CommunitySavers Program Evaluation Report

March 2018 – February 2019

Prepared For:

Ameren Missouri

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July 2019

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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 2018 (PY2018), which occurred from the start of March 2018 to the end of February 2019. The PY2018 cost effectiveness analysis is premised on cost data received to date (end of March 2019). 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 energy (kWh) savings calculations for each implemented measure. Ex post savings 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	March 2019	Program function; communication; tracking and reporting; quality control	Qualitative
Database analysis	Database review	January 2019 to April 2019	Number of projects; project type and details; data quality	Quantitative
Participants (14)	Online/Telephone Survey	December 2018	Program experiences; satisfaction with program	Quantitative and qualitative

*Data Source**	*Method*	*Dates*	*Research Objective*	*Analysis Type*
Tenant (92)	Mail	December 2018 to January 2019	Site visit recruitment; program experiences; satisfaction with program	Quantitative and qualitative
Post-install site visit (25 units)	On-site M&V	January to February 2019	Verify baseline operating conditions	Quantitative and qualitative

* Sample sizes in parentheses

Table 1-2 provides a summary of the energy savings of the PY2018 CommunitySavers Program. The table displays the ex ante kWh, ex post gross kWh, and ex post net kWh savings as compared with the PY2018 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 9,914,662 kWh.

Table 1-2 Summary of kWh Savings for CommunitySavers Program

PY2018 kWh Savings Target	*Reported Ex Ante 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*
4,297,962	11,829,331	9,914,662	84%	9,914,662	100%	231%

Table 1-3 summarizes the ex ante, ex post gross, and ex post net kW savings of the PY2018 program. The ex post gross kW savings were determined through the application of energy-to-demand ratios per end-use to the corresponding evaluated first-year kWh savings. The program ex post gross and net demand savings totaled 2,072.94 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

PY2018 kW Savings Target	*Reported Ex Ante 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*
1,003.73	2,947.11	2,072.94	70%	2,072.94	100%	207%

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 84%, with variable measure-level gross realization rates. The gross realization rate for kW savings was 70%. 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- and site-specific characteristics that were accounted for in the ex post energy savings analysis. Two issues that impacted realization rates were:
    - Common area lighting projects did not uniformly apply the correct lighting stipulated coincident peak demand factor. In particular, the non-24-hour lighting factor was frequently applied to 24-hour lighting.
    - For the residential air source heat pump measures that were described in program tracking data as replacing existing electric resistance furnaces, ex ante heating savings calculations referenced the assumed existing heating equipment efficiency (3.41 HSPF). ADM researched and verified that these measures were installed in newly constructed facilities. Accordingly, ADM applied the federal minimum standard 8.2 HSPF in the calculation of heating energy savings for these measures.
- Ex post net energy savings achieved 231% of the energy savings goal. The total ex post net energy savings for PY2018 totaled 9,914,662 kWh. This amount is 135% of the ex post net energy savings realized during PY2017 (7,334,784 kWh).

  An increase in common area lighting projects was a significant factor in the increase in program energy savings as compared with PY2017. Common area

lighting accounted for approximately 20% of program ex ante energy savings in PY2017 but accounted for 65% of ex ante energy savings in PY2018.

- Program lighting tracking data did not include information regarding property type and heating and cooling system types. Including this data within the program tracking system would facilitate calculating savings impacts inclusive of heating and cooling interactive effects.

1.2 Impact Recommendations

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

- The evaluation found that the non-24-hour lighting stipulated coincident peak demand factor was incorrectly applied to 24-hour lighting measures installed in common areas. The correct value should be applied in future program years.
- Estimates of heating energy savings for air source heat pumps installed in newly constructed facilities should reference the federal minimum standard heating seasonal performance factor. ADM also recommends including a field in future program tracking data to identify new construction projects and to ensure that the appropriate baseline is referenced in ex ante savings calculations.

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) Evaluation of Demand-Side Program and Demand-Side Rates subsection of the Resource Acquisition Strategy Selection section. 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. It was noted that this is particularly the case for non-lighting measures. The cost of efficiency improvements was also noted as a barrier by three of the four respondents. Additionally, staff noted that some properties

may be prevented from financing efficiency projects because of the terms of previous financing arrangements.

- Geography. Analysis of the program activity in comparison to the location of multifamily properties and lower income customers found that program activity was disproportionately concentrated in St. Louis and its surrounding suburbs. However, there was an increase in the share of projects completed in outer St. Louis suburbs from 10% of tenant units in PY2017 to 20% of units in PY2018.
- Insufficient Property Staff. Multifamily property operators may not have staff available to implement efficiency measures. Unlike prior years, none of the survey respondents cited this as a barrier. 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.
- Property Management: Staff noted that while the program tried to reach all types of low-income multifamily properties, it had more success with properties owned by larger property management companies that operate multiple properties in the service territory.

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.
- Staff noted that in the third cycle of the Missouri Energy Efficiency Investment Act, the programs offered will also target low income customers living in single family and in manufactured/mobile homes. These markets will be served by new programs and

Ameren will continue to provide dedicated resources to serving the low-income multifamily market.

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. Ninety percent of participant survey respondents were aware of the common area incentives stated that these incentives completely met their needs for efficiency improvements.

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 reported that the outreach and marketing efforts in PY2018 were similar to the approaches used in other years. During the year, six email newsletters and six postcard mailings were sent to multifamily properties. Staff continued to engage in direct outreach to property managers. Staff also continued to make presentations to neighborhood associations.
- Among those participants that had not received common area, the share of participant survey respondents who reported that they were aware of common area incentives increased from 15% in PY2016, to 83% in PY2017, to 100% in PY2018. Additionally, 67% of respondents aware of the common area incentives reported that they were 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*: Staff noted that some properties have difficulty securing financing for more costly projects such as building envelope improvements. The

program should consider exploring offering on-bill financing as an alternative means for properties to arrange financing.[2]

[2] American Council for an Energy-Efficiency Economy (2013). Apartment hunters: Programs searching for energy savings in multifamily buildings.

Energy Efficiency for All (2015). Energy efficiency programs in multifamily affordable housing.

2 Introduction

This report presents the results of the evaluation 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 PY2018.

2.1 Program Description

The CommunitySavers Program provided financial incentives and services to encourage comprehensive energy efficiency improvements in income-eligible multifamily properties. The program used a “one-stop shop” model through which a dedicated account manager provided 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 received electric service under Ameren Missouri Service Classification of Residential or Non-Residential (excluding lighting classifications) and that met the tenant income qualifications were eligible. Income eligibility was 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 were eligible for incentives for the entire building if at least 51% of tenants met the income requirements. If fewer than 51% of the tenants met the income requirements, the building may have received common area and in-unit upgrades if the owner or manager verified that comparable efficiency improvements have been made in all non-qualifying units.

The program provided the following type of incentives:

- Direct installation of measures at no cost to the property owner or tenant. The direct install measures included:
    - 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 incentives for properties with dwelling units with a residential account 1(M) service rating. Incentives were 25% higher than for non-qualifying residential customers; and
- Custom/standard incentives for common areas. The incentives provided were 25% higher than those offered for non-qualifying non-residential customers.

2.2 Program Trends in PY2018

Figure 2-1 summarizes ex ante savings from March 2018 through April 2019, which was calculated using the field "reporting date." The total ex ante savings for the CommunitySavers program was 11,829,331 kWh for the program year, with a range between 0 kWh and 2,622,664 kWh and an average monthly savings of 909,948 kWh. The highest month for savings occurred in February 2019.

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

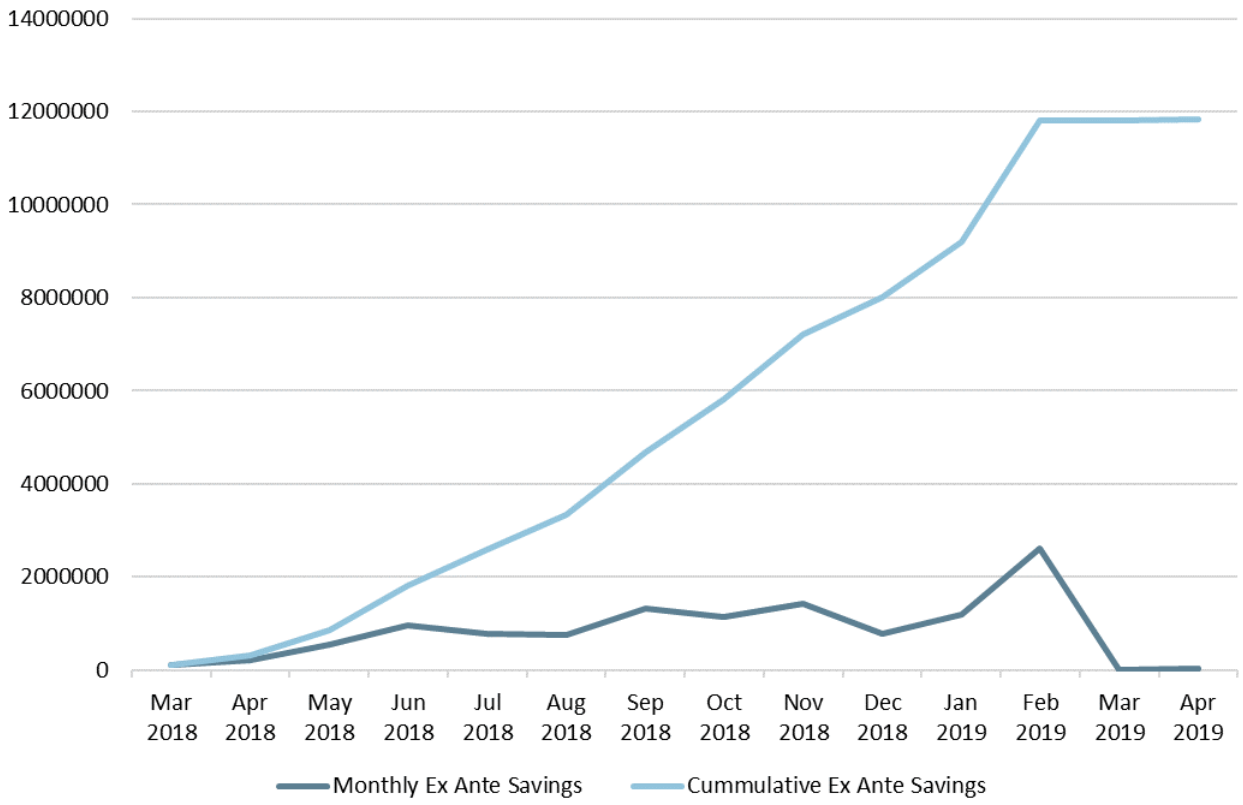


Figure 2-2 summarizes ex ante savings by program component. As shown, 50% of program savings resulted from MFLI Custom measures, followed by MFLI Direct Install measures (21%), and Small Business Direct Install measures (11%). It is noteworthy that the distribution of savings across tracks in PY2018 is a shift from PY2017, during which none of the savings resulted from Custom measures and 57% of savings resulted from MFLI Direct Install measures.

Interior lighting accounted for 87% of MFLI Custom savings, followed by exterior lighting (less than 24/7) at 7%, cooling at 3%, and exterior lighting (24/7) at 2%.

Thirty-one percent of the ex ante savings for the MFLI Direct Install component resulted room air conditioners and dirty filter alarm (MF), followed by HVAC maintenance and tune-ups (13%).

Figure 2-2 Ex Ante Savings by Program Component

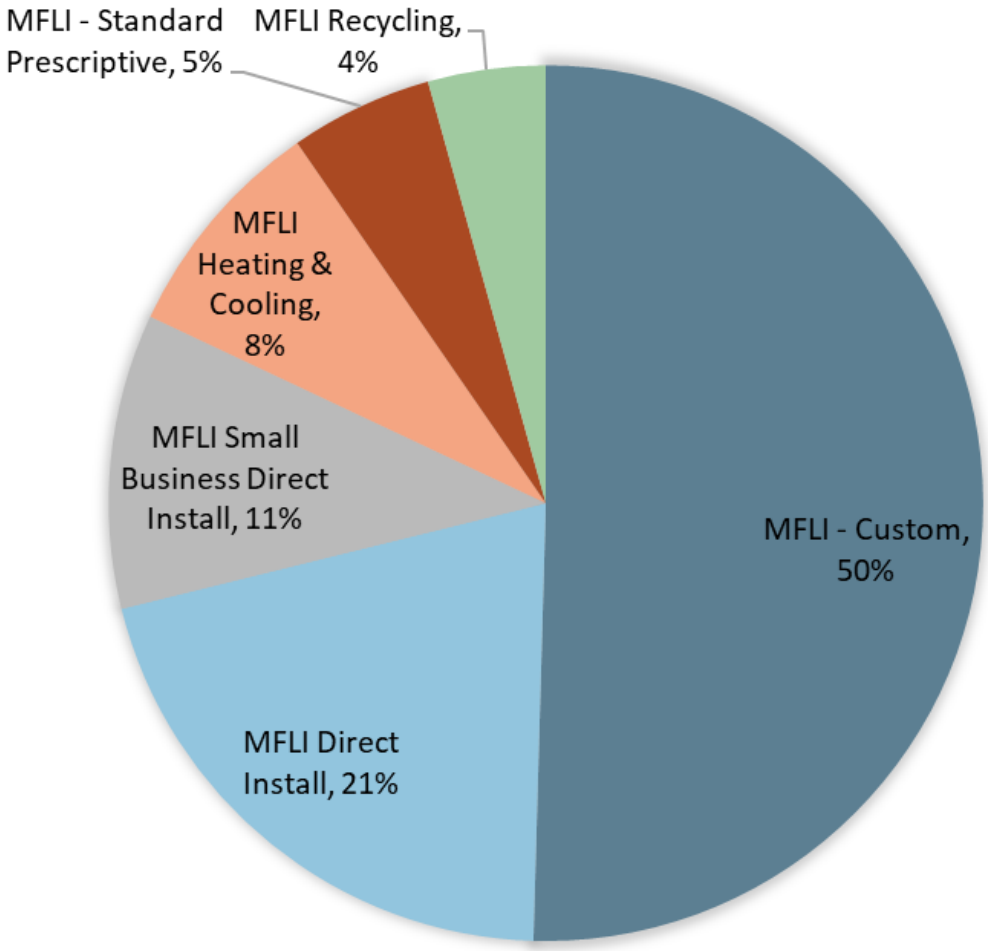


Figure 2-3 summarizes energy savings by end-use for the CommunitySavers Program. Almost two-thirds (65%) of gross ex ante savings resulted from business lighting measures. Residential HVAC accounted for 17% of gross ex ante savings.

Figure 2-3 Ex Ante Savings by End-Use

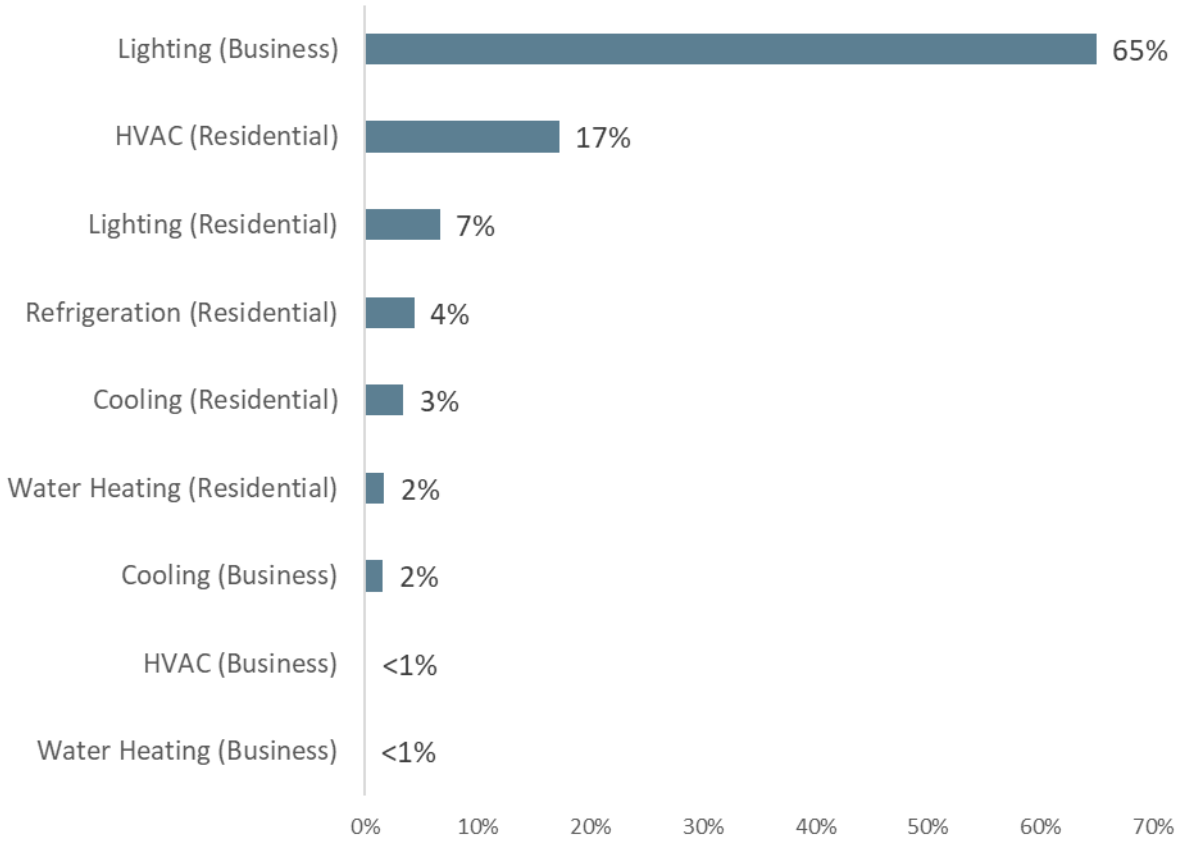
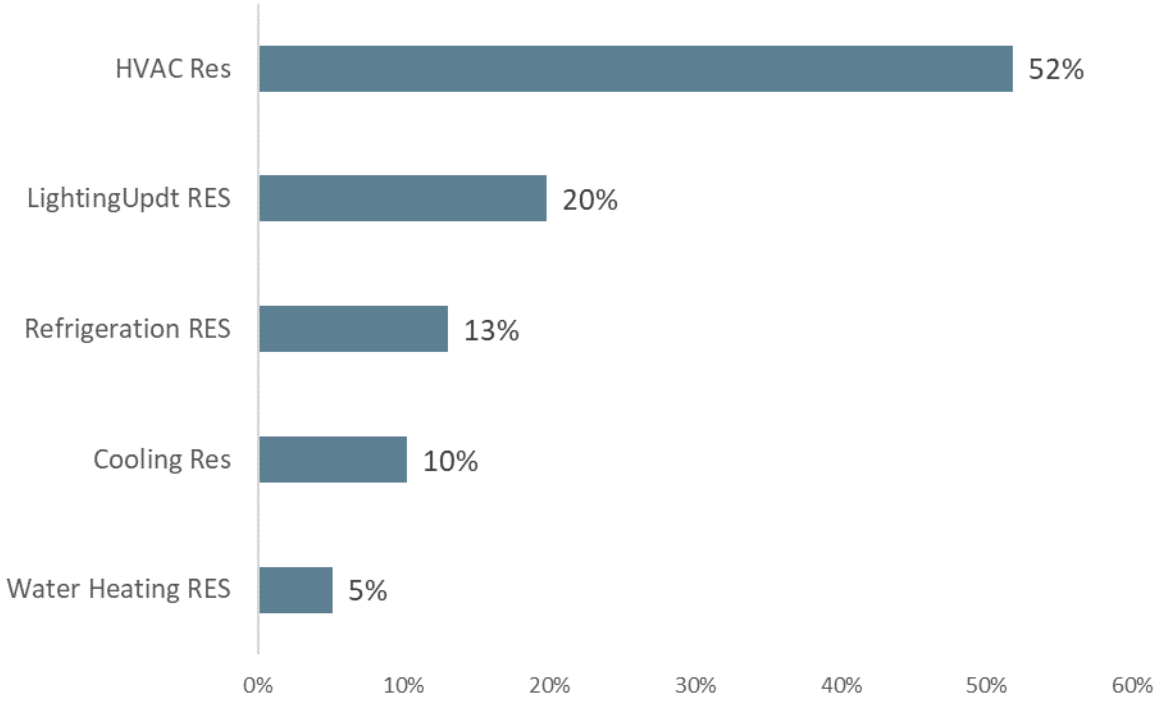


Figure 2-4 summarize ex ante savings by end use among all residential programs (MFLI direct install, MFLI Heating and Cooling, and MFLI Refrigerators). The largest share of savings for residential programs was from HVAC measures (52%), followed by lighting measures (20%), refrigerators (13%), cooling measures (10%), and water heating measures (5%).

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



2.3 Organization of Report

This report on the impact and process evaluation of the program for the period March 2018 through February 2019 is as follows:

- Chapter 3 presents and discusses the methods used for and the results obtained from the impact evaluation.
- 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 the results obtained from the payment analysis.
- Chapter 6 presents and discusses the methods used for and results obtained from the cost effectiveness evaluation.
- Chapter 7 presents evaluation conclusions and recommendations.
- Appendix A: 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: Payment Analysis Regression Results
- Appendix F: Cost Effectiveness Technical Data
- Appendix G: Glossary of Terms

3 Estimation of Ex Post Gross and Net Savings

This chapter explains the estimation of ex post gross and net kWh and kW savings for PY2018 program participants from measures installed at their properties. ADM performed impact analyses in accordance with evaluation requirement in Missouri 4 CSR 240-20.093 Demand-Side Programs Investment Mechanism and 4 CSR 240-20.094 Demand-Side Programs.

Section 3.1 describes the methodology used for estimating ex post gross kWh and kW 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.[3] 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 included program tracking data provided by the implementation contractor and 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. Data from 25 PY2018 and 28 PY2017 site visits were used to develop in-service rates for the program measures.

[3] 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.nrel.gov/docs/fy17osti/68578.pdf, p. 45.

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;
- Refrigerator;
- Low-Flow Showerhead;
- Low-Flow Faucet Aerator
- Hot Water Pipe Insulation;
- Programmable Thermostat;
- Filter Alarm;
- Heat Pump Water Heater;
- Water Chiller;
- Central Air Conditioner;
- Air Source Heat Pump;
- Room Air Conditioner;
- ECM blower motors; 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 program data and referenced the 2018 Ameren Missouri Technical Reference Manual (TRM);
- Commercial efficient equipment wattages were provided by the program implementer;
- Commercial baseline equipment wattages were developed from the implementer provided commercial efficient equipment descriptions and wattages and the Illinois Statewide Technical Reference Manual v. 7.0 (IL TRM);
- Reference cities and participating facility space heating and cooling types used to determine measure HCIF value were derived from program tracking data and program building applications;
- Hours of use were based on information provided in program tracking data. For in-unit lighting measures, hours were based on the housing type (senior housing vs. family housing). Housing type was identified through internet searches of the property. For commercial lighting measures, the implementation contractor provided hours of operation developed through interviews with facility staff;
- 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 3-2 for residential lighting baselines. IL TRM or project information was referenced for commercial lighting.
$Watts_{EE}$	Varies	W	Program data; Project documentation
$ISR_{Residential}$	98%	-	ADM site visits
$ISR_{Commercial}$	100%	-	Quantities verified through documentation review
Quantity	Varies	-	Program data; Project documentation
Hours	Varies	hr	See Table 3-3 hours used for residential lighting measures. Commercial lighting hours were based on values reported in program data.
HCIF	Varies	-	ADM

Table 3-2 summarizes the baseline and efficient wattages used in the calculation of residential lighting savings. The baseline and efficient wattages are sourced from program data.

Table 3-2 Residential Lighting Baseline Wattages

Category Name	*WattsBase*	*WattsEE*
LED - 8W Globe Light G25 Bulb MF	29	7
LED 9-10.5W Downlight E26 Light Bulb MF	43	9
LED - 12W Dimmable Light Bulb MF	53	11
LED - 15W Flood Light PAR30 Bulb MF	55	14

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

Table 3-3 Residential 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
In-Unit, Unknown Type	530	Cadmus PY5 metering study
Exterior	4,322	U.S. Naval Observatory dusk to dawn hours for St. Louis[2]
1. Ameren Missouri Low Income and Process Evaluation: Program Year 2014, p.26 2. http://aa.usno.navy.mil/data/docs/RS_OneDay.php		

ADM developed and referenced the heating and cooling interactive factors presented in Table 3-4 below. The HCIF values were developed using prototypical building models using TMY3 weather data.

Table 3-4 Heating and Cooling Interactive Factors by Reference City

Location	*Cooling*	*Heating*	*HCIF*
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
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[4]:

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

Where,

Age = Age of retired unit, or average age of recycled units if not available[5]

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

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, 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, the percentage of units rebated that are actively in service

[4] The full equation also includes terms for interactions between HDD and CDD days and an unconditioned space binary variable, where the binary 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.

[5] The age of the retired unit was not available for 19 units.

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[6] [kWh/quantity] = 1,181

ISR = In-service rate, the percentage of units rebated that are actively in service

Quantity = Number of units claimed

Table 3-5 summarizes the equation parameters for the energy savings associated with the implementation of efficient refrigerator measures and their reference sources.

Table 3-5 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 visits
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:

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

[6] The deemed energy efficiency savings values are referenced from the Energy Star Efficient Products Database

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 3-6 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:

- Deemed savings input values were sourced from the 2018 Ameren Reference TRM;
- People per household and showerheads per household data was sourced from program tracking data;
- ΔGPM was based on ADM site visit data;
- Estimated ISR was based on ADM site visit data; and
- Quantity of measures were sourced from program tracking data.

Table 3-6 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	-

Parameter	*Value*	*Unit*	*Source*
%Days	0.66	Showers/person/day	Secondary source cited in PY6 Evaluation
ΔGPM	0.7	gal/min	ADM site visits
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 per home	1	Showerheads/ household	Program data
ISR	96%	-	ADM site visits
Quantity	Varies	-	Program data

3.1.2.4 Method for Analyzing Savings from Faucet Aerator Measures

Electric energy savings of faucet aerators were calculated as follows:

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

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 3-7 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:

- Deemed savings input values were sourced from the 2018 Ameren Missouri TRM;
- People per household and faucets per household data was sourced from program tracking data;
- ΔGPM was based on ADM site visit data;
- Estimated ISR was based on ADM site visit data; and
- Quantity of measures were sourced from program tracking data.

Table 3-7 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	ADM site visits
T_{Faucet}	80	°F	ADM site visits; PY7 program data; IL TRM
T_{In}	61.3	°F	Secondary source cited in PY6 Evaluation
BTU to kWh	3,413	BTU/kWh	-
RE	98%	-	Ameren MO TRM
Faucets	1.86	Faucets/household	Program data
Den	8.33	lb/gal	-
C_P	1	BTU/ lb-°F	-
ISR	95%	-	ADM site visits
Quantity	Varies	-	Program data

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 3-8 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 2018 Ameren Missouri 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 3-8 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	-
ISR	96%	-	ADM site visits
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:

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

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} = Equivalent full load cooling hours [hr/year]

$FLH_{Cool\text{-}stat}$ = Equivalent full load cooling hours with setback schedule [hr/year]

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

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

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

$FLH_{Heat\text{-}stat}$ = Equivalent full load heating hours with setback schedule [hr/year]

$Capacity_{Heating}$ = 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

Quantity = Number of units claimed

ISR = In-service rate, the percentage of units rebated that are actively in service

Table 3-9 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 2018 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 3-9 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
$SB_{Degrees\text{-}heat}$	2.1	°F	ADM site visits
$SB_{Degrees\text{-}Cool}$	2.9	°F	ADM site visits
SF_{Heat}	0.03	%/degree	ENERGY STAR calculator
SF_{Cool}	0.06	%/degree	ENERGY STAR calculator
ISR	100%	-	ADM site visits
$HSPF_{ElectricResistance}$	3.41	Btu/W-hr	Electric resistance has a COP of 1.0 which equals 1/0.293 = 3.41 HSPF.
$EFLH_{Cool\text{-}St\text{-}Louis}$	1215	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} = Equivalent full load heating hours [hr/year]

FLH_{cool} = Equivalent full load cooling hours [hr/year]

EI = Efficiency improvement

ISR = In-service rate

Quantity = Number of units claimed

Table 3-10 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 2018 Ameren Missouri TRM;
- Equivalent full load hours referenced the 2018 Ameren Missouri TRM;
- ISR value was based on ADM site visit data; and
- Quantity of measures were sourced from program tracking data.

Table 3-10 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 visits

3.1.2.8 Method for Analyzing Savings from Heat Pump Water Heater Measures

Electric energy savings of early replacement Heat Pump Water Heater were calculated as follows:

$$\Delta kWh_{HPWH\_Total} = \left(\left(\left(\frac{1}{EF_{Base}} - \frac{1}{EF_{Eff}}\right) * \Delta T * Den * \frac{GPM}{Day} * 365 * C_p * \frac{1}{3413}\right) - kWh_{Heat} + kWh_{Cool}\right) * ISR * Quantity$$

Where,

EF_{Base} = Energy factor of baseline water heater

EF_{Eff} = Energy factor of program qualified water heaters

ΔT = Difference between hot water supply and cold water supply [°F]

Den = Water density [lb/gal]

GPM/Day = Gallons of hot water used per day

C_P = Specific water heat [Btu/lb-°F]

kWh_{Heat} = Heating interaction due to heat removed from room to heat water

kWh_{Cool} = Cooling interaction due to heat removed from room to heat water

ISR = In-service rate

Quantity = Number of units claimed

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

- Deemed parameter values referenced the 2018 Ameren Missouri TRM;
- ISR value was based on ADM site visit data; and
- Quantity of measures were sourced from program tracking data.

Table 3-11 Heat Pump Water Heater Replacement Energy Savings Calculation Inputs

Parameter	*Value*	*Unit*	*Source*
EF_{Base}	0.9	-	Ameren MO TRM
EF_{Eff}	2.7	-	Ameren MO TRM
T_{heat}	135	[°F]	Ameren MO TRM
T_{cold}	61.3	[°F]	Ameren MO TRM
Den	8.33	[lb/gal]	-
GPM/Day	64	Gallons	Ameren MO TRM
C_P	1	[Btu/lb-°F]	-
kWh_{heat}	427.5	[kWh]	Ameren MO TRM
kWh_{cool}	163.8	[kWh]	Ameren MO TRM
ISR	100%	-	ADM site visits

3.1.2.9 Method for Analyzing Savings from Chillers

Electric energy savings of early replacement chiller were calculated as follows:

$$\Delta kWH = TONS * ((IPLVbase) - (IPLVee)) * EFLH$$

Where,

TONS = Cooling capacity of the chiller

$IPLV_{Base}$ = Baseline Integrated Part Load Value

$IPLV_{EE}$ = Efficient Integrated Part Load Value

EFLH = Equivalent full load cooling hours *[hr/year]*

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

- Deemed parameter values referenced the 2018 Ameren Missouri TRM, program documentation, and ASHRAE/IESNA minimum standards;
- ISR value was based on ADM site visit data; and
- Quantity of measures were sourced from program tracking data

Table 3-12 Chiller Replacement Energy Savings Calculation Inputs

Parameter	*Value*	*Unit*	*Source*
TONS	280	Ton	Program data
$IPLV_{Base}$	0.596	kW/Ton	ASHRAE/IESNA
$IPLV_{EE}$	0.32	kW/Ton	Program data
ISR	100%	-	ADM site visits
$EFLH_{Cool\text{-}St.\ Louis}$	1215	hr/yr	Ameren MO TRM

3.1.2.10 Method for Analyzing Savings from Central Air Conditioners

First-year electric energy savings of early replacement (ER) and replace-at-fail (RF) central air conditioners were calculated as follows:

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

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

Where,

FLH_{Cool} = Equivalent full load cooling hours [hr/year]

Capacity = Size of new equipment

$SEER_{Exist}$ = Seasonal Energy Efficiency Ratio of existing unit

$SEER_{Base}$ = Seasonal Energy Efficiency Ratio of minimum federal standard unit [kBtu/kWh]

$SEER_{EE}$ = Seasonal Energy Efficiency Ratio of efficient unit

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 2018 Ameren Missouri TRM;
- Capacity and $SEER_{EE}$ 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
$SEER_{Exist}$	10	kBtu/kWh	Ameren MO TRM
$SEER_{Base}$	13	kBtu/kWh	Minimum Federal Standard 2015
$SEER_{EE}$	Varies	kBtu/kWh	Program data
ISR	100%	-	ADM site visits
$FLH_{Cool\text{-}St.\ Louis}$	1215	hr/yr	ENERGY STAR Central air conditioner calculator; EPA 2002

3.1.2.11 Method for Analyzing Savings from Air Source Heat Pumps

First-year electric energy savings of replace-at-fail (RF) air source heat pump measures were calculated as follows:

$$\Delta kWh_{ASHP\_Total\_RF} = \left(\left(\frac{FLH_{Cool} * Capacity * \left(\frac{1}{SEER_{Base}} - \frac{1}{SEER_{EE}} \right)}{1000} \right) + \left(\frac{FLH_{Heat} * Capacity * \left(\frac{1}{HSPF_{Base}} - \frac{1}{HSPF_{EE}} \right)}{1000} \right) \right) * ISR * Quantity$$

Where,

FLH_{Cool} = Equivalent full load cooling hours [hr/year]

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

Capacity = Heating or cooling capacity of the unit

$SEER_{Base}$ = Seasonal Energy Efficiency Ratio of minimum federal standard unit

$SEER_{EE}$ = Seasonal Energy Efficiency Ratio of efficient unit

$HSPF_{Base}$ = Heating seasonal performance factor of minimum federal standard unit

$HSPF_{EE}$ = Heating seasonal performance factor 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 air source heat pump measures and their reference sources. The parameter values were derived from the following sources:

- Capacity and $SEER_{EE}$ values were sourced from program tracking data;
- $HSPF_{EE}$ values were sourced from project documentation;
- ISR value was based on ADM site visit data; and
- Quantity of measures were sourced from program tracking data.

Table 3-14 Air Source Heat Pump Replacement Energy Savings Calculation Inputs

Parameter	*Value*	*Unit*	*Source*
Capacity	Varies	Btu/hr	Program data
$SEER_{Base}$	14	kBtu/kWh	Minimum Federal Standard 2015
$SEER_{EE}$	Varies	kBtu/kWh	Program data
$HSPF_{Base}$	8.2	kBtu/kWh	Minimum Federal Standard 2015
$HSPF_{EE}$	Varies	kBtu/kWh	Project documentation
ISR	100%	-	ADM site visits
$FLH_{Heat\text{-}St.\ Louis}$	2009	hr/yr	ENERGY STAR Air source heat pump calculator; EPA 2002
$FLH_{Cool\text{-}St.\ Louis}$	1215	hr/yr	ENERGY STAR Air source heat pump calculator; EPA 2002

3.1.2.12 Method for Analyzing Savings from Room AC Measures

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

$$\Delta kWh = \frac{FLH * Capacity}{1000} * \left(\frac{1}{EER_{Exist}} - \frac{1}{EER_{EE}}\right) * ISR * Quantity$$

Where,

FLH = Equivalent full load hours of room air conditioning unit [hr/year]

Capacity = Size of efficient unit [Btu/hr]

EER_{Exist} = Energy Efficiency Ratio of replaced unit

EER_{EE} = Energy Efficiency Ratio of efficient unit

ISR = In-service rate

Quantity = Number of units claimed

Table 3-15 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:

- Capacity, EER_{Exist}, and EER_{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 3-15 Room Air Conditioner Replacement Energy Savings Calculation Inputs

Parameter	*Value*	*Unit*	*Source*
Capacity	Varies	Btu/hr	Program data
EER_{Exist}	Varies	Btu/W-hr	Program data
EER_{EE}	Varies	Btu/W-hr	Program data
ISR	100%	-	ADM site visits
$FLH_{Cool\text{-}St.\ Louis}$	1215	hr/yr	ENERGY STAR Room air conditioner calculator; EPA 2002

3.1.2.13 Method for Analyzing Savings from ECM Blower Motor Measures

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

$$\Delta kWh = Deemed\ Savings * ISR$$

Where,

Deemed Savings = Estimated savings for ECMs based on the 2018 Ameren Missouri TRM

ISR = In-service rate

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

- The deemed savings value referenced the 2018 Ameren Missouri TRM;
- ISR value was based on ADM site visit data; and
- Quantity of measures were sourced from program tracking data.

Table 3-16 ECM Blower Motor Energy Savings Calculation Inputs

Parameter	Values	Source
Deemed Savings	392.5	Ameren MO TRM
ISR	100%	ADM site visits

3.1.2.14 Method for Analyzing Savings from HVAC 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 recharge, 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 equipment [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

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

$\eta_{Pre\text{-}effective}$ = Measured efficiency of HVAC equipment immediately before maintenance

$\eta_{Post\text{-}effective}$ = Measured efficiency of HVAC equipment immediately after maintenance

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

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

Table 3-17 summarizes the equation parameters for the energy savings associated with the implementation of HVAC tune-up measures and their reference sources. The parameter values were derived from the following sources:

- Deemed parameter values referenced the 2018 Ameren Missouri TRM or the Illinois Statewide Technical Reference Manual v.7.0 (IL TRM);
- Capacity and MF_e data 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 3-17 HVAC 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	Program data
$SEER_{CAC}$	Varies	kBtu/kWh	Program data
$SEER_{ASHP}$	Varies	kBtu/kWh	Program data
$FLH_{St.\ Louis}$	2009	hr/yr	ENERGY STAR Air source heat pump calculator; EPA 2002
$Capacity_{Heat}$	Varies	Btu/hr	Program data
$HSPF_{ASHP}$	6.8	Btu/w-hr	IL TRM

Parameter	*Value*	*Unit*	*Source*
MF_e	Varies	-	Program data
ISR	100%	-	ADM site visits

3.1.3 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 3-18.

Table 3-18 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	0.0004660805	kW/kWh
Programmable Thermostat	Residential	HVAC	0.0004660805	kW/kWh
Faucets	Residential	Water Heating	0.0000887318	kW/kWh
Showers	Residential	Water Heating	0.0000887318	kW/kWh
Pipe Insulation	Residential	Water Heating	0.0000887318	kW/kWh
Filter Alarm	Residential	HVAC	0.0004660805	kW/kWh
Lighting	Residential	Lighting	0.0001492529	kW/kWh
Refrigeration	Residential	Refrigeration	0.0001285253	kW/kWh
Central Air Conditioner	Residential	Cooling	0.0009474181	kW/kWh
Room Air Conditioner	Residential	Cooling	0.0009474181	kW/kWh
ASHP	Residential	HVAC	0.0004660805	kW/kWh
ECM Blower Motor	Residential	HVAC	0.0004660805	kW/kWh
Lighting	Business	Lighting, Exterior Lighting, Miscellaneous	0.0001899635 0.0000056160 0.0001379439	kW/kWh
HVAC (Ventilation)/ ASHP	Business	HVAC	0.0004439830	kW/kWh
Heat Pump Water Heater	Business	Water Heating	0.0001811545	kW/kWh
Chiller	Business	Cooling	0.0009106840	kW/kWh
Appendix E of the MEEIA Cycle 2 Stipulation and Agreement				

3.2 Results of Ex Post Savings Estimation

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 3.2.1.11 provides a summary of measure-level savings.

3.2.1.1 LED Lighting Measures

Table 3-19 below summarizes the ex ante and ex post kWh savings for LED lighting measures by space type. As shown, the gross kWh realization rate for all lighting is 85%. However, that percentage varies significantly, depending on the location where measures were installed (i.e. the space type).

Ex ante savings values for residential lighting measures referenced the 2018 Ameren Missouri TRM that fully deems fixed savings based on the measure descriptor. Ex ante savings values for business lighting measures were based on custom calculations using site specific data (e.g. existing wattages of replaced lamps and hours of use data developed from staff interviews).

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 where the lighting measures were installed; and
- For all residential lamps, an in-service rate of 98% developed from site visit data was applied.

For residential lighting measures, the primary contributor to the difference between ex ante and ex post energy savings is that different hours of use values were referenced in calculations. Ex ante savings calculations applied a single hours of use value of 694 to all residential lighting measures, whereas ADM applied variable hours of use values based on the space type in which the lighting measures were installed, as specified in Table 3-3. The remaining difference between ex ante and ex post energy savings for residential lighting measures is explained by the evaluated in-service rate.

For business lighting measures, the primary contributor to the difference between ex ante and ex post energy savings is that, for most cases, different baseline wattages were referenced in calculations. Ex ante savings calculations applied existing wattages of replaced lamps and fixtures, whereas ADM applied EISA-compliant baselines, where applicable, determined by efficient lamp type and wattage. The remaining difference

between ex ante and ex post energy savings for business lighting measures is explained by ex post savings calculations applying heating and cooling interactive factors (HCIF) to measures that were installed in conditioned spaces. Ex ante savings calculations did not apply HCIF adjustments.

Table 3-19 Lighting Ex Post kWh Savings

Space Type	*Reported Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*	*Ex Post Net kWh Savings*	*Estimated Net-to-Gross Ratio*
Residential (Interior Tenant Units): Senior Housing	76,434	39,626	52%	39,626	100%
Residential (Interior Tenant Units): Family Housing	697,513	683,491	98%	683,491	100%
Residential: Exterior	3,729	20,139	540%	20,139	100%
Residential: Unknown	3,473	2,671	77%	2,671	100%
Business Lighting	7,671,061	6,419,014	84%	6,419,014	100%
Total	8,452,209	7,164,941	85%	7,164,941	100%

Table 3-20 summarizes the ex post kW savings resulting from lighting measures. The overall gross kW savings realization rate is 63%. The realization rate is a function of the gross kWh realization rate and the use of incorrect coincident factors in the calculation of ex ante kW savings for business lighting, most notably the non-24-hour lighting stipulated coincident peak demand factor being applied for 24-hour lighting measures.

Table 3-20 Lighting Ex Post Peak kW Savings

Space Type	*Reported Ex Ante kW Savings*	*Ex Post Gross kW Savings*	*Gross kW Savings Realization Rate*	*Ex Post Net kW Savings*	*Deemed Net-to-Gross Ratio*
Residential (Interior Tenant Units): Senior Housing	11.41	5.91	52%	5.91	100%
Residential (Interior Tenant Units): Family Housing	104.11	102.01	98%	102.01	100%
Residential: Exterior	0.56	3.01	540%	3.01	100%
Residential: Unknown	0.52	0.40	77%	0.40	100%
Business Lighting	1,355.91	823.14	61%	823.14	100%
Total	1,472.50	934.47	63%	934.47	100%

3.2.1.2 Refrigerator Recycling and Replacement Measures

Table 3-21 summarizes ex post kWh savings resulting from refrigerator replacements. The ex post kWh savings are 718,350 and are equal to 137% of the ex ante savings. Ex ante savings estimates are calculated using the 2018 Ameren Missouri TRM deemed kWh savings per-unit value of 499 kWh. In contrast, the ex post savings calculation is based on the energy consumption of the existing and efficient refrigerators. Overall, the ex post savings calculation used mostly project-specific information to calculate energy savings associated with early replacement of the refrigerator measures.

Table 3-21 Refrigerator Ex Post kWh Savings

Reported Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*	*Ex Post Net kWh Savings*	*Deemed Net-to-Gross Ratio*
524,449	718,350	137%	718,350	100%

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 PY2018 refrigerator measures.

Table 3-22 PY2018 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	2	1,631	373	1,258
1980-1989	90	1,499	375	1,124
1990-1992	190	1,069	375	693
1993-2000	659	1,007	377	630
2001-2010	91	976	376	600
Unknown	19	1,080	386	694
Total	1,051	1,060	376	683

Table 3-23 summarizes ex post kW savings resulting from refrigerator replacements in PY2018. The ex post kW savings are 92.33 and are equal to 137% of the ex ante kW savings.

Table 3-23 Refrigerator Ex Post kW Savings

Reported Ex Ante kW Savings	*Ex Post Gross kW Savings*	*Gross kW Savings Realization Rate*	*Ex Post Net kW Savings*	*Deemed Net-to-Gross Ratio*
67.40	92.33	137%	92.33	100%

3.2.1.3 Low-Flow Showerhead Measures

Table 3-24 summarizes ex post kWh savings for low-flow showerheads. Ex post kWh savings totaled 98,546 kWh, which equaled 84% of ex ante kWh savings. Ex ante savings estimates are calculated using the 2018 Ameren Missouri TRM that applies a fully deemed value of 276 kWh/unit, whereas, the ex post savings calculation is dependent on the household size (i.e. number of bedrooms) of the multifamily unit where the measures were installed and the quantity of measures verified on site. The resulting per-unit ex post gross kWh savings value for low-flow showerhead measures in PY2018 was 232 kWh/unit, down from 397 kWh/unit in PY2017.

The primary contributor to a decrease in the kWh/unit from PY2017 to PY2018 is the reduction in average number of people per household, dependent on program tracking data, from 1.86 in PY2017 to 1.52 in PY2018.

Additionally, ADM referenced collected field data to obtain gallons per minute (GPM) of installed low-flow showerheads (1.5 GPM) and the Ameren MO TRM to obtain the baseline gallons per minute (2.2 GPM) to calculate a GPM difference of 0.7. This GPM difference is lower than it was in PY2017 (1.0 GPM), further reducing the realized kWh/unit.

Finally, the estimated in-service rate slightly increased from 94% in PY2017 to 96% in PY2018.

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

Reported Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*	*Ex Post Net kWh Savings*	*Deemed Net-to-Gross Ratio*
116,961	98,546	84%	98,546	100%

Table 3-25 summarizes ex post kW savings for low-flow showerheads. Ex post peak kW reductions equaled 8.74 kW, which is 84% of ex ante kW savings.

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

Reported Ex Ante kW Savings	*Ex Post Gross kW Savings*	*Gross kW Savings Realization Rate*	*Ex Post Net kW Savings*	*Deemed Net-to-Gross Ratio*
10.39	8.74	84%	8.74	100%

3.2.1.4 Faucet Aerator Measures

Table 3-26 summarizes ex post kWh savings for faucet aerators. Ex post kWh savings totaled 57,265 kWh, which equals 73% of ex ante savings. Ex ante savings estimates are calculated using the 2018 Ameren Missouri TRM that applies a fully deemed value of 49 kWh/unit, whereas, the ex post savings calculation is dependent on the number of faucets per household, household size (i.e. number of bedrooms) of the multifamily unit where the measures were installed, and the quantity of measures verified on site. The resulting per-unit ex post gross kWh savings value for low-flow faucet aerator measures was 36 kWh/unit, down from 41 kWh/unit in PY2017.

The primary contributor to a decrease in the kWh/unit from PY2017 to PY2018 is the reduction in average number of people per household, dependent on program tracking data, from 1.71 in PY2017 to 1.60 in PY2018.

Finally, ADM referenced collected field data to estimate an in-service rate for low-flow faucet aerators of 95%, down from 98% in PY2017.

The combined net effect of each of these factors is a reduction in the per-unit ex post gross kWh savings from 41 kWh/unit in PY2017 to 36 kWh/unit in PY2018.

Table 3-26 Faucet Aerator Ex Post kWh Savings

Reported Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*	*Ex Post Net kWh Savings*	*Deemed Net-to-Gross Ratio*
78,295	57,265	73%	57,265	100%

Table 3-27 summarizes ex post kW savings for faucet aerators. Ex post kW savings totaled 5.08 and equaled 73% of ex ante kW savings.

Table 3-27 Faucet Aerator Ex Post kW Savings

Reported Ex Ante kW Savings	*Ex Post Gross kW Savings*	*Gross kW Savings Realization Rate*	*Ex Post Net kW Savings*	*Deemed Net-to-Gross Ratio*
6.95	5.08	73%	5.08	100%

3.2.1.5 Hot Water Pipe Insulation Measures

Table 3-28 summarizes ex post kWh savings for hot water pipe insulation implemented through the program. Ex post kWh savings totaled 5,681 kWh, which equals 94% of ex ante savings.

The primary contributor to the difference between ex ante and ex post energy savings is that an in-service rate of 96% was applied in ex post savings calculations. ADM discovered that the pipe wrap was not present in a single tenant unit at one site visited during field inspections.

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

Reported Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*	*Ex Post Net kWh Savings*	*Deemed Net-to-Gross Ratio*
6,042	5,681	94%	5,681	100%

As shown in Table 3-29, ex post kW savings totaled 0.50 and equaled 94% of ex ante savings.

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

Reported Ex Ante kW Savings	*Ex Post Gross kW Savings*	*Gross kW Savings Realization Rate*	*Ex Post Net kW Savings*	*Deemed Net-to-Gross Ratio*
0.54	0.50	94%	0.50	100%

3.2.1.6 Programmable Thermostat Measures

Table 3-30 summarizes ex post kWh savings from the installation of programmable thermostats. Ex post savings totaled 553,297 kWh and is equal to 164% of ex ante savings.

Ex ante savings estimates were calculated using the 2018 Ameren Missouri TRM, which applies fully deemed savings values based on the number of units installed. Two per unit

values were used: 194 kWh and 234 kWh. In contrast, the ex post savings calculation methodology is dependent on several factors, including the size of the system in Btu/hr, thermostat setback degrees, and equivalent full load hours of the equipment for which the programmable thermostat measures are installed.

Furthermore, there was an increase in the average per unit savings in PY2018 from PY2017 because of an increase in the capacity of HVAC units with electric resistance heating. (from 21,000 BTU/hr to 24,000 BTU/hr). This change resulted in higher per unit savings in PY2018.

Table 3-30 Programmable Thermostat Ex Post kWh Savings

Reported Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*	*Ex Post Net kWh Savings*	*Deemed Net-to-Gross Ratio*
336,736	553,297	164%	553,297	100%

Table 3-31 summarizes the ex post kW savings, which totaled 257.88 kW and were equal to 164% of the expected kW savings.

Table 3-31 Programmable Thermostat Ex Post kW Savings

Reported Ex Ante kW Savings	*Ex Post Gross kW Savings*	*Gross kW Savings Realization Rate*	*Ex Post Net kW Savings*	*Deemed Net-to-Gross Ratio*
156.95	257.88	164%	257.88	100%

3.2.1.7 Filter Alarm Measures

Table 3-32 summarizes ex post kWh savings for filter alarms. Ex post savings totaled 300,253 kWh and were equal to 74% of the ex ante savings. The reason for the difference between ex ante and ex post energy savings is that an in-service rate of 58% was applied in ex post savings calculations, whereas ex ante calculations assumed a 78% realization rate. ADM found that 8 of the 19 sampled filter alarms were not installed. ADM did not determine if the filter alarms were either installed and then removed or never installed in the first place.

Table 3-32 Filter Alarm Ex Post kWh Savings

Reported Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*	*Ex Post Net kWh Savings*	*Deemed Net-to-Gross Ratio*
405,326	300,253	74%	300,253	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

Reported Ex Ante kW Savings	*Ex Post Gross kW Savings*	*Gross kW Savings Realization Rate*	*Ex Post Net kW Savings*	*Deemed Net-to-Gross Ratio*
188.91	139.94	74%	139.94	100%

3.2.1.8 Heat Pump Water Heater Measures

Table 3-34 summarizes ex post kWh savings for heat pump water heaters implemented through the program. Ex post savings totaled 2,849 kWh and were equal to 111% of the ex ante savings.

Table 3-34 Heat Pump Water Heater Ex Post kWh Savings

Reported Ex Ante kWh Savings	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*	*Ex Post Net kWh Savings*	*Deemed Net-to-Gross Ratio*
2,578	2,849	111%	2,849	100%

Table 3-35 summarizes the ex post kW savings results, which totaled 0.52 kW and were equal to 111% of the ex ante kW savings.

Table 3-35 Heat Pump Water Heater Ex Post kW Savings

Reported Ex Ante kW Savings	*Ex Post Gross kW Savings*	*Gross kW Savings Realization Rate*	*Ex Post Net kW Savings*	*Deemed Net-to-Gross Ratio*
0.47	0.52	111%	0.52	100%

3.2.1.9 HVAC Replacement Measures

Table 3-36 summarizes ex post kWh savings for HVAC replacement measures. Ex post savings across all HVAC measures totaled 519,654 kWh and were equal to 33% of the ex ante savings. The primary factors contributing to differences between the ex post and ex ante savings are discussed below.

Air Source Heat Pumps: For the residential air source heat pump (ASHP) measures described in program tracking data as replacing electric resistance furnaces (identified as "Replace-at-fail Elec Resist Furnace" catalog name), ex ante heating savings calculations referenced an existing heating equipment efficiency of 3.41 HSPF. ADM found that all of the air source heat pumps identified as replace-at-fail were installed in newly constructed facilities. Accordingly, ADM applied the federal minimum standard 8.2 HSPF in the calculation of ex post gross heating energy savings for these measures. The impact on savings was significant because ASHPs described as replacing electric resistance furnaces upon failure accounted for 98% of the total residential ASHP ex ante kWh savings.

To address this discrepancy going forward, ADM has the following recommendations:

- Include a field in the program tracking data to identify new construction projects; and
- Ensure that the ex ante savings estimate for new construction equipment is based on a baseline equipment efficiency equal to the federal minimum efficiency standard.

Room Air Conditioners: Ex ante savings estimates for ENERGY STAR room air conditioner units were calculated using the 2018 Ameren Missouri TRM fully deemed savings value of 499 kWh/unit. The Ameren Missouri TRM sites an assumed baseline EER of 9.8 and an efficient EER of 10.8. The value assumed for capacity was not provided.

In contrast, the ex post energy savings methodology employed engineering equations that were dependent on constant equivalent full load cooling hours for St. Louis and data provided on project-specific inputs, including the nominal EER rating of the existing equipment (average of 9.45), the nominal capacity in Btuh/hr of the efficient equipment, and nominal EER rating of the efficient equipment (range from 11.51 to 11.81). The resulting per-unit ex post gross kWh savings value for ENERGY STAR room air conditioner measures was 276 kWh/unit.

Table 3-36 HVAC Replacement Measures Ex Post kWh Savings

Equipment Type	*Reported Ex Ante 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	45,196	47,629	105%	47,629	100%
Air Source Heat Pump	889,372	98,086	11%	98,086	100%
ECM Blower Motor	62,015	62,015	100%	62,015	100%
Room Air Conditioner	363,771	200,847	55%	200,847	100%
HVAC Ventilation[7]	8,226	16,873	205%	16,873	100%
Chiller	185,786	94,204	51%	94,204	100%
Total	1,554,367	519,654	33%	519,654	100%

Table 3-37 summarizes ex post kW savings for the HVAC replacement measures. Review of the data determined that variable coincident peak factors, including values that were not equal to any of the stipulated coincident peak factors, were applied to estimate ex ante kW savings. ADM referenced stipulated coincident factors in estimating ex post kW savings.

Table 3-37 HVAC Replacement Measures Ex Post kW Savings

Equipment Type	*Reported Ex Ante 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	42.82	45.12	105%	45.12	100%
Air Source Heat Pump	424.17	45.72	11%	45.72	100%
ECM Blower Motor	48.68	28.90	59%	28.90	100%
Room Air Conditioner	186.54	190.29	102%	190.29	100%
HVAC Ventilation	7.49	7.49	100%	7.49	100%
Chiller	169.19	85.79	51%	85.79	100%
Total	878.89	403.31	46%	403.31	100%

[7] HVAC ventilation measures are air source heat pump units installed through the business component.

3.2.1.10 HVAC Tune-Ups and Refrigerant Recharge Measures

Table 3-38 summarizes ex post kWh savings for air conditioner tune-ups and refrigerant recharge. The ex post savings across both measures totaled 493,825 and were equal to 140% of ex ante kWh savings.

Ex ante kWh savings were calculated using the 2018 Ameren Missouri TRM fully deemed savings values of 297 kWh per-unit for air conditioner tune-ups and 132 kWh per-unit for refrigerant recharge.

Ex post kWh savings were developed using an engineering equation that referenced MFLI subcontractor measured data from the pre- and post-period during the day of the tune-up, constant equivalent full load cooling hours for St. Louis, and heating and cooling equipment capacities that varied by project site and unit. The average ex post kWh savings for air conditioner tune-up and refrigerant recharge measures were 422 kWh/unit and 461 kWh/unit, respectively.

The realization rate of the complete maintenance process was 140% for the PY2018 program year, and 197% for the PY2017. The lower realization rate was due, in part, to a decrease in overall system capacity size from 22,918 BTU/hr in PY2017 to 22,786 BTU/hr in PY2018 . The decrease in realization rate was also a function of a decrease in the number of heat pumps units receiving maintenance that provide year-round savings after the tune-up: 24 heat pump units were serviced in PY2017 versus seven in PY2018.

Table 3-38 HVAC Tune-Ups Measures Ex Post kWh Savings

Equipment Type	*Reported Ex Ante 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	306,053	370,849	121%	370,849	100%
RCA10%	46,316	122,976	266%	122,976	100%
Total	352,369	493,825	140%	493,825	100%

Table 3-39 summarizes the ex post kW savings for air conditioner tune-ups and refrigerant recharge measures. The ex post kW savings across both measures totaled 230.16 and were equal to 140% of ex ante kW savings. The differences between ex ante and ex post kW savings resulted from the difference between ex ante and ex post kWh savings.

Table 3-39 HVAC Tune-Ups Ex Post kW Savings

Equipment Type	*Reported Ex Ante 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	142.65	172.85	121%	172.85	100%
RCA10%	21.46	57.32	267%	57.32	100%
Total	164.10	230.16	140%	230.16	100%

3.2.1.11 Measure-level Summary of Ex Post Savings

The PY2018 measure-level ex ante and ex post kWh and kW savings for the residential component of the CommunitySavers Program are summarized in Table 3-40 and Table 3-41, respectively. Similarly, Table 3-42 and Table 3-43 present the PY2018 measure-level ex ante and ex post kWh and kW savings, respectively, for the commercial component of the CommunitySavers Program.

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

Measure	*Number of Measures*	*Reported Ex Ante kWh Savings*	*Ameren Missouri TRM kWh Savings*	*Ex Post Gross kWh Savings*	*Ex post Gross kWh Savings as a Percentage of Reported Ex Ante kWh Savings*
ASHP SEER 15 Replace at Fail Elec Resist Furnace	105	710,220	710,220	46,027	6%
ASHP SEER 16 Replace at Fail	23	21,712	21,712	13,845	64%
ASHP SEER 16 Replace at Fail Elec Resist Furnace	24	157,440	157,440	38,214	24%
CAC SEER 14 Replace at Fail	11	1,802	1,802	1,843	102%
CAC SEER 15 Early Replacement	30	27,750	27,750	29,160	105%
CAC SEER 15 Replace at Fail	30	8,970	8,970	8,972	100%
CAC SEER 16 Early Replacement	7	6,675	6,699	7,655	115%
Concept 3 Installation Auto Fan	158	62,015	62,015	62,015	100%
Dirty Filter Alarm	2,145	405,326	405,405	300,253	74%
ENERGY STAR Refrigerator	1,051	524,449	524,449	718,350	137%
ENERGY STAR Room Air Conditioner	729	363,771	363,771	200,847	55%
HVAC Maintenance and Tune-Up	1,031	306,053	306,207	370,849	121%
LED 12W Dimmable Light Bulb	3,752	123,816	123,816	118,642	96%
LED 15W Flood Light PAR30 Bulb	3	60	60	91	151%
LED 8W Globe Light G25 Bulb	5,248	73,472	73,472	76,840	105%
LED 9-10.5W Downlight E26 Light Bulb	25,383	583,801	583,809	550,354	94%
Low Flow Faucet Aerator	1,598	78,295	78,302	57,265	73%
Low Flow Showerhead	424	116,961	117,024	98,546	84%
Pipe Insulation	1,211	6,042	5,922	5,681	94%
Programmable Thermostat	1,684	336,736	326,696	553,297	164%
RCA 10% Improvement	348	46,316	127,020	122,976	266%
Total	**44,995**	**3,961,680**	**4,032,561**	**3,381,722**	**85%**

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

Measure	*Number of Measures*	*Reported Ex Ante kW Savings*	*Ameren Missouri TRM kW Savings*	*Ex Post Gross kW Savings*	*Ex post Gross kW Savings as a Percentage of Reported Ex Ante kW Savings*
ASHP SEER 15 Replace at Fail Elec Resist Furnace	105	331.02	331.07	21.45	6%
ASHP SEER 16 Replace at Fail	23	19.77	10.12	6.45	33%
ASHP SEER 16 Replace at Fail Elec Resist Furnace	24	73.38	73.37	17.81	24%
CAC SEER 14 Replace at Fail	11	1.71	1.71	1.75	102%
CAC SEER 15 Early Replacement	30	26.29	26.30	27.63	105%
CAC SEER 15 Replace at Fail	30	8.50	8.49	8.50	100%
CAC SEER 16 Early Replacement	7	6.32	6.35	7.25	115%
Concept 3 Installation Auto Fan	158	48.68	28.91	28.90	59%
Dirty Filter Alarm	2,145	188.91	188.97	139.94	74%
ENERGY STAR Refrigerator	1,051	67.40	67.37	92.33	137%
ENERGY STAR Room Air Conditioner	729	186.54	341.14	190.29	102%
HVAC Maintenance and Tune-Up	1,031	142.65	142.69	172.85	121%
LED 12W Dimmable Light Bulb	3,752	18.48	18.76	17.71	96%
LED 15W Flood Light PAR30 Bulb	3	0.01	0.01	0.01	151%
LED 8W Globe Light G25 Bulb	5,248	10.97	10.50	11.47	105%
LED 9-10.5W Downlight E26 Light Bulb	25,383	87.14	86.30	82.14	94%
Low Flow Faucet Aerator	1,598	6.95	6.87	5.08	73%
Low Flow Showerhead	424	10.39	10.39	8.74	84%
Pipe Insulation	1,211	0.54	0.48	0.50	94%
Programmable Thermostat	1,684	156.95	152.40	257.88	164%
RCA 10% Improvement	348	21.46	120.41	57.32	267%
Total	**44,995**	**1,414.05**	**1,632.60**	**1,156.00**	**82%**

Table 3-42 Summary of Commercial Measure-Level Ex Post kWh Savings

Measure	*Number of Measures*	*Reported Ex Ante kWh Savings*	*Ameren Missouri TRM kWh Savings*	*Ex Post Gross kWh Savings*	*Ex post Gross kWh Savings as a Percentage of Reported Ex Ante kWh Savings*
A-Line LED lamp <=20w replacing incandescent >=40w	265	99,628	39,432	57,990	58%
Chiller	1	185,786	112,784	94,204	51%
Exterior LED replacing HID_SBDI	1,237	979,366	1,143,235	722,056	74%
Exterior LED replacing HID_STANDARD	425	334,873	228,948	250,612	75%
Exterior Lighting (24/7)	191	101,563	205,803	75,082	74%
Exterior Lighting (less than 24/7) - EUL 15	9	447	447	2,497	559%
Exterior Lighting (less than 24/7) - EUL 17	1	22	22	22	100%
Exterior Lighting (less than 24/7) - EUL 9	2,013	445,546	171,105	372,371	84%
Heat Pump Water Heater	1	2,578	141,041	2,849	111%
HP under 65,000	10	8,226	1,740	16,873	205%
Interior LED replacing HID	6	2,948	2,948	2,846	97%
Interior Lighting - EUL 11	105	41,794	41,794	28,871	69%
Interior Lighting - EUL 15	26	1,574	1,574	4,014	255%
Interior Lighting - EUL 16	79	30,218	30,218	17,619	58%
Interior Lighting - EUL 17	6,136	2,865,553	2,865,553	2,549,465	89%
Interior Lighting - EUL 9	7,827	2,273,335	2,273,335	1,771,217	78%
LED (BAR or R) Reflector Lamp	201	37,578	36,441	47,835	127%
LED (BAR or R) Reflector Lamp (>= 12 Hours of Use)	21	6,799	5,166	5,978	88%
LED (PAR) Reflector Lamp	14	3,890	2,933	8,804	226%
LED Exit Sign - 3_0 W_CF 9 base	30	7,293	7,293	8,935	123%
LED Exit Sign - 3_0 W_Inc30 base	66	14,784	14,771	14,233	96%
LED replacing fluorescent T12	802	251,881	43,869	209,325	83%
LED replacing fluorescent T5	2	1,051	1,051	1,064	101%
LED replacing fluorescent T8	807	170,919	34,298	268,178	157%

Measure	*Number of Measures*	*Reported Ex Ante kWh Savings*	*Ameren Missouri TRM kWh Savings*	*Ex Post Gross kWh Savings*	*Ex post Gross kWh Savings as a Percentage of Reported Ex Ante kWh Savings*
Total	**20,275**	**7,867,651**	**7,405,800**	**6,532,940**	**83%**

Table 3-43 Summary of Commercial Measure-Level Ex Post kW Savings

Measure	*Number of Measures*	*Reported Ex Ante kW Savings*	*Ameren Missouri TRM kW Savings*	*Ex Post Gross kW Savings*	*Ex post Gross kW Savings as a Percentage of Reported Ex Ante kW Savings*
A-Line LED lamp <=20w replacing incandescent >=40w	265	18.93	7.50	9.50	50%
Chiller	1	169.19	38.36	85.79	51%
Exterior LED replacing HID_SBDI	1,237	186.04	6.43	4.06	2%
Exterior LED replacing HID_STANDARD	425	63.61	1.28	1.41	2%
Exterior Lighting (24/7)	191	0.57	1.17	10.36	1816%
Exterior Lighting (less than 24/7) - EUL 15	9	0.00	0.00	0.01	559%
Exterior Lighting (less than 24/7) - EUL 17	1	0.00	0.00	0.00	100%
Exterior Lighting (less than 24/7) - EUL 9	2,013	2.50	32.41	2.09	84%
Heat Pump Water Heater	1	0.47	25.55	0.52	111%
HP under 65,000	10	7.49	0.77	7.49	100%
Interior LED replacing HID	6	0.56	0.02	0.54	97%
Interior Lighting - EUL 11	105	7.94	7.94	3.98	50%
Interior Lighting - EUL 15	26	0.30	0.30	0.76	255%
Interior Lighting - EUL 16	79	5.74	5.74	2.43	42%
Interior Lighting - EUL 17	6,136	544.35	544.35	351.68	65%
Interior Lighting - EUL 9	7,827	431.85	431.85	336.47	78%
LED (BAR or R) Reflector Lamp	201	7.14	6.91	5.66	79%

Measure	*Number of Measures*	*Reported Ex Ante kW Savings*	*Ameren Missouri TRM kW Savings*	*Ex Post Gross kW Savings*	*Ex post Gross kW Savings as a Percentage of Reported Ex Ante kW Savings*
LED (BAR or R) Reflector Lamp (>= 12 Hours of Use)	21	1.29	0.98	0.22	17%
LED (PAR) Reflector Lamp	14	0.74	0.56	0.05	7%
LED Exit Sign - 3_0 W_CF 9 base	30	1.39	1.39	1.23	89%
LED Exit Sign - 3_0 W_Inc30 base	66	2.81	2.81	1.96	70%
LED replacing fluorescent T12	802	47.85	8.34	39.76	83%
LED replacing fluorescent T5	2	0.20	0.20	0.15	73%
LED replacing fluorescent T8	807	32.10	6.54	50.82	158%
Total	**20,275**	**1,533.06**	**1,131.39**	**916.94**	**60%**

3.2.1.12 Measure-level Summary of Per-Unit Savings

Table 3-44 presents the per-unit ex ante, Ameren Missouri TRM, and ex post kWh and kW savings by program measure for the residential component of the CommunitySavers Program. Similarly, Table 3-44 presents the per-unit ex ante, Ameren Missouri TRM, and ex post kWh and kW savings by program measure for the commercial component of the CommunitySavers Program.

Table 3-44 Summary of Residential Measure-Level Per-Unit Savings

Measure	*Number of Measures*	*Per-unit Reported Ex Ante kWh Savings*	*Per-unit Ameren Missouri TRM kWh Savings*	*Per-unit Ex Post Gross kWh Savings*	*Per-unit Reported Ex Ante kW Savings*	*Per-unit Ameren Missouri TRM kW Savings*	*Per-unit Ex Post Gross kW Savings*
ASHP SEER 15 Replace at Fail Elec Resist Furnace	105	6,764	6,764	438	3.1526	3.1530	0.2043
ASHP SEER 16 Replace at Fail	23	944	944	602	0.8598	0.4400	0.2806
ASHP SEER 16 Replace at Fail Elec Resist Furnace	24	6,560	6,560	1,592	3.0575	3.0570	0.7421
CAC SEER 14 Replace at Fail	11	164	164	168	0.1550	0.1550	0.1587

Measure	*Number of Measures*	*Per-unit Reported Ex Ante kWh Savings*	*Per-unit Ameren Missouri TRM kWh Savings*	*Per-unit Ex Post Gross kWh Savings*	*Per-unit Reported Ex Ante kW Savings*	*Per-unit Ameren Missouri TRM kW Savings*	*Per-unit Ex Post Gross kW Savings*
CAC SEER 15 Early Replacement	30	925	925	972	0.8764	0.8766	0.9209
CAC SEER 15 Replace at Fail	30	299	299	299	0.2833	0.2830	0.2834
CAC SEER 16 Early Replacement	7	954	957	1,094	0.9030	0.9065	1.0360
Concept 3 Installation Auto Fan	158	393	393	393	0.3081	0.1830	0.1829
Dirty Filter Alarm	2,145	189	189	140	0.0881	0.0881	0.0652
ENERGY STAR Refrigerator	1,051	499	499	683	0.0641	0.0641	0.0878
ENERGY STAR Room Air Conditioner	729	499	499	276	0.2559	0.4680	0.2610
HVAC Maintenance and Tune-Up	1,031	297	297	360	0.1384	0.1384	0.1676
LED 12W Dimmable Light Bulb	3,752	33	33	32	0.0049	0.0050	0.0047
LED 15W Flood Light PAR30 Bulb	3	20	20	30	0.0030	0.0030	0.0045
LED 8W Globe Light G25 Bulb	5,248	14	14	15	0.0021	0.0020	0.0022
LED 9-10.5W Downlight E26 Light Bulb	25,383	23	23	22	0.0034	0.0034	0.0032
Low Flow Faucet Aerator	1,598	49	49	36	0.0043	0.0043	0.0032
Low Flow Showerhead	424	276	276	232	0.0245	0.0245	0.0206
Pipe Insulation	1,211	5	5	5	0.0004	0.0004	0.0004
Programmable Thermostat	1,684	200	194	329	0.0932	0.0905	0.1531
RCA 10% Improvement	348	133	365	353	0.0617	0.3460	0.1647

Table 3-45 Summary of Commercial Measure-Level Per-Unit Savings

Measure	*Number of Measures*	*Per-unit Reported Ex Ante kWh Savings*	*Per-unit Ameren Missouri TRM kWh Savings*	*Per-unit Ex Post Gross kWh Savings*	*Per-unit Reported Ex Ante kW Savings*	*Per-unit Ameren Missouri TRM kW Savings*	*Per-unit Ex Post Gross kW Savings*
A-Line LED lamp <=20w replacing incandescent >=40w	265	376	149	219	0.0714	0.0283	0.0358
Chiller	1	185,786	112,784	94,204	169.1923	38.3600	85.7904
Exterior LED replacing HID_SBDI	1,237	792	924	584	0.1504	0.0052	0.0033
Exterior LED replacing HID_STANDARD	425	788	539	590	0.1497	0.0030	0.0033
Exterior Lighting (24/7)	191	532	1,078	393	0.0030	0.0061	0.0542
Exterior Lighting (less than 24/7) - EUL 15	9	50	50	277	0.0003	0.0003	0.0016
Exterior Lighting (less than 24/7) - EUL 17	1	22	22	22	0.0001	0.0001	0.0001
Exterior Lighting (less than 24/7) - EUL 9	2,013	221	85	185	0.0012	0.0161	0.0010
Heat Pump Water Heater	1	2,578	141,041	2,849	0.4670	25.5502	0.5161
HP under 65,000	10	823	174	1,687	0.7492	0.0773	0.7491
Interior LED replacing HID	6	491	491	474	0.0933	0.0028	0.0901
Interior Lighting - EUL 11	105	398	398	275	0.0756	0.0756	0.0379
Interior Lighting - EUL 15	26	61	61	154	0.0115	0.0115	0.0293
Interior Lighting - EUL 16	79	383	383	223	0.0727	0.0727	0.0308
Interior Lighting - EUL 17	6,136	467	467	415	0.0887	0.0887	0.0573
Interior Lighting - EUL 9	7,827	290	290	226	0.0552	0.0552	0.0430
LED (BAR or R) Reflector Lamp	201	187	181	238	0.0355	0.0344	0.0282
LED (BAR or R) Reflector Lamp (>= 12 Hours of Use)	21	324	246	285	0.0615	0.0467	0.0103
LED (PAR) Reflector Lamp	14	278	210	629	0.0528	0.0398	0.0035
LED Exit Sign - 3_0 W_CF 9 base	30	243	243	298	0.0462	0.0462	0.0411
LED Exit Sign - 3_0 W_Inc30 base	66	224	224	216	0.0426	0.0425	0.0297
LED replacing fluorescent T12	802	314	55	261	0.0597	0.0104	0.0496
LED replacing fluorescent T5	2	526	526	532	0.0998	0.0998	0.0734
LED replacing fluorescent T8	807	212	43	332	0.0398	0.0081	0.0630

4 Process Evaluation

This chapter presents the results of the process evaluation of the Ameren Missouri CommunitySavers Program during PY2018. The purposes of this process evaluation are to assess the effectiveness of Ameren Missouri's PY2018 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) Evaluation of Demand-Side Program and Demand-Side Rates subsection of the Resource Acquisition Strategy Selection section: 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 five 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 two staff members of Ameren Missouri and its implementation contractor, ICF International (ICF); 92 tenants; and 14 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 (2), Ameren Missouri (1), ICF (1)	In-depth interview	March 2019	Program function; communication; tracking and reporting; quality control	Qualitative
Database analysis	Database review	March 2019 to April 2019	Number of projects; project type and details; data quality	Quantitative

*Data Source**	*Method*	*Dates*	*Research Objective*	*Analysis Type*
Participants (14)	Online/Telephone Survey	December 2018	Program experiences; satisfaction with program	Quantitative and qualitative
Tenant (92)	Mail	December 2018 to January 2019	Site visit recruitment; program experiences; satisfaction with program	Quantitative and qualitative
Post-install site visit (25 units)	On-site M&V	January to February 2019	Verify baseline operating conditions	Quantitative and qualitative

* Sample sizes in parentheses

4.1.1 Program Staff Feedback

Ameren Missouri and ICF staff noted that PY2018 was a successful year for the program. The program design and operations remained largely unchanged in PY2018. Staff noted that the PY2018 marketing activities included outreach in the form of email newsletters, mailed postcards, presentations to community associations, and direct outreach to onsite property managers and property management companies.

Staff noted that encouraging properties to implement non-lighting common area projects is a challenge because of the higher cost of these measures.

4.1.2 Program Database

ADM analyzed program data to characterize the types of projects completed during the year, and the geographic distribution of projects. The findings of the analysis are:

- The share of program savings resulting from MFLI direct install measures decreased from 57% in PY2017 to 21% in PY2018. There was also a large increase in the share of savings resulting from custom measures; in PY2017, there were no custom measures installed and in PY2018 50% of the ex ante savings resulted from custom measures. Staff reported that the increase was due, in part, to the routing of lighting measures through the custom program because prescriptive incentives, which are linked to the business program incentives, were decreased.
- Lighting measures were most often installed in tenant units with 76% of units receiving these measures. Additionally, 75% of units received HVAC measures (Tune-ups, refrigerant charge, dirty filter alarms, and programmable thermostats). In comparison, 26% received refrigerators, and 18% received water heating measures.
- Participating properties were disproportionately located in St. Louis and its suburbs relative to the distribution of multifamily properties and low-income residents.

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.

The most frequently mentioned sources of awareness, each mentioned by two respondents were word of mouth, from another person in the organization, from the program account manager or other representative, at a seminar, and through previous experience with the program.

All survey respondents who had not completed a common area project indicated they were aware that Ameren Missouri also offers financial incentives for making energy efficiency improvements to common areas of properties.

Two-thirds or more of survey respondents were satisfied with the field representatives on-time arrival for appointment, appearance (ID badge, uniform, presentability), courtesy and professionalism, willingness to help, product/service/program knowledge, and preparedness (i.e., came with all tools/parts needed). One respondent was dissatisfied with this aspect of the program.

Sixty-seven percent of survey respondents were satisfied with the length of time required to perform the installation/service, but two respondents were dissatisfied with this aspect of their participation.

Sixty-six percent of respondents were satisfied with the steps to get through the program and 58% were satisfied with the energy efficiency improvements made through the program. Eighty-six percent of respondents were satisfied with the program overall.

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.

Eighty-seven percent of tenants reported that the energy efficiency improvements made to their homes reduced their electricity costs. Eighty-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 high. Eighty-eight percent of tenants were very satisfied with the efficiency improvements made to the shared/common areas of the property, 76% of tenants were very satisfied with the installation process, 76% were very satisfied with the information improvements made to their homes, and 70% were very satisfied with the energy efficiency improvements made in their home.

4.2 Program Staff Feedback

ADM interviewed the Ameren Missouri program manager, and two ICF program managers. During the interviews, staff discussed several topics related to program design and operational procedures. The focus of the interviews was on changes made since PY2017. The following sections summarize the findings of these interviews.

4.2.1 Program Design and Goals

Overall staff thought that the program performed very well during the year. Staff noted that some barriers had been addressed prior to PY2018 including the legislation change that allowed the program to enroll properties that received the Low Income Tax Credits for common area rebates, the addition of non-24 hour exterior lighting, and the partnership with Spire to deliver measures to properties with natural gas water and space heating.

A notable change in program activity in PY2018 was the large increase in the share of savings resulting from custom measures – mostly from custom lighting measures. Staff noted that the increase was due to a change in the incentives for the prescriptive lighting measures which were tied to the incentives offered in the business program. ICF staff indicated that they routed lighting projects through the custom track to be able to provide customers with incentive levels that would encourage them to install the measures.

An ongoing challenge is encouraging properties to make non-lighting improvements to common areas such as building envelope improvements and improvements to centralized heating and cooling systems. Ameren Missouri staff noted that in the future, the program will focus on whole building retrofits to encourage adoption of additional measures. ICF staff noted that the higher costs of some measures present a significant barrier and require higher incentives. Furthermore, the respondent noted that higher incentives are important because properties may not always be able to take advantage of financing opportunities because of the terms of previous financing arrangements.

4.2.2 Program Staffing and Roles

One of the ICF program managers who supported the program in PY2018 and PY2017 did not support the program in PY2019. Aside from this, staff reported that there were not any other significant changes to staffing or roles.

4.2.3 Program Communication

Communication processes remain consistent with those in place in PY2018. Ameren Missouri and ICF staff held a standing weekly meeting to discuss program status and current issues. During this meeting staff discussed current program issues that needed to be addressed. Additionally, Ameren Missouri and ICF staff met monthly to discuss the overall program strategy. At one point of the year, staff noted that they increased the

frequency of the monthly meeting to twice a month because of additional planning needs. Regular ad hoc communications between the Ameren Missouri and ICF managers occurred as well.

4.2.4 Program Marketing and Outreach

The marketing approach used during PY2018 was consistent with the approach used in prior years of the cycle. During PY2018, staff sent email newsletters and mailed postcards to property managers – 6 of each were sent in PY2018—to increase awareness of the program offerings. Additionally, the program continued to present information about the program to neighborhood associations. Direct outreach to individual properties and property management companies continued to be very important for developing projects.

Ameren Missouri staff noted that while outreach was made to all types of low-income multifamily properties, the program was particularly successful with larger property management companies with multiple properties during the cycle.

Staff continued to use leave behind materials to educate tenants and case studies, but these materials were not modified in PY2018.

4.2.5 DI Subcontractors and Trade Allies

ICF staff reported that there was not any large group training of trade ally efforts but that the program engaged in one-on-one outreach and training to trade allies. Staff reported that trade allies were not a significant source of program projects.

4.2.6 Program Participation Process

The program participation process remained the same in PY2018.

4.2.7 Quality Control and Verification

The quality control and verification processes remained largely the same in PY2018. Staff reported that they did increase pre-direct install verifications to get better information on the types of fuel used for water and space heating at the property. Ameren Missouri staff reported that the quality control processes were working well and any issues identified were addressed.

4.2.8 Program Reporting and Project Tracking

Ameren Missouri staff reported that they received several reports that meet different needs and that the reports were provided on time.

4.3 Database Analysis

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

4.3.1 Analysis of Completed Projects

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

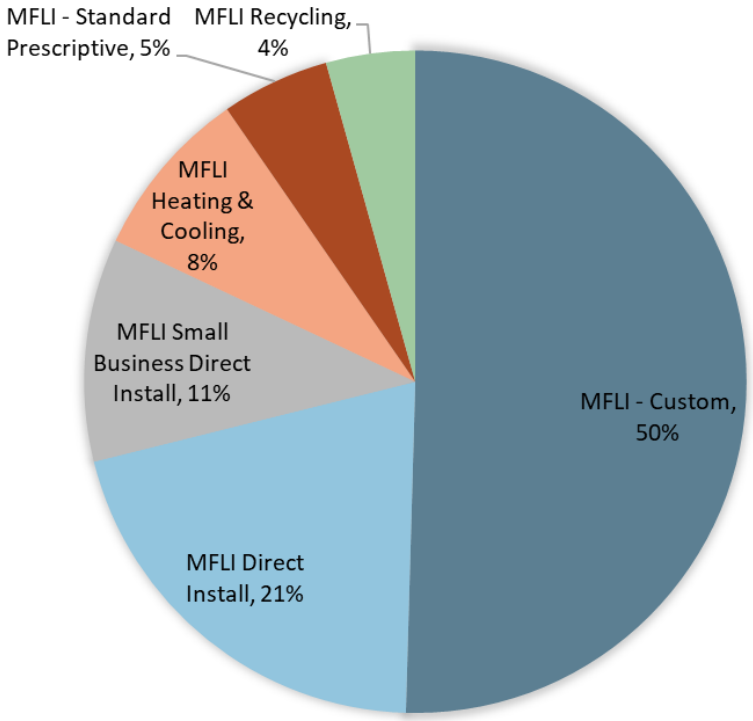
4.3.1.1 Overall Analysis of Projects and Participants

In total, 131 properties and 3,787 tenant units received efficiency measures through CommunitySavers in PY2018.[8]

Figure 4-1 displays program savings by program component. As shown, 50% of program savings resulted from MFLI Custom measures, followed by MFLI Direct Install measures (21%), and Small Business Direct Install measures (11%).

Interior lighting accounted for 87% of the overall savings within the MFLI Custom component, followed by exterior lighting (less than 24/7) at 7%, cooling at 3%, and exterior lighting (24/7) at 2% (not shown). Thirty-two percent of the MFLI Direct Install ex ante savings resulted from room air conditioners and dirty filter alarm (MF), followed by HVAC maintenance and tune-ups (13%) (not shown).

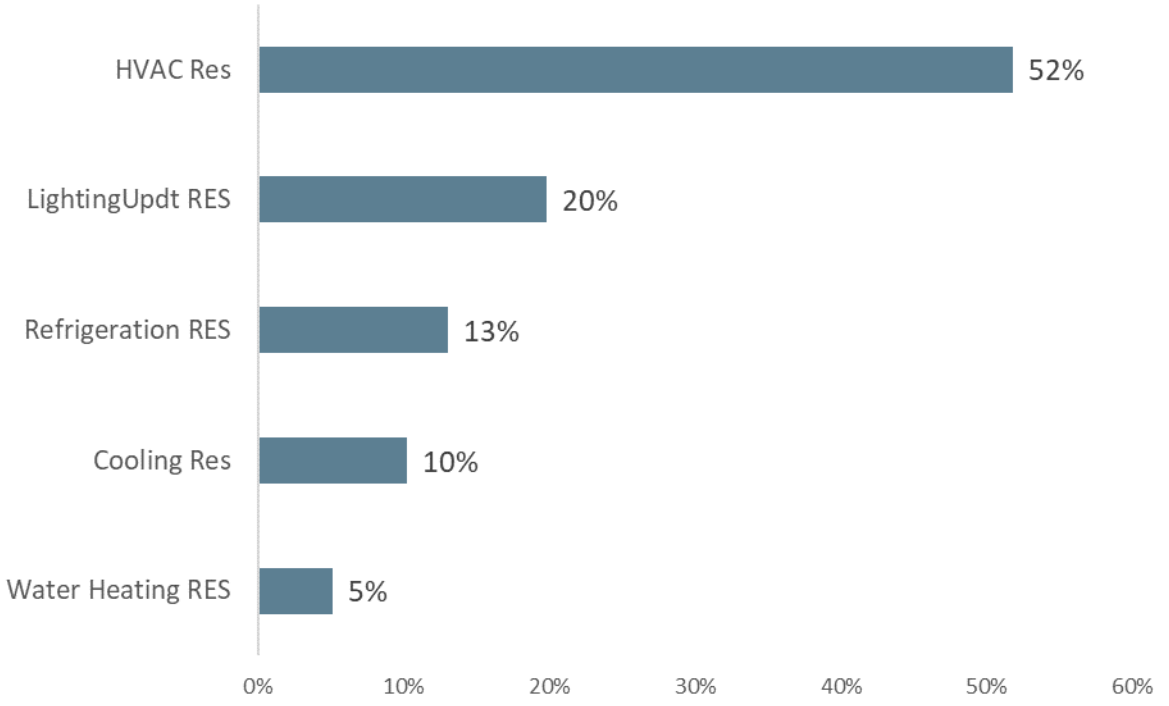
Figure 4-1 Ex Ante kWh Savings by Program Component



[8] The number of tenant units is based on the count of unique account numbers for measures provided through residential program components.

As shown in Figure 4-2, ex ante savings for residential measures were distributed across the five end-uses, with HVAC measures accounting for the largest share of savings (52%). Lighting accounted for 20% of residential savings, refrigerators for 13%, and cooling measures for 10%.

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



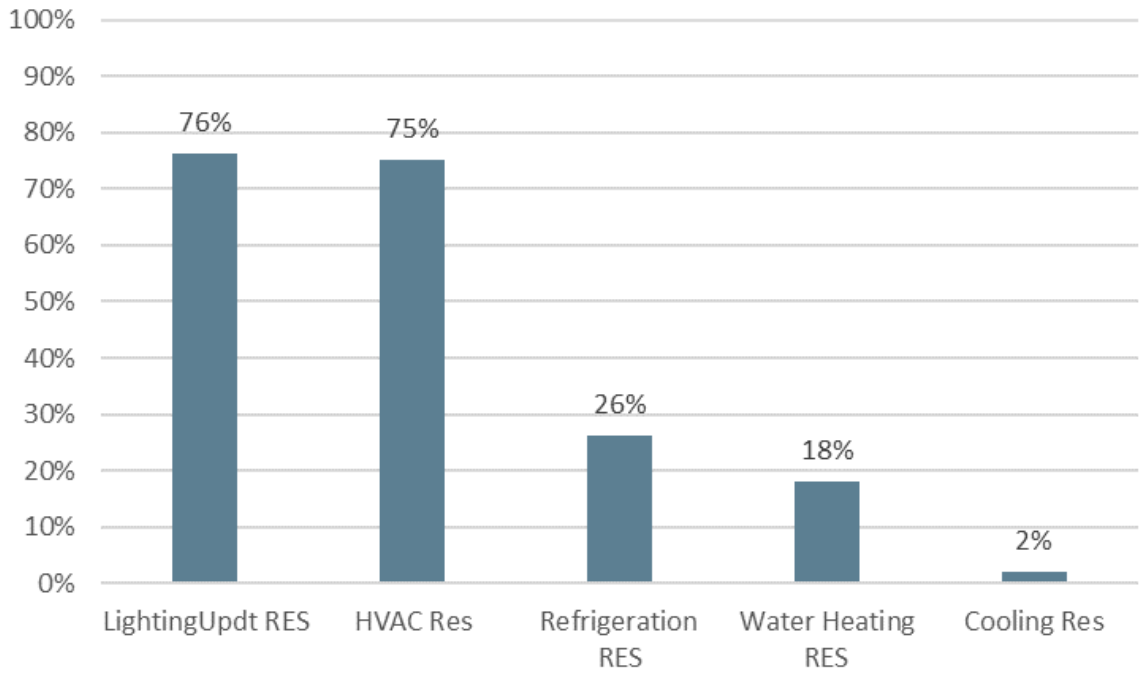
4.3.1.2 Direct Install Projects

Figure 4-3 summarizes the share of units receiving measures within the various end-uses. As shown, 76% of units received lighting measures, followed by HVAC (75%), refrigerators (26%), water heating (18%), and cooling (2%).

The number of tenant units that received measures in PY2018 declined from 4,486 in PY2017 to 3,787 in PY2018.[9] Of the properties that received common area measure incentives in PY2018, approximately 40% received tenant measures during the PY2016 – PY2018 period.

[9] Based on a count of unique account numbers.

Figure 4-3 Percent of Units Receiving End-Use



4.3.1.3 Geographic Area

The majority of tenant units (70%), buildings (64%), and projects ex ante savings (59%) were in St. Louis and its near suburbs (Table 4-2). To put these values in context, the table also displays the distribution of multifamily housing and lower-income rental customers. While both indicators are imperfect proxies for the low-income multifamily property target market, they both 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 = 3,787)*	*Properties (N = 131)*	*Ex Ante kWh Savings*	*Multifamily Housing[1]*	*Household Income of < $50,000[2]*
St. Louis and near suburbs[3]	70%	68%	58%	49%	41%
Outer suburbs[4]	18%	20%	18%	25%	24%
All other areas[5]	11%	18%	24%	26%	35%
Total	100%	100%	100%	100%	100%

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
4. ZIP codes 63100-63199.
5. ZIP codes 63000-63099 and 63300-63399.
6. ZIP codes 63501, 63701, 63703, 63740, 63841, 64024, 65065, 65101, and 65109.

4.4 Owner/Manager Survey

ADM contacted 32 owners and managers that completed projects through the program in PY2018 and 14 responded to the survey, for a response rate of approximately 44%. Participants were initially contacted by telephone.

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

4.4.1 Description of Sample

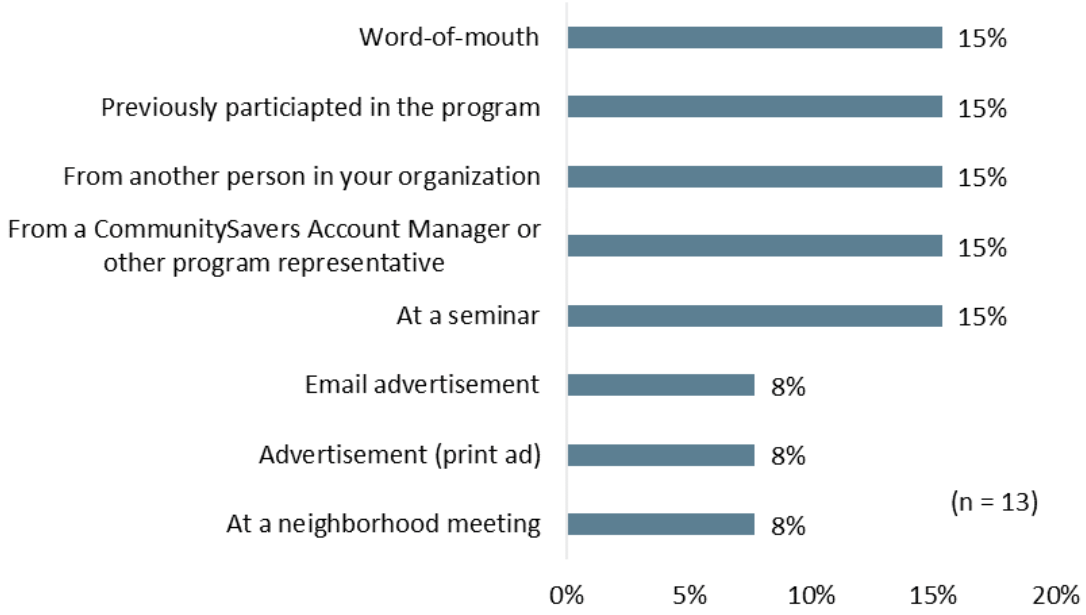
Seven respondents had completed in-unit direct install projects and eight had completed common area projects during the program year.

One-half of respondents (50%) reported that their organization both owned and managed the property that received efficiency improvements through the program, 29% indicated that they only managed the property, and 7% indicated they own it only.

4.4.2 Program Awareness

The most common sources of awareness, each cited by two respondents (15%), were word-of-mouth, from another person in the company, from a program account manager or other program representative, at a seminar, or through previous participation in the program. Figure 4-4 summarizes all the responses for program awareness.

Figure 4-4 Program Awareness



4.4.3 Awareness of Common Area Incentives

All survey respondents indicated they were aware that Ameren Missouri also offers financial incentives for making energy efficiency improvements to common areas of properties. Four respondents indicated they were very likely to complete energy efficiency improvements in the common areas of the property in the future, while one indicated they were somewhat unlikely.

Ninety percent of respondents who completed common are projects stated that the available incentives completely met their needs and another 10% indicated they “mostly” met their needs (see Table 4-3).

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=13)*
1 - Not at all	0%
2	0%
3	0%
4	10%
5 - Completely	90%

4.4.4 Barriers to Efficiency and Reasons for Participating in the program

Reducing tenants’ bills and improving tenants’ comfort and satisfaction were the most common reasons for completing the in-unit efficiency improvements at the property. Table

4-4 summarizes all the motivations for marking the improvements noted by owners and managers.

Table 4-4 Reasons for Completing In-Unit Improvements

Response	*Percentage of Responses (n = 7)*
Reduce tenant utility bills	86%
Improve tenant comfort and satisfaction	71%
Reduce property utility bills	29%
To take advantage of rebates/no-cost efficiency improvements	29%
To replace old or non-functioning equipment	14%
To make the units more attractive to prospective tenants	14%
Some other reason	14%

Respondents discussed the challenges in making efficiency improvements to their buildings, either through the program, or in general. The challenges included funding, issues with tenants, problems with equipment and other items (see below for a summary).

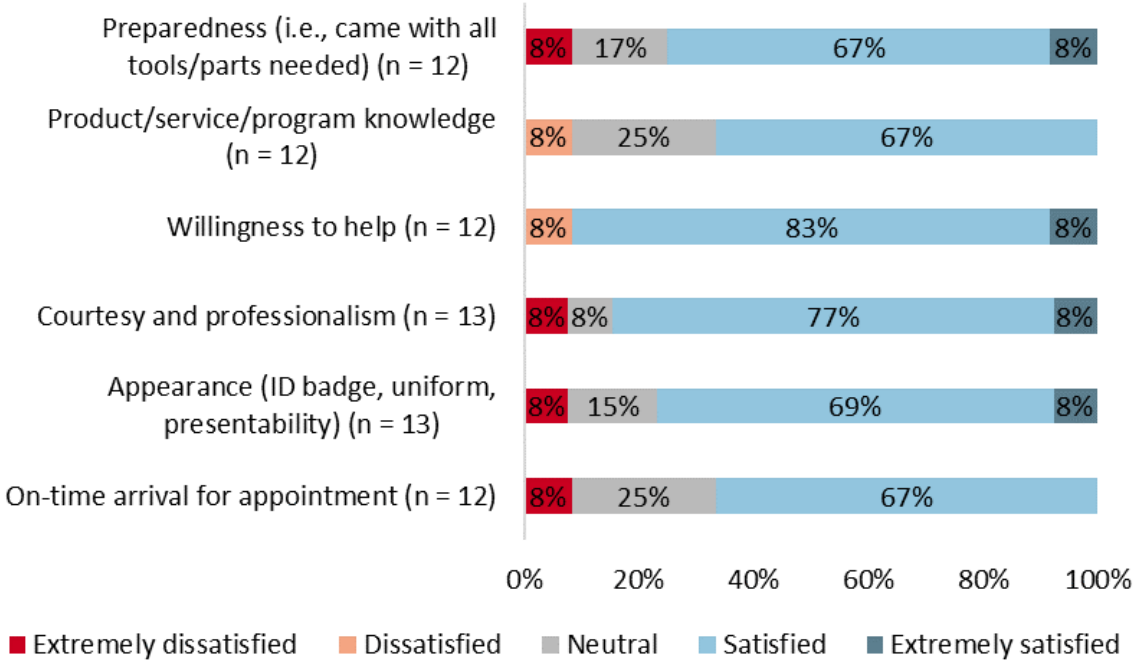
- *Financial challenges*: Three respondents indicated they are limited by financial constraints ranging from funding to cost of project to nonpayment of rent.
- *Equipment issues*: One respondent stated they received the wrong bulbs.
- *High costs for tenants*: Two respondent stated that tenant energy bills were high.
- *Trade ally issues*: One respondent indicated they had difficulty working with the subcontractor.
- *Scheduling issues*: One respondent stated there are issues with scheduling.

4.4.5 Experiences with Field Service Representatives

Three survey respondents indicated a CommunitySavers Program representative provided a free energy assessment of their property. Among those who received the assessment, all somewhat or completely agreed that the assessment was completed efficiently, the representative was courteous and knowledgeable, the assessment was comprehensive, and the recommendations based on the energy assessment were appropriate for the property.

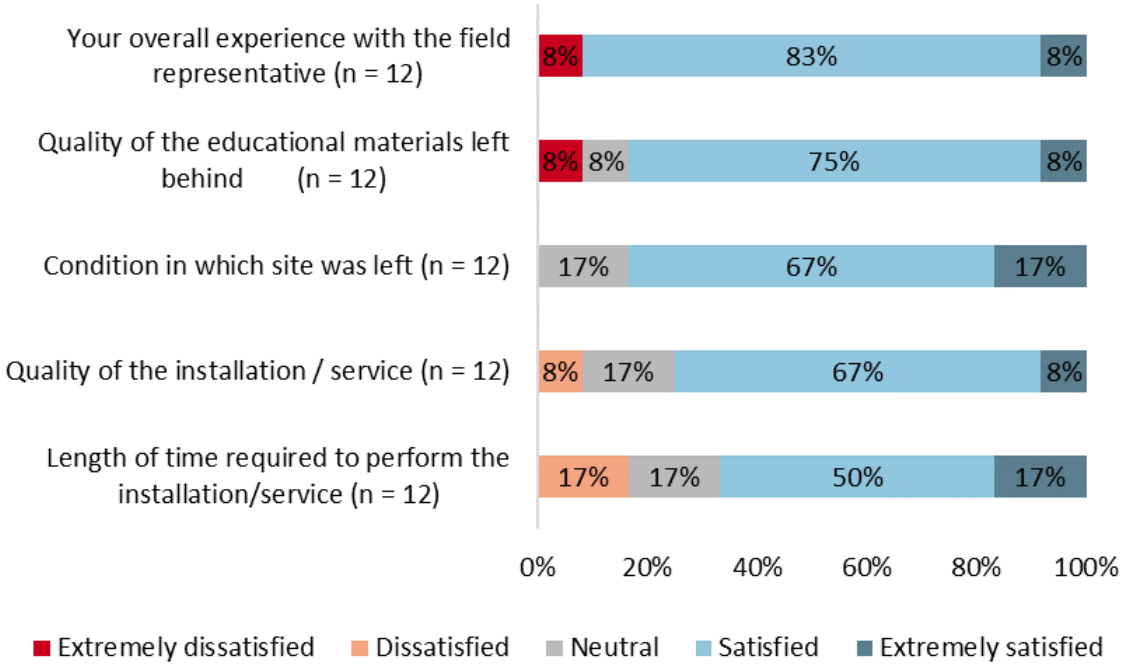
Most survey respondents were satisfied with the on-time arrival for appointment, appearance (ID badge, uniform, presentability), courtesy and professionalism, willingness to help, product/service/program knowledge, and preparedness (i.e., came with all tools/parts needed). One respondent was dissatisfied with multiple aspects of their experience and stated that the process was “unorganized” and that there was “bad communication.” Figure 4-5 summarizes the results.

Figure 4-5 Owner/Manager Satisfaction with the Field Service Representative



Most survey respondents were satisfied with length of time required to perform the installation/service, quality of the installation / service, condition in which site was left, quality of the educational materials left behind, and their overall experience with the field representative (see Figure 4-6).

Figure 4-6 Overall Satisfaction with the Field Service Representative and Quality of Work Performed



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

- *Very nice and helpful (n = 3).*
- *Fabulous job (n = 1).*

4.4.6 Interactions with Program Staff

Sixty-seven percent of survey respondents indicated a program representative inspected the work done after the project was completed and 46% indicated they had interactions with an account manager. Among those who reported an inspection, all completely agreed that the inspector was courteous and efficient (n = 5). Among those who had interactions with an account manager, all were somewhat or extremely satisfied with the services provided. Sixty-six percent of respondents were satisfied with the steps to get through the program and 58% were satisfied with the energy efficiency improvements made through the program (see Table 4-5).

Table 4-5 Satisfaction with Steps to Get Through Program and Energy Efficiency Improvements

Response	The steps you had to take to get through the program (n = 12)	The energy efficiency improvements made through the program (n = 12)
Extremely satisfied	8%	8%
Satisfied	58%	50%
Neutral	25%	25%
Dissatisfied	8%	17%
Extremely dissatisfied	0%	0%

Nine survey respondents reported they had heard feedback from tenants about the energy efficiency improvements made. Among those who heard feedback, 63% indicated the feedback was mostly positive, 13% indicated a mix of positive and negative feedback, and 25% said they had mostly heard negative feedback.

Below is the positive feedback that respondents received from tenants:

- Receiving the light bulbs and brightness of new lighting (n = 5).

Below is the negative feedback from tenants:

- Tenants were not satisfied with the thermostats (n = 1).
- Contractors left mess after project completion (n = 1).
- The changes increased energy bill (n = 1).

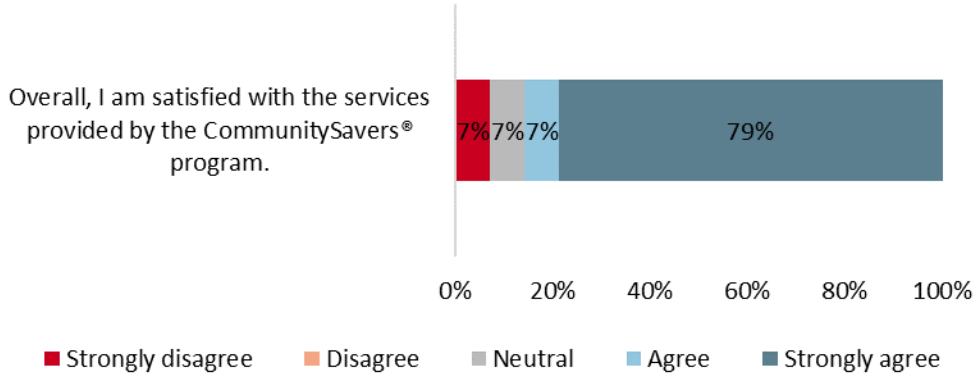
4.4.7 Overall Satisfaction

Participants were largely satisfied with the services provided by the CommunitySavers Program (see Figure 4-7). Additionally, most (71%) indicated they were very likely to recommend the program to a colleague (see Table 4-6).

Table 4-6 Likelihood of Recommending CommunitySavers Program to a Colleague

Response	*Percentage of Responses (n = 14)*
Very likely	71%
Somewhat likely	0%
Neutral	14%
Somewhat unlikely	0%
Very unlikely	14%

Figure 4-7 Owner/Manager Satisfaction with CommunitySavers



Survey participants were provided an opportunity to provide suggestions on how to improve the program. Below are their suggestions on how to improve the CommunitySavers Program:

- Increase education services (n = 1).
- Increase cold calling and other advertising (n = 1).
- Provide a better product (n = 1).
- Improve communication and arrival time (n = 1).

4.5 Tenant Survey

ADM mailed surveys to 850 tenant addresses listed in the program tracking data and received 92 responses. Participants either returned a paper survey or completed the survey online. The completion rate was 10.8%.

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

Eighty-seven percent of tenants reported that the energy efficiency improvements made to their homes reduced their electricity costs. In addition to those energy benefits, 84% 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 (see Table 4-7).

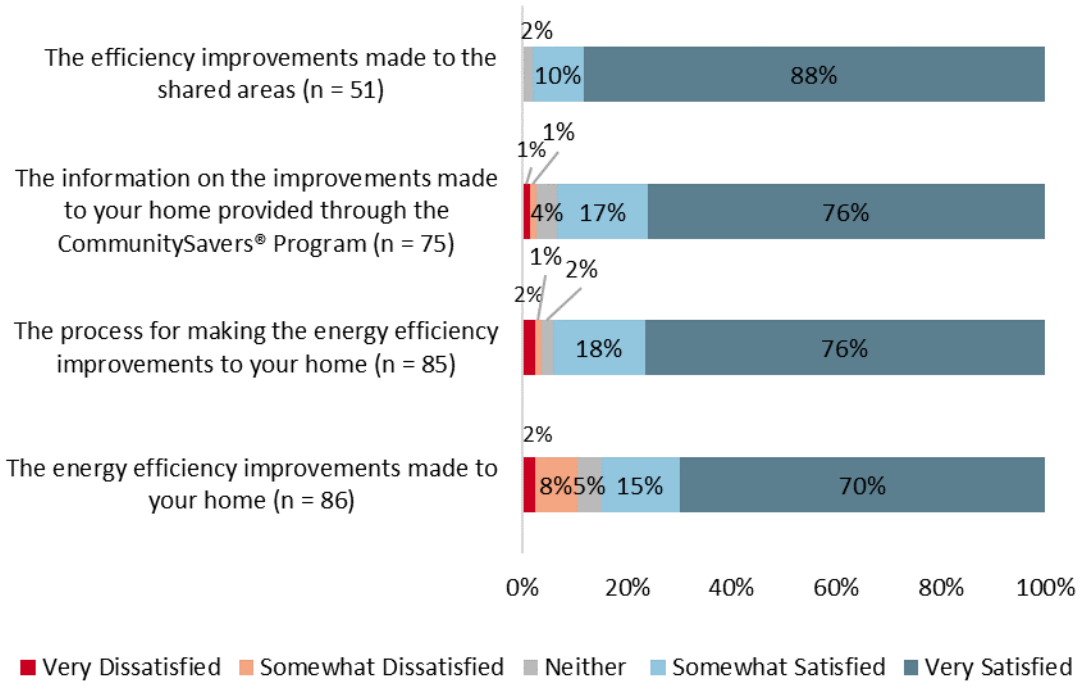
Table 4-7 Non-Energy Benefits from Energy Efficiency Home Improvements

Response	*Percentage of Responses (n = 90)*
The home feels more comfortable	55%
The appliances and heating or cooling equipment are more reliable	24%
There is less noise from the appliances	21%
There have been health improvements	10%
The home is safer	10%
There is less noise from the outside	9%
Other	16%

4.5.2 Overall Program Satisfaction

Tenant satisfaction with the program processes and measures was high. Eighty-eight percent of tenants were very satisfied with the efficiency improvements made to the shared areas, 76% of tenants were very satisfied with the process for making energy efficient improvements, 76% were very satisfied with the information on the improvements made to their homes, and 70% were very satisfied with the energy efficiency improvements made in their home (see Figure 4-8).

Figure 4-8 Tenant Satisfaction with the CommunitySavers Program



Survey participants were provided an opportunity to leave any additional comments and feedback for the program. Table 4-8 summarizes the comments made. The most frequently made types of comments were positive remarks about the program and the

equipment installed. Other comments reflected issues noted by tenants, such as difficulty using thermostats and other needed improvements for the properties.

Table 4-8 Summary of Additional Comments

Type of Comment	*n*
Positive remarks/comments about program	21
Satisfied with equipment installed	9
Property needs additional improvements	3
Decreased energy bills	3
Home is less comfortable	2
Faulty equipment	2
Dislikes improvements	1
Increase energy bill	1
Difficulty with thermostat	1
Did not notice improvements	1
Satisfied with trade ally who performed work	1

5 Payment Analysis

This chapter presents the methodology used and results of the assessment of the CommunitySavers program on customer payment behavior and electricity bills. This analysis examines impacts on:

- Customer bill amounts;
- Amounts owed at the time a disconnect notice was served; and
- Receipt of a disconnect notice.

5.1 Methodology for Estimating Program Effects on Bill Payment Behavior

The following subsections outline the methodology used in analysis of program impacts on bill payments.

5.1.1 Data Sources

ADM utilized data from the following sources in the analysis of bill payment impacts:

- Participation data: Program participation records for the March 1, 2016 through December 31st, 2018 period.
- Customer account records: ADM received Ameren Missouri customer account records that contained the customer name, customer account number, premise ID, service address, and telephone number. The request was limited to the zip codes in which Community Savers projects had occurred. Information was requested for any accounts active in the past four years.
- Customer payment records: ADM received payment records with the customer account and the following data
    - Billing records with billing period date, kWh consumption per period, and billed amount per period;
    - Bill payment information including the payment amount, the method of payment, and the date the payment was processed; and
    - Cut notice records that included the reasons for the notice and the account balance at the time of the notice.
- Third-party data purchased from Infogroup with demographic data.

5.1.2 Matched Comparison Group Development

A matched comparison group was developed using third-party demographic data and Ameren Missouri customer records. The comparison group consisted of customers who did not receive any services through the CommunitySavers Program during the PY2016-

PY2018 period. Some of the customers in the comparison group may have received services during MEEIA 1.

5.1.2.1 Data Preparation

ADM developed a database of Ameren Missouri customer account records, customer demographics provided by Infogroup, and Ameren Missouri customer payment records for the matched control group design.

The first step in the preparation of the database was to develop a set of records to match to third party data. The steps used were as follows:

1) ADM received a list of Ameren Missouri customer account records for all residential customers residing in zip codes in which Community Savers projects occurred during the PY2016 – PY2018 period.
2) All records for accounts not active after 4/1/2016 were removed from the database.
3) Using program participation data, ADM matched 4,826 treatment group account numbers to these records. All treatment group records were retained in the initial preparation of the database.
4) For non-treatment group customers, ADM identified likely multifamily properties using common multifamily address identifiers such as unit, APT, and apartment. Additionally, publicly available data for St. Louis county that identified multifamily housing was also referenced. Records were retained if they either (a) Included the address identifiers or (b) were listed in in St. Louis county records as a multifamily property. A random sample of 95,174 non-treatment group customers were selected.
5) Information on the 100,000 treatment and non-treatment group customers was provided to Infogroup for matching to their database of demographic characteristics.
6) A list of all treatment group customers and all non-treatment group customers with the complete demographic data matched was provided to Ameren Missouri. Ameren Missouri provided the payment records for this group.
7) The data set used in the analysis was restricted to treatment group customers with at least 12 months of pre-treatment and 12 months of post-treatment data. The comparison group was restricted to customers with at least 24 months data.

5.1.2.2 Development of the Matched Comparison Group

ADM used a propensity score matching approach to develop a comparison group. Using this approach, a propensity score was estimated for the set of treatment group customers (i.e., those who received program services) and a group of customers who did not receive

program services using a logit model. The model included the following covariates to develop a propensity score:

- A binary variable indicating that that customer lived in multifamily housing;
- A binary variable indicating that customer was a renter;
- A score indicating the likelihood that the customer was a homeowner;
- The number of members living in the household;
- Household income; and
- A term for the interaction between income and the number of members living in the household.

One-to-one nearest neighbor matching was used based on the logit values estimated in the model.

Overall the matching process identified a set of customers for the comparison group with demographic characteristics very similar to those of the treatment group.

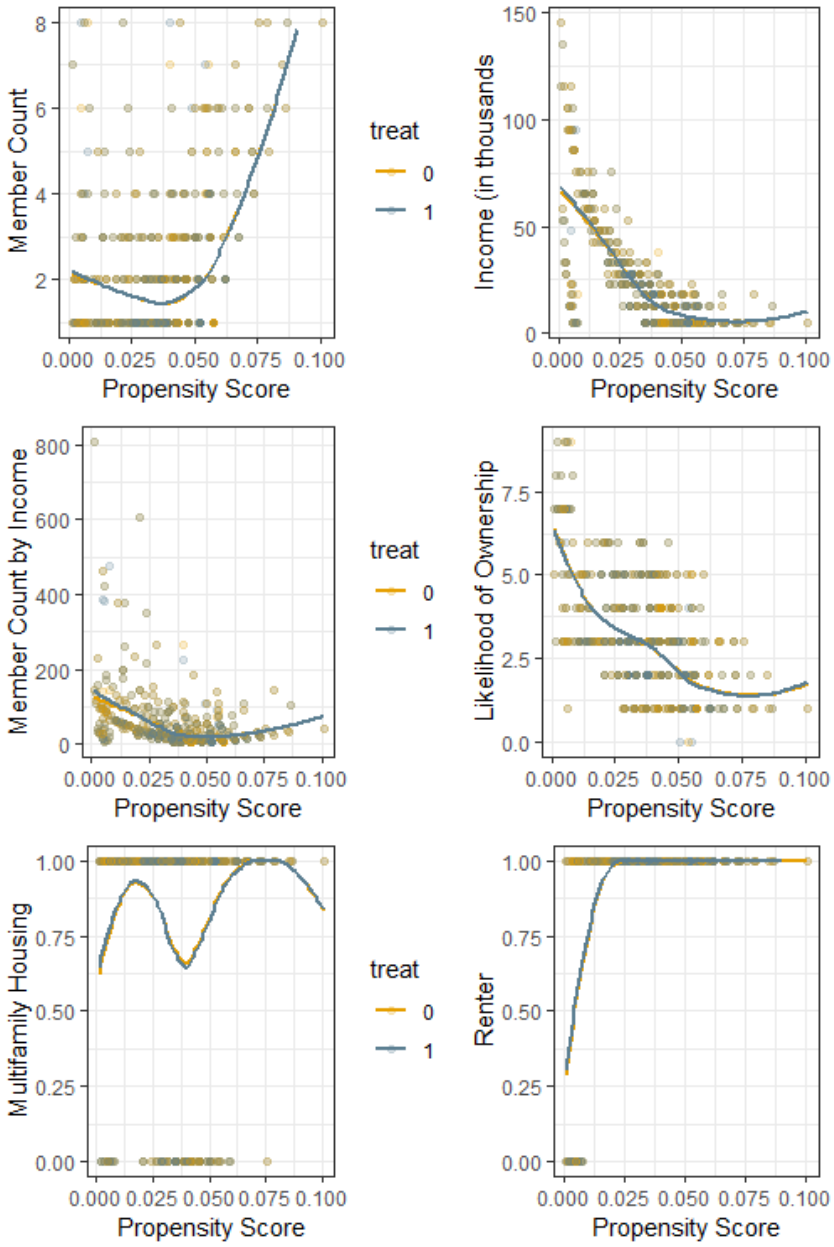
Table 5-1 summarizes the mean values on the covariates for the comparison and treatment groups. As shown, the means were similar and there were no statistically significant differences.

Table 5-1 Comparison of Average Values for the Comparison and Treatment Group

Covariate	*Average for the Comparison Group*	*Average for the Treatment Group*
member_count_cov	1.87	1.88
income_cov	21.54	21.74
membercount_by_income_cov	40.77	42.31
own_likelihood_cov	2.91	2.90
multifamily_cov	0.81	0.81
renter_cov	0.95	0.95

Figure 5-1 presents plots of the propensity scores for treatment and comparison group customers against the covariates. As shown, the relationship between propensity score and the values on the covariates were very similar for the treatment and comparison groups.

Figure 5-1 Covariate Balance Plots



5.1.2.3 Estimation of Program Impacts

A fixed effects model was used to estimate program impacts. The model used was as follows:

$$Y_{it} = a_t + b_i + \beta D_{it} + \epsilon_{it}$$

Where, a is a fixed effect for monthly billing period, b is a fixed effect for the customer, and D is a binary variable coded as 1 if the period was during or after the billing period in

which the customer received program services and otherwise coded a 0. For customers in the comparison group, D was equal to 0 for all periods.

The outcome variable Y was either:

- The total billed amount for the period;
- The amount owed when a disconnect notice was served; or
- A binary indicator of whether a disconnect notice was received during the period.

This fixed effect model was chosen because it was flexible and could handle variable periods in which customers received program services.

5.2 Results

The following sections present the results of the payment analyses.

5.2.1 Bill Amount

The results for the bill amount are shown in Table 5-2. As shown, the post period program effect was not statistically significant. However, the effect was in the direction of what would be expected – customers who received services had monthly bills that were $2.28 lower than customers in the comparison group and for customers in the treatment group before receiving services.

Table 5-2 Regression Results for Bill Amount

	Coef.	*Robust Std. Err.*	*t*	*p value*	*Lower Bound*	*Upper Bound*
Post	-2.28	2.76	-0.83	0.41	-7.69	3.13
Constant	144.81	0.72	200.79	0.00	143.39	146.22
F(1,1139) = 0.68, p = .41						

5.2.2 Amount Owed at Time Disconnect Notice was Served

Customers owed less at the time a disconnect notice was served after receiving services than before and then customers in the comparison group. On average, the amount owed when a notice was served was $22.19 less than the amount owed by customers in the comparison group or during the pre-treatment period.

Table 5-3 Regression Results for Amount Owed when a Disconnect Notice was Served

	Coef.	*Robust Std. Err.*	*t*	*p value*	*Lower Bound*	*Upper Bound*
Post	-22.19	5.57	-3.99	<.01	-33.12	-11.25
Constant	254.41	1.57	162.40	<.01	251.33	257.49
F(1,563) = 15.88, p < .01						

5.2.3 Receipt of Disconnect Notice

Table 5-4 presents results of a logistic regression of the program impact on the receipt of a disconnect notice. As shown, the result of the program was not statistically significant. Moreover, the direction of the effect suggests that customers had a higher probability of receiving a disconnect notice than customers in the comparison group or before they received program services.

Table 5-4 Regression Results for Receipt of Disconnect Notice

	Coef.	*Robust Std. Err.*	*t*	*p value*	*Lower Bound*	*Upper Bound*
Post	0.11	0.06	1.86	0.06	-0.01	0.23
F(1, 563) = 3.46, p = .06						

6 Cost Effectiveness Evaluation

This chapter summarizes the results of the cost effectiveness evaluation of the Ameren Missouri CommunitySavers Program. The PY2018 cost effectiveness analysis is premised on cost data received to date (end of March 2019).

Cost effectiveness analysis was completed by Morgan Marketing Partners 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 Technical Data provides additional information on the data sources test formulas, inputs, and methodology.

Table 6-1 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 6-1 Results of Cost Effectiveness Evaluation

Variable	*Value*
UCT	0.85
TRC	0.80
RIM	0.33
PCT	7.35
SCT	1.01
NPV of UCT Lifetime Benefits (2016 Dollars)	$4,173,059

7 Conclusions and Recommendations

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

7.1 Impact Conclusions

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

- The overall program kWh gross realization rate was 84%, with variable measure-level gross realization rates. The gross realization rate for kW savings was 70%. 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- and site-specific characteristics that were accounted for in the ex post energy savings analysis. Two issues that impacted realization rates were:
    - Common area lighting projects did not uniformly apply the correct lighting stipulated coincident peak demand factor. In particular, the non-24-hour lighting factor was frequently applied to 24-hour lighting.
    - For the residential air source heat pump measures that were described in program tracking data as replacing existing electric resistance furnaces, ex ante heating savings calculations referenced the assumed existing heating equipment efficiency (3.41 HSPF). ADM researched and verified that these measures were installed in newly constructed facilities. Accordingly, ADM applied the federal minimum standard 8.2 HSPF in the calculation of heating energy savings for these measures.
- Ex post net energy savings achieved 231% of the energy savings goal. The total ex post net energy savings for PY2018 totaled 9,914,662 kWh. This amount is 135% of the ex post net energy savings realized during PY2017 (7,334,784 kWh).

  An increase in common area lighting projects was a significant factor in the increase in program energy savings as compared with PY2017. Common area lighting accounted for approximately 20% of program ex ante energy savings in PY2017 but accounted for 65% of ex ante energy savings in PY2018.
- Program lighting tracking data did not include information regarding property type and heating and cooling system types. Including this data within the program tracking system would facilitate calculating savings impacts inclusive of heating and cooling interactive effects.

7.2 Impact Recommendations

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

- The evaluation found that the non-24-hour lighting stipulated coincident peak demand factor was incorrectly applied to 24-hour lighting measures installed in common areas. The correct value should be applied in future program years.
- Estimates of heating energy savings for air source heat pumps installed in newly constructed facilities should reference the federal minimum standard heating seasonal performance factor. ADM also recommends including a field in future program tracking data to identify new construction projects and to ensure that the appropriate baseline is referenced in ex ante savings calculations.

7.3 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) Evaluation of Demand-Side Program and Demand-Side Rates subsection of the Resource Acquisition Strategy Selection section. 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. It was noted that this is particularly the case for non-lighting measures. The cost of efficiency improvements was also noted as a barrier by three of the four respondents. Additionally, staff noted that some properties may be prevented from financing efficiency projects because of the terms of previous financing arrangements.
- Geography. Analysis of the program activity in comparison to the location of multifamily properties and lower income customers found that program activity was disproportionately concentrated in St. Louis and its surrounding suburbs. However, there was an increase in the share of projects completed in outer St. Louis suburbs from 10% of tenant units in PY2017 to 20% of units in PY2018.

- Insufficient Property Staff. Multifamily property operators may not have staff available to implement efficiency measures. Unlike prior years, none of the survey respondents cited this as a barrier. 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.
- Property Management: Staff noted that while the program tried to reach all types of low-income multifamily properties, it had more success with properties owned by larger property management companies that operate multiple properties in the service territory.

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.
- Staff noted that in the third cycle of the Missouri Energy Efficiency Investment Act, the programs offered will also target low income customers living in single family and in manufactured/mobile homes. These markets will be served by new programs and Ameren will continue to provide dedicated resources to serving the low-income multifamily market.

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. Ninety percent of participant survey respondents were aware of the common area incentives stated that these incentives completely met their needs for efficiency improvements.

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 reported that the outreach and marketing efforts in PY2018 were similar to the approaches used in other years. During the year, six email newsletters and six postcard mailings were sent to multifamily properties. Staff continued to engage in direct outreach to property managers. Staff also continued to make presentations to neighborhood associations.
- Among those participants that had not received common area, the share of participant survey respondents who reported that they were aware of common area incentives increased from 15% in PY2016, to 83% in PY2017, to 100% in PY2018. Additionally, 67% of respondents aware of the common area incentives reported that they were 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*: Staff noted that some properties have difficulty securing financing for more costly projects such as building envelope improvements. The program should consider exploring offering on-bill financing as an alternative means for properties to arrange financing.[10]

[10] American Council for an Energy-Efficiency Economy (2013). Apartment hunters: Programs searching for energy savings in multifamily buildings.

Energy Efficiency for All (2015). Energy efficiency programs in multifamily affordable housing.

Appendix A: ICF Program Manager Interview Guide

Roles and Responsibilities

1. Has your role changed in the past year?
2. Were there any other staffing changes during the program year?

Program Design and Goals

3. Looking at the program data, it looks like a notably larger share of the program savings came from common area custom lighting projects. What do you think accounts for that increase?
    a. Did these projects tend to come from properties that previously participated in the program?
    b. Why were these projects routed through the custom incentive program?
    c. Are the hours of operation based on interviews with property management?
4. 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?
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?

Communication with Utility

6. What, if any, regularly scheduled program communication do you have with Ameren Missouri regarding the program? Anything else?

Marketing

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

7. 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?

8. 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?

9. Were any of the marketing materials or leave behind materials revised or were there new materials developed?

10. Has the program solicited any earned media such as releasing press releases? Have these resulted in any success?

11. How do you track the effectiveness of outreach and marketing efforts?

12. What do you think has worked well to recruit properties to the program?

13. Is there anything you would like to improve upon with the marketing and outreach approach?

Trade Allies & Other Program Partners

14. 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.

15. 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?

16. 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?

17. 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?

18. Were any of the marketing materials or leave behind materials revised or were there new materials developed?

19. Has the program solicited any earned media such as releasing press releases? Have these resulted in any success?
20. What do you think has worked well to recruit properties to the program?
21. Is there anything you would like to improve upon with the marketing and outreach approach?

Participation Process

22. Last year you mentioned that you changed the program so that properties no longer need to move through a sequence of participation steps that starts with direct install, an audit, and then moves to common area measures. Was that still the process this year?
    a. If a property starts with common area improvements, what effort is then made to encourage the direct install component?

Tracking & Reporting

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

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

Now let's talk about Quality Control…

25. Did anything change in the quality control and verification processes in PY2018/19?
    a. Frequency of QC visits
    b. Types of data collected during visits

Conclusion / Wrap Up

26. What would you say are the greatest strengths of the program?
27. What would you say most needs to be changed about the program?
28. 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

1. Has your job title or role changed in the past year?
2. Briefly, what are your responsibilities with regards to CommunitySavers?

Program Management

3. Were there any changes in staffing at Ameren for the CommunitySavers Program in the past year?
4. Who did you work with at ICF in the past year?

Program Design and Goals

5. Did the incentive amounts or measure offerings change in the past program year?
6. I noticed that custom savings, particularly lighting savings, increased a lot in the last program year. Do you have any information on why it increased?
7. Thinking about the 2018-2019 program year, how do you think CommunitySavers performed?
    a. Will the program be offered in the next program period or will there be a differently designed program?
    b. Is there anything that you think needs to be changed about the program to address any concerns you may have?
    c. [If not obvious] What needs to change to address those concerns?
    d. What might prevent those changes?
    e. How and when might changes to address those concerns occur?
8. 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?
9. Are there any types of multifamily low-income housing that the program has been particularly effective in reaching in the past three years?

a. Geographic regions

b. Large vs small property management companies

c. Private, public, and nonprofit owned properties

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

    a. (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?]

Marketing

11. What outreach did the program engage in with community groups and organizations in 2018-19?

12. Did Ameren engage in or otherwise support any direct outreach or marketing activities?

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

Communication

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

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

Tracking & Reporting

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

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

Quality Control

17. From your perspective, how adequate are ICF's procedures for ensuring quality control?

18. Are there any improvements that you would like to see made to the quality control process?

Conclusion

19. What would you say are the greatest strengths of the program?
20. What would you say most needs to be changed about the program?
21. 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.
    1. 1 – Strongly Disagree
    2. 2 – Disagree
    3. 3 – Neutral
    4. 4 – Agree
    5. 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?
    1. At a seminar
    2. At a neighborhood meeting
    3. From a CommunitySavers Account Manager or another program representative
    4. From a search engine (Google, Yahoo, Bing)
    5. From another person in your organization
    6. Previously participated in the program
    7. Other (Please specify)
    98. 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]
    1. Improve tenant comfort and satisfaction
    2. Reduce tenant utility bills
    3. Reduce property utility bills
    4. To take advantage of rebates/no-cost efficiency improvements
    5. To replace old or non-functioning equipment
    6. To make the units more attractive to prospective tenants
    7. Some other reason – please describe: _____
    98. 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?
    1. Yes
    2. No
    98. 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]?
    1. 1 – Very likely
    2. 2 – Somewhat likely
    3. 3 - Neither likely nor unlikely
    4. 4 – Somewhat unlikely
    5. 5 - Very unlikely
    98. 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?

   1. 1 – Not at all
   2. 2
   3. 3
   4. 4
   5. 5 – Completely

   98. 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?

    1. Yes
    2. No

    98. 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?

    1. Yes
    2. No
    98. 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?

    1. 1 – Very likely
    2. 2 – Somewhat likely
    3. 3 - Neither likely nor unlikely

4. 4 – Somewhat unlikely
5. 5 - Very unlikely
98. Don’t know

Measurement and Verification

17. After your project was completed, did a program representative inspect the work done through the program?
    1. Yes
    2. No
    98. 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?
    1. Yes
    2. No
    98. Not sure

[DISPLAY Q20 IF Q19 = 1]

20. How satisfied are you with the service provided by your account manager?
    1. 1 – Extremely Dissatisfied
    2. 2 – Dissatisfied
    3. 3 – Neutral

4. 4 – Satisfied
5. 5 – Extremely Satisfied

98. 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?

1. Yes
2. No

98. Don’t know

[DISPLAY Q25 IF Q24 = 1]

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

1. Mostly positive
2. A mix of positive and negative feedback
3. Mostly negative

98. 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]?

    1. Own it only
    2. Manage it only
    3. Both own and manage it

    98. 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

Appendix E: Payment Analysis Regression Results

Figure E-1 Regression Output for Bill Amount

```
Fixed-effects (within) regression               Number of obs      =     39165
Group variable: account_nu~r                    Number of groups   =      1140

R-sq:  within  = 0.0001                         Obs per group: min =        25
       between = 0.0089                                        avg =      34.4
       overall = 0.0013                                        max =        38

                                                F(1,1139)          =      0.68
corr(u_i, Xb)  = -0.0612                        Prob > F           =    0.4092

                      (Std. Err. adjusted for 1140 clusters in account_number)
------------------------------------------------------------------------------
             |               Robust
billed_amo~t |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     post_ps |  -2.277282   2.758283    -0.83   0.409    -7.689169    3.134605
       _cons |   144.8058    .721175   200.79   0.000     143.3908    146.2208
-------------+----------------------------------------------------------------
     sigma_u |  96.447002
     sigma_e |  97.266791
         rho |  .49576812   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Figure E-2 Regression Output for Amount Owed at Time of Disconnect Notice

```
Fixed-effects (within) regression               Number of obs      =      3845
Group variable: account_nu~r                    Number of groups   =       564

R-sq:  within  = 0.0056                         Obs per group: min =         1
       between = 0.0001                                        avg =       6.8
       overall = 0.0017                                        max =        24

                                                F(1,563)           =     15.88
corr(u_i, Xb)  = -0.0589                        Prob > F           =    0.0001

                      (Std. Err. adjusted for 564 clusters in account_number)
------------------------------------------------------------------------------
             |               Robust
disconnect~t |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     post_ps |  -22.18742   5.567025    -3.99   0.000    -33.12209   -11.25274
       _cons |   254.4117   1.566585   162.40   0.000     251.3346    257.4888
-------------+----------------------------------------------------------------
     sigma_u |  75.530187
     sigma_e |  104.86337
         rho |   .3415821   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Figure E-3 Regression Output for Receipt of Disconnect Notice

```
Conditional fixed-effects logistic regression   Number of obs      =     19337
Group variable: account_number                  Number of groups   =       564

                                                Obs per group: min =        25
                                                               avg =      34.3
                                                               max =        37

                                                F(     1,     563) =      3.46
Log likelihood  = -7509.4766                    Prob > F           =    0.0633

                        (Replications based on 564 clusters in account_number)
------------------------------------------------------------------------------
             |              Jackknife
rec_disc_n~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   1.post_ps |   .1122276   .0603234     1.86   0.063    -.0062588     .230714
------------------------------------------------------------------------------
```

Appendix F: Cost Effectiveness 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 Morgan Marketing Partners 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 residential customers.
- Summer Peak would occur during the 16th hour of a July day on average
- Avoided costs from the 2017 Integrated Resource Plan that was filed October 1, 2017 were used for all measures.
- 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 PY2018 cost effectiveness analysis is premised on cost data received to date (end of March 2019).

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*
$4,173,059	9.66%

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 PY2018 Cost Data

Administrative Costs (2016 Dollars)	*Incentive Costs (2016 Dollars)*	*Total Costs (2016 Dollars)*
$4,041,602	$846,261	$4,887,863

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 $4,173,059. Incentives and overhead totaled $4,887,863 which yields a benefit-cost ratio of 0.85.

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

UCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$2,828,002	
Avoided Electric Capacity	$944,821	
Avoided T&D Electric	$400,236	
Incentives		$846,261
EM&V, Admin, Data Tracking		$4,041,602
Total	$4,173,059	$4,887,863
UCT Benefit - Cost Ratio	0.85	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

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 $4,173,059. The benefits consist of the utility's total avoided costs of $5,227,932, which yields a benefit-cost ratio of 0.80.

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

TRC Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Avoided Electric Production	$2,828,002	
Avoided Electric Capacity	$944,821	
Avoided T&D Electric	$400,236	
Participation Costs (net)		$1,186,330
EM&V, Admin, Data Tracking		$4,041,602
Total	$4,173,059	$5,227,932
TRC Benefit - Cost Ratio	0.80	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

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 $4,173,059 and the costs total $12,765,450. 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 0.33. 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	$2,828,002	
Avoided Electric Capacity	$944,821	
Avoided T&D Electric	$400,236	
Incentives		$846,261
EM&V, Admin, Data Tracking		$4,041,602
Lost Revenues		$7,877,587
Total	$4,173,059	$12,765,450
RIM Benefit - Cost Ratio	0.33	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

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 $8,723,849. The costs include gross participant costs, totaling $1,186,330 and yielding a benefit-cost ratio of 7.35.

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

PCT Calculations		
Category	*Benefits (2016 Dollars)*	*Costs (2016 Dollars)*
Bill Savings (Gross)	$7,877,587	
Incentives	$846,261	
Participant Cost (Gross)		$1,186,330
Total	$8,723,849	$1,186,330
PCT Benefit - Cost Ratio	7.35	

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 $5,636,337 and the costs totaled $5,585,067. The financial data for the SCT test yields a benefit-cost ratio of 1.01.

[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	$3,805,704	
Avoided Electric Capacity	$1,309,693	
Avoided T&D Electric	$520,940	
Participation Costs (net)		$1,267,372
EM&V, Admin, Data Tracking		$4,317,695
Total	$5,636,337	$5,585,067
SCT Benefit - Cost Ratio	1.01	
Note: Incentive costs in excess of measure incremental costs are allocated to other/miscellaneous costs.		

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.