioner Replacement Energy Savings Calculation Inputs

Parameter	*Value*	*Unit*	*Source*
Btu/H	Varies	Btu/hr	Ameren, Source Data
%replaced	100%	-	Site Visit Data
EER_{Exist}	6.7	Btu/W-hr	Ameren MO TRM
$EER_{New-Base}$	Varies	Btu/W-hr	Program Data
$FLH_{Heat-St.\ Louis}$	2009	hr/yr	Ameren MO TRM
$FLH_{Cool-St.\ Louis}$	1215	hr/yr	Ameren MO TRM

Electric energy savings of ECM blower motors were calculated as follows:

$$\Delta kWh = Deemed\ Savings\ * \%HeatingEFLH$$

Where,

Deemed Savings = Estimated savings for ECMs based on the Ameren Missouri TRM

%HeatingEFLH = % of savings from efficient units during the heating season

$$= \frac{EFLH_{Heat}}{EFLH_{Heat} + EFLH_{Cool}}$$

$EFLH_{Heat}$ = Full load heating hours [hr]

$EFLH_{Cool}$ = Full load cooling hours [hr]

Table 3-15 summarizes the equation parameters for the energy savings associated with the implementation of central air conditioner measures and their reference sources. The parameter values were derived from the following sources:

- The deemed savings value referenced the Ameren Missouri TRM;
- An adjustment ratio was applied to the Ameren Missouri TRM deemed savings value to discount the savings already claimed by early replacement of the air conditioning unit;
- ISR value was based on ADM site visit data; and
- Quantity of measures were sourced from program tracking data.

Table 3-15 ECM Blower Motor Energy Savings Calculation Inputs

Parameter	*Values*	*Source*
Deemed Savings	392.5	Ameren Missouri TRM
$FLH_{Heat\text{-}St.\ Louis}$	2009	hr/yr
$FLH_{Cool\text{-}St.\ Louis}$	1215	hr/yr

3.1.2.9. Method for Analyzing Savings from Air Conditioner Tune-Up Measures

Electric energy savings of central air conditioner tune-ups, including refrigerant recharge, were calculated as follows:

$$\Delta kWh_{CAC\_Total} = \left(\left(\frac{FLH_{Cool} * \ Capacity_{Cool} * \left(\frac{1}{SEER_{CAC}} \right)}{1000} \right) * MF_e \right) * ISR * Quantity$$

Electric energy savings of air source heat pump tune-ups, including refrigerant, were calculated as follows:

$$\Delta kWh_{ASHP\_Total} = \left(\left(\frac{FLH_{Cool} * \ Capacity_{Cool} * \left(\frac{1}{SEER_{ASHP}} \right) * MF_e}{1000} \right) + \left(\frac{FLH_{Heat} * \ Capacity_{Heat} * \left(\frac{1}{HSPF_{ASHP}} \right) * MF_e}{1000} \right) \right) * ISR * Quantity$$

Refrigerant recharge (RCA10%) savings were isolated from tune-up savings by:

$$kWhSavings_{RCA10\%} = \frac{\sum kWhSavings_{TuneUp+RCA10\%}}{Units} - \frac{\sum kWhSavings_{TuneUp}}{Units}$$

Where,

FLH_{Cool} = Equivalent full load hours of air conditioning [hr/year]

$Capacity_{Cool}$ = Cooling Capacity of system [Btu/hr]

$$Capacity_{Cool} = 4.5 \ x \ CFM \ x \ (h_1 \ - \ h_2)$$

h_1 = enthalpy in

h_2 = enthalpy out

FLH_{Heat} = Equivalent full load hours of heating [hr/year]

$Capacity_{Heat}$ = Heating Capacity of system [Btu/hr] (1 ton = 12,000 Btu/hr)

$HSPF_{ASHP}$ = Heating System Performance Factor of existing Air Source Heat Pump after tuning [kBtu/kWh]

$SEER_{CAC}$ = SEER Efficiency of existing central air conditioning unit receiving maintenance

$SEER_{ASHP}$ = SEER Efficiency of existing air source heat pump unit receiving maintenance

MF_e = Maintenance energy savings factor

$$MF_e = (1 - \frac{\eta_{Pre-Effective}}{\eta_{Post-Effective}})$$

$\eta_{Pre\text{-}effective}$

$\eta_{Post\text{-}effective}$

$kWhSavings_{TuneUp+RCA10\%}$ = kWh savings from units receiving both measures

$kWhSavings_{TuneUp}$ = kWh savings from units receiving only a tune-up

Table 3-16 summarizes the equation parameters for the energy savings associated with the implementation of room air conditioner measures and their reference sources. The parameter values were derived from the following sources:

- Deemed parameter values referenced the Ameren Missouri TRM or the 2016 Illinois TRM;
- %replaced value referenced ADM site visit data;
- ISR value was based on ADM site visit data; and
- Quantity of measures were sourced from program tracking data.

Table 3-16 Air Conditioner Tune-Up Energy Savings Calculation Inputs

Parameter	*Value*	*Unit*	*Source*
$FLH_{St.\ Louis}$	1215	hr/year	ENERGY STAR Air source heat pump calculator; EPA 2002
$Capacity_{Cool}$	Varies	Btu/hr	Source Data: Nominal Capacity
$SEER_{CAC}$	10	kBtu/kWh	2016 IL TRM
$SEER_{ASHP}$	10	kBtu/kWh	2016 IL TRM
$FLH_{St.\ Louis}$	2009	hr/yr	ENERGY STAR Air source heat pump calculator; EPA 2002
$Capacity_{Heat}$	Varies	Btu/hr	Source Data: Nominal Capacity
$HSPF_{ASHP}$	6.8	Btu/w-hr	Ameren MO TRM

Parameter	Value	Unit	Source
ISR	100%	-	ADM Site Visit

3.1.1. Procedures for Estimating Ex Post Peak Demand Reductions from Measures Implemented through the Program

Peak demand reductions were calculated by factoring first year kWh savings by the applicable stipulated end-use coincident peak demand factor. The factor applied for each measure type is listed in Table 3-17.

Table 3-17 Application of Coincident Peak Demand Factors

Measure	Program Type	End-Use Category	Coincident Peak Demand Factors	Units
HVAC Maintenance and Tune-Up/ RCA10%	Residential	HVAC	0.000466081	kW/kWh
Programmable Thermostat	Residential	HVAC, Cooling	0.000466081	kW/kWh
Faucets	Residential	Water Heating	0.000088732	kW/kWh
Showers	Residential	Water Heating	0.000088732	kW/kWh
Pipe Insulation	Residential	Water Heating	0.000088732	kW/kWh
Filter Alarm	Residential	HVAC	0.000466081	kW/kWh
Lighting	Residential	Lighting	0.000149253	kW/kWh
Refrigeration	Residential	Refrigeration	0.000128525	kW/kWh
Air Conditioner	Residential	Cooling	0.000947418	kW/kWh
ECM Blower Motor	Residential	-	-	-
Lighting	Business	Lighting, Exterior Lighting, Miscellaneous	0.0001899635, 0.0000056160 0.0001379439	kW/kWh
Appendix E of the MEEIA Cycle 2 Stipulation and Agreement				

3.2. Results of Ex Post Savings Estimation

To estimate ex post gross kWh savings and gross peak ex post kW reductions for the CommunitySavers Program, data were collected through post-installation site visits. In total, 28 site visits were performed. ADM used the data to confirm measure installations, assess current in-service rates, and record information on programmable thermostat settings.

Because the net-to-gross (NTG) ratio for the CommunitySavers Program is estimated to be 1.0, the gross savings estimated are equal to the net savings.

3.2.1. Ex Post kWh Savings and kW Reductions by Measure

The following sections present results of the ex post analysis of gross and net kWh savings and kW reductions for each measure type. Section 0 provides a summary of measure-level savings.

3.2.1.1. LED Lighting Measures

Table 3-18 summarizes ex ante and ex post kWh savings. As shown, the gross kWh realization rate for all lighting is 108%. However, that percentage varies significantly, depending on the location where measures were installed (i.e. the space type).

For most lighting measures implemented through the program, ex ante savings values for most lighting measures reference the 2017 Ameren Missouri Technical Reference Manual (Ameren Missouri TRM) that fully deems fixed savings based on the measure descriptor. In contrast, the ex post savings were estimated using engineering equations and savings estimates dependent on multiple factors, including:

- The estimated hours of use that vary based on the space type where the lighting measures were installed.
- Heating and cooling factors, that vary by reference city, are incorporated into the ex post savings method.
- For in-unit and exterior residential lamps, an in-service rate of 97% developed from site visit data was applied. ADM staff did not locate all LED lamps at one location.

For a subset of business lighting measures where LED lamps replaced HID lamps, ex ante savings were based on custom calculations using site specific data (e.g. hours of use developed from staff interviews). The realization rate for these measures was 96%. The difference between the ex ante and ex post savings calculations was the ex post analysis applied HCIFs in the savings estimates of lamps located in conditioned spaces whereas ex ante calculations did not apply an HCIF.

Table 3-18 Lighting Ex Post kWh Savings

Space Type	*Ex Ante kWh Savings*	*PY2017 Ameren Missouri TRM kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*	*Ex Post Net kWh Savings*	*Deemed Net-to-Gross Ratio*
Residential (Interior Tenant Units): Senior Housing	54,173	59,714	31,248	58%	31,248	100%
Residential (Interior Tenant Units): Family Housing	621,472	673,641	604,676	97%	604,676	100%
Residential: Exterior	10,380	13,918	72,500	698%	72,500	100%
Business Lighting	1,524,645	1,218,152	1,679,362	110%	1,679,362	100%
Total	2,210,672	1,965,425	2,387,787	108%	2,387,787	100%

Table 3-19 summarizes the ex post kW savings resulting from lighting measures. The overall gross kW savings realization rate is 77%.

Table 3-19 Lighting Ex Post Peak kW Savings

Space Type	*Ex Ante kW Savings*	*PY2017 Ameren Missouri TRM kW Savings*	*Ex Post Gross kW Savings*	*Gross kW Savings Realization Rate*	*Ex Post Net kW Savings*	*Deemed Net-to-Gross Ratio*
Residential: Senior Housing	10.64	8.91	4.66	44%	4.66	100%
Residential: Family Housing	131.35	100.54	90.25	69%	90.25	100%
Residential: Exterior	1.81	2.08	10.82	598%	10.82	200%
Business Lighting	315.21	165.97	248.98	79%	248.98	300%
Total	459.01	277.50	354.71	77%	354.71	100%

3.2.1.1. Refrigerator Recycling and Replacement Measures

Table 3-20 summarizes ex post kWh savings resulting from refrigerator replacements. The ex post kWh savings are 821,640 and are equal to 83% of the ex ante savings. Ex ante savings estimates are calculated using the 2017 Ameren Missouri Technical Reference Manual (TRM) fixed savings to unit rate value of 888 kWh. In contrast, the ex post savings calculation is based on the energy consumption of the actual baseline and efficient refrigerators, when that data is available. When baseline model data was not available, the ex post savings calculation method was based on a deemed value from ENERGY STAR. Overall, the ex post savings calculation used mostly project specific

information in order to calculate energy savings associated with early replacement of the refrigerator measures.

Table 3-20 Refrigerator Ex Post kWh Savings

Ex Ante kWh Savings	*PY2017 Ameren Missouri TRM kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*	*Ex Post Net kWh Savings*	*Deemed Net-to-Gross Ratio*
990,890	559,878	821,640	83%	821,640	100%

Table 3-21 summarizes the number of units recycled, the average kWh usage of the baseline and efficient models, and the average per unit kWh savings for PY2017 refrigerator measures. For comparison purposes, Table 3-22 summarizes the number of units recycled, the average kWh usage of the baseline and efficient models, and the average per unit kWh savings for PY2016 refrigerator measures. As shown, the average baseline usage increased from the PY2016 evaluation. Two factors may have contributed to the change.

First, the PY2017 methodology was changed from the approach used in PY2016. In PY2016, baseline consumption was based on age and size ranges. In comparison, the PY2017 methodology allows for a more granular approach, using project specific age and size data of the units to estimate baseline unit consumption.

Second, in contrast to PY2016, the average refrigerator unit was smaller in size in PY2017 for units manufactured in 1980-1989, and larger for all other periods. The variation in unit size may explain the higher baseline usage found for PY2017 units manufactured in the periods, 1993-2000 and 2001-2010. The average size of units does not explain why the baseline consumption was lower in PY2017 than in PY2016 for units manufactured in 1990-1992, because the units were larger on average in PY2017.

Table 3-21 PY2017 Baseline and Efficient kWh Usage by Baseline Age

Baseline Refrigerator Age	*Number of Units*	*Average Ex Post Baseline kWh Usage*	*Average Ex Post Efficient kWh Usage*	*Average per Unit Ex Post kWh Savings*
1970-1979	24	1,581	411	1,169
1980-1989	203	1,508	362	1,146
1990-1992	78	1,069	397	672
1993-2000	721	1,021	402	618
2001-2010	67	988	396	592
Unknown	29	1,181	387	794
Total	1,122	1,074	394	732

Table 3-22 PY2016 Baseline and Efficient kWh Usage by Baseline Age

Baseline Refrigerator Age	*Number of Units*	*Average Ex Post Baseline kWh Usage*	*Average Ex Post Efficient kWh Usage*	*Average per Unit Ex Post kWh Savings*
1980-1989	16	1,720	390	1,330
1990-1992	14	1,272	405	867
1993-2000	259	869	387	479
2001-2010	65	556	399	169
Total	354	889	390	499

Table 3-23 summarizes ex post kW savings which totaled 105.60 kW for PY2017.

Table 3-23 Refrigerator Ex Post kW Savings

Ex Ante kW Savings	*PY2017 Ameren Missouri TRM kW Savings*	*Ex Post Gross kW Savings*	*Gross kW Savings Realization Rate*	*Ex Post Net kW Savings*	*Deemed Net-to-Gross Ratio*
115.82	71.96	105.60	91%	105.60	100%

3.2.1.2. Low-Flow Showerhead Measures

Table 3-24 summarizes ex post kWh savings for low-flow showerheads. Ex post kWh savings totaled 746,706 kWh, which equaled 179% of ex ante kWh savings.

Table 3-24 Low-Flow Showerhead Ex Post kWh Savings

Ex Ante kWh Savings	*PY2017 Ameren Missouri TRM kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*	*Ex Post Net kWh Savings*	*Deemed Net-to-Gross Ratio*
416,742	519,432	746,706	179%	746,706	100%

Table 3-25 summarizes ex post kW savings for low-flow showerheads. Ex post peak kW reductions equaled 66.26 kW, which is 112% of ex ante kW savings.

The difference between the reported ex ante kW savings and the ex post kW savings is attributed to the difference between the coincident peak demand factors. ADM estimated the ex ante CF factor by dividing ex ante kW by ex ante kWh and found a value of 0.000152756. The ex post calculation applied a value of 0.0000887318.

Table 3-25 Low-Flow Showerhead Ex Post kW Savings

Ex Ante kW Savings	*PY2017 Ameren Missouri TRM kW Savings*	*Ex Post Gross kW Savings*	*Gross kW Savings Realization Rate*	*Ex Post Net kW Savings*	*Deemed Net-to-Gross Ratio*
59.21	46.09	66.26	112%	66.26	100%

3.2.1.3. Faucet Aerator Measures

Table 3-26 summarizes ex post kWh savings for faucet aerators. Ex post kWh savings totaled 127,228 kWh, which equals 94% of ex ante savings. Ex ante savings estimates are calculated using the 2017 Ameren Missouri Technical Reference Manual (TRM) that applies a fully deemed value of 49 kWh/unit; whereas, the ex post savings calculation is dependent on the household size (i.e. number of bedrooms) of the facility where the measures are installed.

Table 3-26 Faucet Aerator Ex Post kWh Savings

Ex Ante kWh Savings	*PY2017 Ameren Missouri TRM kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*	*Ex Post Net kWh Savings*	*Deemed Net-to-Gross Ratio*
135,205	152,782	127,228	94%	127,228	100%

Table 3-27 summarizes ex post kW savings for faucet aerators. Ex post kW savings totaled 11.29 and equaled 65% of ex ante kW savings.

Table 3-27 Faucet Aerator Ex Post kW Savings

Ex Ante kW Savings	*PY2017 Ameren Missouri TRM kW Savings*	*Ex Post Gross kW Savings*	*Gross kW Savings Realization Rate*	*Ex Post Net kW Savings*	*Deemed Net-to-Gross Ratio*
17.26	13.56	11.29	65%	11.29	100%

3.2.1.4. Hot Water Pipe Wrap Insulation Measures

Table 3-28 summarizes ex post kWh savings for faucet aerators. Ex post kWh savings totaled 26,186 kWh, which equals 21% of ex ante savings. The major differences between the ex post savings calculation method from the ex ante savings calculation method are as outlined:

- Ex ante savings estimates were calculated using an average value of 21 kWh per foot. The 2017 Ameren Missouri Technical Reference Manual (TRM) fully deemed savings value of 4.89 kWh/unit (length, ft.) and the ex post savings calculation is 5 kWh/ unit (length, ft.).
- For hot water pipe wrap insulation measures, an in-service rate of 93% was applied. At one site, ADM found that the pipe wrap was not present.

Table 3-28 How Water Pipe Insulation Measures Ex Post kWh Savings

Ex Ante kWh Savings	*PY2017 Ameren Missouri TRM kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*	*Ex Post Net kWh Savings*	*Deemed Net-to-Gross Ratio*
122,462	28,220	26,186	21%	26,186	100%

As shown in Table 3-29, ex post kW savings totaled 2.32 and equaled 20% of ex ante savings.

Table 3-29 Hot Water Pipe Insulation Measures Ex Post kW Savings

Ex Ante kW Savings	*PY2017 Ameren Missouri TRM kW Savings*	*Ex Post Gross kW Savings*	*Gross kW Savings Realization Rate*	*Ex Post Net kW Savings*	*Deemed Net-to-Gross Ratio*
11.36	2.50	2.32	20%	2.32	100%

3.2.1.5. Programmable Thermostat Measures

Table 3-30 summarizes ex post kWh savings from the installation of programmable thermostats. Ex post savings totaled 1,284,548 kWh and is equal to 211% of ex ante savings.

Ex ante savings estimates were calculated using the 2017 Ameren Missouri Technical Reference Manual (TRM), which applies a fully deemed savings value based on the number of units installed. In contrast, the ex post savings calculation methodology is dependent on several factors, such as the size of the system, setback degrees, and effective full load hours of the equipment to which the programmable thermostat measures are installed.

Table 3-30 Programmable Thermostat Ex Post kWh Savings

Ex Ante kWh Savings	*PY2017 Ameren Missouri TRM kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*	*Ex Post Net kWh Savings*	*Deemed Net-to-Gross Ratio*
609,226	506,534	1,284,548	211%	1,284,548	100%

Table 3-31 summarizes the ex post kW savings. Ex post peak savings totaled 598.70 kW and were equal to 211% of the expected kW savings.

Table 3-31 Programmable Thermostat Ex Post kW Savings

Ex Ante kW Savings	*PY2017 Ameren Missouri TRM kW Savings*	*Ex Post Gross kW Savings*	*Gross kW Savings Realization Rate*	*Ex Post Net kW Savings*	*Deemed Net-to-Gross Ratio*
283.95	350.66	598.70	211%	598.70	100%

3.2.1.6. Filter Alarm Measures

Table 3-32 summarizes ex post kWh savings for filter alarms. Ex post savings totaled 358,126 kWh and were equal to 124% of the ex ante savings. The major differences between the ex post savings calculation method and the ex ante savings calculation method are as outlined:

- Ex ante savings estimates were calculated using the 2017 Ameren Missouri Technical Reference Manual (TRM) fully deemed savings value; whereas, the ex post savings calculation methodology is dependent on the effective full load hours of the equipment to which the filter alarm measures are installed.
- For filter alarm measures, an in-service rate of 58%, based on site visit data, was applied. ADM found that a filter alarm was not installed at four locations. In one case the filter alarm was not installed correctly but was sitting on top of the unit. For the remaining three cases the field technician did not find a whistle installed at the premise.

Table 3-32 Filter Alarm Ex Post kWh Savings

Ex Ante kWh Savings	*PY2017 Ameren Missouri TRM kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*	*Ex Post Net kWh Savings*	*Deemed Net-to-Gross Ratio*
289,354	480,060	358,126	124%	358,126	100%

Table 3-33 summarizes the ex post kW savings results. The difference between ex ante and ex post kW savings resulted from the difference in ex ante and ex post kWh savings.

Table 3-33 Filter Alarm Ex Post kW Savings

Ex Ante kW Savings	*PY2017 Ameren Missouri TRM kW Savings*	*Ex Post Gross kW Savings*	*Gross kW Savings Realization Rate*	*Ex Post Net kW Savings*	*Deemed Net-to-Gross Ratio*
134.86	223.75	166.92	124%	166.92	100%

3.2.1.7. HVAC Replacement Measures

Table 3-34 summarizes ex post kWh savings for HVAC Replacement Measures by equipment type. Ex post savings across all HVAC measures totaled 50,730 kWh and were equal to 152% of the ex ante savings. The major differences between the ex post savings calculation method from the ex ante savings calculation method are as outlined:

- Ex post SEER 16 savings were equal to 117% of the Ameren Missouri TRM value, but the SEER 14 unit savings were equal to 28% of the Ameren Missouri TRM savings. The SEER 14 unit was not identified as an early replacement measure and ADM applied a normal replacement baseline to estimate savings for the measure. However, the magnitude of the ex ante savings estimate suggests that an early replacement baseline was used.
- Ex ante savings estimates for both central air conditioner units and room air conditioner units are calculated using the 2017 Ameren Missouri Technical Reference Manual (TRM) fully deemed savings values. In contrast, the ex post energy savings methodology employed engineering equations and the results were dependent on project specific factors such as equipment capacity and full load cooling hours.

Table 3-34 HVAC Replacement Measures Ex Post kWh Savings

Equipment Type	*Ex Ante kWh Savings*	*PY2017 Ameren Missouri TRM kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*	*Ex Post Net kWh Savings*	*Deemed Net-to-Gross Ratio*
Central Air Conditioner	13,211	13,257	14,721	111%	14,721	100%
ECM Motor	5,103	5,103	9,050	177%	9,050	100%
Room Air Conditioner	14,970	14,970	26,960	180%	26,960	100%
Total	33,284	33,329	50,730	152%	50,730	100%

Table 3-35 summarizes ex post kW savings for the air conditioner replacements. The ratio of ex ante kW to ex ante kWh was equal to 0.0002197729 and the stipulated CF for cooling is equal to 0.0009474181.

Table 3-35 HVAC Replacement Measures Ex Post kW Savings

Equipment Type	*Ex Ante kW Savings*	*PY2017 Ameren Missouri TRM kW Savings*	*Ex Post Gross kW Savings*	*Gross kW Savings Realization Rate*	*Ex Post Net kW Savings*	*Deemed Net-to-Gross Ratio*
Central Air Conditioner	12.51	12.56	13.95	111%	13.95	100%
ECM Motor	3.92	0.00	0.00	0%	0.00	100%
Room Air Conditioner	3.29	14.18	25.54	777%	25.54	100%
Total	19.72	26.74	39.49	200%	39.49	100%

3.2.1.8. HVAC Tune-Ups and Refrigerant Recharge Measures

Table 3-36 summarizes ex post kWh savings for air conditioner tune-ups and refrigerant recharge. The overall tune-up gross kWh realization rate is 197%.

The ex ante fully deemed kWh savings values were 297 kWh/unit for tune-ups and 512 kWh/unit for refrigerant recharge.

Ex post savings were developed using an engineering equation that used MFLI subcontractor measured data from the pre- and post-period during the day of the tune-up, as well as information on full load cooling hours, unit heating capacity, and unity cooling capacity that varied by project site and unit. The average ex post kWh savings for HVAC tune-up and refrigerant recharge measures are 573 kWh/unit and 332 kWh/unit, respectively.

Table 3-36 HVAC Tune-Ups Measures Ex Post kWh Savings

Equipment Type	*Ex Ante kWh Savings*	*PY2017 Ameren Missouri TRM kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*	*Ex Post Net kWh Savings*	*Deemed Net-to-Gross Ratio*
HVAC Tune-Up	305,877	635,283	1,225,778	401%	1,225,778	100%
RCA10%	472,064	121,704	306,055	65%	306,055	100%
Total	777,941	756,987	1,531,833	197%	1,531,833	100%

Table 3-37 summarizes the ex post kW savings for HVAC tune-up measures. The effective ex ante coincident factor (ex ante kW/ex ante kWh) applied to all tune up measures was equal to 0.000488896.

Table 3-37 HVAC Tune-Ups Ex Post kW Savings

Equipment Type	*Ex Ante kW Savings*	*PY2017 Ameren Missouri TRM kW Savings*	*Ex Post Gross kW Savings*	*Gross kW Savings Realization Rate*	*Ex Post Net kW Savings*	*Deemed Net-to-Gross Ratio*
HVAC Tune-up	149.54	296.04	571.31	382%	571.31	100%
RCA10%	98.84	56.70	142.65	144%	142.65	100%
Total	248.38	352.74	713.96	287%	713.96	100%

3.2.1.9. Summary of Ex Post Savings

PY2017 ex post kWh and kW savings are summarized by program measure in Table 3-38 and Table 3-39, respectively.

Table 3-38 Summary of Residential Measure-Level Ex Post kWh Savings

Measure	*Number of Measures*	*Reported Ex Ante kWh Savings by Verified Measures*	*Per Unit PY2017 Ameren TRM kWh Savings*	*PY2017 Ameren Missouri TRM kWh Savings*	*Gross Ex Post kWh Savings*	*Per Unit Gross Ex Post kWh Savings*	*Gross kWh Savings as a Percent of PY2017 Reported Ex Ante kWh Savings*
CAC SEER 14	1	816	816	816	232	232	28%
CAC SEER 16	13	12,396	957	12,441	14,489	1,115	117%
Concept 3 Installation Auto Fan	13	5,103	393	5,103	9,050	696	177%
Dirty Filter Alarm	2,540	289,354	189	480,060	358,126	141	124%
ENERGY STAR Refrigerator	1,122	990,890	499	559,878	821,640	732	83%
ENERGY STAR Room Air Conditioner	30	14,970	499	14,970	26,960	899	180%
HVAC Maintenance and Tune-Up	2,139	305,877	297	635,283	1,225,778	573	401%
LED 12W Dimmable Light Bulb	1,944	46,129	33	64,152	67,553	35	146%
LED 15W Flood Light PAR30 Bulb	133	4,121	20	2,660	3,737	28	91%
LED 18W Flood Light PAR38 Bulb	191	5,692	38	7,258	45,278	237	795%
LED 8W Globe Light G25 Bulb	6,520	83,966	14	91,280	85,180	13	101%
LED 9-10.5W Downlight E26 Light Bulb	25,301	546,119	23	581,923	506,676	20	93%
Low Flow Faucet Aerator	3,118	135,205	49	152,782	127,228	41	94%
Low Flow Showerhead	1,882	416,742	276	519,432	746,706	397	179%
Pipe Insulation	5,771	122,462	5	28,220	26,186	5	21%
Programmable Thermostat	2,689	609,226	194	506,534	1,284,548	478	211%
RCA 10% Improvement	922	472,064	132	121,704	306,055	332	65%
Total	**54,329**	**4,061,130**	**-**	**3,784,495**	**5,655,422**	**104**	**139%**

Table 3-39 Summary of Residential Measure-Level Ex Post kW Savings

Measure	*Number of Measures*	*Reported Ex Ante kW Savings by Verified Measures*	*PY2017 Ameren Missouri TRM kW Savings*	*Gross Ex Post kW Savings*	*Per Unit Gross Ex Post kW Savings*	*Gross kW Savings as a Percent of PY2017 Reported Ex Ante kW Savings*
CAC SEER 14	1	0.77	0.77	0.22	0.2198	28%
CAC SEER 16	13	11.74	11.79	13.73	1.0559	117%
Concept 3 Installation Auto Fan	13	3.92	0.00	0.00	0.0000	0%
Dirty Filter Alarm	2,540	134.86	223.75	166.92	0.0657	124%
ENERGY STAR Refrigerator	1,122	115.82	71.96	105.60	0.0941	91%
ENERGY STAR Room Air Conditioner	30	3.29	14.18	25.54	0.8514	777%
HVAC Maintenance and Tune-Up	2,139	149.54	296.04	571.31	0.2671	382%
LED 12W Dimmable Light Bulb	1,944	8.26	9.57	10.08	0.0052	122%
LED 15W Flood Light PAR30 Bulb	133	0.65	0.40	0.56	0.0042	85%
LED 18W Flood Light PAR38 Bulb	191	0.95	1.08	6.76	0.0354	708%
LED 8W Globe Light G25 Bulb	6,520	31.36	13.62	12.71	0.0019	41%
LED 9-10.5W Downlight E26 Light Bulb	25,301	102.57	86.85	75.62	0.0030	74%
Low Flow Faucet Aerator	3,118	17.26	13.56	11.29	0.0036	65%
Low Flow Showerhead	1,882	59.21	46.09	66.26	0.0352	112%
Pipe Insulation	5,771	11.36	2.50	2.32	0.0004	20%
Programmable Thermostat	2,689	283.95	350.66	598.70	0.2226	216%
RCA 10% Improvement	922	98.84	56.70	142.65	0.1547	144%
Total	**54,329**	**1,034.35**	**1,199.53**	**1,810.27**	**0.0333**	**176%**

Table 3-40 Summary of Commercial Measure-Level Ex Post kWh Savings

Measure	*Reported Number of Measures*	*Reported Ex Ante kWh Savings by Unverified Measures*	*Per Unit PY2017 Ameren TRM kWh Savings*	*PY2017 Ameren Missouri TRM kWh Savings*	*Gross Ex Post kWh Savings*	*Per Unit Gross Ex Post kWh Savings*	*Gross kWh Savings as a Percent of PY2017 Reported Ex Ante kWh Savings*
A-Line Lamp <= 11W	597	169,592	253	50,235	124,310	208	73%
A-Line Lamp >= 11W	2,591	417,629	149	385,094	656,123	253	157%
Exterior LED replacing HID_SBDI	351	352,762	938	329,301	352,762	1,005	100%
Exterior LED replacing HID_STANDARD	38	22,802	577	21,926	22,802	600	100%
Interior LED replacing HID_SBDI	70	35,566	508	35,566	26,532	379	75%
LED (BAR or R) Reflector Lamp	21	35,987	181	2,357	4,147	197	12%
LED (BAR or R) Reflector Lamp (>= 12 Hours of Use)	75	15,872	246	18,450	14,801	197	93%
LED (PAR) Reflector Lamp	324	140,286	210	68,297	91,930	284	66%
LED 100 Watt Lamp (12 hrs per day)	11	19,528	924	8,318	8,766	797	45%
LED 100 Watt Lamp (24 hrs per day)	10	1,562	1,848	18,484	10,570	1,057	677%
LED 52 Watt Lamp	9	7,395	1,078	9,698	4,530	503	61%
LED Exit Sign	120	20,688	224	13,204	15,505	129	75%
LED MR16	0	N/A	173	0	0	0	0%
Linear LED 25W	385	27,409	33	12,859	39,036	101	142%
Linear LED 32W	2,864	218,953	55	156,661	278,741	97	127%
Interior LED replacing HID_STANDARD	152	38,614	577	87,703	28,806	190	75%
Total	**7,618**	**1,524,645**	**-**	**1,218,152**	**1,679,362**	**220**	**110%**

Table 3-41 Summary of Commercial Measure-Level Ex Post kW Savings

Measure	*Reported Number of Measures*	*Reported Ex Ante kW Savings by Unverified Measures*	*PY2017 Ameren Missouri TRM kW Savings*	*Gross Ex Post kW Savings*	*Per Unit Gross Ex Post kW Savings*	*Gross kW Savings as a Percent of PY2017 Reported Ex Ante kW Savings*
A-Line Lamp <= 11W	597	19.53	9.54	23.61	0.0396	121%
A-Line Lamp >= 11W	2,591	116.46	73.15	124.64	0.0481	107%
Exterior LED replacing HID_SBDI	351	67.01	1.85	1.98	0.0056	3%
Exterior LED replacing HID_STANDARD	38	4.33	0.12	0.13	0.0034	3%
Interior LED replacing HID_SBDI	70	6.76	6.76	5.04	0.0720	75%
LED (BAR or R) Reflector Lamp	21	0.78	0.45	0.79	0.0375	101%
LED (BAR or R) Reflector Lamp (>= 12 Hours of Use)	75	5.37	3.50	2.81	0.0375	52%
LED (PAR) Reflector Lamp	324	16.07	12.97	17.46	0.0539	109%
LED 100 Watt Lamp (12 hrs per day)	11	1.47	1.58	1.67	0.1514	113%
LED 100 Watt Lamp (24 hrs per day)	10	3.51	3.51	2.01	0.2008	57%
LED 52 Watt Lamp	9	1.84	1.84	0.86	0.0956	47%
LED Exit Sign	120	5.11	1.82	2.14	0.0178	42%
LED MR16	0	N/A	0.00	0.00	0.0000	0%
Linear LED 25W	385	6.68	2.44	7.42	0.0193	111%
Linear LED 32W	2,864	52.95	29.76	52.95	0.0185	100%
Interior LED replacing HID_STANDARD	152	7.34	16.66	5.47	0.0360	75%
Total	**7,618**	**315.21**	**165.97**	**248.98**	**0.0327**	**79%**

4. Process Evaluation

This chapter presents the results of the process evaluation of the Ameren Missouri CommunitySavers Program during PY2017. The purposes of this process evaluation are to assess the effectiveness of Ameren Missouri's PY2017 CommunitySavers Program in delivering appropriate energy efficiency technologies to low-income multifamily properties served by Ameren Missouri and to identify ways to improve the CommunitySavers Program 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.

4.1. 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 4-1, the team interviewed or surveyed three staff members of Ameren Missouri and its implementation contractor, ICF International (ICF); 83 tenants; and 32 property owners or managers. The team also reviewed and analyzed the program database to characterize the population of program participants and review data quality. High-level findings follow.

Table 4-1 Evaluation Data Collection Activities

*Data Source**	*Method*	*Dates*	*Research Objective*	*Analysis Type*
Program staff (3), Ameren Missouri (1), ICF (2)	In-depth interview	February 2017 to March 2017	Program function; communication; tracking and reporting; quality control	Qualitative
Database analysis	Database review	January 2017 to April 2017	Number of projects; project type and details; data quality	Quantitative
Participants (32)	Online/Telephone Survey	November 2017 to March 2017	Program experiences; satisfaction with program	Quantitative and qualitative

*Data Source**	*Method*	*Dates*	*Research Objective*	*Analysis Type*
Tenant (83)	Mail	November 2017 to December 2017	Site visit recruitment; program experiences; satisfaction with program	Quantitative and qualitative
Post-install site visit (28 units)	On-site M&V	January to February 2017	Verify baseline operating conditions	Quantitative and qualitative

* Sample sizes in parentheses

4.1.1. Program Staff Feedback

The program had much greater success with completing common area improvements in PY2017 as compared to PY2016. Key factors identified were:

- The restriction that prevented properties that receive the Low Income Housing Tax Credit from receiving incentives for common area improvements was removed by act of legislation.
- The program partnered with Spire to deliver efficiency improvements in properties with natural gas water and space heating.
- Incentives were offered for common area lighting that operated for less than 24 hours.

Staff engaged with representatives of PACE and began providing information about the program to property managers and owners, but noted there has been little interest. Staff believe that partnering with the Missouri Housing Development Commission (MHDC) or leveraging the LIHTC may provide additional financing opportunities.

4.1.2. Program Database

ADM analyzed program data to characterize the types of projects completed during the year, the property occupancy types (i.e., subsidized, low-income market rate), and the geographic distribution of projects. The findings of the analysis are:

- More than 30% of ex ante kWh savings resulted from common area lighting and residential heating and cooling measures – a significant increase from PY2016.
- HVAC measures (Tune-ups, refrigerant charge, dirty filter alarms, and programmable thermostats) were most commonly implemented, with 32% of units receiving HVAC measures. In comparison, 28% received lighting measures, 25% received water heating measures, and 14% received refrigerators.

- Participating properties were disproportionately located in St. Louis and its suburbs relative to the distribution of multifamily properties, low-income residents, and subsidized housing.

4.1.3. Owner/Manager Surveys

The owner/manager survey collected data on program awareness, barriers to energy efficiency, experience and satisfaction with the program representatives, processes, and measures.

Participants most frequently reported that the program account manager was the source of awareness (cited by 43%) and 29% of respondents stated they learned of the program from another person in their organization.

Respondents that did not complete a common area incentive project were largely aware of the availability of the incentives for these measures (83%) – a significant increase from 15% in PY2016.

Participants were largely satisfied with the field service representatives performing measure installations. Participants were most likely to be dissatisfied with the length of time to complete the installations; 5% of respondents were dissatisfied with the time required to install the measures.

Most survey respondents were satisfied with the steps required to complete the program project (84%) and the program overall (84%), and nearly all were satisfied with the efficiency improvements made through the program.

4.1.4. Tenant Surveys

The tenant survey collected information on the perceived benefits of the efficiency improvements, and satisfaction with their complexes' participation in the program.

Sixty-four percent of tenants reported that the energy efficiency measures resulted in non-energy benefits, most frequently improved home comfort and reliability of appliances or heating and cooling equipment.

Tenant satisfaction with the program processes and measures was fairly high. Seventy-nine percent of tenants were satisfied with the installation process and less than 10% were dissatisfied with it. A few tenants noted dissatisfaction with the improvements made, namely, that the work took longer to make than expected, that they did not like the programmable thermostat, and that they were not clear on what improvements were made.

4.2. Program Staff Feedback

ADM interviewed the Ameren Missouri program manager, and two ICF program manages. During the interviews, staff discussed several topics related to program design

and operational procedures. The focus of the interviews were on changes made since PY2017. The following sections summarize the findings of these interviews.

4.2.1. Program Design and Goals

Program staff discussed changes in the market environment and the program design that reduced barriers to participation in PY2017.

A legislation change allowed the program to enroll properties that received the Low Income Housing Tax Credit in the common area rebates. Staff indicated that this was a significant benefit to the program and contributed to the increase in common area improvements.

Another key change was the addition of exterior lighting in spaces that did not operate for 24 hours a day. In PY2016 incentives were limited to 24 hour lighting because of a focus on demand savings.

CommunitySavers partnered with Spire (which provides natural gas in the Ameren Missouri service territory) to deliver efficiency improvements to properties with natural gas water and space heating. For these projects, the direct install costs are split between Ameren Missouri and Spire.

Staff also noted some barriers to participation that remain. One of the barriers noted was that the incentives for window replacements may be too low to encourage window replacements. Staff noted that the custom incentives are not high enough to cover the full cost of window replacements and therefore are limited in terms of their effect on encouraging properties to replace their windows.

Staff discussed how financing may assist some properties to make additional retrofits through the program for those properties that need the cash flow to support projects even if the payback is good. To support this staff spoke with representatives of PACE and provide information to property managers and owners on PACE financing, but indicated that there has not been a lot of interest. That said, staff believe that partnering with the Missouri Housing Development Commission (MHDC) or leveraging the LIHTC may provide additional financing opportunities.

4.2.1. Program Staffing and Roles

ICF increased staffing for the program by adding a second program manager. The second program manager focuses on common area improvements whereas the other program manager focuses on the direct install projects. ICF also added additional support staff.

The Ameren Missouri program manager also changed in PY2017.

4.2.2. Program Communication

Communication processes remain consistent with the program operations during PY2017. Ameren Missouri and ICF staff hold a standing weekly meeting to discuss program status and current issues. During this meeting staff get “down in the weeds” to discuss current program issues that need to be addressed. Additionally, Ameren Missouri and ICF staff meet monthly to discuss the overall program strategy. Regular ad hoc communications between the Ameren Missouri and ICF managers occurs as well.

Internally, Ameren Missouri holds a weekly team meeting to discuss the broader residential portfolio as well as quarterly department meetings to discuss the coordinator. Additional Ameren Missouri staff are informed of relevant issues as needed, for example, the communications department would be informed when there is an opportunity to have a story about a program or project.

ICF holds standing staff meetings three days a week. The purpose of the meeting is to check in on the status of the program, make sure that applications and invoices are processed in a timely matter, review what is working well and issues that need attention.

4.2.3. Program Marketing and Outreach

The program engaged in a variety of marketing and outreach activities during PY2017. One marketing tactic use was the distribution of a quarterly newsletter and post cards with information about the program. These materials were sent to previous program participants as well as available lists of property managers and owners.

Staff also noted that they have been involved with various property management groups. The program is involved in the St. Louis Apartment Association, which hosts multiple events during the year that were attended by program staff. Additionally, the program continued its involvement with the Tower Grove Neighborhood Association. This association focuses on energy efficiency improvements in apartment buildings, particularly those that are locally managed and owned, and hosts two to three events a year that staff attend. The Missouri Housing Development Corporation hosted an application workshop in Kansas City that was attended by developers and larger property management companies.

Another tactic used in PY2017 to increase awareness of program rebates is to engage with the trade allies that are affiliated with the Residential Heating and Cooling and Biz Savers Programs. Staff indicated that they have been working with these trade ally networks and have received referrals through them. It was noted that this is particularly important for HVAC improvements so that information about the incentives can be provided to property managers and owners if they contact an HVAC contractor or dealer when an HVAC system fails.

Direct outreach to property managers and owners continued to be a key form of participant recruitment. Staff believe that finding the correct decision maker and completing the energy audit is particularly effective for recruiting properties.

Two case studies highlighting two projects were developed during the program year and are available on the program website. The case studies discuss the experience of the property manager with the program, the upgrades made, and the benefits achieved through the program. Additionally, the program brochure was updated to include common area improvements.

4.2.4. DI Subcontractors and Trade Allies

The program continued to work with the same three direct install subcontractor firms that the program worked with in PY2017, plus added an additional firm to better serve additional portions of the service territory.

Staff engaged in outreach to Ameren Missouri's trade allies that work with the residential heating and cooling and the business program through training sessions on the CommunitySavers and through trade ally newsletters. Staff believed that outreach to the trade ally networks would be more effective than broader outreach to the trades because these companies are already engaged with the program and familiar with incentive program processes.

In the summer of 2017, the program held a large trade ally training session in advance of the anticipated end of the LIHTC exclusion. Approximately, 30 contractors attended the training. Many of these contractors were active in the BizSavers or Residential Heating and Cooling Program. During the training staff provided an overview of the program and the primary message was that trade allies should notify the program if they have a property that might be eligible for the program and that the program. It was emphasized that the program would verify that the property met the program's income requirements and did not expect trade allies to do this. Additionally, the program attended the annual training held for the residential HVAC trade allies.

In addition to this group training, staff also noted that they work closely with several trade allies on a one-on-one basis. As the program identifies trade allies that seem particularly interested and engaged, they will provide this training at the trade ally's site.

Staff reported that this outreach to the trade ally network has resulted in some projects brought to the program by a trade ally. When a trade ally brings a project to the program, program staff engage the property manager in the concierge service to identify other potential projects at the property.

4.2.5. Program Participation Process

While the overall program participation process remained the same in PY2017, staff discussed a change in the approach to developing direct install and common area improvements. In PY2016 the approach was that properties would first receive the free no-cost direct install measures, followed by a property audit and common area measures. A lesson learned was that this approach did not always work for a couple of reasons. First, properties that are good candidates for direct install measures may not be good candidates for common area improvements, and in fact, may have relatively little common area space. Second, the direct install process requires facility staff time and that property management may not be willing to proceed to an additional project immediately following work because they have other matters to attend to. Because of these issues, staff focused on building a separate common area project pipeline in PY2017, although staff noted that they continue to focus on providing comprehensive retrofits.

Another change made is that some of the direct install subcontractors are now providing the education and training to tenants. Subcontractors were trained to provide the tenant training.

4.2.5.1. Quality Control and Verification

No changes were made to the program's quality control and verification processes.

4.2.6. Program Reporting and Project Tracking

Staff revised some of the data fields to simplify the data collected during HVAC tune-ups. Additionally, staff updated the Fulcrum data tool to add automated options and streamline the process. The tool has also been configured to collect the refrigerator replacement data.

4.3. Database Analysis

The evaluation team carried out an analysis of the participant database to identify characteristics of participating participants and the projects completed.

4.3.1. Analysis of Completed Projects

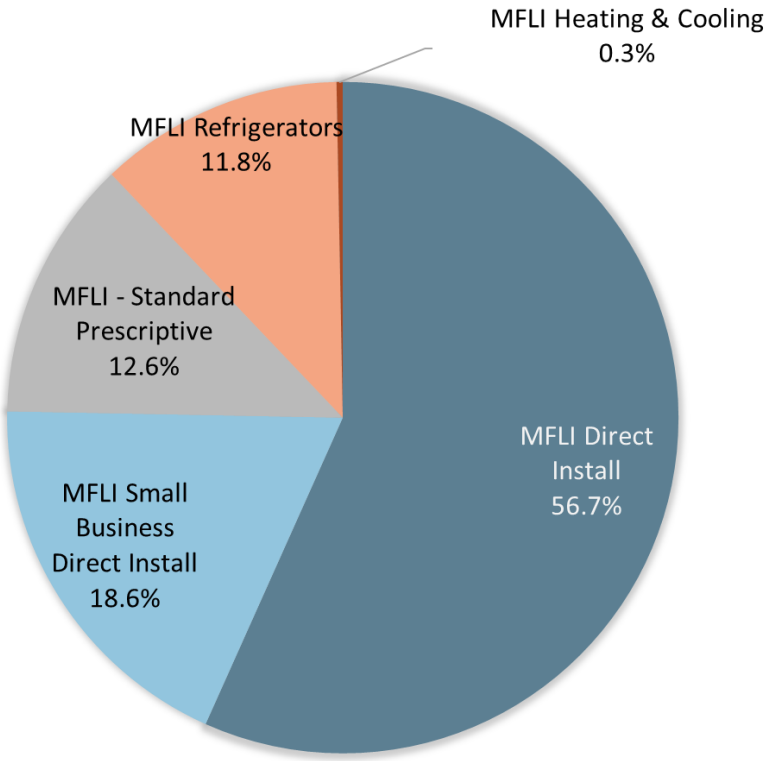
The following subsections provide an overall analysis of projects and participants and show analyses of program participation by program subcomponent, measures implemented, property occupancy type, and geographic location of completed projects.

4.3.1.1. Overall Analysis of Projects and Participants

In total, 62 properties and 4,486 tenant units received efficiency measures through CommunitySavers in PY2017.[7]

Figure 4-1 displays program savings by program component. As shown, 57% of program savings resulted from direct install measures, followed by Small Business Direct Install at 19%, and Standard Prescriptive at 13%. RCA 10% improvement accounted for the largest portion of the overall savings within MFLI direct install at 15%, followed by low flow showerheads, fixed at 13% and programmable thermostats at 11%. Twenty-five percent of the ex ante savings for the MFLI Small Business Direct Install came from the exterior LED replacing HID measure.

Figure 4-1 Ex Ante kWh Savings by Program Component

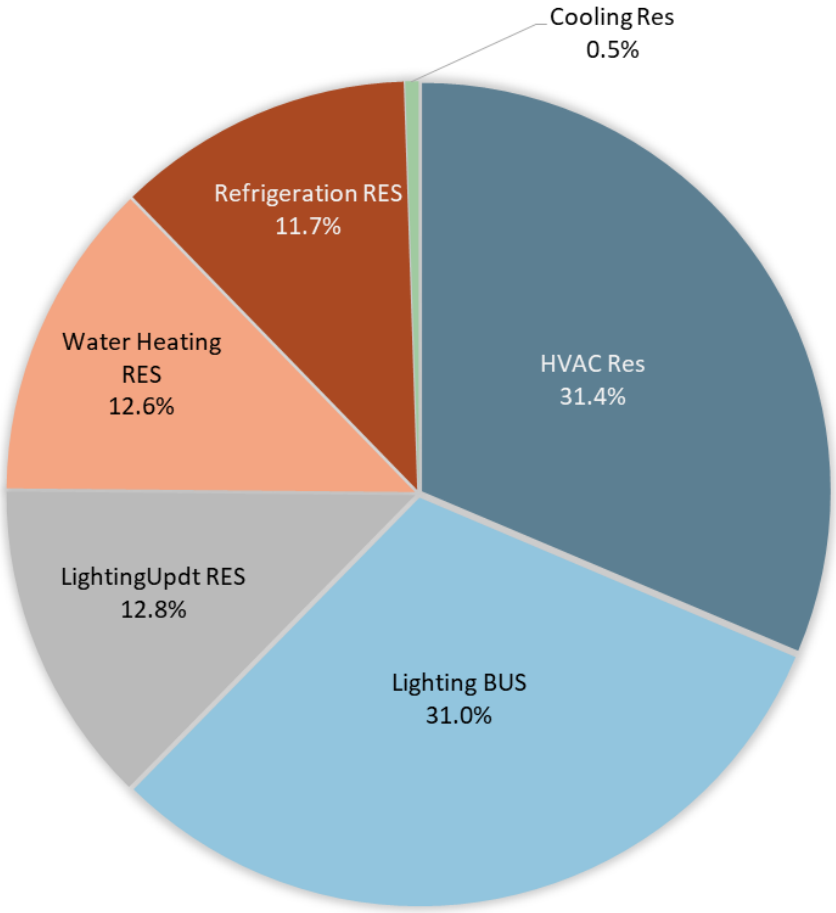


As shown in Figure 4-2 ex ante savings were distributed across the five end-uses, with HVAC savings accounting for the largest share of program savings (45%). The remaining

[7] The 62 properties includes one property for which the property name was missing. The number of tenant units is based on the count of unique account numbers for measures provided through residential program components.

ex ante savings were distributed across lighting (19%), water heating (18%), refrigeration (17%), and cooling (0.5%) measures.

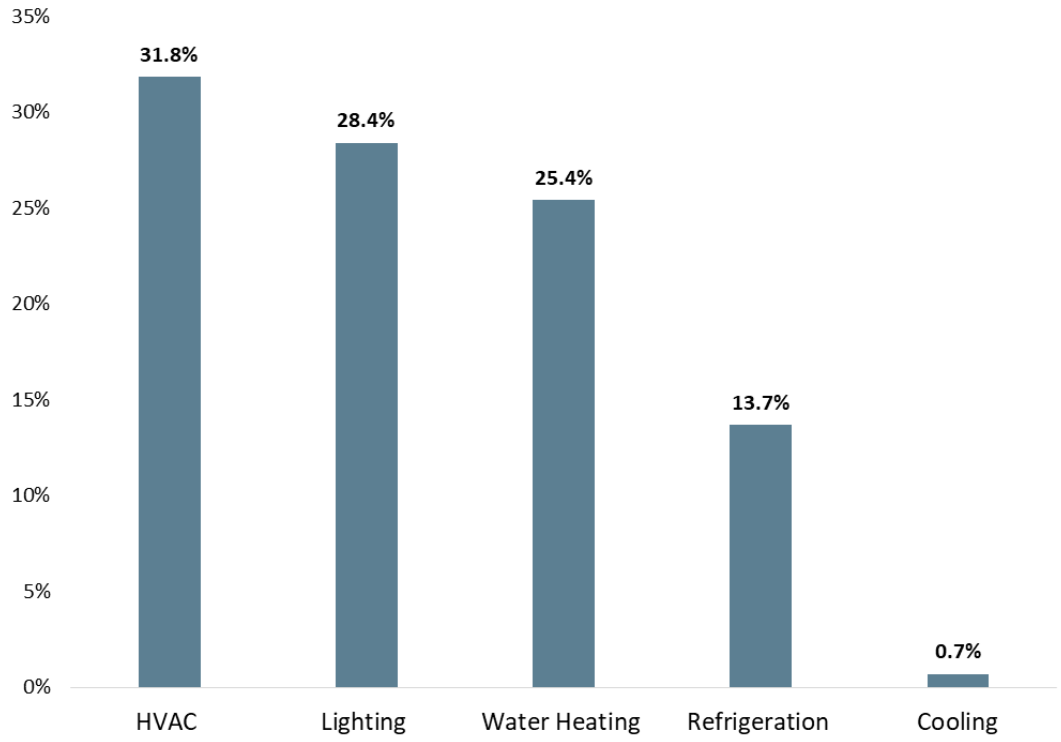
Figure 4-2 Ex Ante Savings by End Use for Residential Measures



4.3.1.1. Direct Install Projects

Figure 4-3 summarizes the share of units receiving measures within the four end-uses. As shown, 32% of units received HVAC measures (e.g., furnace whistle, tune-ups, or programmable thermostats). Twenty-eight percent of units received lighting measures and 25% received water heating measures, while 14% received refrigerator replacements.

Figure 4-3 Percent of Units Receiving End-Use



4.3.1.2. Geographic Area

The majority of tenant units (78%), buildings (65%), and projects ex ante savings (71%) were in St. Louis and its near suburbs, and most of the remainder where in the outer suburbs (Table 4-2). To put these values in context, the table also displays the distribution of multifamily housing, lower-income rental customers, and locations of subsidized housing. While all three indicators are imperfect proxies for the low-income multifamily property target market, they all suggest that program activity is more heavily concentrated in the St. Louis region than low-income multifamily properties are.

Table 4-2 Geographical Distribution of Completed Projects

Area	*Tenant Units (N = 4,486)*	*Properties (N = 62)*	*Ex Ante kWh Savings*	*Multifamily Housing[1]*	*Household Income of < $50,000[2]*	*Subsidized Housing Properties[3]*
St. Louis and near suburbs[4]	79%	65%	70%	49%	41%	38%
Outer suburbs[5]	10%	26%	16%	25%	24%	12%
All other areas[6]	12%	10%	13%	26%	35%	48%
Total	100%	100%	100%	100%	100%	98%

1. Defined as structures with three or more attached units. U.S. Census Bureau, 2011-2015 American Community Survey 5-Year Estimates
2. $50,000 threshold used as proxy for 200% of Federal Poverty Level (2017 200% FPL for a four-person household is $49,200) U.S. Census Bureau, 2011-2015 American Community Survey 5-Year Estimates
3. National Housing Preservation Database. http://www.preservationdatabase.org/
4. ZIP codes 63100-63199.
5. ZIP codes 63000-63099 and 63300-63399.
6. ZIP codes 63559, 63701, 63703, and 64644.

4.4. Owner/Manager Survey

ADM contacted 54 owners and managers that completed projects through the program in PY2017 and 32 responded to the survey, for a response rate of approximately 59%. Participants were initially contacted by email to complete the survey online. Non-respondents were contacted by telephone to complete the survey. Nineteen respondents completed the survey online and the remaining 13 completed the survey by telephone.

4.4.1. Description of Sample

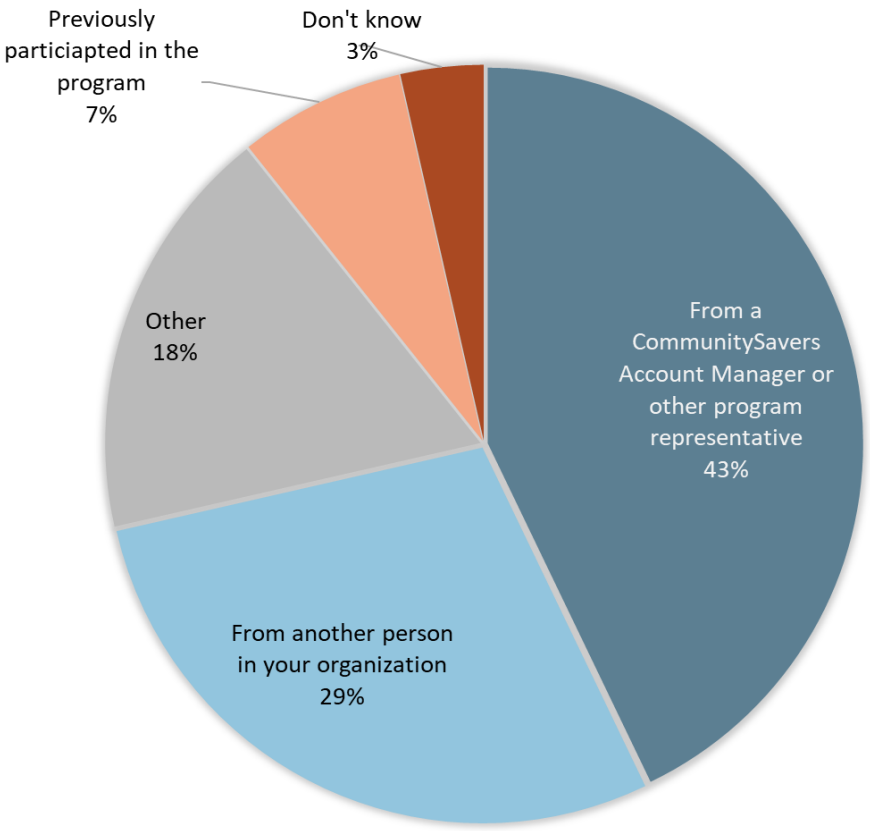
One respondent completed MFLI Heating and Cooling projects and 12 respondents completed Small Business Direct Install lighting projects, and 26 completed in-unit direct install projects.

A majority of respondents (69%) reported that their organization both owned and managed the property that received efficiency improvements through the program, and 31% indicated that they only managed the property.

4.4.2. Program Awareness

Respondents were most likely to report that they learned of the program from a CommunitySaver Program account manager (43%) (see Figure 4-4). The account manager is the primary staff person responsible for program outreach and so it is to be expected that this person would be the primary source of program awareness. Another 29% of respondents stated that they learned of the program from another person in their organization and 18% indicated they learned from other sources, which included the USDA, advertisement online, sales person, and TGS Landlord Training Program.

Figure 4-4 Source of Program Awareness



4.4.3. Awareness of Common Area Incentives

Among survey participants who did not receive incentives for common area improvements, 83% were aware that these incentives were available, while 17% indicated they did not know about the incentives. Those who were aware, 67% were either very or somewhat likely to complete an energy efficiency improvement in the common area. One respondent indicated they were very unlikely to complete a project in the common area but did not provide a reason for this.

Thirty-eight percent of respondents stated that the available incentives completely met their needs and another 45% indicated they “mostly” met their needs (see Table 4-3).

Of the three respondents, none indicated a CommunitySaver Program representative provided a free energy assessment of their property, with 33% responding no and 67% were unsure. It may be the case that these respondents received an audit but did not realize it was being performed.

Table 4-3 Common Area Measures

How well did the types of common area equipment for which incentives are offered fit your needs?	*Percent of Respondents (n=29)*
1 - Not at all	7%
2	0%
3	7%
4	45%
5 - Completely	38%
Don't know	3%

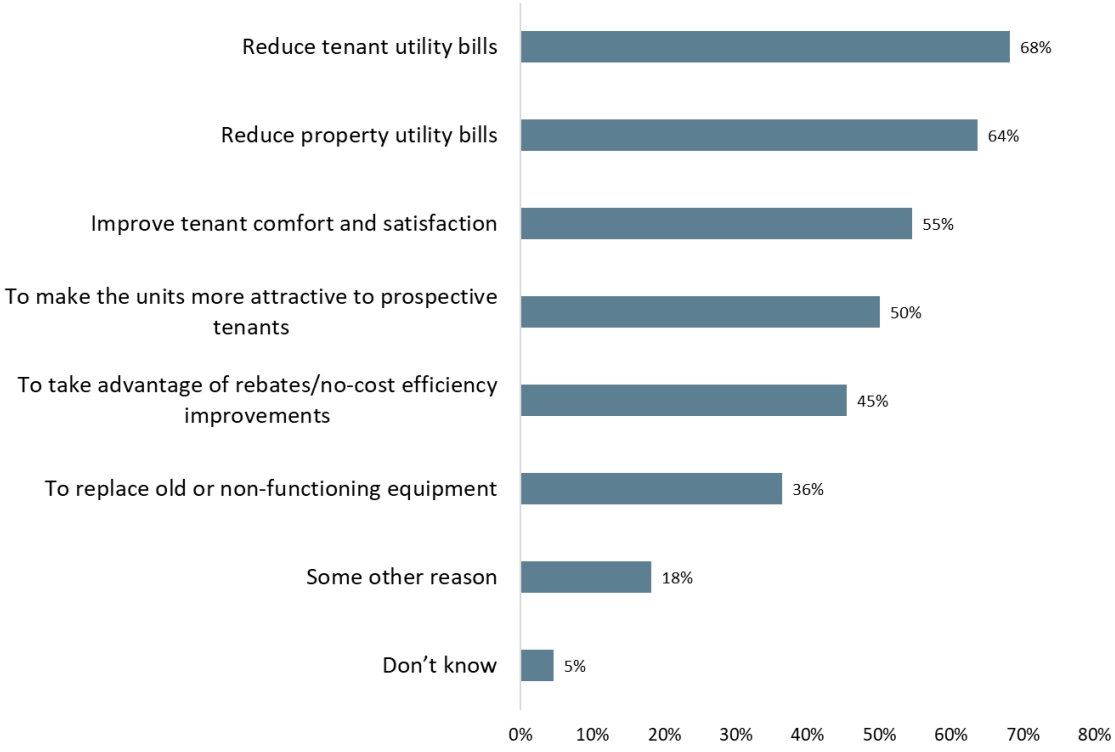
4.4.4. Barriers to Efficiency and Reasons for Participating in the program

Respondents discussed the challenges they face in making efficiency improvements to their buildings. The challenges included funding, timing, issues with tenants, problems with equipment and other items (see below).

- Financial challenges: Six respondents indicated they are limited by financial constraints ranging from funding to cost of project to nonpayment of rent. "*Do not have the money...we have 100+ year old buildings and need windows and doors. We received a $38,000 bid for windows for our building with 4 units...we desperately need new inside front doors for 8 units...appliances for 8 units are very small apartment size and old."*
- Timing issues: Four respondents stated there are issues with the timing of projects (e.g., long time frame to complete projects, timing of delivery of materials, or scheduling conflicts with tenants or contractors).
- Residents not cooperating or understanding the technology: Three respondents noted that residents do not always want to cooperate with the improvement process or lack awareness or knowledge of programmable thermostats. "G*etting the residents to accept the changes is the hugest challenge. Many of them concerned that their bill will go up, don't like the low water pressure and [have] difficulties with the thermostats."*
- Issues with the equipment: Two respondents stated they had issues with the equipment, with one person indicating the "*cross fitting fixtures that weren't compatible"* and the other stated the *"quality of the refrigerators, we have had a problem with at least 12% of the refrigerators they replaced."*
- Lack of staffing resources: One respondent stated that it was difficult to have enough staff involved for larger projects.
- One respondent indicated they had difficulty working with the utility or program representative.

Respondents provided a variety of reasons for participating in the program (see Figure 4-5). The most common motivation was reducing tenant bills (cited by 68% of respondents), followed by reducing property utility bills (64%) and improving tenant comfort and satisfaction (55%). Among those who did not receive common area improvements through the program, 55% stated their motivation was to reduce property utility bills.

Figure 4-5 Reasons for Competing In-Unit Efficiency Improvements



** Totals exceed 100% because respondents could select more than one*

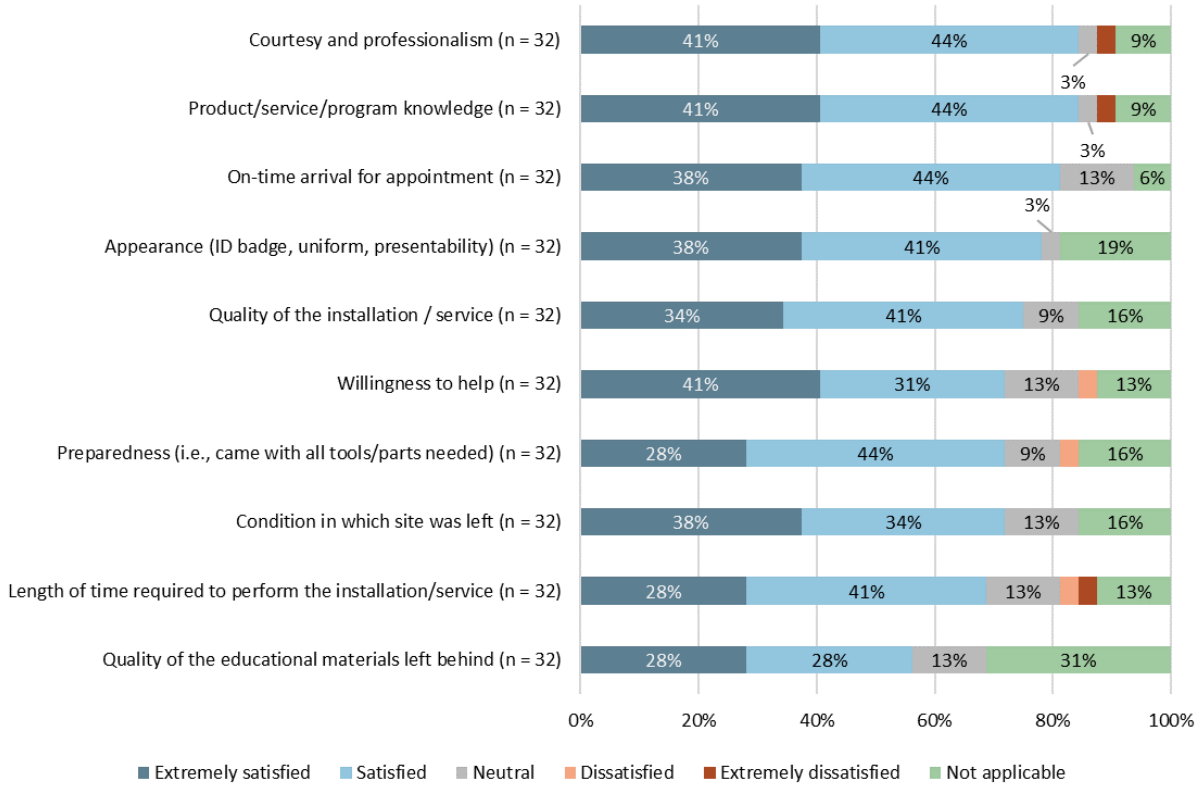
4.4.5. Experiences with Field Service Representatives

Most survey respondents (84%) indicated a level of satisfaction with their experience with the field representative. As shown in Figure 4-6, respondents were consistent with how positively they rated each aspect of their experience with the field service representatives. Between 56-84% of respondents rated each aspect of their experience with the field service representative as satisfied or very satisfied.

Respondents were most satisfied with the courtesy and professionalism of the field service representative, the product installed, service provided or program knowledge, and the on-time arrival for appointment with 81-84% of respondents reporting a level of satisfaction with these aspects. Seventy-eight percent of respondents expressed satisfaction with the appearance (ID badge, uniform, etc.) of the representatives, 75% with the quality of the installation, 72% with the condition the site was left in and the

representative's willingness to help. Owners/managers expressed the least amount of satisfaction with the quality of the educational materials left behind, with 56% indicating a level of satisfaction and 31% stating not applicable. This may indicate that representatives are not leaving education materials behind.

Figure 4-6 Satisfaction with Field Service Representatives



Five respondents provided additional comments on their experience with the field staff. See their responses below.

- *I would like to see the time frame improved to get projects completed.*
- *The field service representative was great however the contractors that did the work was not good at all.*
- *AC tune-ups in the spring isn't feasible. Due to the rain the guys had to keep coming back.*
- *The service rep was very knowledgeable and helped us work through a lot of problems especially with the thermostats. We also had a bunch of defects as well.*
- *Great program but quality of product could have been better, not the least expensive but maybe a letter above to cut back on service calls and avoid inconveniencing residents.*

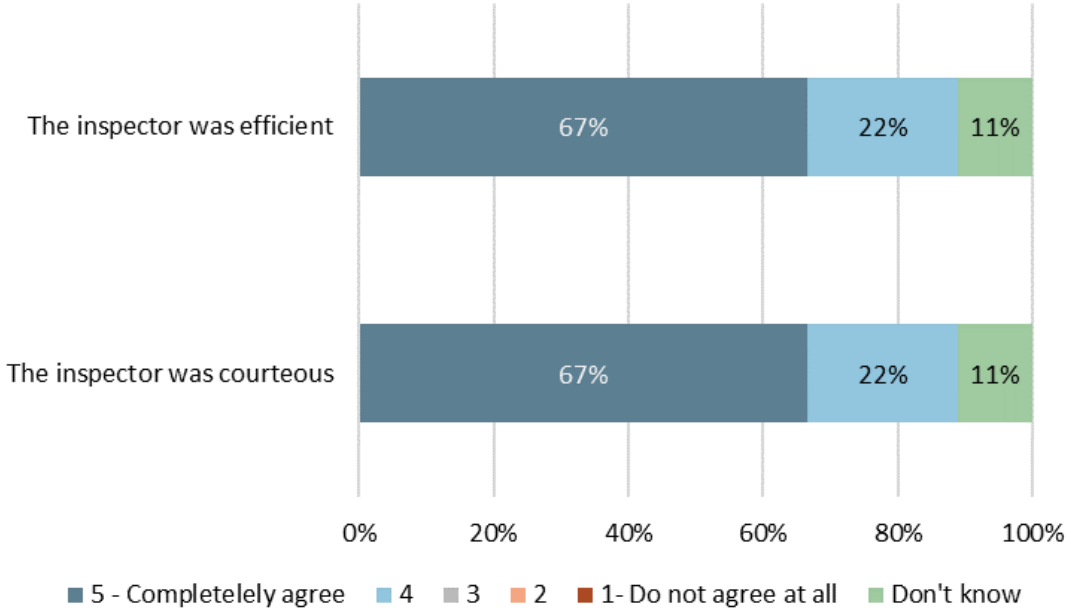
- *Very nice man.*

4.4.6. Interactions with Program Staff

Eighteen of the 32 total respondents (56%) reported that a program representative inspected the work done through the program at their location. The majority of respondents (89%) either agreed or strongly agreed that the inspector was courteous, and that the inspector was efficient (See Figure 4-7)

Most respondents (79%) were very or somewhat likely to recommend CommunitySaver Program to other colleagues and 9% were very or somewhat unlikely.

Figure 4-7 Satisfaction with Inspector



Ameren Missouri provides a dedicated account manager to assist property managers and owners with completing energy efficiency improvements if desired. Twenty-one respondents (66%) reported working with an Ameren Missouri account manager and 25% indicated they did not have interactions. Of those survey participants who had interactions with the account manager, 43% were extremely satisfied, 52% were satisfied and 5% were neutral.

4.4.7. Overall Satisfaction

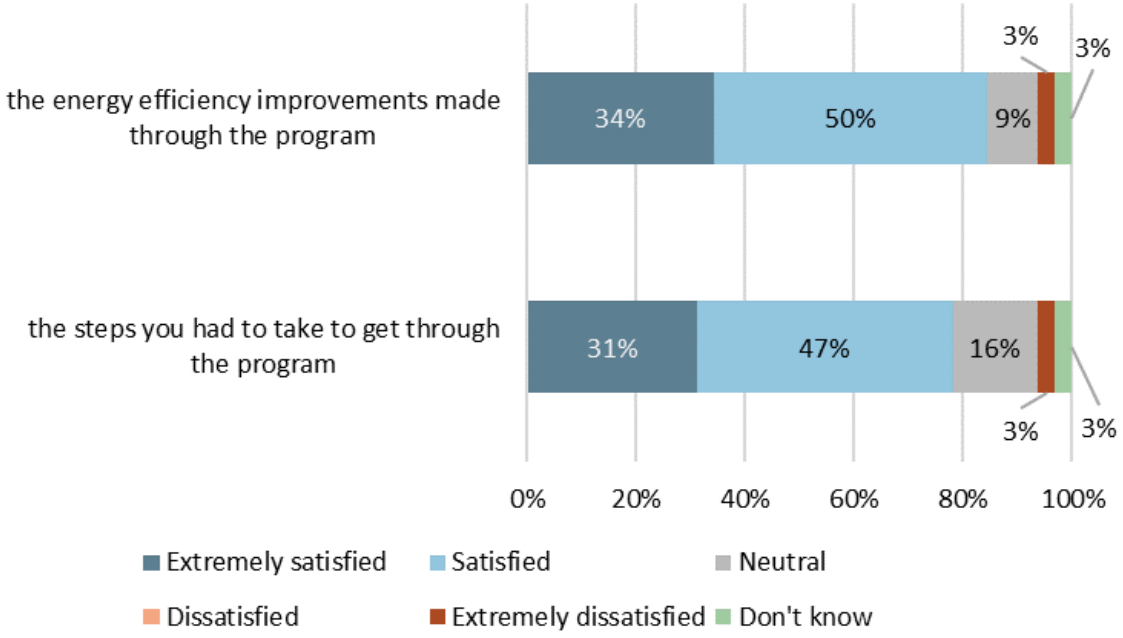
Overall, respondents were satisfied with the program. As seen in Table 4-4, 88% of respondents stated that they agreed or strongly agreed with the statement “Overall, I am satisfied with the services provided by the CommunitySavers Program,” and 6% disagreed with the statement.

Table 4-4 Overall Satisfaction with CommunitySavers

Responses	*Percent (n = 32)*
Strongly disagree	0%
Disagree	6%
Neutral	6%
Agree	50%
Strongly agree	38%

Respondents were also generally satisfied with the participation steps and measures installed, as shown in Figure 4-8. Almost all respondents (94%) stated that they were satisfied or extremely satisfied with the improvements made through the program, and 78% stated they were satisfied or very satisfied with the steps it took to get through the program. Two respondent who were dissatisfied with the steps required of the program stated that it "*a lot of the thermostats didn't work so we have to change a lot of them out*" and "*I have had a lot of Ameren Missouri staff members with conflicting information and it was very unclear navigating through the rebate."*

Figure 4-8 Satisfaction with Elements of the Program



Of the respondents who heard feedback from tenants about energy efficiency improvements (n = 20), less than half (45%) heard mostly positive feedback from tenants, 50% heard a mix of positive and negative feedback, and 5% heard mostly negative feedback.

The types of positive feedback that respondents from tenants:

- Pleased with new equipment (e.g., refrigerators, thermostats, showerhead) (n = 5)
- Satisfied with indoor and outdoor lighting (e.g., brighter parking lot) (n = 8)
- Tenants saw reduced utility bill (n = 3)

The types of negative feedback from tenants:

- Not happy with the reduced water pressure (n = 4)
- Issues (e.g., not working, difficulty understanding how they work, challenges programming) with thermostats (n = 5)
- Do not like the refrigerators, either too small or not cooling (n = 2)
- Aerators leak (n = 1)

Suggestions to improve the CommunitySavers Program provided by survey respondents:

- Provide information about what rebates/incentives are available to customers and keep them up-to-date on programs.[8]
- Reduce the length of time for projects (e.g., faster turnaround time for materials/equipment and processing incentives).

4.5. Tenant Survey

ADM mailed surveys to 850 tenant addresses listed in the program tracking data and received 83 responses. Participants either returned a paper survey or completed the survey online. The completion rate was 9.8%.

In addition to collecting information used for the analysis of program energy savings, the tenant survey was designed to collect information on tenants perceived benefits of the efficiency improvements, and satisfaction with multiple aspects of the program.

4.5.1. Perceived Impacts on Energy Costs

Thirty-nine percent of respondents reported they noticed a reduction in their home energy costs, while 18% did not indicate the improvement reduced costs and 43% were not sure (see Table 4-5).

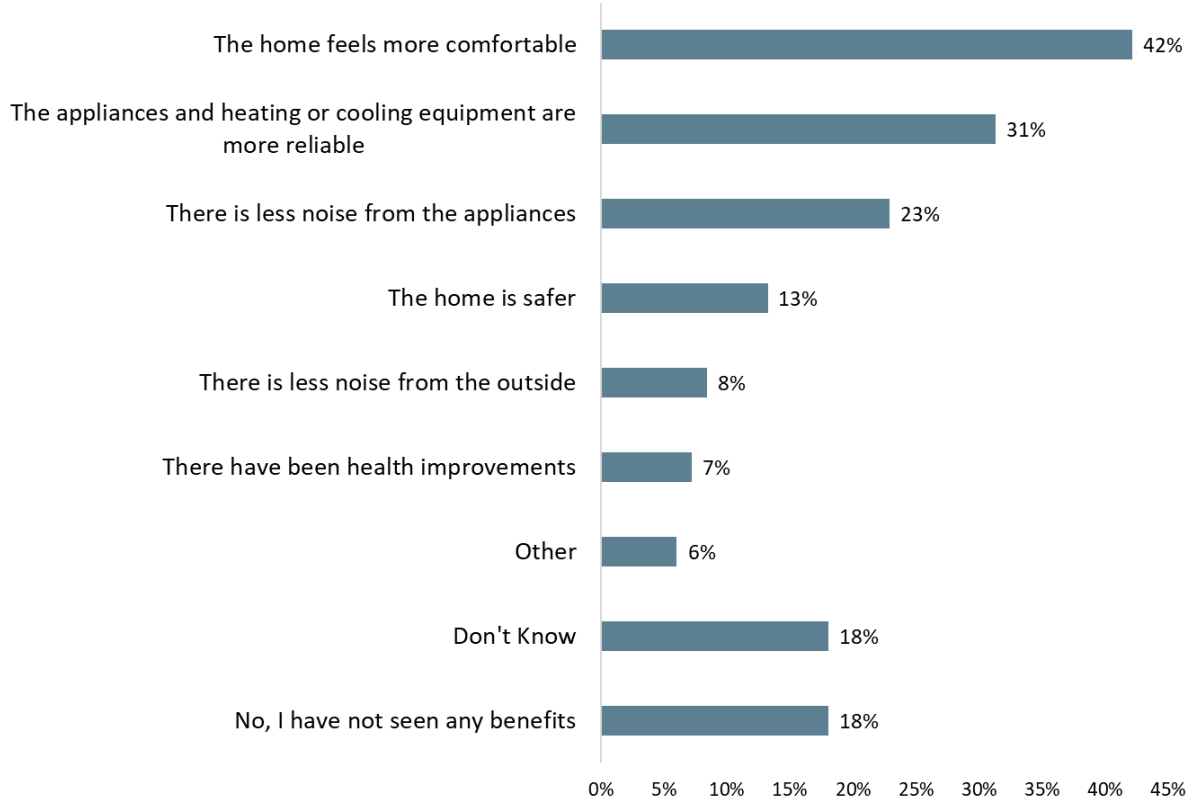
[8] The incentive offers that would be most appropriate would be discounted lighting and ENERGY STAR air purifier rebates.

Table 4-5 Participant Reported Reduction in Energy Cost

Would you say that the energy efficiency improvements made to your home have reduced your electricity costs?	*Percent of Respondents (n = 83)*
Yes	39%
No	18%
Don't Know	43%

Sixty-four percent of respondents reported that they had realized one or more non-energy benefits from the measures implemented through the program (see Figure 4-9). The most frequently reported benefit, noted by 42% of respondents, was having a more comfortable home after the completion of the improvements. Other more frequently noted benefits were improved reliability of appliances or the heating and cooling system (noted by 31%) and quieter operations of appliance (23%).

Figure 4-9 Non-Energy Benefits from Energy Efficiency Improvements



**The sum of the responses totals to more than 100% because some respondents reported more than one benefit.*

4.5.2. Overall Program Satisfaction

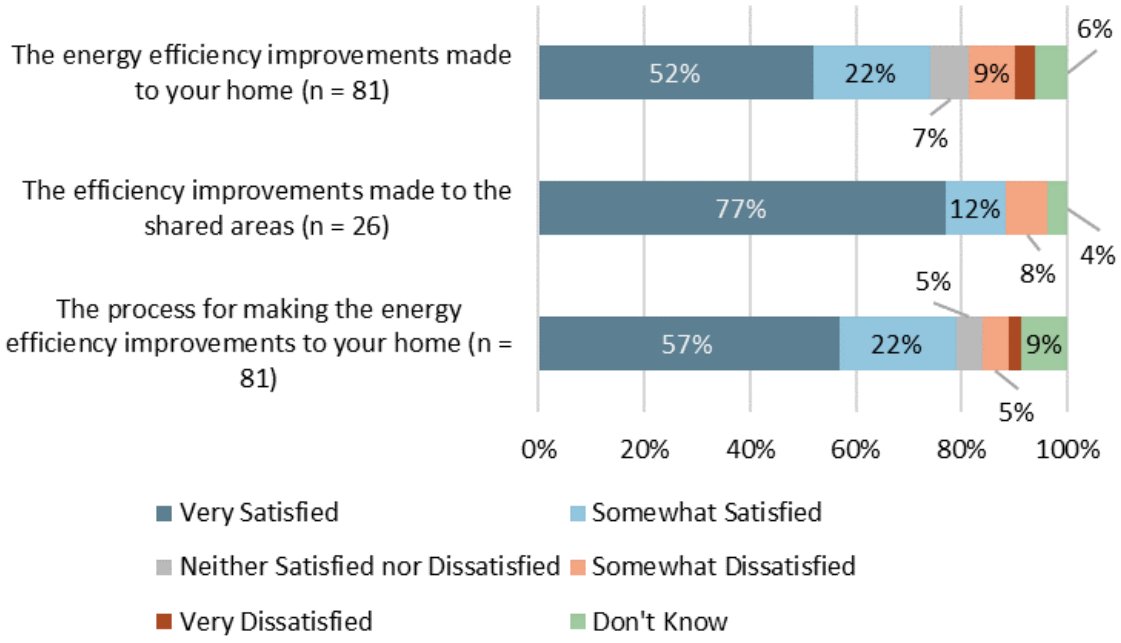
Most tenants (74%) were very or somewhat satisfied with the energy efficiency improvement made to their homes, 7% were neutral and 13% were very or somewhat

dissatisfied. Among those who expressed dissatisfaction with the improvements to customer homes, below are the reasons provided:

- Problems with the thermostat and/or heating and cooling (n = 5)
- Issues with lighting (n = 2)
- Work not completed to satisfaction (n = 5)
- Did not see any difference in utility bill and saw increase in water bill (n = 1)
- Longer shower time (n = 1)

Tenants were generally satisfied with each of the program elements they were asked to rate (see Figure 4-10). Seventy-nine percent of survey participants were somewhat or very satisfied with the process for making improvements, the improvements made to their home (74%), and the improvements made to shared spaces (88%).

Figure 4-10 Tenant Satisfaction with Program Elements



The reasons given by participants for their dissatisfaction are summarized below:

- Work took longer than expected and there were too many individuals in the home (n = 2)
- Unsure how to use programmable thermostat (n = 1)
- Improvement were not specified (n = 1)

Fifty-seven percent of respondents indicated they were somewhat or very satisfied with the information on the improvement made to their homes, with 23% indicating they were not aware of any information provided through the program.

Table 4-6 Satisfaction with the information on the improvements made to customer homes

Responses	*Percent of Respondents (n = 82)*
Very Satisfied	39%
Somewhat Satisfied	18%
Neither Satisfied nor Dissatisfied	5%
Somewhat Dissatisfied	6%
Very Dissatisfied	1%
Not aware or any information provided through the program	23%
Don't know	7%

Of the 7% who expressed their dissatisfaction with the information provided, one respondent had difficulty with programming the thermostat, one respondent indicated they had not seen any improvement and another tenant expressed frustration with the work performed. *"Our heating and cooling system is water-based (old time radiator) they did not check them or air seeping in windows."*

Twenty-six survey participants were aware of the improvements to the common areas of their building. Of the 32% of respondents that recalled energy efficiency improvements being made to common spaces of their building, 88% indicated they were satisfied or very satisfied with the improvements made to the common areas.

Survey participants were given an opportunity to leave any additional comments and feedback for the program. Table 4-7 summarizes the comments made. The most frequently made types of comments were positive remarks about the program and the improvements made. Other comments reflected issues noted by tenants, such as difficulty using thermostats and draftiness or problems with the program windows.

Table 4-7 Summary of Additional Comments

Type of Comment	*n*
Appreciate program	5
Likes improvements	3
Difficulty with programmable thermostats	2
Feel drafty/window improvements needed	2
Dislikes improvements	2
Unclear about what improvements were done	2
Saving money	2
Light bulbs failed	1
Difficulty with program staff	1
Home is more comfortable	1
Home feels safer	1
Doesn't understand why energy bill is high.	1
Little notice of improvements	1
Install crew was unprofessional	1

5. Cost Effectiveness Evaluation

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

Cost effectiveness analysis was completed by Ameren Missouri using DSMore software. 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 program, 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 F: Cost Effectiveness - Critical Technical Data provides additional information on the data sources test formulas, inputs, and methodology.

Table 5-1 shows the resulting cost benefit scores for the program. Any score above one signifies cost effectiveness. The following table also summarizes the net present value of the UCT lifetime benefits. The program passes the UCT, TRC, PTC and SCT cost effectiveness tests. The program's RIM test score was less than 1.0.

Table 5-1 Results of Cost Effectiveness Evaluation

Variable	*Value*
UCT	2.09
TRC	3.66
RIM	0.48
PCT	41.30
SCT	4.66
NPV of UCT Lifetime Benefits (2016 Dollars)	$4,439,405

6. 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.

6.1. Impact Conclusions

Below is a list of conclusions associated with the impact analyses.

- The overall program kWh gross realization rate was 131%, with variable measure-level gross realization rates. The sources of the differences between ex ante savings and ex post energy savings are discussed in Section 3.2. Overall, much of the difference between ex ante and ex post energy savings is associated with the use of fully deemed ex ante measure energy savings values that do not account for measure-specific characteristics which were accounted for in the ex post energy savings analysis.
- Ex post net energy savings equaled 146% of the energy savings goal. The total ex post net energy savings for PY2017 totaled 7,334,784 kWh. This amount is more than triple the ex post net energy savings realized during PY2016 (2,349,841 kWh).

  An increase in common area lighting projects was a significant factor in the increase in program energy savings as compared with PY2016. Common area lighting accounted for less than 1% of program ex ante energy savings in PY2016 and accounted for 20.2% of ex ante energy savings in PY2017. Implementation and Ameren Missouri staff attributed the increase in energy savings to three factors: 1) a legislative change that allowed properties that receive the Low-Income Housing Tax Credit (LIHTC) to receive common area incentives; 2) a heightened focus on building the common area project pipeline as a recruitment activity distinct from that of developing direct install projects, and 3) the inclusion of exterior lighting measures that operated during fewer than 24 hours a day. Additionally, the implementation contractor added an additional project manager to focus on common area projects.
- The measure names applied to some common area lamps did not clearly map to Ameren Missouri TRM savings.
- Program lighting tracking data generally provided fairly limited information regarding the lighting projects and did not include information such as space type, lamp wattages, and heating and cooling system types.

6.2. Impact Recommendations

Based on the above conclusions, the evaluation team offers the following impact recommendations.

- Clarify measure naming conventions for business lighting measures. Review the measure name descriptions in the data to ensure that categories map to Ameren Missouri TRM measures. This should help with the assignment of savings values that are consistent with the Ameren Missouri TRM.
- Track additional data on lighting measures. Ideally, program tracking data for lighting projects would include data on lamp type, lamp wattage, number of lamps, and space type for the lamps. Staff has initiated the tracking of additional data.

6.3. Regulator Research Questions – Process Conclusions and Recommendations

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?

- Multiple market imperfections were identified that may prevent low-income multifamily property owners from investing in energy efficiency improvements either through the CommunitySavers Program or outside of it. The identified market imperfections are: cost, geography, lack of property staff resources, and split incentives.
- Cost. The cost of energy efficient equipment is a barrier to completing efficiency improvements through the program and outside of it. Program staff that work with multifamily property owners and managers noted that cost is a barrier to efficiency improvements in the properties managed. As an example, staff noted that cost of envelope improvements such as windows is high in comparison with the incremental cost covered by the incentive. This sentiment was echoed by six out of 32 survey respondents as well.
- Geography. Analysis of the program activity in comparison with the location of multifamily properties, lower income customers, and subsidized multifamily properties found that program activity was disproportionately concentrated in St. Louis and its surrounding suburbs.
- Insufficient Property Staff. Multifamily property operators may not have staff available to implement efficiency measures. As was the case in PY2016, one survey respondent stated that they did not have the staff available to implement efficiency improvements

at the property.[9] Additionally a program staff member suggested that in some cases properties that complete direct install projects are not willing to immediately initiate a common area project because their staff need to refocus on other priorities. CommunitySavers is designed to minimize the time required by property managers and owners through the assistance provided by the account manager who will assist with program paperwork and the scheduling of the work completed.

- Split Incentives: One form of split incentives in multifamily properties occurs when the tenant pays the cost of the electricity use, but the owner is responsible for choices that affect how efficiently the equipment and building utilizes electricity. This issue is most likely to occur for equipment and building characteristics that affect tenant energy use. The program addresses the barrier to efficiency resulting from the split incentives between owners and occupants by providing the direct install measures and HVAC tune-ups at no cost to the building operator or the tenant.

Research Question 2: Is target market segment appropriately defined, or does it need further subdivision or merging with other segments?

- The target market is appropriately defined. The program targets subsidized multifamily properties and properties with tenants residing in non-subsidized housing with an income of at or below 200% federal poverty level.
- Because providing services to the low-income multifamily market requires a sufficiently specialized set of outreach and project implementation processes, maintaining the focus on this market with dedicated staff resources to serving is preferable to merging with resources serving other markets.

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

- The program offers measures that cover all major multifamily in-unit end-use needs: lighting, appliances, space cooling and heating, and water heating. Additionally, the Standard and SBDI incentives available for common areas cover lighting, commercial refrigeration and kitchen equipment, and pool pumps. Building envelope and other improvements are eligible for Custom incentives.
- Participant survey respondents did not identify any additional measures that should be included in the program. Seventy-eight percent of participant survey respondents aware of the common area incentives stated that these incentives completely met their needs for efficiency improvements. One respondent indicated that the windows and doors were not addressed – these measures are covered in the building audit and are

[9] Prior evaluations of CommunitySavers also identified staffing issues as a barrier to program participation. Ameren Missouri Low Income and Process Evaluation: Program Year 2015.

incentivized through the custom incentive component but may not have been addressed because they are cost prohibitive. Another respondent indicated that not all of the common area lighting was replaced, but it was unclear if the respondent did not want to pursue the replacement of that lighting or if it was not covered through the program. Additionally, 84% of property managers indicated satisfaction with the equipment installed through the program.

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

- The communication and delivery channels are appropriate to the target market segment. Staff used a variety of approaches to promote the program incentives including direct outreach to property managers and owners, working with community groups and apartment associations, and working with Ameren Missouri trade allies to promote the program incentives.
- Staff stated that during PY2017 they were involved in the St. Louis Apartment Association and attended multiple events during the year, that they continued their association with the Tower Grove Neighborhood Association, and that they attended an application workshop hosted by the Missouri Housing Development Corporation and provided information about the program to developers and property management companies. Staff also continued their direct outreach to multifamily property owners and managers. Repeated contact with property managers and owners is important for this market segment because this segment is typically viewed as unresponsive and difficult to reach and staff continued to engage in this activity.[10]
- Staff engaged with the Missouri Housing Development Corporation and attended PACE meetings during PY2017. Staff noted that they have provided information to property managers on PACE financing but that there was little interest in it.
- Staff engaged in outreach to trade allies during PY2017 and reported that they received project referrals from the trade allies. Staff emphasized the importance of outreach to HVAC contractors, in particular, because they may be contacted by property managers or owners in the event that their HVAC equipment fails.
- Implementation staff noted that during PY2017 they focused on building a pipeline of common area projects distinct from the pipeline of direct install projects. This was contrasted with the approach used in PY2016 that focused on direct install projects as a first step in the participation process. Additionally, the program implementation

[10] Energy Efficiency for All (2015). Program design guide: Energy efficiency programs in multifamily affordable housing. Energy Efficiency for All Project.

contactor increased staffing such that there are separate program staff members focused on managing the direct install and the common area components.

- Two case studies were developed in PY2017 featuring complexes that implemented lighting, HVAC, appliance, and water heating improvements.
- Among those participants that had not received common area incentives at the time of the survey, the share of participant survey respondents who reported that they were aware of common area incentives from 15% in PY2016 to 83% in PY2017. Additionally, 67% of respondents aware of the common area incentives reported that they were somewhat or very likely to complete a common area project at the property.

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

- *EM&V Recommendation*: Continued engagement with PACE may provide additional opportunities to finance higher cost measures with longer measure lives. Reviewed literature indicates that the inability of property managers and PACE administrators to estimate project energy savings may be a factor that limits PACE participation. The program should consider identifying itself as a potential resource for property managers and PACE administrators for estimation of project energy savings.
- *EM&V Recommendation*: Provide links to PACE and other financing opportunities on the program website along with brief information about the key benefits of PACE financing (included in a tax assessment, transferable in the even the property is sold) to increase awareness of the opportunities.

6.4. Update to PY2016 EM&V Recommendations

The following summarizes the PY2016 recommendations and the program's response to them.

EM&V Recommendation: Include fields in program tracking data for HVAC replacement unit SEER and capacity. Currently, information on SEER is built into the measure name and capacity level is not recorded in the data. Staff reported that this information is being added to the program data.

- Program Response: This has been added.

EM&V Recommendation: Provide information on unit space heating and cooling type for LED projects. Space conditioning equipment information is used to appropriately apply heating and cooling interactive factors in the estimate of lighting savings. Space heating and cooling type was available from project applications but some applications indicated that the properties had multiple heating types.

- Program Response: For properties with multiple heating types, program staff can provide additional data as requested.

EM&V Recommendation: To improve average savings for refrigerator replacements, consider limiting year of manufacture to 2000 or earlier, as was the case in PY2015. ADM recognizes that multiple factors should be considered when setting the year of manufacture, including the value of refrigerator replacements as a measure that may be entice property managers to complete a program project that includes additional efficiency measures.

Program Response: "Revised to limit manufacture to June 2001 or earlier”

EM&V Recommendation: Improve screening of refrigerator replacements. Although the three refrigerators replaced that were manufactured after 2001 comprise less than 1% of refrigerator replacements, staff should review screening protocols to prevent additional units not qualified for the program from being replaced in the future.

- Program Response: Revised screening to include data provided directly from each manufacturer in addition to appliance data code search.

EM&V Recommendation: Although Ameren Missouri applies the correct coincident factor when reporting kW savings, a calculation error within Vision resulted in incorrect ex ante kW reduction estimates. Staff should correct calculations made within the Vision data system so that ex ante kW estimates tracked in the system are correct.

- Program Response: This has been corrected.

EM&V Recommendation: Provide tenants and building maintenance staff with instructions on how to correctly install the dirty filter alarm. ADM observed instances where the filter alarms were oriented incorrectly by the installing subcontractor and tenants or maintenance technicians may have similar difficulty installing the device correctly.

- Program Response: Maintenance staff is present during installs and observes the installation of the dirty filter alarm

EM&V Recommendation: Continue to develop relationships with financing institutions. Staff recognizes that facilitating financing is key to developing common area improvement projects that require properties to fund a portion of the measure cost. Additionally, financial organizations may also be an important source of referrals and may direct property managers and owners to the program when they are in the process of seeking financing for building improvements.

- Program Response: Program staff attended PACE meetings and Missouri Housing Development Corp. events, to gain information about these programs and connect

with property managers who are applying for these programs to encourage them to participate in CommunitySavers as well.

EM&V Recommendation: Develop marketing materials focused on common area improvements. The program brochure focuses on direct install measures, although it does reference the availability of other incentives. Staff should consider developing marketing materials that focus on common area improvements such as SBDI lighting projects that can be completed at no cost to the owner.

- Program Response: Program collateral and website has been updated to cover the program from an overarching multifamily approach -so it also references the common area improvement opportunities. The e-newsletter and postcards to property managers highlight common area measures in a seasonally appropriate manner - for example, highlighting LED measures in the fall/winter when it is darker, and HVAC measures in the springtime as AC units are turned on and maintenanced.

EM&V Recommendation: Develop case studies based on common area projects. A few common area projects have been completed in PY2016 and early PY8. Staff should look to these successes to develop case studies to promote these projects with other property managers and owners. Case studies that illustrate the cost savings, ease of participation, and service provided by program staff should be effective at addressing concerns related to project costs and time commitments. Other important messages include the financial benefits of reduced maintenance and equipment longevity (i.e., for LED lighting in particular).

- Program Response: Two case studies have been developed, which include both direct install and common area measures.

EM&V Recommendation: Focus trade ally outreach on HVAC suppliers and contractors. Split-incentives between owners and occupants are most likely to adversely impact decisions to install efficient air conditioner and heat pump replacement projects. For this reason, replacements are most likely to occur when units burn out. HVAC contractors and suppliers are positioned to effectively intercede on behalf of the program to encourage multifamily properties to install efficient equipment when systems are replaced.

- Program Response: A summer 2017 event provided program training to contractors, with an emphasis on HVAC contractors. A second event is planned for March 2018. In addition, a program account manager attended the HVAC trade ally training events to share information about the CommunitySavers program.

Appendix A: ICF Program Manager Interview Guide

Roles and Responsibilities

1. To begin with, can you tell me a little bit about your role?
2. Were there any other staffing changes during the program year?

Program Design and Goals

Now I'd like to hear about program goals, and the types of properties it works with.

3. Looking at the program data, it looks like a notably larger share of the program savings came from common area improvements such as SB direct install and standard prescriptive measures. What do you think accounts for that increase?
    a. Did these projects tend to come from properties that previously participated in the program?
4. Another thing I noticed is that the share of tenant units receiving water heating and lighting measures increased. What do you think accounts for that increase?
5. What barriers do you think there are to multifamily participation in the direct install or common area improvements?
    a. Any barriers for specific measures?
6. Overall, how well do you think CommunitySavers performed this year?
    a. [If indicates any issues:] What particular issues or concerns do you have about the design of the programs?
    b. [If not obvious] What needs to change to address those concerns?
    c. What might prevent those changes?
    d. How and when might changes to address those concerns occur?

Internal Communications

7. What, if any, regularly scheduled program communication do you have with other ICF staff regarding the program?

Communication with Utility

8. What, if any, regularly scheduled program communication do you have with Ameren Missouri regarding the program? Anything else?
9. Do you have informal communications with any Ameren Missouri staff regarding the CommunitySaver program?

Trade Allies & Other Program Partners

10. Where there any changes made to the contractors that you work with to do the direct install measures?
11. Did you provide any training or other activities with the direct install trade allies or the BizSavers trade allies during the year?
    a. Aside from doing the installations, do they have another role in the program such as recruiting participants?

Marketing

Now, I'd like to hear about marketing activities for the program.

12. What types of outreach activities to groups such as housing authorities and community development corporations during the program year?
    a. Did these outreach activities lead to the development of any new projects?
13. Did you engage in any outreach to LIHTC properties that had previously received direct install measures to promote the common area incentives since these properties can now receive those incentives?
14. Did you engage in any outreach to trade associations or to contractors that would install AC systems or the common area improvements?
    b. Have contractors brought any common area projects to the program?
15. Were any of the marketing materials or leave behind materials revised or were there new materials developed?
16. Has the program solicited any earned media such as releasing press releases? Have these resulted in any success?
17. What do you think has worked well to recruit properties to the program?
18. Is there anything you would like to improve upon with the marketing and outreach approach?

Participation Process

19. Did the program participation process remain the same in 2017-18?
20. Did the requirement to provide education to 85% of tenants remain during the program year?
21. Were there any changes to how tenant education was provided?
    a. Are there any changes that you would like to make to that process?

Tracking & Reporting

Next, I'd also like to hear about tracking and reporting.

22. My understanding is that program is currently using a paper based process with project information being input manually into the tracking database is that correct?
23. How well is the current tracking and reporting process working to meet your needs for managing the implementation of the program?
24. Is there anything about the data tracking or reporting process that you think could be changed or improved upon?

Quality Control and Verification

Next, I'd also like to hear about tracking and reporting.

25. My understanding is that 5% of direct install units are inspected each quarter and that 5% of complexes receiving AC tune-ups are inspected. Did that continue in during the 2017 program year?
26. Were there any changes made to the quality control and verification processes?

Conclusion / Wrap Up

27. What would you say are the greatest strengths of the program?
28. What would you say most needs to be changed about the program?
29. Are you aware of opportunities to streamline any of the program activities? If so, which activities, and what changes would you like to see, and what would have to occur for those changes to be implemented?
30. Is there anything else about the program that we have not discussed that you feel should be mentioned?

Appendix B: Ameren Missouri Program Manager Interview Guide

Roles and Responsibilities

31. What is your job title?
32. Were you with Ameren Missouri before you moved into your role with CommunitySavers?
33. Briefly, what are your responsibilities with regards to CommunitySavers?

Program Management

34. Who do you report to for the program?
35. And who reports to you? What are their roles?
36. Who do you work with at ICF?

Program Design and Goals

37. It looked like the incentives for the Residential and Heating and Cooling measures, as well as the standard, custom and small business incentives remained the same in the current program year as in the previous program year. Is that correct?
38. Thinking about the 2017-PY2017 program year, how do you think CommunitySavers performed?
    a. [If indicates any issues:] What particular issues or concerns do you have about the design of the programs?
    b. [If not obvious] What needs to change to address those concerns?
    c. What might prevent those changes?
    d. How and when might changes to address those concerns occur?
39. What barriers to participation do you think there are?
    a. [If any] What could Ameren Missouri do to overcome those barriers? [If any] Why hasn't that action been implemented so far?
    b. What could ICF do to overcome those barriers? [If any] Why hasn't that action been implemented so far?
    c. To what extent do budgetary concerns limit investments in common areas of the property? What types of multi-family properties are most affected by budget factors?

40. Are there any portions of the multifamily low-income market that you think the program could reach better?

    d. (Probe for differences between publicly owned, publicly assisted, non-profit owned, and privately owned.)

    e. (Probe for differences in building size)

    f. (If any) What changes are needed to address those opportunities? [e.g., program evolution, bigger budget, more staff, measure-cost reduction, or implementation or program delivery changes?]

Communication

41. What, if any, regularly scheduled program communication do you have with ICF regarding the program?

42. Do you have informal communications with any ICF staff regarding the CommunitySaver program?

Trade Allies & Other Program Partners

43. What interaction, if any, do Ameren Missouri staff have with trade allies and other program partners?

44. In your view how well has the outreach and engagement of contractors, vendors, and trade allies gone?

45. From your perspective, how well is ICF managing trade allies or other program partners?

46. [IF CONCERNS NOTED] What is being done about those concerns? What else should be done? [Probe about the various aspects of managing TAs – recruiting, training, keeping them informed]

47. Do you have any suggestions for ways to improve the program with regard to trade allies and program partners?

48. Have you heard any feedback from trade allies or program partners so far, and if so, what have you heard?

Marketing

49. What outreach did the program engage in with community groups and organizations in 2017-18?

50. What marketing and outreach activities do you think are most important for driving program activity?

Tracking & Reporting

Next, I'd also like to hear about tracking and reporting.

51. How well is the current tracking and reporting process working to meet your needs?

Conclusion

52. What would you say are the greatest strengths of the program?
53. What would you say most needs to be changed about the program?
54. Are you aware of opportunities to streamline any of the program activities? If so, which activities, and what changes would you like to see, and what would have to occur for those changes to be implemented?
55. Is there anything else about the program that we have not discussed that you feel should be mentioned?

Appendix C: Property Manager / Owner Survey

Overall Satisfaction

To begin with, please select the number that indicates the degree to which you agree with the following statement:

1. Overall, I am satisfied with the services provided by the CommunitySavers Program.
    a. 1 – Strongly Disagree
    b. 2 – Disagree
    c. 3 – Neutral
    d. 4 – Agree
    e. 5 – Strongly Agree

Awareness

[NOTE: These questions are only asked the first time the contact completes a survey during the program year]

[DISPLAY Q2 IF ADMIN = 1]

2. How did you first learn about Ameren Missouri's energy efficiency improvements for multi-family properties?
    a. At a seminar
    b. At a neighborhood meeting
    c. From a CommunitySavers Account Manager or another program representative
    d. From a search engine (Google, Yahoo, Bing)
    e. From another person in your organization
    f. Previously participated in the program
    g. Other (Please specify)
    h. Don't know

[DISPLAY Q3 IF ADMIN = 1]

3. Could you briefly describe challenges, if any, you face in making energy efficiency improvements to low income multifamily properties you manage and/or own?

In-Unit Direct Install

[DISPLAY Q4 IF IN_UNIT = 1]

4. What were the main reason(s) for deciding to complete the in-unit efficiency improvements at the property? (Select all that apply) [MULTISELECT]
   a. Improve tenant comfort and satisfaction
   b. Reduce tenant utility bills
   c. Reduce property utility bills
   d. To take advantage of rebates/no-cost efficiency improvements
   e. To replace old or non-functioning equipment
   f. To make the units more attractive to prospective tenants
   g. Some other reason – please describe: _____
   h. Don't know

[DISPLAY Q5 IF COMMON_AREA = 0]

5. In addition to the no-cost energy efficiency improvements offered, did you know that Ameren Missouri also offers financial incentives for making energy efficiency improvements to common areas of your property?
   a. Yes
   b. No
   c. Don't know

[DISPLAY Q6 IF Q5 = 1]

6. How likely are you to complete energy efficiency improvements in the common areas of the property located at [LOCATION]?
   a. 1 – Very likely
   b. 2 – Somewhat likely
   c. 3 - Neither likely nor unlikely
   d. 4 – Somewhat unlikely
   e. 5 - Very unlikely
   f. Don't know

[DISPLAY Q7 ONLY IF Q6 > 3]

7. Why are you unlikely to make energy efficiency improvements in the common areas of your property?

Common Area Direct Install

[DISPLAY Q8 IF COMMON_AREA= 1 OR Q5 = 1]

8. How well did the types of common area equipment for which incentives are offered through the CommunitySavers Program fit your needs?

   a. 1 – Not at all

   b. 2

   c. 3

   d. 4

   e. 5 – Completely

   f. Don't know

[DISPLAY Q9 ONLY IF Q8 < 4]

9. Why did the range of incentivized equipment options for common areas not completely meet your needs?

Energy Audit/Custom/Prescriptive Measures

[DISPLAY IF CUST_STAND = 1]

10. Did a CommunitySavers Program representative provide a free energy assessment of your property?

    a. Yes

    b. No

    c. Don't Know

[DISPLAY Q11 IF Q10 = 1]

11. Using the scale provided, please indicate your agreement with the following statements regarding the program representative that completed the assessment.

	1-Do not agree at all	2	3	4	5-Completely agree	Don't know
a. The representative was courteous and knowledgeable						
b. The assessment was completed efficiently						
c. The assessment was comprehensive						
d. The recommendations based on the energy assessment were appropriate for my property						

[DISPLAY Q12 IF Q10 = 1]

12. Were there any recommended property improvements or equipment replacements that you did not implement?

    a. Yes

    b. No

    c. Don't Know

[DISPLAY Q13 IF Q12=1]

13. Which recommended property improvements or equipment replacements did you not implement and why?

Satisfaction with Field Service Representative

14. Based on your recent experience with the CommunitySavers Program, please rate your level of satisfaction with the Field Service Representative who performed work at your property. Please select N/A if an item is not applicable to you.

	Extremely Dissatisfied	Dissatisfied	Neutral	Satisfied	Extremely Satisfied	N/A
a. On-time arrival for appointment						
b. Appearance (ID badge, uniform, presentability)						
c. Courtesy and professionalism						
d. Willingness to help						
e. Product/service/program knowledge						
f. Preparedness (i.e., came with all tools/parts needed)						
g. Length of time required to perform the installation/service						
h. Quality of the installation / service						
i. Condition in which site was left						
j. Quality of the educational materials left behind						
j. Your overall experience with the field representative						

15. Please use this space to share any additional thoughts on your Field Service representative.

16. Based on this experience, how likely are you to recommend CommunitySavers Program to a colleague?

    a. 1 – Very likely

    b. 2 – Somewhat likely

    c. 3 - Neither likely nor unlikely

d. 4 – Somewhat unlikely

e. 5 - Very unlikely

f. Don’t know

Measurement and Verification

17. After your project was completed, did a program representative inspect the work done through the program?

a. Yes

b. No

c. Don’t know

[DISPLAY Q18 If Q17=1]

18. Using the scale provided, please rate your agreement with the following statements:

	1-Do not agree at all	2	3	4	5-Completely agree	Don’t know
a. The inspector was courteous						
b. The inspector was efficient						

Customer Satisfaction

19. Ameren Missouri provides a dedicated account manager to assist property managers and owners with completing energy efficiency improvements. During your most recent experience with the CommunitySavers Program, did you have any interactions with an account manager?

a. Yes

b. No

c. Not sure

[DISPLAY Q20 IF Q19 = 1]

20. How satisfied are you with the service provided by your account manager?

a. 1 – Extremely Dissatisfied

b. 2 – Dissatisfied

c. 3 – Neutral

d. 4 – Satisfied

e. 5 – Extremely Satisfied

f. Don't know

[DISPLAY Q21 IF Q20 = "Extremely dissatisfied" or "Dissatisfied"]

21. Why are you dissatisfied with the service provided by the account manager?

22. Thinking about your most recent experience with the program, how satisfied are you with:

	Extremely Dissatisfied	Dissatisfied	Neutral	Satisfied	Extremely Satisfied	Don't know
a. the steps you had to take to get through the program						
b. the energy efficiency improvements made through the program						

[DISPLAY Q23 IF Q22A OR B = 1 OR 2]

23. Please describe the ways in which you were not satisfied with the aspects of the program mentioned above.

24. Have you heard any feedback from tenants about the energy efficiency improvements made?

a. Yes

b. No

c. Don't know

[DISPLAY Q25 IF Q24 = 1]

25. Would you describe the feedback you heard as mostly positive, mostly negative, or mixed?

a. Mostly positive

b. A mix of positive and negative feedback

c. Mostly negative

d. Don't know

[DISPLAY Q26 IF Q25 = 1 OR 2]

26. What positive feedback have you heard?

[DISPLAY Q27 IF Q25 = 2 OR 3]

27. What negative feedback have you heard

28. How can the CommunitySavers Program implementation team provide you with better service?

Firmographic

29. Does your organization manage, own, or own and manage the property located at [LOCATION]?

    a. Own it only

    b. Manage it only

    c. Both own and manage it

    d. Not sure

Appendix D: Tenant Survey

This survey is about your experience with the energy efficiency improvements made to your home through Ameren Missouri's CommunitySavers® Program.

Please mark your answer to the questions with an **X**.

When you have completed the survey, please mail it using the included stamped and addressed envelope.

1. Our records indicate that the following energy saving improvements were made to your residence through Ameren Missouri's CommunitySavers® Program. Can you confirm that the following improvements were made?

	Yes, this improvement was made	No, this improvement was not made	Don't know
<IMP1>	( )	( )	( )
<IMP2>	( )	( )	( )
<IMP3>	( )	( )	( )
<IMP4>	( )	( )	( )
<IMP5>	( )	( )	( )
<IMP6>	( )	( )	( )
<IMP7>	( )	( )	( )

2. We would also like to know if you have removed and are no longer using any of the equipment that was installed through Ameren Missouri's CommunitySavers® Program.

   For each of the following, please indicate if you have removed and are no longer using that equipment. Also, please write the number of items removed, if applicable.

	No, have not removed equipment	Yes, removed equipment	Number of items removed **(Write Number)**
<MEAS1>	( )	( ) →	_____
<MEAS2>	( )	( ) →	_____
<MEAS3>	( )	( ) →	_____
<MEAS4>	( )	( ) →	_____
<MEAS5>	( )	( ) →	_____
<MEAS6>	( )	( ) →	_____
<MEAS7>	( )	( ) →	_____

→ Go to Page 2

[PASSWORD]

3. Overall, how satisfied are you with the energy efficiency improvements made to your home?
   ( ) Very satisfied → **Go to Q5**
   ( ) Somewhat satisfied → **Go to Q5**
   ( ) Neither satisfied nor dissatisfied → **Go to Q5**
   ( ) Somewhat dissatisfied
   ( ) Very dissatisfied
   ( ) Don't know → **Go to Q5**

4. What improvements are you dissatisfied with and why are you dissatisfied with them?

   _____

   _____

   _____

5. How satisfied are you with the process for making the energy efficiency improvements to your home?
   ( ) Very satisfied → **Go to Q7**
   ( ) Somewhat satisfied → **Go to Q7**
   ( ) Neither satisfied nor dissatisfied → **Go to Q7**
   ( ) Somewhat dissatisfied
   ( ) Very dissatisfied
   ( ) Don't know → **Go to Q7**

6. Why are you dissatisfied with the process?

   _____

   _____

7. How satisfied are you with the information on the improvements made to your home provided through the CommunitySavers® Program?
   ( ) Not aware or any information provided through the program → **Go to Q9**
   ( ) Very satisfied → **Go to Q9**
   ( ) Somewhat satisfied → **Go to Q9**
   ( ) Neither satisfied nor dissatisfied → **Go to Q9**
   ( ) Somewhat dissatisfied
   ( ) Very dissatisfied
   ( ) Don't know → **Go to Q9**

8. Why are you dissatisfied with the information provided?

   _____

   _____

   _____

→ **Go to Page 3**

9. Are you aware of any energy efficiency improvements made to the shared areas (for example, hallways, stairways) of your building through Ameren Missouri's CommunitySavers® Program?
   ( ) Yes
   ( ) No → **Go to Q12**

10. How satisfied are you with the efficiency improvements made to the shared areas?
    ( ) Very satisfied → **Go to Q12**
    ( ) Somewhat satisfied → **Go to Q12**
    ( ) Neither satisfied nor dissatisfied → **Go to Q12**
    ( ) Somewhat dissatisfied
    ( ) Very dissatisfied
    ( ) Don't know→ **Go to Q12**

11. Why are you dissatisfied with the improvements made to the shared areas?

    _____

    _____

12. Would you say that the energy efficiency improvements made to your home have reduced your electricity costs?
    ( ) Yes
    ( ) No
    ( ) Don't know

13. Have you seen any benefits from the energy efficiency improvements made to your home?

    Please mark as many as apply
    ( ) The home feels more comfortable
    ( ) There is less noise from the outside
    ( ) There is less noise from the appliances
    ( ) There have been health improvements
    ( ) The home is safer
    ( ) The appliances and heating or cooling equipment are more reliable
    ( ) Other (Please describe)_____

    ( ) No, I have not seen any benefits
    ( ) Don't know

14. We are performing in-home inspections of the energy efficiency improvements made through the program. If selected, you would receive a $50 gift card to Walmart for an approximately 30 minute visit. Would you be interested in allowing ADM Associates to complete one of these inspections of the efficiency improvements made inside your home?

    ( ) Yes → **Please provide your name and telephone number:** _____
    _____
    ( ) No
    → **Go to Page 4**

15. Do you have any other comments about the Ameren CommunitySavers® Program or the improvements made to your home?

_____

_____

_____

Thank You!

Please use the included stamped and addressed envelope to return the survey

[PASSWORD]

Appendix E: PACE Literature Review

ADM completed a literature review on the use of C-PACE financing for multifamily efficiency projects. The overall objective was to identify best practices for integrating PACE financing into utility efficiency programs to encourage additional efficiency opportunities.

ADM identified and reviewed 21 reports and other publications on PACE financing. Most of this literature discussed policies and practices for administering PACE programs and comparatively little addressed best practices for integration of PACE financing with multifamily efficiency incentive programs. Moreover, as noted below, the number of PACE-financed affordable multifamily housing projects has been limited (Mugica, 2018), a finding that suggests there are challenges to using PACE as a means to fund efficiency projects in affordable multifamily housing.

What follows is a summary of findings on the potential benefits of PACE as an investment vehicle, the challenges identified as contributing to the limited use of PACE, case studies of successful implementation of PACE financing, and a discussion of best practices that may inform how the CommunitySavers Program can leverage the availability of PACE financing.

Background of PACE Financing

Property Assessed Clean Energy (PACE) financing is a mechanism that allows state and local governments to levy assessments on properties for energy efficient improvements. This type of financing can be used for commercial, industrial, and residential buildings and is applicable to HVAC and lighting upgrades, solar panel installation, envelope measures updates or installation, and various other water saving or energy efficient upgrades. C-PACE is available applicable to multi-family projects.

PACE in Multifamily Housing

PACE provides an opportunity to finance energy efficiency improvements in multifamily properties and may help address barriers to efficiency improvements. Specifically, PACE financing can address first-cost issues associated with making efficiency improvements to multi-family properties. PACE financing also provides a means to align the costs of an efficiency project with the utility bill savings to address split-incentive issues that affect decisions to make efficiency improvements in multifamily properties.

Other benefits of PACE financing that have been cited include the following:

- Repayment of financing through tax assessments can be characterized as an operating cost instead of debt (PACENow, 2013).
- Unlike many other financing options, C-PACE can be transferred to new ownership if the property is sold (Adamczyk, Chant, Morse, & Cahalane, 2018) and does not require accelerated repayment of the outstanding amount in the event of default

(Renew Missouri, 2011). This may perceived as a lower risk financing approach that property managers may be willing to invest in.

- C-PACE transactions are considered short term transactions and not a long-term liability (Adamczyk, et al., 2018).
- C-PACE financing may be best used to fill gaps in financing resulting from caps or other limits on other financing sources (Adamczyk, et al., 2018).
- Long-term payback period (Flanders, Johnson, and Dunsky, 2012).

Disadvantages

Despite the apparent benefits of PACE financing for funding affordable multifamily efficiency projects, the National Resource Defense Council (NRDC) reported that while over 1,000 C-PACE transactions have occurred, only 15 were for affordable multifamily housing (Mugica, 2018). Some of the factors identified as potentially contributing to the low uptake are (Adamczyk, et al., 2018):

- Multifamily housing transactions are particularly complicated and thus not particularly attractive to PACE Administrators. The complication is greatest for properties that receive federal subsidies.
- Multifamily housing may be able to secure more affordable financing from other sources.
- Limited technical support is available from PACE Administrators and owners may not have the time or expertise to develop PACE projects on their own.
- Other property improvements may take precedence of efficiency improvements.

Some recent developments may increase the potential for PACE projects in the future. Once such development is the Office of Energy Efficiency and Renewable Energy launching of a Commercial PACE Working Group, which seeks to create technical assistance tools for state and local governments. The overarching goal of this effort is to increase C-PACE investments by the year 2022. Technical assistance can potentially mitigate challenges for state and local governments, create a peer sharing platform and additional resources from technical experts. Another development is that financing costs have begun to decrease in comparison to other available options (Adamczyk, et al., 2018).

Case Studies

ADM was unable to identify case studies or best practice reviews of how utility programs successfully integrate PACE financing for multifamily projects. What follows are examples of PACE administrators that have worked with multifamily properties to complete PACE funded projects.

Set the PACE St. Louis

Set the PACE St. Louis is one of the leading multifamily PACE programs. Through a request for proposal (RFP), the City of St. Louis chose Energy Equity Funding to provide turnkey administration for PACE (Regional Energy Efficiency Organizations, 2016). This program offers 100% financing and is available for various kinds of C-PACE. One of the notable multifamily projects from Set the PACE St. Louis, was the retrofitting of an elementary school into multifamily loft apartments. The school site retrofitted windows and LED lighting, installed a new roof and building envelop updates, and solar panels. This project has a 20-year loan and an expected $1.6 million in utility savings (Regional Energy Efficiency Organizations, 2016).

Key Practices:

- Frequent engagement with property owners;
- Relationship building with funding sources; and
- Ability to combine with incentives from local utilities (including Ameren Missouri).

Energize NY

As of January 2017, Energize NY completed three multifamily projects, one low-income apartment unit and two senior living centers (Energize NY, 2018). One of these projects required 5-year financing, while the other two needed 20-year financing. The projects used a combination of bonds, PACE financing, and incentives through New York State Energy Research and Development Authority's (NYSERDA) Multifamily program to accomplish these retrofits.

Key Practices:

- In collaboration with the Energy Improvement Corporation, Energize NY developed a comprehensive handbook with necessary forms and references that can be used for newer affordable multifamily projects (Adamczyk et al., PY2017; Energy Improvement Corporation Inc., 2013).

PACE Equity

PACE Equity, a project developer and financier, is a "one-stop shop" that helps interested parties navigate paperwork, find contractors, engineering, and financing (Pace Equity, n.d.). PACE Equity helped finance the first new construction multifamily PACE project in the country, The Preserve at Aldersgate in Little Rock, Arkansas (Pace Equity, n.d.). The Preserve installed geothermal HVAC, LED lighting, windows, and roofing. PACE Equity was able to finance 10% of a $6.4 million new construction project, with an estimated savings of over $1.9 million over 20 years. This project used a combination of mortgage debt, developer equity and PACE equity.

Recommended Practices in Implementing PACE for the Multifamily Housing Sector

The following are recommended practices for encouraging PACE projects identified in the literature.

- Pursue projects with the fewest obstacles, but also be open to working with in the public housing sector. A pilot program called RAD may make using PACE financing an option if public housing is in the process of becoming privately-owned but is still affordable housing (Adamczyk, et. al., 2018).
- Consider potential in U.S. Department of Agriculture (USDA) properties. USDA is interested in the use of PACE financing to retrofit rural properties (Adamczyk, et. al., 2018).
- Consider PACE as gap financing for cases where other financing with more favorable interest rates have been capped or limited (Adamczyk, et. al., 2018).
- Public and private organizations that promote energy efficiency through affordable housing through incentives should collaborate to facilitate awareness and use of PACE financing (Henry and Ryan, 2016).

Considerations for CommunitySavers to Encourage use of PACE Financing

The following are steps that CommunitySavers staff could consider to encourage PACE financed projects.

- Maintain relationships regional PACE administration organizations. Program staff reported that they met with staff at PACE administration organizations during PY2017. Staff should continue to maintain these relationships to ensure that these staff are aware of the opportunities provided by CommunitySavers so that they can provide program information to parties interested in PACE financing.
- Provide information on the program website on PACE administration organizations. Providing links to organizations such as the Missouri Clean Energy District and Set the PACE St. Louis along with brief information about the key benefits of PACE financing (included in a tax assessment, transferable in the even the property is sold) may help to increase awareness of the opportunities.
- Position CommunitySavers as a resource for to help property owners and PACE administrators quantify energy saving impacts to qualify for PACE financing and identifying projects that are cost effective.
- PACE financing may be particularly useful for measures that have relatively high replacement costs, but the incentive amount that is based on the incremental cost does not cover a significant portion of the replacement cost and that have longer measure lifetimes that will allow for a longer repayment period. In particularly building envelope measures and HVAC systems may be good candidates for PACE financing.

Bibliography for PACE Literature Review

Adamczyk, P., Chant, E., Morse, S., & Cahalane, K. (2018). Commercial PACE for Affordable Multifamily Housing. Retrieved from https://energyefficiencyforall.org/sites/default/files/Report%20CPACE%20for%20Affordable%20Multifamily%20Housing.pdf

Johnson, K. (2013). Apartment Hunters: Programs Searching for Energy Savings in Multifamily Buildings. American Council for an Energy-Efficient Economy: Research Report E13N. Retrieved from http://aceee.org/research-report/e13n

DeVries, C. (2013). The Story of PACE. Retrieved from: http://stateenergyreport.com/2013/08/10/the-story-of-pace/

Energy Improvement Corporation Inc. (2013). Energize NY Benefit Finance 5+ Units Multifamily Program Handbook. Retrieved April 12, 2018 from http://energizeny.org/uploads/eic-documents/EIC_MF_Handbook_Jul_2013.pdf

Energy Programs Consortium (2013). Multifamily Energy Efficiency: Reported Barriers and Emerging Practices. Retrieved April 12, 2018 from https://aceee.org/files/pdf/resource/epc_%20multifamily_housing_13.pdf

Flanders, A., Johnson, K., Dunsky, P. (2012). Evaluation of the Efficiency Main Trust PACE loan program: Review of successful practices in financing. Prepared for the Efficiency Trust. Retrieved from https://www.efficiencymaine.com/docs/Efficiency-Maine-PACE-Successful-Practices-Report-Final.pdf

Grind, K. (2017, August 15). More Borrowers Are Defaulting on Their 'Green' PACE Loans. The Wall Street Journal. Retrieved from https://www.wsj.com/articles/more-borrowers-are-defaulting-on-their-green-pace-loans-1502789401

Henry, C & Ryan, S. (2016). PACE financing opportunities in the affordable housing sector. Environmental Defense Fund. Retrieved from http://blogs.edf.org/texascleanairmatters/files/2016/11/PACE-for-Aff-Housing_FINAL-111416-EDF-KPT.pdf

Khouri, A. (2017, June 4). These loans were created to help homeowners, for some they did the opposite. LATimes.com. Retrieved from http://www.latimes.com/business/la-fi-pace-loans-20170604-story.html

Mugica, Y. (2018, January 4). Can C-PACE Be Effective Financing for Multifamily Housing? [Blog post]. Retrieved from https://www.nrdc.org/experts/yerina-mugica/can-c-pace-be-effective-financing-multifamily-housing

Pace Equity (n.d.). PACE Equity Breaks New Ground with The Preserve at Aldersgate. Retrieved from http://pacenation.us/wp-content/uploads/2017/08/AldersgateCaseStudy_Overview.pdf

PACENow (2013). Property Assessed Clean Energy Case Study N 3: First multifamily property used PACE financing in Washington, DC. Retrieved April 12, 1018, from http://www.pacenation.us/wp-content/uploads/2013/06/DCPACE-_HUD-Case-Study.pdf

Regional Energy Efficiency Organizations (2016). Multifamily Energy Efficiency Retrofits: Barriers and Opportunities for Deep Energy Savings. Retrieved from http://www.swenergy.org/data/sites/1/media/documents/publications/documents/SWEEP-Multifamily-Report.pdf

Renew Missouri (2011). Implementing PACE in Missouri: Commerical/Industrial/Agricultural PACE Program Best Practices. Retrieved from: http://pacenation.us/wp-content/uploads/2012/08/PACE-Best-Practices-Implementing-PACE-in-Missouri-Final.pdf

U.S. Department of Energy (2016). Best Practice Guidelines for Residential PACE Financing Programs. Retrieved April 12, 2018 from https://www.energy.gov/sites/prod/files/2016/11/f34/best-practice-guidelines-RPACE.pdf

U.S. Department of Energy (n.d.). Commercial PACE. Retrieved April 12, 2018 from https://betterbuildingssolutioncenter.energy.gov/financing-navigator/option/cpace

U.S. Department of Housing and Urban Development (2015). Background on New Guidance on Multifamily PACE in California. Retrieved from https://www.hudexchange.info/resources/documents/Background-on-New-Guidance-on-Multifamily-PACE-in-California.pdf

U.S. Department of Energy (2013). U.S. Department of Energy Clean Energy Finance Guide: Chapter 12. Commercial Property-Assessed Clean Energy (PACE) Financing. Retrieved from https://www.energy.gov/sites/prod/files/2014/06/f16/ch12_commercial_pace_all.pdf

U.S. Department of Energy (n.d.). Commercial Property Assessed Clean Energy (PACE) Primer [PowerPoint slides]. Retrieved from https://www1.eere.energy.gov/wip/pdfs/commercial_pace_primer_revised.pdf

U.S. Department of Energy. Lessons Learned for Residential Energy Efficiency Programs: Financing. Retrieved from https://rpsc.energy.gov/sites/default/files/publication/c-1292_BBRP_SC_LL_Workforce_Development.pdf

U.S. Department of Energy (2018). Technical Assistance Overview: C-PACE Working Group. Retrieved from https://www.energy.gov/sites/prod/files/2018/04/f50/C-PACE_Working_Group_TA_Overview_V6.pdf

Appendix F: Cost Effectiveness - Critical Technical Data

The following appendix presents the critical technical data used to develop the cost effectiveness test results for the program. ADM provided the inputs for the cost effectiveness testing by measure end use and effective useful life. The analysis was performed by Ameren Missouri using DSMore.

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, the economic and financial assumptions used for developing the model were from Ameren Missouri. Some of those assumptions include:

- Discount Rate = 6.46% for Utility Cost Test (UCT), Total Resource Cost (TRC) test, Ratepayer Impact Measure (RIM) test, and Participant Cost Test (PCT); 3.00% for Societal Cost Test (SCT).
- Line losses = Nonresidential customers 4.84%, 5.72% for M1 residential customers.
- Summer Peak would occur during the 16th hour of a July day on average
- Avoided Electric costs from the 2014 Integrated Resource Plan filing were used for measures delivered between March 1, 2017 and September 28, 2017. Avoided costs from the 2017 Integrated Resource Plan that was filed October 1, 2017 were used for all measures delivered on or after October 1, 2017.
- 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 = 2%

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.

A number of residential portfolio-level costs are reflected in the program-level cost effectiveness analysis. These residential portfolio-level costs include those for EM&V, education and outreach, portfolio administration, and data tracking. Residential portfolio costs were allocated by the program's share of the net present value (NPV) of the utility cost test (UCT) benefits of the residential portfolio. The NPV of the UCT benefits and the apportionment factor are shown in Table F-1.

Table F-1 Residential Portfolio Cost Apportionment Factor

NPV of UCT Benefits (2016 Dollars)	*Apportionment Factor*
$4,439,405	4.75%

Table F-2 summarizes program UCT costs by cost category. The values presented below are inclusive of the allocated portfolio costs and are shown in 2016 dollars.

Table F-2 Ameren Missouri PY2017 Cost Data

Administrative Costs (2016 Dollars)	*Incentive Costs (2016 Dollars)*	*Total Costs (2016 Dollars)*
$1,010,724	$1,113,516	$2,124,240

Each cost test provides a benefit-cost ratio that reflects the net benefit or cost to a specific stakeholder. For example, the Utility Cost Test (UCT) takes into account all program costs and benefits from the utility (or program administrator) perspective, to demonstrate how the program impacts the utility relative to other program stakeholders. If the ratio is less than one, the costs outweigh the benefits; if the ratio is greater than one, the benefits outweigh the costs. Table F-3 below is a summary of benefit and cost inputs for each cost test performed.[11]

[11] EPA, Understanding Cost-Effectiveness of energy efficiency programs: Best Practices, Technical Methods, and Emerging Issues for Policy-Makers, 2008. http: //www.epa.gov/cleanenergy/documents/suca/cost-effectiveness.pdf, pg. 3-6

Table F-3 Summary of Benefits and Costs Included in Each Cost Effectiveness Test

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

CommunitySavers Cost Test Inputs and Results

Table F-4 summarizes the key financial benefit and cost inputs for the CommunitySavers Program Utility Costs Test (UCT). Ameren Missouri's avoided cost of energy is $4,439,405. Incentives and overhead totaled $2,124,240 which yields a benefit-cost ratio of 2.09.

Table F-4 Utility Cost Test (UCT) Inputs and Results

UCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$2,659,599	
Avoided Electric Capacity	$1,343,120	
Avoided T&D Electric	$436,686	
Administration Costs		$1,010,724
Implementation / Participation Costs		$0
Other / Miscellaneous Costs		$0
Incentives		$1,113,516
Total	$4,439,405	$2,124,240
UCT Benefit - Cost Ratio	2.09	

The TRC test results, shown in Table F-5, reflect the CommunitySavers Program impacts on participating and non-participating customers in the Ameren Missouri service territory. The participant measure costs and overhead make up the total costs of $1,212,368. The benefits consist of the utility's total avoided costs of $4,439,405, which yields a benefit-cost ratio of 3.66.

Table F-5 Total Resource Cost Test (TRC) Inputs and Results

TRC Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$2,659,599	
Avoided Electric Capacity	$1,343,120	
Avoided T&D Electric	$436,686	
Administration Costs		$1,010,724
Implementation / Participation Costs		$0
Other / Miscellaneous Costs		$0
Participant Costs		$201,644
Total	$4,439,405	$1,212,368
TRC Benefit - Cost Ratio	3.66	

The RIM test reflects the program impacts on utility rates. Table F-6 summarizes key inputs for the RIM test. The net benefits include the avoided utility costs of $4,439,405 and the costs total $9,339,534. The same costs are included in the UCT are included in the RIM test; however, lost revenues from reduced energy bills are also included. The financial data for the RIM test yields a benefit-cost ratio of 0.48. The ratio suggests that rates have the potential to increase over time. However, a RIM test result of greater than 1.0 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.[12]

Table F-6 Ratepayer Impact Measure Test (RIM) Inputs and Results

RIM Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$2,659,599	
Avoided Electric Capacity	$1,343,120	
Avoided T&D Electric	$436,686	
Administration Costs		$1,010,724
Implementation / Participation Costs		$0
Other / Miscellaneous Costs		$0
Incentives		$1,113,516
Lost Revenue		$7,215,295
Total	$4,439,405	$9,339,534
RIM Benefit - Cost Ratio	0.48	

Table F-7 summarizes the key financial inputs to the PCT, which reflects the program impacts on the participants. The benefits include the program incentives and energy bill savings, which total $8,328,811. The costs include gross participant costs, totaling $201,644 and yielding a benefit-cost ratio of 41.30.

Table F-7 Participant Cost Test (PCT) Inputs and Results

PCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Bill Savings	$7,215,295	
Incentives	$1,113,516	
Participant Costs		$201,644
Total	$8,328,811	$201,644
PCT Benefit - Cost Ratio	41.30	

The SCT reflects the program impacts on society; the key financial inputs are displayed in Table F-8. The benefits include the avoided utility costs of $5,835,109 and the costs totaled $1,253,094. The financial data for the SCT test yields a benefit-cost ratio of 4.66.

[12] EPA, Understanding Cost-Effectiveness of energy efficiency programs: Best Practices, Technical Methods, and Emerging Issues for Policy-Makers, 2008. http: //www.epa.gov/cleanenergy/documents/suca/cost-effectiveness.pdf, pg. 3-6

Table F-8 Societal Cost Test (SCT) Inputs and Results

SCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$3,508,984	
Avoided Electric Capacity	$1,778,644	
Avoided T&D Electric	$547,481	
Administration Costs		$1,044,676
Implementation / Participation Costs		$0
Other / Miscellaneous Costs		$0
Participant Costs		$208,418
Total	$5,835,109	$1,253,094
SCT Benefit - Cost Ratio	4.66	

Appendix G: Glossary of Terms

Adjustments: Modifications on ex ante analysis conditions (e.g. hours of lighting operation) because of observations made by ADM field technicians during the measurement and verification (M&V) on-site visit, which change baseline energy or energy demand values.

Baseline: The projected scenario where the subject project or program was not implemented. Baseline conditions are sometimes referred to as “business-as-usual” conditions. Baselines are defined as either project-specific baselines or performance standard baselines.

Confidence (level): A confidence level is a value that indicates the reliability of a calculated estimate from a sample. A higher confidence level indicates a stronger estimate that is more likely to lie within the population parameter. It is an indication of how close an estimated value derived from a sample is to the true population value of the quantity in question. The confidence level is the likelihood that the evaluation has captured the true impacts of the program within a certain range of values (i.e., precision).

Cost-effectiveness: The present value of the estimated benefits produced by an energy efficiency program compared to the estimated total costs to determine if the proposed investment or measure is desirable (e.g., whether the estimated benefits exceed the estimated costs from a societal perspective). It is an indicator of the relative performance or economic attractiveness of any energy efficiency investment or practice.

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).

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).

Ex Ante kWh Savings: The estimation of electrical energy (kWh) expected to be saved by implementing 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.

Ex Ante Peak kW Savings: The estimation of electrical energy demand (kW) expected to be saved by implementing 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.

Ex Post Gross 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.

Ex Post Gross 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 kWh savings.

Gross Peak kW Savings Realization Rate: The ratio of ex post (or "realized") gross kW savings over ex ante kW savings.

Gross Realization Rate: The ratio of ex post gross energy savings over ex ante 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.

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).

Ex Post Net 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.

Ex Post Net 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, and non-participant spillovers. 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 %), 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.