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Ameren Missouri Program Year 2019 Annual EM&V Report

Volume 2: Residential Portfolio Report

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Table of Contents

Table of Tables

Table of Figures

Table of Equations

1. Executive Summary

This volume of the PY2019 Annual Report presents evaluation results from the Ameren Missouri PY2019 portfolio of residential energy efficiency programs as described in Ameren Missouri's 2019-21 Missouri Energy Efficiency Investment Act (MEEIA) Energy Efficiency Plan. In this document, the evaluation team provides portfolio-level results for PY2019, as well as detailed findings for each program. Results for the business and demand response portfolios are provided in separate volumes.

During PY2019, Ameren Missouri offered seven programs for residential customers. The portfolio of residential programs included the following:

- Residential Lighting
- Heating Ventilation and Air Conditioning (HVAC)
- Home Energy Reports (HER)
- Energy Efficient Products (EEP)
- Energy Efficient Kits (EE Kits)
- Multifamily Market Rate (MFMR)
- Appliance Recycling (ARP)

In addition to these seven programs, Ameren Missouri offered two programs targeted specifically to low income residential customers. As such, this volume also covers the Single Family and Multifamily Low-Income Programs (SFLI and MFLI, respectively). Collectively, the nine programs referenced here are referred to as the "residential programs" throughout this volume.

The following sections present overarching key evaluation findings and recommendations for the residential programs. The remainder of this volume is organized as follows:

- Chapter 2 presents the general evaluation approach for the residential programs, including overarching evaluation objectives and an overview of the PY2019 evaluation activities and methodologies.
- Chapters 3 - 11 present evaluation results for the nine residential programs.

1.1 Portfolio Impact Results

At the portfolio level, the PY2019 Ameren Missouri residential programs achieved their first year energy savings goal, but fell short of their first year demand savings goal, achieving 118,579 MWh and 36.05 MW respectively. Performance related to last year demand savings was mixed with the portfolio achieving the target for 10-14 EUL, but not meeting the less than 10 or 15+ EUL targets.[1]

[1] Throughout this volume, we refer to "goals" and "targets." Ameren Missouri's 2019-21 MEEIA Energy Efficiency Plan sets annual first year energy and demand savings goals. In addition, Ameren Missouri developed impact targets that are used to determine Earnings Opportunities.

Table 1-1. PY2019 Residential Portfolio Impact Summary

	Ex Ante Gross	Gross RR	Ex Post Gross	NTGR	Ex Post Net	Goal/Target Net	% of Goal/Target
First Year Savings							
Energy Savings (MWh)	141,729	107%	151,405	68%	118,579	111,693	106%
Demand Savings (MW)	38.62	109%	41.98	69%	36.05	45.91	79%
Last Year Demand Savings							
< 10 EUL (MW)	0.28	1,048%	2.92	72%	9.20	16.92	54%
10-14 EUL (MW)	3.28	95%	3.11	105%	3.27	3.02	108%
15+ EUL (MW)	22.64	90%	20.28	67%	13.61	17.11	80%

Portfolio performance was largely driven by the Residential Lighting, HVAC and Home Energy Report (HER) programs, which collectively contribute approximately 90% of Ameren Missouri's first year residential savings. As shown in Table 1-2, the Lighting Program far exceeded first year energy and demand savings goals while the HVAC and HER programs performed at lower levels than anticipated.

Table 1-2. PY2019 Residential Portfolio First Year Impact Summary

	Ex Ante Gross	Gross RR	Ex Post Gross	NTGR	Ex Post Net	Goal Net	% of Goal
First Year Energy Savings (MWh)							
Lighting	86,553	114%	98,634	64%	62,818	12,659	496%
HVAC	39,647	97%	38,531	76%	29,275	44,361	66%
Home Energy Report	NA	NA	NA	NA	15,241	35,250	43%
Efficient Products	4,981	100%	4,922	85%	4,170	8,222	51%
Energy Efficient Kits	6,280	88%	5,512	78%	4,274	6,551	65%
Multifamily Market Rate	2,240	77%	1,731	90%	1,558	2,292	68%
Appliance Recycling	2,028	102%	2,074	60%	1,242	2,358	53%
Total Residential	**141,729**	**107%**	**151,405**	**68%**	**118,579**	**111,693**	**106%**
First Year Demand Savings (MW)							
Lighting	13.02	117%	15.30	64%	9.74	1.89	515%
HVAC	22.15	106%	23.54	71%	16.75	23.28	72%
Home Energy Report	NA	NA	NA	NA	7.10	16.43	43%
Efficient Products	1.57	100%	1.57	80%	1.25	2.14	58%
Energy Efficient Kits	1.22	84%	1.03	79%	0.82	1.16	70%
Multifamily Market Rate	0.34	76%	0.26	90%	0.23	0.67	34%
Appliance Recycling	0.32	90%	0.29	54%	0.16	0.34	46%
Total Residential	**38.62**	**109%**	**41.98**	**69%**	**36.05**	**45.91**	**79%**

Table 1-3. PY2019 Residential Portfolio Last Year Demand Impact Summary

	Ex Ante Gross	Gross RR	Ex Post Gross	NTGR	Ex Post Net	Target Net	% of Target
< 10 EUL							
Lighting	0.00	NA	2.69	64%	1.71	-	NA
HVAC	0.00	NA	0.00	NA	0.25	-	NA
Home Energy Report	NA	NA	NA	NA	7.10	16.43	43%
Efficient Products	0.00	NA	0.00	NA	0.02	0.03	55%
Energy Efficient Kits	0.00	NA	0.00	NA	0.01	-	NA
Multifamily Market Rate	0.06	5%	0.00	90%	0.00	0.11	2%
Appliance Recycling	0.22	108%	0.23	44%	0.10	0.34	30%
Total Residential	**0.28**	**1,061%**	**2.92**	**72%**	**9.20**	**16.92**	**54%**
10-14 EUL							
Lighting	0.00	NA	0.00	NA	0.00	-	NA
HVAC	0.57	100%	0.56	211%	1.19	-	NA
Home Energy Report	NA	NA	NA	NA	0.00	-	NA
Efficient Products	1.57	100%	1.57	76%	1.19	2.11	56%
Energy Efficient Kits	0.87	86%	0.75	90%	0.67	0.76	88%
Multifamily Market Rate	0.20	104%	0.21	90%	0.18	0.15	125%
Appliance Recycling	0.08	29%	0.02	128%	0.03	0.00	NA
Total Residential	**3.28**	**95%**	**3.11**	**105%**	**3.27**	**3.02**	**108%**
15+ EUL							
Lighting	13.02	97%	12.61	64%	8.03	1.89	425%
HVAC	9.15	80%	7.31	73%	5.34	14.51	37%
Home Energy Report	NA	NA	NA	NA	0.00	0.00	NA
Efficient Products	0.00	NA	0.00	NA	0.04	-	NA
Energy Efficient Kits	0.36	80%	0.28	46%	0.13	0.40	33%
Multifamily Market Rate	0.08	60%	0.05	90%	0.04	0.32	14%
Appliance Recycling	0.03	106%	0.03	81%	0.03	0.00	NA
Total Residential	**22.65**	**90%**	**20.28**	**67%**	**13.61**	**17.11**	**80%**

Among the residential programs in the Low-Income Portfolio, performance against savings goals was also mixed. While the Multifamily Low-Income Program exceeded its first year energy savings goals, the Single Family Low-Income Program did not, and neither achieved first year demand savings goals. The implementation team also struggled to achieve savings from measures with longer lifetimes across both programs as illustrated by the percentage of 15+ EUL last year demand savings targets achieved. That said, both programs performed well against the average percent of energy savings per property metric established for this MEEIA cycle. In particular, the Single Family Low-Income Program achieved an average of 22%

savings per property while the Multifamily Low-Income Program achieved an average of 17% savings per property.

Table 1-4. PY2019 Single Family Low-Income Impact Summary

	Ex Ante Gross	Gross RR	Ex Post Gross	NTGR	Ex Post Net	Goal/Target Net	% of Goal/Target
First Year Savings							
Energy Savings (MWh)	2,272	98%	2,222	100%	2,222	8,556	26%
Demand Savings (MW)	0.57	100%	0.58	100%	0.58	1.83	31%
Last Year Demand Savings							
< 10 EUL (MW)	0.33	48%	0.16	100%	0.16	0.34	47%
10-14 EUL(MW)	0.09	113%	0.10	100%	0.10	0.06	167%
15+ EUL(MW)	0.15	96%	0.14	100%	0.14	1.39	10%

Table 1-5. PY2019 Multifamily Low-Income Impact Summary

	Ex Ante Gross	Gross RR	Ex Post Gross	NTGR	Ex Post Net	Goal/Target Net	% of Goal/Target
First Year Savings							
Energy Savings (MWh)	1,366	77%	1,053	100%	1,053	900	117%
Demand Savings (MW)	0.26	85%	0.22	100%	0.22	0.40	54%
Last Year Demand Savings							
< 10 EUL	0.07	84%	0.06	100%	0.06	-	NA
10-14 EUL	0.02	173%	0.03	100%	0.03	-	NA
15+ EUL	0.06	198%	0.12	100%	0.12	0.40	31%

Across all of the residential programs, the following factors were particularly influential in the ex post net energy and demand savings results from the PY2019 evaluation:

- In the first year of Ameren Missouri's new MEEIA cycle, the utility worked with a range of new partners and focused on establishing relationships and processes to support the effective and successful execution of the residential portfolio. The first step in this process involved establishing the residential programs within target markets and developing an integrated program data-tracking system to monitor performance and support evaluation. Delays in these areas affected both the implementation and evaluation of the residential programs (i.e., limited participation in some offerings, lack of centralized data tracking etc.) in PY2019. As evidenced in the program-specific chapters of this report volume, while the implementation and evaluation teams coordinated extensively on the data fields to be tracked by program through several iterations and data requests, the actual data received at the close of the program year was not sufficient to determine the ex ante savings assumptions used by the implementation partners in all cases. As such, the implementation and evaluation teams must continue to work together to establish data needs, QC processes and data flows. The launch of Franklin Energy's integrated data-tracking system in PY2020, should greatly aid in this process.

- The evaluation team updated parameters used to calculate ex post energy savings to better reflect current market conditions, which led to differences between ex ante and ex post results. Specifically, as part of the program-specific evaluation efforts, we updated In-Service Rates (ISRs), TRM assumptions, and Net-to-Gross-Ratios (NTGRs) among other parameters, which drove the ex post results for individual programs.

1.2 Key Process Findings and Recommendations

Ameren Missouri launched a new residential portfolio with ambitious energy and demand savings goals in PY2019 working closely with Franklin Energy and their implementation partners (referred to collectively as the implementation team). As such, PY2019 was a growth year for the portfolio with time and resources dedicated to solidifying program design and implementation processes including data tracking.

Overall, Ameren Missouri customers participating in the utility's PY2019 energy efficiency programs are highly satisfied with their experience and the utility overall demonstrating a successful customer-facing launch to the new cycle. Furthermore, research with participating contractors in the HVAC Program, a key network of service providers for the portfolio, indicates high levels of satisfaction with the program, as well as program influence on their business practices. As Ameren Missouri and the implementation team enter their second year of the MEEIA plan cycle, they are well positioned to leverage these positive customer experiences and adapt based on participant feedback.

The evaluation team presents the following key program-specific conclusions and recommendations from across the portfolio:

Residential Lighting

- Conclusion: The Residential Lighting Program discounted a large number of LEDs in PY2019. By selling nearly 2.8 LEDs per residential customer (with three-quarters of bulbs sold during the final three months of the program year), the program demonstrated that it can move a lot of bulbs through price reductions and product placement within stores. However, the residential lighting market is transforming and barriers such as customer awareness and product availability no longer exist for most customers. Three-quarters of lighting products on retailer shelves are LEDs and nearly two-thirds of customers' light sockets contain an efficient bulb.
  - Recommendation: Ameren Missouri's Residential Lighting Program has been a successful program that has delivered a lot of energy savings to the residential portfolio, but the program should consider moving away from a mass market program design that sells a large volume of standard bulbs at major retailers to a targeted design that focuses on bulb types with lower saturation and market share and on customers who still face barriers to adoption.
- Conclusion: The program made a special effort to engage discount stores that do not typically sell lighting such as St. Vincent De Paul, Salvation Army, Goodwill, and Habitat Restore. These stores tend to serve lower income customers. By bringing discounted LEDs into these stores, the program attempted to reach customers it may not reach through other participating retailers. Along with Dollar Tree stores, these discount retail stores sold 10% of bulbs discounted through the program. Our evaluation research shows that these efforts to reach lower income customers were successful and are needed. We found lower customer free ridership at discount stores than at large retailers. In

addition, in-home lighting audits show that low-income customers lag other customers in their use of efficient bulbs. The higher cost of all types of LEDs continues to be a barrier for low-income customers.

- Recommendation: Ameren Missouri should continue, and if possible, expand efforts to reach low-income customers through its lighting program and other programs that target low-income customers.

HVAC

- Conclusion: The HVAC Program continues to be a key driver of savings within the residential portfolio. While participation was lower than desired in PY2019, the implementation team and Ameren Missouri worked closely to implement strategies, such as increased incentive levels, to try and increase participation.
- Conclusion: Early replacement is a critical component of the HVAC Program in terms of achieving energy and demand savings for the portfolio. As such, the ability of the implementation team to reach residential consumers who would not otherwise have considered replacing their functioning HVAC system, is key to the ongoing success of the program. Based on discussions over the course of PY2019, the implementation team is already working with the evaluation team to think through changes to program design and delivery to better identify potential candidates for early retirement.
  - Recommendation: In the second year of the program, we recommend updates to the program's logic model so that the program's theory of change (i.e., how the HVAC market currently functions around the replacement of existing equipment without program intervention) is better aligned with current HVAC market conditions, clearly codified and inclusive of (1) the programmatic activities that will enable the implementation team to identify customers that engage the market intent on replacing existing equipment, and (2) the strategies for inducing these customers to replace functioning or repairable existing CAC equipment earlier than they otherwise would have. In conjunction, we recommend that the implementation team update program design and delivery to be consistent with the theory of change.

Home Energy Reports

- Conclusion: Per household energy savings from treatment Waves 1 and 2 are larger than those from Wave 3. Waves 1 and 2 targeted customers with higher baseline consumption values and almost exclusively included single family homes. While Wave 3 was the largest in terms of number of participants, multifamily customers made up close to one-quarter of the wave and had lower average baseline consumption. Based on our experience evaluating HER programs, lower baseline consumption typically leads to less potential for reductions in energy usage.
  - Recommendation: If future waves are selected for the HER Program, Ameren Missouri and its implementers should explicitly define whether its program goals are to maximize savings or to broaden eligibility beyond high usage customers. Moving forward, Ameren Missouri should consider refining its customer approach to target 1) customers with higher baseline consumption or 2) single family customers who tend to have more control over making energy related capital improvements within their households.

Efficient Products

- Overall, based on the high levels of participant satisfaction, the PY2019 REP Program is running smoothly. However, given how much the program fell short of its goals, participation is the biggest challenge. Increasing program awareness will help, but the current measure mix may be a bigger impediment to participation. This is especially true for the mail-in channel, which has only two measures, one of which (pool pumps) has a small target market. While more contractor-focused marketing could help boost participation rates for the mail-in channel, the addition of new measures and more targeted marketing is likely needed to boost participation in the program overall.
  - Recommendation: Consider introducing new measures when cost-effective. Two of the measures rebated through the program are generally replacement-on-burnout measures that are serviced by contractors (pool pumps and heat pump water heaters). Such measures offer a limited ability to stimulate increased participation.
  - Recommendation: While the product assortment is likely the biggest impediment to increasing participation, any broadening of the assortment should be done with careful consideration of marketing. Marketing is clearly needed to promote these products and steer customers to the rebates and the Online Store, thus increasing participation. The program should focus on increasing customer awareness of the availability of the rebates for all products but increasing contractor awareness will also help for contractor-serviced measures.

1.3 Portfolio Cost Effectiveness Results

Cost-effectiveness analysis compares the benefits of an energy efficiency or demand response program with the cost of delivering it, expressed as the ratio of the net present value (NPV) of lifetime benefits to the costs. A cost-effectiveness ratio of greater than 1.0 means that the benefits generated by the program exceeded its costs. Cost-effectiveness can be assessed from several different "perspectives," using different tests, with each test including a slightly different set of benefits and costs.

The evaluation team assessed the cost-effectiveness of each of the nine residential programs, using five costs-effectiveness tests recommended by the California Standard Practice Manual[2] and used in prior evaluations:

- **Total Resource Cost (TRC) Test:** Perspective of all utility customers (participants and nonparticipants) in the utility service territory;
- **Utility Cost Test (UCT):** Perspective of utility, government agency, or third-party program implementer;
- **Ratepayer Impact Measure (RIM) Test:** Impact of efficiency measure on nonparticipating ratepayers overall;
- **Participant Cost Test (PCT):** Perspective of the customers installing the measures; and

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

- **Societal Cost Test (SCT):** Perspective of all utility customers (participants and nonparticipants) in the utility service territory.[3]

Table 1-6 summarizes the cost-effectiveness results for the nine residential programs, including two residential Low-Income Portfolio programs. All programs were cost-effective in PY2019 based on the TRC test except Efficient Products, Appliance Recycling, Home Energy Reports, Single Family Low-Income and Multifamily Low-Income Programs.[4]

Table 1-6. Summary of Residential Cost-Effectiveness Results

Program	TRC	UCT	RIM	PCT
Lighting	15.57	5.52	0.55	n/a
Efficient Products	0.96	1.37	0.46	2.80
HVAC	1.76	1.78	0.57	4.63
Appliance Recycling	0.79	0.73	0.30	26.06
Energy Efficiency Kits	2.62	2.60	0.50	8.24
Home Energy Reports	0.44	0.44	0.26	n/a
Multifamily Market Rate	1.12	0.86	0.33	8.23
Single Family Low-Income	0.54	0.44	0.27	3.62
Multifamily Low-Income	0.42	0.32	0.21	5.34

Cost-effectiveness results for the overall Residential Portfolio – including the Residential Demand Response Program but excluding the Single Family Low-Income and Multifamily Low-Income Programs – are presented in Volume 1.

[3] Although we developed SCT results as a part of our evaluation, this section does not show the results because they are equivalent to TRC results due to two factors: (1) Ameren Missouri does not include non-energy impacts in cost-effectiveness testing, and (2) Ameren Missouri uses the same planning assumptions for both tests, including the discount rate.

[4] MEEIA and the Revised Statues of Missouri (RSMo) acknowledge low-income programs as a special circumstance and do not require the programs to be cost-effective as implemented. Results are shown for comparative and planning purposes.

2. Evaluation Approach

While the evaluation team conducted separate evaluations of each of the residential programs, most research objectives and evaluation activities were common across the programs. To reduce repetition, this chapter discusses research objectives common to all residential programs and presents an overview of the evaluation approach and activities conducted to address the research objectives. Additional, program-specific detail, where needed, is presented in the individual program chapters.

2.1 Research Objectives

The residential portfolio evaluation was designed to address numerous process, gross impact, net impact, and cost-effectiveness objectives. A fifth category of objectives focused on responding to the five key research questions stipulated in 4 CSR 240-22.070(8). The research objectives addressed by the PY2019 residential portfolio evaluations include:

Process Objectives

- Characterize program participation with respect to the number and characteristics of participants and completed projects;
- Assess the effectiveness and customer/trade ally acceptance of new program offerings and approaches;
- Assess how well the educational information, energy savings opportunities, and implementation process are understood by customers;
- Measure customer satisfaction, with program processes and implementers, and motivations for participating;
- Identify opportunities for improvement in customer experience;
- Provide evaluation results that can be used to improve the design and implementation of the programs; and
- Ensure that the implementer's tracking system contains the data necessary to support program evaluation.

Gross Impact Objectives

- Verify program tracking data;
- Verify measure installation; and
- Estimate the first year and last year[5] ex-post gross energy (kWh) and demand (kW) savings.

[5] Last year savings represent the energy or demand savings expected to occur in the final year of a measure's expected useful life.

Attribution/Net Impact Objectives

- Determine net-to-gross ratios (NTGR), including an assessment of free ridership and participant and trade ally spillover (not applicable to all programs);
- Estimate the first-year ex-post net energy (kWh) and demand (kW) savings; and
- Estimate the last-year ex-post net demand (kW) savings, by EUL bin.

Cost-Effectiveness

- Assess the cost-effectiveness of each business program and the business portfolio as a whole using industry-standard cost-effectiveness tests
- Ensure alignment of cost-effectiveness testing assumptions and parameters with the PY2019 business evaluation results, Ameren Missouri's TRM Revisions 3.0, and industry best practices.
- Provide total program benefits, costs, net benefits, and cost-effectiveness testing results.

CSR Mandated Research Questions (4 CSR 240-22.070(8))

- What are the primary market imperfections that are common to the target market segment?
- Is the target market segment appropriately defined, or should it be further subdivided or merged with other market segments?
- Does the mix of end-use measures included in the program appropriately reflect the diversity of end-use energy service needs and existing end-use technologies within the target market segment?
- Are the communication channels and delivery mechanisms appropriate for the target market segment?
- What can be done to more effectively overcome the identified market imperfections and to increase the rate of customer acceptance and implementation for select end uses/measure groups included in the Program?

2.2 Evaluation Activities and Methodologies

The evaluation team met the objectives of the PY2019 evaluation through a combination of research activities as outlined in Table 2-1. The evaluation team designed research for each program based on its design, level of participation, and type of energy efficiency technologies among other factors. Table 2-1 shows the research activities conducted for each program.

Table 2-1. Research Activities by Program

Research Activity	Lighting	EEP	HVAC	HER	ARP	EE Kits	MF MR	SF LI	MF LI
Program Manager and Implementer Interviews	✓	✓	✓	✓	✓	✓	✓	✓	✓
Program Material Review	✓	✓	✓	✓	✓	✓	✓	✓	✓
Tracking System Review	✓	✓	✓	✓	✓	✓	✓	✓	✓
Program Theory Logic Model Review	✓	✓	✓	✓	✓	✓	✓	✓	✓
Participant Research									
Participant Survey	✓	✓	✓	✓	✓	✓	-	✓	-
In-Store Customer Intercepts	✓	-	-	-	-	-	-	-	-
Price Elasticity Modeling	✓	-	-	-	-	-	-	-	-
Market Partner Surveys/In-Depth Interviews	✓	-	✓	-	-	-	-	-	-
Shelf Stocking Study	✓	-	-	-	-	-	-	-	-
Gross Impact Analysis									
Database Review	✓	✓	✓	-	✓	✓	✓	✓	✓
Engineering Analysis	✓	✓	✓	-	✓	✓	✓	✓	✓
Desk Reviews	-	-	✓	-	-	-	-	-	-
Consumption Analysis	-	-	-	✓	-	-	-	-	-
Attribution/Net Impact Analysis									
Free Ridership	✓	✓	✓	-	✓	✓	-	-	-
Participant Spillover	✓	✓	✓	-	✓	✓	-	-	-
Trade Ally Spillover			✓	-			-	-	-
Non-Participant Spillover	✓	✓	✓	-	✓	✓	-	-	-

The following subsections provide a general description of each evaluation activity. Program-specific details are included in each program chapter, where relevant.

Program Manager and Implementer Interviews

To support evaluation planning, we conducted in-person interviews with program implementation staff in January 2019. In these interviews, we explored details of the design and planned implementation for each program, as well as program staff's evaluation priorities.

Given that many of the residential programs launched later in the year than anticipated, we conducted a second round of interviews with the implementation team part way through the program year. We conducted this second in—depth interview to understand more about the early stages of program implementation, any challenges that program teams encountered to date, and program data tracking and reporting processes.

Program Material Review

We conducted a comprehensive review of all available program materials, including marketing and implementation plans, customer communications, and educational and training materials. This review served to familiarize the Team with details of program design and implementation.

Tracking System Review

In February 2019, the evaluation team reviewed a set of proposed data fields for all residential energy efficiency programs. The purpose of this review was to ensure that the implementer, Franklin Energy, and its partners collected the data necessary for the evaluation team to accurately complete the evaluation, including customer/contractor contact data (e.g., name, address, phone number, and e-mail address) to support survey efforts and key equipment characteristics (e.g., sizes and model numbers) to support the impact analysis. We developed a memo summarizing our findings of the review and recommended the additional fields be tracked.[6]

The evaluation team subsequently provided input on multiple iterations of the Franklin Energy data fields, and ultimately received program-tracking data from each individual implementation partner, as opposed to a single centralized data tracking system managed by Franklin Energy as initially envisioned.

Participant Research

For most residential programs, the evaluation team conducted research with program participants. This participant research consisted of quantitative online surveys conducted with Ameren Missouri residential customers who had participated in the residential programs during PY2019. The general topics covered across the residential programs included:

- Customer experience with the program and trade allies where appropriate
- Sources of program information
- Satisfaction with the program overall and different program components
- Recommendations for program improvement
- Free ridership (FR) and participant spillover (PSO) for select programs[7]

While initially planned, this evaluation did not include interviews with Multifamily Market Rate or Multifamily Low Income participants or participating organizations in the Single Family Low Income Program due to the small number of participants/participating organizations in the programs. We therefore postponed this research to the PY2020 evaluation.

Details of the individual data collection activities including population sizes, sampling approaches, and response rates are presented in the individual program chapters. Final data collection instruments are provided under separate cover.

Market Partner Research

We conducted market partner research for the Residential Lighting and HVAC Program evaluations. For the Lighting Program we conducted interviews with participating retailers and manufactures, and for the HVAC Program we conducted quantitative online surveys with participating HVAC contractors. For detailed descriptions of both data collection efforts, see Sections 0 and 4, respectively.

[6] Memo titled *Program Tracking Data Review – Residential Energy Efficiency Programs*, dated March 5, 2019.
[7] This evaluation did not include an assessment of FR or PSO for the SFLI program.

Details of the individual data collection activities including areas of exploration, population sizes, sampling approaches, and response rates are presented in the individual program chapters. Final data collection instruments are provided under separate cover.

Gross Impact Analysis

The PY2019 gross impact analyses for the Ameren Missouri residential programs are based on the Ameren Missouri TRM and deemed savings tables, supplemented with evaluation-based results. Gross impact activities included review of the program-tracking database, and engineering desk reviews for a sample of projects for the HVAC Program.

The gross impact analysis developed first and last year ex post gross energy and demand savings. The following details should be noted:

- We applied deemed technology-specific coincidence factors (CF) from Ameren Missouri's TRM to ex post energy savings to calculate ex post demand savings.
- Last year ex post energy and demand savings reflect baseline adjustments for lighting measures (see additional information below) and early-replacement HVAC measures (Central Air Conditioner, Air Source Heat Pumps, Ground Source Heat Pumps, and Ductless Minisplit Heat Pumps). For all other measure types, last year energy and demand savings equal first savings.
- Last year ex post demand savings are presented by three EUL categories: less than 10 years, 10-14 years, and 15 years or more.

Database Review and Engineering Analysis

To determine gross impacts associated with the majority of Ameren Missouri's PY2019 programs, we first reviewed the program-tracking database to check that project data was recorded fully and correctly, and that the database contained all needed information to estimate program savings. We also examined the incented measures to ensure that they met all program requirements. We then conducted an engineering analysis, which involved reviewing program tracking data to verify that the correct TRM algorithms and deemed savings assumptions were used to calculate ex ante savings. We then calculated ex post savings using TRM algorithms, deemed savings assumptions, and any updated evaluation-estimated parameters, such as in-service rates derived from desk reviews and/or participant survey data.[8]

We resolved any discrepancies found in the databases and provide details related to any gross savings adjustments in the program-specific sections of this report.

Engineering Desk Reviews

We performed engineering desk reviews for a sample of HVAC Program CAC and ASHP projects. For the selected projects, we reviewed all program documents including applications, invoices, and specification sheets to verify accuracy of data in the program tracking database and ultimately use the updated data to estimate gross impacts. Additional detail is provided in Appendix A.

[8] Ex ante applied Revision 2.0 (dated 12/21/2018) of the Ameren Missouri 2019-21 MEEIA Energy Efficiency Plan Appendix I – TRM: Residential Measures (referred to as the "Ameren Missouri TRM"). Ex post applied Revision 3.0 (released November 2019) of the Ameren Missouri TRM.

Net Impact Analysis

To determine net savings for the PY2019 residential programs, we developed net-to-gross ratios (NTGRs) that we applied to ex post gross savings. Exceptions to this approach are made for the Home Energy Reports Program, which is evaluated using a consumption analysis approach, as well as the Single Family and Multifamily Low-Income Programs for which we assume a NTGR of 1.

Net-to-Gross Ratio Development

Our NTG analysis included consideration of free ridership (FR), participant spillover (PSO), trade ally spillover (TASO), and non-participant spillover (NPSO), depending on program design. We developed estimates of FR, PSO, and TASO based on the online surveys with participants and estimates of TASO based on the online survey with HVAC contractors. The NTGR was calculated as follows:

NTGR = 1 – FR + PSO + TASO + NPSO

It should be noted that while initially planned, this evaluation did not include a FR or PSO analysis for the MFMR Program, due to very low program participation in PY2019. Instead, we applied the program planning NTGR value of 0.90.[9]

Table 2-2 summarizes, by program, which NTGR components were estimated as part of the PY2019 evaluation. The subsections following the table provide more detail on the estimation of FR, PSO, TASO and NPSO.

Table 2-2. Components of NTGR by Program

NTGR Component	Lighting	EEP	HVAC	HER	ARP	EE Kits	MF MR	SF LI	MF LI
Free Ridership	✓	✓	✓	-	✓	✓	-	-	-
Participant Spillover	✓	✓	✓	-	✓	✓	-	-	-
Trade Ally Spillover	-	-	✓	-	-	-	-	-	-
Non-Participant Spillover	✓	✓	✓	-	✓	✓	-	-	-

Free Ridership

Free riders are program participants who would have completed the same energy efficiency upgrade without the program. FR scores represent the percentage of savings that would have been achieved in the absence of the program. FR scores can range from 0% (not a free-rider; the participant would not have completed the project without the program) to 100% (a full free-rider; the participant would have completed the project without the program). FR scores between 0% and 100% represent partial free-riders, i.e., participants who were to some degree influenced by the program to complete the energy efficiency upgrade.

For programs within the residential portfolio, the FR assessment generally consisted of two components:[10]

[9] The evaluation team felt this value was appropriate given experience evaluating similar programs in other jurisdictions, as well as the design of the MFMR Program. Based on our experience with the multifamily market's hard-to-serve nature and unique decision-making process around larger measures like insulation, we felt that the program's planning value of 0.90 appropriately captured program influence around deeper custom retrofits that the program is offering, including heating, cooling, and shell measures.
[10] The evaluation team used modified algorithms for the EE Kits and Appliance Recycling Programs given their program designs. Additional detail is provided within the program-specific chapters of the report.

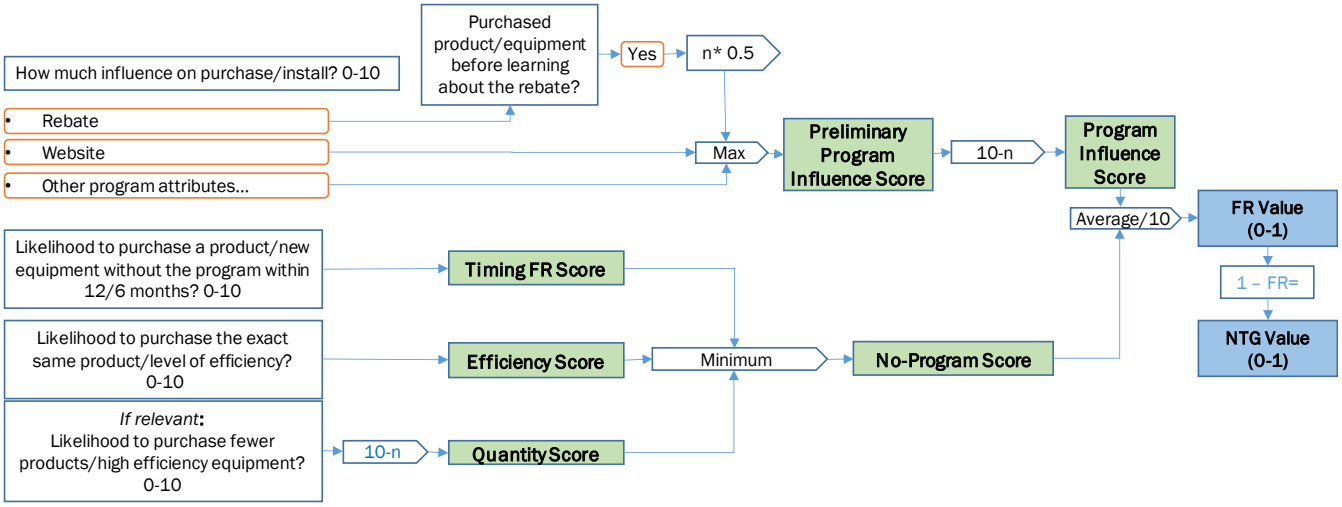
- A Program Influence component, based on the participant's perception of the program's influence on the decision to carry out the energy-efficient project; and
- A No-Program component, based on the participant's intention to carry out the energy-efficient project without program funds.

When scored, each component assesses the likelihood of FR on a scale of 0 to 10, with the two scores averaged and for a combined total FR score. FR is the mean of the two components:

$$Free\ Ridership\ (FR) = Mean(Program\ Influence, No\ Program\ Score)$$

As different and opposing biases potentially affect the two main components, the No-Program component typically indicates higher FR than the Program Influence component. Therefore, combining these decreases the biases. Figure 2-1 presents a diagram of the respondent-level FR algorithm used for the HVAC, Efficient Products and Lighting (online component only).

Figure 2-1. Overview of General Residential Free-Ridership Algorithm



Additional detail on the free ridership methodology used in the evaluation of the residential portfolio is presented in each of the relevant program chapters.

Participant Spillover

PSO refers to additional energy efficiency upgrades participants made at the time of or after their participation in the residential programs that were influenced by the programs but for which they did not receive a program incentive. PSO is expressed as a percentage of program savings.

To determine if a survey respondent is eligible for PSO savings, we asked a series of questions about additional energy efficiency installations that they made without receiving an incentive and the degree to which the program influenced their decision to install the efficient equipment. The survey included two program influence questions:

a. *Q1. How much did your experience with the Program influence your decision to make these energy efficient improvements on your own? [SCALE 0-10; 0 means "no influence" and 10 means "greatly influenced"]*

b. *Q2. How likely is it you would have made these energy efficiency improvements if you had not received a rebate through the Program? [SCALE 0-10; 0 means "definitely would not" and 10 means "definitely would"]*

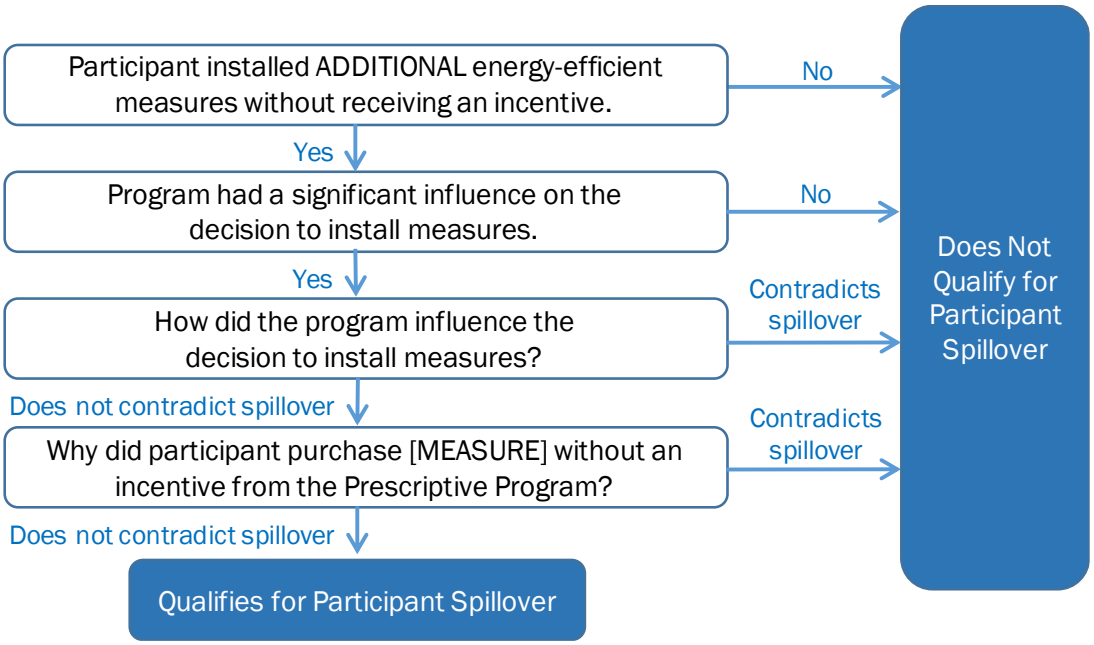
To supplement these numeric responses, the survey contains open-ended questions about how the program influenced the decision to make the upgrades and why the participant made the installations without a program incentive. A respondent's additional energy efficiency installations are deemed eligible for PSO if two conditions are met: (1) the Program Influence Factor (see below) is greater than 5.0 and (2) the open-ended responses do not contradict that the installations were eligible for PSO.

The Program Influence Factor was calculated as follows:

Program Influence Factor = (Q1 Response + (10 – Q2 Response)) ÷ 2

Figure 2-2 presents a diagram of the PSO eligibility determination methodology used for this evaluation, including references to question numbers.

Figure 2-2. Participant Eligibility for Spillover



For participants with qualifying installations, we attempted to conduct follow-up calls to collect more-detailed information for each additional measure, such as quantities (where applicable), the baseline and efficient wattages (for lighting measures), or the hours of use (where relevant).

To estimate the savings achieved by spillover measures, we used two approaches:

- For spillover measures reported by survey respondent that also completed a follow-up call, we used the measure-specific data collected through the follow-up call, as well as the appropriate Ameren Missouri TRM algorithm to estimate measure-level savings. This is consistent with the approach we used to determine savings for measures installed through program participation (i.e., using measure-specific data from the program tracking database to calculate savings).

- For spillover measures reported by survey respondents that could not be reached for a follow-up call, we applied the average measure-level savings per participant calculated from those survey respondents for whom we were able to conduct follow-up calls. For measures for which we had no additional information from follow-up calls, we used the Ameren Missouri TRM algorithm and default values to estimate the spillover measure savings.

It is important to note that the evaluation team did not include spillover savings from the installation of lighting measures given the potential for double counting with the Residential Lighting Program. Many customers do not know they are purchasing program-discounted LEDs so it is not possible to verify that the LEDs they purchased were not discounted by Ameren Missouri. In addition, the Residential Lighting Program evaluation estimates and claims savings from non-discounted LEDs that were influenced by the Ameren Missouri program.

Non-Participant Spillover

Ameren Missouri has been running energy efficiency programs for many years. A key component of the residential portfolio has been the marketing and outreach campaign to promote the programs and general energy-efficiency awareness among customers. Sustained utility program and general marketing can affect customers' perceptions of their energy usage, and, in some cases, motivate them to take efficiency actions outside of the utility's program. We define NPSO as the energy savings that Ameren Missouri's program marketing activities caused but did not rebate.

We developed estimates for non-participant spillover (NPSO) and included these additional savings in the net impacts to the applicable residential programs. In the remainder of this section, we provide an overview of our data sources and methods for estimating NPSO. For more detailed discussion of NPSO methods, see Appendix A.

The NPSO analysis uses data we collected through a residential general population survey of a random sample of 4,804[11] Ameren Missouri residential customers. After completing the survey, we matched survey respondents' account numbers to those of all PY2019 program participants and excluded residential program participants from the analysis.[12] We removed program participants for all residential programs except upstream Lighting and Multifamily (low-income and market-rate). Upstream Lighting data does not contain customer-specific information due to its design and the Multifamily program tracking data does not contain the tenant information necessary to identify program participants. We considered customers who were part of the legacy and 2019 HER treatment groups as participants and dropped them from the analysis as well. After removing 1,354 confirmed program participants, we were left with 3,450 non-participant respondents for analysis. We took respondents through a series of screening questions for each relevant measure to estimate the affect that Ameren Missouri programs had on their decision to move forward with installing the associated measures.

[11] 4,755 respondents completed the entire survey. We added 49 partial completes for this analysis because they completed the entire NPSO question battery, bringing the total to 4,804.

[12] We removed participant respondents after survey fielding instead of during sample development or survey fielding through screening questions for several reasons: (1) The survey served multiple purposes. In addition to using results to estimate NPSO, the survey contained questions to support program process evaluations and market studies. We needed to ask these additional questions of the entire residential customer base to have representative and usable results; (2) At the time of the survey fielding, we did not have a complete list of all PY2019 participants; (3) Previous NPSO surveys for Ameren Missouri suggest customers overreport their participation in Ameren Missouri programs.

NPSO savings are limited to measure installations that (1) the Ameren Missouri residential program portfolio supports (i.e. "like" measures), (2) could be theoretically due to Ameren Missouri's promotional efforts, and (3) are not the focus of NPSO estimation through specific program evaluations (see Table 2-3). We provide detailed information on the screening criteria used in Appendix A.

Table 2-3. NPSO Applicable Programs and Measures

Measure	Program
Kitchen faucet aerator	Energy Efficient Kits, Appliance Recycling
Bathroom faucet aerator	Energy Efficient Kits, Appliance Recycling
Low flow showerhead	Energy Efficient Kits, Appliance Recycling
Hot water pipe insulation	Energy Efficient Kits, Appliance Recycling
Central air conditioner (CAC)	HVAC
Air source heat pump (ASHP)	HVAC
Ground source heat pump (GSHP) a	HVAC
Ductless/Minisplit Heat Pump (DMSHP)	HVAC
Furnace fan with electronic commutating motor (ECM)	HVAC
Advanced (i.e., learning or smart) thermostat	Energy Efficient Products, HVAC
Advanced power strips a	Energy Efficient Products
Pool pump	Energy Efficient Products
Heat pump water heater (HPWH)	Energy Efficient Products
Recycled refrigerator	Appliance Recycling
Recycled freezer	Appliance Recycling

Note that we excluded measures that are only available through low income programs (e.g., insulation and AC tune-ups) as these measures are not available to the Ameren Missouri's broader customer base. We also excluded LEDs because we estimated NPSO for lighting measures through the in-store customer intercepts that are part of the Residential Lighting Program evaluation. We do include HVAC measures in the NPSO survey but asked additional survey questions to avoid double counting savings. The HVAC Program evaluation included an estimation of NPSO through participating contractors. To avoid double counting savings, we asked all respondents who installed a new energy efficient HVAC unit for the name of their contractor and excluded any installations performed by participating contractors. This will restrict NPSO savings from this survey to installations performed by non-participating contractors

Once we determined the final list of NPSO measures, we determined whether each respondent should receive full or partial credit for their measures based on Criterion B (see Appendix A). We then determined average savings per measure using deemed savings values from the Ameren Missouri TRM, or in some cases the average of several deemed savings values we used in the 2019 program evaluations. We determined the total NPSO savings amongst surveyed non-participants by applying the adjusted measure quantities to the average savings values for each measure. We determined the total NPSO amongst Ameren Missouri non-participants by extrapolating the average savings amongst non-participants (n=3,450) to the population of Ameren Missouri non-participants (N=637,968). The last step was to allocate NPSO to each program based on the relative size of its ex-post gross savings.

Lighting Price Elasticity Modeling

The evaluation team used price elasticity modeling to develop an additional estimate of FR for the upstream channel of the Residential Lighting Program. As part of this research activity, we developed regression models of program sales data to estimate price elasticity and predict bulb sales at non-discounted prices. We calculated FR based on the predicted sales volume in the absence of program discounts relative to the actual sales that occurred during the evaluation period.

Home Energy Report Consumption Analysis

The evaluation team used a monthly consumption analysis approach to determine impacts from the Home Energy Reports Program. Given the experimental design, the estimated savings are considered net savings. We used treatment and control group monthly billing data to estimate net savings per household over the program period. The net savings are further adjusted using joint savings analysis to ensure that savings are not double-counted between programs. We also compared Uplight's (the program implementer) estimated electric savings to those we developed for this evaluation.

3. Residential Lighting

This section summarizes the PY2019 evaluation methodology and results for the Ameren Missouri Residential Lighting Program. Additional details on the methodology are presented in Appendix A. Data collection instruments are included in Appendix B.

3.1 Evaluation Summary

The Ameren Missouri Residential Lighting Program is designed to increase sales and awareness of ENERGY STAR® qualified LED lighting products. The target market consists of all residential customers within the Ameren Missouri service territory. Ameren Missouri delivers the Lighting Program through two channels: (1) upstream, through retail partners, and (2) through the Ameren Missouri Online Store.

Through its upstream channel, the program provides incentives to retail partners to reduce costs and increase sales of qualified LED lighting products. Though the incentives are paid to the retailers, they translate into immediate point-of-purchase (POP) discounts for customers when they purchase program-qualified LEDs. The upstream program emphasizes the training of retail outlet staff to discuss the benefits of efficient lighting and also offers in-store marketing materials to increase customer awareness. Additional marketing activities include lighting clinics and events at retailers, pop-up retail shops, proximity mobile marketing, on-line advertising, co-op advertising, coupons, print, radio, television commercials, billboards, and on-bill messaging.

Ameren Missouri launched a new Online Store on March 1, 2019.[13] The Online Store offers Ameren Missouri customers a select assortment of efficient LED lighting products that customers can purchase directly from the site.[14],[15] In this case, the incentives translate to immediate online discounts at checkout. In addition to providing all customers access to a streamlined approach for obtaining energy-efficient products, the Online Store also ensures that customers who do not live near a participating retailer have access to discounted LED products.

The one notable change to mid-year implementation was that for the upstream channel, the program implemented a comprehensive plan in October that expanded the number of participating retailers, number of participating store locations, number of incented products on each MOU, and increased per-bulb incentive levels. Note that the incentive levels were increased for both the upstream and Online Store channels. Additional marketing efforts were also deployed to make customers aware of the new deals. Because of the increased discounts, some retailers emphasized the products by placing them on end caps, aisle pallets, and bulk stacks.

[13] Note that Ameren Missouri offered an online store in past years though through a different implementer. March 2019 was the launch of the current Online Store with the new implementer, Uplight (who itself is a recent merger of Tendril and Simple Energy).
[14] In addition to lighting, the Online Store offers discounts on smart thermostats and advanced power strips. The store also sells other products without a discount including water saving products, HVAC air filters, and smart home devices. Only the lighting measures are being evaluated in this study.
[15] The current Online Store lighting main page can be viewed here: https://amerenmissouristore.com/collections/lighting.

3.1.1 Participation Summary

In total, the upstream channel incented 2,716,116 individual bulbs from sales across 273 participating retailer stores; the Online Store incented 10,756 bulbs purchased by 737 unique Ameren Missouri customers (see Table 3-1). The upstream channel dominates the Residential Lighting Program representing 99.6% of ex ante gross MWh and MW savings.

Table 3-1. PY2019 Lighting Program Participation Summary by Channel

Channel	Customers/Stores		Bulbs		Ex Ante Gross Savings			
	Number	%	Number	%	MWh	%	MW	%
Upstream	273	27%	2,716,116	99.6%	86,168	99.6%	12.97	99.6%
Online Store	737	73%	10,756	0.4%	384	0.4%	0.06	0.4%
Total	**1,010**	**100%**	**2,726,872**	**100.0%**	**86,553**	**100.0%**	**13.02**	**100.0%**

Proportionally, customers purchased similar types of LEDs across channels (see Table 3-2). In both channels, customers purchased many more standard LED bulbs than reflector or specialty bulbs.[16] In the upstream channel, 79% of all bulbs sold were standard LEDs compared to 13% reflectors and 8% specialty bulbs. The Online Store sold a similar distribution of bulb types with 72% being standard, 19% reflectors, and 9% specialty bulbs.

Table 3-2. PY2019 Lighting Program Participation Summary by Channel and Bulb Type

Channel	Bulb Type	Customers/Stores		Bulbs		Ex Ante Gross Savings			
		Number	%	Number	%	MWh	%	MW	%
Upstream	Standard	273	100%	2,152,115	79%	69,106	80%	10.40	80%
	Reflector	270	99%	353,711	13%	10,004	12%	1.51	12%
	Specialty	273	100%	210,290	8%	7,059	8%	1.06	8%
Upstream Subtotal		**273**		**2,716,116**	**100%**	**86,168**	**100%**	**12.97**	**100%**
Online Store	Standard	458	62%	7,728	72%	256	67%	0.04	67%
	Reflector	156	21%	2,026	19%	95	25%	0.01	25%
	Specialty	123	17%	1,002	9%	33	9%	<0.01	9%
Online Subtotal		**737**	**100%**	**10,756**	**100%**	**384**	**100%**	**0.06**	**100%**
Total		**1,010**		**2,726,872**		**86,553**		**13.02**	

3.1.2 Key Impact Results

Table 3-3 presents annual savings achieved in PY2019. As shown, the program achieved 496% of Ameren Missouri's net energy savings goal. Though the program realization rate was greater than 100%, the program vastly exceeded its savings goals due to selling more LEDs through the upstream channel than planned.

[16] In this report, we separate reflector bulbs from the specialty category. We find differences in the market for reflectors versus globes and candelabras, which could influence program impacts and future program designs. In this report, specialty includes any screw-based bulb that is not an A19 or a reflector. In most cases, a specialty bulb would be a globe or candelabra.

Table 3-3. PY2019 Lighting Program Impact Summary

	Ex Ante Gross	Realization Rate	Ex Post Gross	NTGR	Ex Post Net	Goal/Target Net	% of Goal/Target
First Year Savings							
Energy Savings (MWh)	86,553	114.0%	98,634	63.7%	62,818	12,659	496%
Demand Savings (MW)	13.02	117.5%	15.30	63.7%	9.74	1.89	515%
Last Year Demand Savings							
< 10 EUL (MW)	0.00	NA	2.69	63.7%	1.71	0.00	NA
10-14 EUL (MW)	0.00	0.00	0.00	NA	0.00	0.00	NA
15+ EUL (MW)	13.02	96.8%	12.61	63.7%	8.03	1.89	425%

Key impact results include:

- Realization rates greater than 100% for energy (114%) and demand savings (118%) are primarily due to the in-store customer intercept interviews finding more commercial installations of program-discounted bulbs than assumed in Appendix F deemed savings tables (4% compared to 1%). LEDs installed in commercial settings have higher energy savings than those installed in residential settings.
- The Online Store has a realization rate of 89% due to a low first-year in-service rate (ISR) (44%). Because the Online Store channel represents such a small proportion of the total program (0.4% of total ex ante gross savings), it has little detectible effect on the overall program realization rate.
- The lighting program achieved 425% of Ameren Missouri's filed net last year demand savings. This differs slightly from the first-year demand savings goal because of adjustments that were made to account for some bulbs that the evaluation team found were installed in commercial facilities purchased through the upstream channel.

Overall, the Lighting Program was the largest program in the PY2019 residential portfolio, accounting for 54% of ex post net residential portfolio energy savings and 27% of ex post net residential portfolio demand savings.

3.1.3 Key Process Findings

To meet the requirements of Missouri Code of State Regulations (CSR) for demand-side process evaluations, we provide responses to the five required process evaluation questions in Table 3-4.

Table 3-4. Summary of Responses to CSR Process Evaluation Requirements

CSR Required Process Evaluations Questions	Findings
What are the primary market imperfections that are common to the target market segment?	▪ Market imperfections have historically been product availability, customer awareness of energy-efficient lighting options and benefits, and the higher cost of these products. ▪ Product availability is no longer a barrier. LEDs are the most frequently stocked bulb at lighting retailers across all bulb types (i.e., standard, reflector, and specialty). ▪ Customer awareness is a decreasing barrier. The vast majority of customers have LEDs installed in their homes. Two-thirds of customer light sockets also contain either a CFL or an LED. ▪ LEDs still cost more than incandescents, but the price difference has narrowed.

CSR Required Process Evaluations Questions	Findings
	▪ Despite these positive signs of market progress, customer use of efficient bulbs varies by household income and use case (i.e., socket type). Lower-income customers have lower LED penetrations and efficient bulb saturation than other customers. Low-income customers are also more likely to purchase the lowest cost bulb rather than consider factors like energy efficiency. Sockets that take a standard bulb also have greater efficient bulb saturation than reflector or specialty sockets.
Is the target market segment appropriately defined, or should it be further subdivided or merged with other market segments?	▪ The target market for the Residential Lighting Program is all residential customers within Ameren Missouri service territory. ▪ The program targets low-income customers by engaging discount stores that do not typically sell lighting such as St. Vincent De Paul, Salvation Army, Goodwill, and Habitat Restore. These stores tend to serve lower income customers. By bringing low-cost LEDs into these stores, the program attempted to reach customers it may not reach through other participating retailers. Still, nearly 90% of program-discounted bulbs were sold at large warehouse, big box, and DIY retailers though the upstream channel. ▪ Given the high level of efficient bulb socket saturation among non-low-income customers, the program could benefit from a more targeted design. Truly subdividing the market into low-income versus non-low-income and using tailored program designs for each customer segment would be appropriate.
Does the mix of enduse measures included in the program appropriately reflect the diversity of enduse energy service needs and existing enduse technologies within the target market segment?	▪ Standard bulbs are the most commonly used bulb in customer homes and have long been the focus of the Residential Lighting Program. This focus made sense when socket saturation of efficient bulbs was low across all use cases. But now that nearly 70% of light sockets that take a standard bulb contain an efficient bulb, the time is right to shift the program's focus to LED reflector and specialty bulbs, which cost more and lag in use. An exception is the low-income customer segment, as noted previously. Low-income customers could still use support increasing their use of all efficient bulb types, including standard bulbs.
Are the communication channels and delivery mechanisms appropriate for the target market segment?	▪ For the upstream channel, the program used in-store and out of store marketing. Our evaluation found that in-store marketing was the primary driver of sales. Given the nature of the product, marketing at the point-of-purchase is appropriate. ▪ Program implementers added new discount retailers to the program increase the focus on low-income customers. This was an effective strategy that the program should continue and even expand, if possible. In turn, the program should reduce its emphasis on sales of standard bulbs at non-discount stores. ▪ The Online Store accounted for less than 1% of program sales and savings. With the growing customer reliance on online shopping more generally, the Online Store has unrealized potential. The channel is particularly useful for targeted marketing to underserved customers, which is more difficult to do through the mass market upstream channel.
What can be done to more effectively overcome the identified market imperfections and to increase the rate of customer acceptance and implementation for select	▪ Price is the remaining market imperfection, but much more so for low-income customers. The program should continue its partnerships with low-income retailers that do not traditionally sell lighting and other retailers in low-income neighborhoods. ▪ Customers have been slower to adopt reflector and specialty efficient lighting, in part because the previous product, CFLs, was expensive and did not meet customer expectations. LEDs are a superior product and price have fallen, but they still cost more than incandescents. The program could do more to increase adoption by focusing program budget on non-standard products.

CSR Required Process Evaluations Questions	Findings
enduses/measure groups included in the Program?	

3.1.4 Conclusions and Recommendations

Based on the results of this evaluation, the evaluation team offers the following conclusions and recommendations for the Residential Lighting Program moving forward:

- Conclusion #1: The Residential Lighting Program discounted a large number of LEDs in PY2019. By selling nearly 2.8 LEDs per residential customer (with three-quarters of bulbs sold during the final three months of the program year), the program demonstrated that it can move a lot of bulbs through price reductions and product placement within stores. However, the residential lighting market is transforming and barriers such as customer awareness and product availability no longer exist for most customers. Three-quarters of lighting products on retailer shelves are LEDs and nearly two-thirds of customers' light sockets contain an efficient bulb.
  - Recommendation: Ameren Missouri's Residential Lighting Program has been a successful program that has delivered a lot of energy savings to the residential portfolio, but the program should consider moving away from a mass market program design that sells a large volume of standard bulbs at major retailers to a targeted design that focuses on bulb types with lower saturation and market share and on customers who still face barriers to adoption.
- Conclusion #2: The program made a special effort to engage discount stores that do not typically sell lighting such as St. Vincent De Paul, Salvation Army, Goodwill, and Habitat Restore. These stores tend to serve lower income customers. By bringing discounted LEDs into these stores, the program attempted to reach customers it may not reach through other participating retailers. Along with Dollar Tree stores, these discount retail stores sold 10% of bulbs discounted through the program. Our evaluation research shows that these efforts to reach lower income customers were successful and are needed. We found lower customer free ridership at discount stores than at large retailers. In addition, in-home lighting audits show that low-income customers lag other customers in their use of efficient bulbs. The higher cost of all types of LEDs continues to be a barrier for low-income customers.
  - Recommendation: Ameren Missouri should continue, and if possible, expand efforts to reach low-income customers through its lighting program and other programs that target low-income customers.
- Conclusion #3: Results from our in-home lighting audits show that saturation of efficient bulb technologies varies by socket type. Efficient bulbs are in 69% of standard sockets, 58% of reflector sockets, and only 37% of specialty sockets. The reflector market has seen a particularly rapid change due to the superior nature of LED technologies compared to CFLs. Customers have yet to install large numbers of efficient bulbs in their specialty sockets.
  - Recommendation: Ameren Missouri should consider continuing its support of reflector and specialty LEDs at large mass market retailers to speed adoption of efficient bulbs in non-standard uses. However, program administrators should keep a watchful eye on the reflector market, which is changing rapidly and may only need support in the short term.

- Conclusion #4: The Online Store channel only represented 0.3% of total program ex post gross savings. There is clear opportunity for growth here, which would be beneficial for a couple reasons. With the growing customer reliance on online shopping more generally, the Online Store has unrealized potential. The channel is particularly useful for targeted marketing to underserved customers, which is more difficult to do through the mass market upstream channel.
  - Recommendation: Online stores are only limited by the amount of traffic hitting the site. Online Store participants who purchased either lighting were more likely to learn about the store through direct communication from Ameren Missouri than the mass media marketing activities the program used. Ameren Missouri could use the Online Store and targeted direct marketing as another avenue to reach underserved customers.

3.2 Evaluation Methodology

As described in Section 3.1, the evaluation team performed both impact and process evaluation activities to assess the performance of the PY2019 Ameren Missouri Residential Lighting Program. In addition to the overarching research objectives outlined for the residential portfolio, the evaluation team explored the following Lighting Program-specific objectives:

- Characterize program participation based on bulbs discounted through the program with respect to the number of bulbs, bulb characteristics, and retailer type and location;
- Assess customer knowledge of and satisfaction with energy-efficient lighting products;
- Measure Online Store customer satisfaction with program processes, discounted products, and motivations for participating through the online store;
- Evaluate the effectiveness of program marketing materials in informing customers about the benefits of LEDs and their impact on customer purchases;
- Measure retailer satisfaction, with program processes and implementers;
- Assess which Stock Keeping Units ("SKU") should no longer be offered because of market changes; and
- Provide evaluation results that can be used to improve the design and implementation of the Residential Lighting Program.

The evaluation team conducted a variety of research activities to complete this PY2019 Lighting Program evaluation (see Table 3-5). Following the table, we outline program-specific aspects of key evaluation methodologies.

Table 3-5. PY2019 Evaluation Activities for the Lighting Program

Evaluation Activity	Description
Program Manager and Implementer Interviews	▪ Conducted one interview in September with program staff to gain detailed information on the step-by-step operational conditions and implementation efforts to gain an understanding of program design and delivery.
Program Material Review	▪ Reviewed program marketing and outreach plans and materials to inform evaluation activities.
Program Theory/ Logic Model Review	▪ Reviewed implementer's program theory/logic model to understand program activities and their expected outputs and outcomes, including expected impacts on the market.
Tracking System Review	▪ Reviewed implementer's tracking system to ensure that data required for the evaluation was being collected and reported appropriately.
Online Store Participant Survey	▪ Completed online surveys with 189 customers that purchased lighting through Ameren Missouri's Online Store to inform gross savings (e.g., in-service rate), NTG (FR and PSO), and yield process-related insights.
In-Store Customer Intercept Surveys	▪ Conducted 416 interviews with customers purchasing lighting products at 11 participating retail stores to estimate program FR, PSO, and NPSO, leakage, and residential versus commercial usage of program lighting, and yield process-related insights.
Price Elasticity Modeling	▪ Estimated price elasticity curves to estimate program FR.
Retailer/Manufacturer Interviews	▪ Conducted six interviews with participating retailers and manufacturers to collect data to inform our evaluation of program processes and gain information about the state of the lighting market.
Lighting Shelf Stocking Study[a]	▪ Visited eight unique retail locations to gather information about lighting product availability and pricing to monitor changes in the lighting market that could impact program design. ▪ Conducted a web scraping study to collect information about lighting product availability and pricing to monitor changes in the lighting market that could impact program design.
Database Review	▪ Reviewed program database to check that program data were complete and that program-incented measures met all program requirements.
Engineering Analysis	▪ Verified that ex ante savings used correct deemed savings values. ▪ Estimated overall and measure-level ex post gross impacts using TRM algorithms, deemed savings assumptions, and evaluation-estimated parameters.
Attribution/Net Impact Analysis	▪ Developed estimates of FR, PSO, and NPSO. ▪ Estimated PY2019 net impacts.

a The comparison of results from the lighting retail shelf stocking study and the web scraping will be delivered as a separate memo and are not included in this report.

Online Store Participant Survey

We conducted two rounds of online surveys with customers purchasing LEDs through Ameren Missouri's Online Store. The surveys covered a range of topics including verification of LED purchase, installation, and persistence of purchased LEDs; assessment of program processes; measurement of participant satisfaction with program processes, informational materials, and measures offered, and estimation of participant free ridership and spillover.

To aid recall, we aimed to conduct the surveys close to the time that the customers participated in the program (See Table 3-6). However, at the same time, we had to balance against the need for some time to go by to assess PSO effects accurately and first-year ISRs as participants need time to install the bulbs and take additional program-induced actions. We administered the first wave in October 2019 (covering program activity March 1, 2019, through July 31, 2019) and the second wave in January 2020 (covering program activity August 1, 2019, through November 31, 2019).

Table 3-6. PY2019 RL Program Survey Sampling Details by Bulb Type

Bulb Type	Population	Have E-mails	% With E-mails	Bad E-mails	Valid Sample Frame	Completes	Response Rate
Standard LED	430	430	100%	13	417	116	28%
Reflector LED	172	172	100%	1	171	42	25%
Specialty LED	124	124	100%	4	120	31	26%
Total	**726**	**726**	**100%**	**18**	**711**	**189**	**27%**

We sent e-mail invites to all members of the sample frame (i.e., we attempted a census). We sent participants the initial e-mail invite as well as two reminders to complete the survey. In the end, a total of 189 RL participants completed the survey throughout both waves. The overall population-weighted response rate was for the PY2019 REP Program was 27%.

In-Store Customer Intercept Surveys

The evaluation team conducted in-store intercept interviews with 414 customers purchasing lighting from nine unique retail locations.[17] We conducted the intercepts between October and December of 2019.

Interviews took place at a selection of do-it-yourself (DIY), big-box retailers, and community discount stores. To gain entry to the stores, we accompanied a program field representative who was conducting an in-store lighting demonstration. The program representative helped the interviewer gain permission to return to the store and conduct additional interviews during the two days following the in-store demo. When selecting stores, we aimed to capture both geographic and sales volume variability but were limited to the stores where we could get permission to conduct the interviews. It is also not cost-effective to conduct intercept interviews retailers that sell a small number of bulbs. Therefore, our sample design is a convenience sample. Despite these constraints, we selected a sample of retailers that represented about half (48%) of program sales across the Ameren Missouri service territory.

Interviewers spent 2-3 days at each location. We conducted interviews on the days of the week, and during hours when residential customers are more likely to shop, Fridays, Saturdays, Sundays, and Mondays between 9 am and 5 pm. We attempted to interview all customers purchasing lighting, including LEDs discounted through the program, LEDs not discounted, and incandescent, halogen, and CFL light bulbs.

We instructed the field interviewers to station themselves in the lighting aisle of the store and to approach customers after they had made their purchase decision and were preparing to leave the aisle. Interviewers asked customers to complete a short survey in exchange for a $10 gift card to that particular retail store. For

[17] We visited two stores twice to maximize the number of completed interviews during the fielding period, completing interviews during 11 total visits.

the smaller community discount stores that did not have their gift cards, we offered customers generic $10 Visa gift cards. Interviewers recorded customers' answers using an electronic tablet.

Table 3-7 contains a summary of the total number of completed intercept interviews by store type and the number of storefronts associated with each store type in which we completed intercept interviews.

Table 3-7. In-Store Customer Interviews by Store type

Store Type	Locations	Completed Interviews
Do It Yourself (DIY)	4	264
Big Box	2	67
Discount	3	82

Price Elasticity Modeling

The goal of the price elasticity modeling was to develop an additional estimate of FR for the upstream channel. As part of this research activity, we developed regression models of program sales data to estimate price elasticity and predict bulb sales at non-discounted prices. We calculated FR based on the predicted sales volume in the absence of program discounts relative to the actual sales that occurred during the evaluation period. Details of the methodology are provided in Appendix A.

Shelf Stocking Survey

As part of the overall project, the evaluation team conducted shelf surveys in a selection of the stores visited for the intercepts. The goal of the shelf surveys was to collect information on bulb availability and pricing. The field staff conducting the in-store intercepts conducted the shelf surveys on their first day at the store to familiarize themselves with the products, especially the discounted models. The field staff was instructed to record information on each lighting product sold that was either a program-discounted bulb or could be purchased instead of a program-discounted product. The stocking study excluded linear fluorescent bulbs and other specialized products such as unique pin-based products, oven lamps, etc. For each product, the field staff recorded regular and sales prices, whether the program or the retailer discounted it, and bulb characteristics (e.g., type, shape, lumens, actual efficient wattage, equivalent wattage). In total, we completed shelf surveys in six retail locations across the three types of retailers we visited (Table 3-8).

Table 3-8. Shelf Surveys by Store Type

Store Type	Locations
Do It Yourself (DIY)	3
Big Box	1
Discount	2

At the same time as the in-store shelf stocking, the evaluation team conducted web scraping of lighting products sold through the online stores of the same DIY and big-box retailers where we collected in-store stocking data. The main objective of the web scraping was to determine if web scraping produces similar results to in-store stocking studies and could be used for future studies. Web scraping costs less to conduct and could be conducted more frequently. We will provide the results of this comparison in a future memo.

Retailer/Manufacturer Interviews

The evaluation team completed a total of six interviews with retail and manufacturer representatives. We aimed to gather information about program processes, including program satisfaction, any challenges to program delivery, recommended process improvements, and perceived barriers to customer purchase of efficient lighting. We also used these interviews to collect information about the state of the lighting market, the impact of the program on the market, and future plans and predictions given the uncertainty of EISA 2020.

The sample frame for manufacturers and retailers was supplied to us by the upstream program manager and included a total of 20 contacts from 17 companies and generally included all retailers and manufacturers that were involved in the PY2019 program. We reached out to nearly all retailer and manufacturer contacts, with a purposeful focus on the retailers and manufacturers representing the most program sales.

Table 3-9 provides a summary of the retailer and manufacturer interviews by jurisdiction and stakeholder type. The table also provides the percent of sales accounted for by each group of interviewed respondents.

Table 3-9. Retailer and Manufacturer Interview Sample

Interviewee Type	Unique Contacts in Sample	Completed Interviews[a]
Retailer	9	2
Manufacturer	11	5

a One interviewee represented both a retailer and manufacturer, so the sum of this column exceeds the six interviews we conducted.

Impact Analysis

Gross Impact Analysis

The impact analysis consisted of a program tracking database review to identify database errors and duplicate records, as well as ensure that the implementer applied savings algorithms and assumptions outlined in the Ameren Missouri TRM[18] and Appendix F deemed savings tables. The team also developed and applied gross savings adjustments for ISRs and leakage by channel (from the in-store intercepts for the upstream channel; from the participant surveys for the Online Store channel). Details of the gross impact methodology are provided in Appendix A.

Attribution/Net Impact Analysis

The NTG analysis for the PY2019 Residential Lighting Program included the estimation of FR, PSO, and NPSO at the channel by bulb type level. Overall, the NTGR for the Residential Lighting Program is calculated as follows:

$$NTGR = 1 - FR + PSO + NPSO$$

Table 3-10 shows the sources for each of the three NTGR parameters by channel.

[18] Ex ante applied Revision 2.0 (dated 12/21/2018) of the Ameren Missouri 2019-21 MEEIA Energy Efficiency Plan Appendix I – TRM: Residential Measures (referred to as the "Ameren Missouri TRM"). Ex post applied Revision 3.0 (released November 2019) of the Ameren Missouri TRM.

Table 3-10. Summary of NTGR Components and Sources

Parameter	Information Source	
	Upstream	Online Store
FR	In-Store Intercepts; Sales Data Analysis	Online Store Participant Surveys
PSO	In-Store Intercepts	Online Store Participant Surveys
NPSO	In-Store Intercepts	NA

Each information source has strengths and weaknesses. Estimating what a customer would have hypothetically purchased if the program had not discounted LEDs is challenging. The in-store interviews take place at the time of purchase allowing us to hear in real time the factors that influenced the customer's purchase decision. The customer has not had time to install and experience the product so the responses will not be biased by the post-purchase experience. But because the interviews are conducted in person, customers may be reluctant to admit that they would not purchase an energy efficient bulb if it cost more.

The elasticity model results only use program sales data instead of full category lighting data. The theory underlying the model is that any lift in sales due to price reductions is a shift in sales from a less efficient product to an LED, which may or may not be the case given all the alternative products on the market. We also know from having used this method many times, that results are highly influenced by the amount of price variation in the data. Free ridership and price variation are typically negatively correlated; we find higher free ridership when we have less price variation. Finally, when we estimate sales without program discounts, we are extrapolating study results beyond the data used to estimate the model, which can bias the predicted results.

Given the challenges inherent with each method, we combined the results to produce an overall estimate of FR for the upstream channel. First, we differentiated between discount and non-discount stores because they are so different, and we only had an estimate of FR from the self-report method because of lack of price variation.[19] For non-discount stores, we had FR estimates from both methods. We did not make a judgment about what technique might be better so we took a straight average of the intercept and sales data values. Details of the NTGR methodology are presented in Appendix A.

3.3 Evaluation Results

3.3.1 Process Results

Because the Ameren Missouri Residential Lighting Program is delivered via two different channels – upstream as well as through the Ameren Missouri Online Store – we present the process results by channel. We focus first on the upstream channel, which makes up 99.7% of the overall Lighting Program based on ex post gross savings, and then move on to the Online store (representing 0.3% of program savings).

[19] Note that price elasticity modeling requires variability in product prices by bulb type. No price variability was present across the discount stores, so they were not part of the price elasticity modeling effort.

Upstream Channel

Program Participation

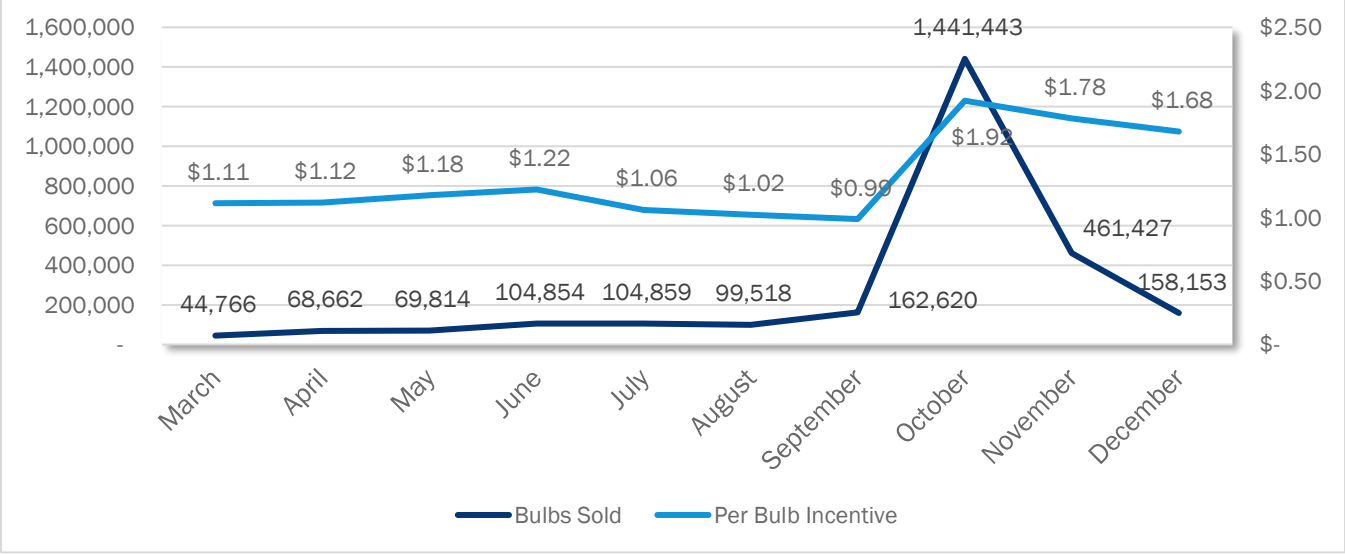
Overall, participation in the upstream channel was strong, with standard LEDs dominating sales (Table 3-11). A total of 2,716,116 bulbs were discounted through the upstream channel in PY2019. More than three-quarters (79%) being standard LEDs, while only 13% were reflector LEDs, and 8% specialty LEDs.

Table 3-11. PY2019 Lighting Program Upstream Sales

Bulb Type	Bulbs	
	Number	%
Standard	2,152,115	79%
Reflector	353,711	13%
Specialty	210,290	8%
Total	**2,716,116**	**100%**

In general, sales revealed a slight increasing trend from March through September. However, there is a tremendous spike in October, when the program implemented a comprehensive plan that expanded the number of participating retailers, number of participating store locations, number of incented products on each MOU, and increased per-bulb incentive levels. Figure 3-1 shows the volume of sales by month throughout PY2019 for the upstream channel along with the average per bulb incentive. From March through September, 655,093 total bulbs were incented through the program with an average incentive per bulb of $1.10; in October alone, 1,441,443 bulbs were incented when the incentive level was increased to $1.92 per bulb. The relative decrease in monthly sales for November and December is likely due to the trailing impacts of the October promotions, but also the decrease in per bulb incentives in November ($1.78) and December ($1.68) and the holidays competing for customers dollars.

Figure 3-1. PY2019 Lighting Program Upstream Channel Bulb Sales and Average Per Bulb Incentive by Month



The Residential Lighting Program sells discounted LEDs through a wide range of retailers across the Ameren Missouri service territory. In total, the program had 273 participating retailers in PY2019. Club stores dominate sales accounting for about half (51%) of all upstream channel sales (Table 3-12). About one-fifth of sales (21%) are from DIY retailers, 17% from big-box retailers, 10% from discount retailers, and about 1% from small hardware stores.

The program made a special effort to engage discount stores that do not typically sell lighting such as St. Vincent De Paul, Salvation Army, Goodwill, and Habitat Restore.[20] These stores tend to serve lower-income customers. By bringing low-cost LEDs into these stores, the program attempted to reach customers it may not reach through other participating retailers.

Table 3-12. PY2019 Lighting Program Upstream Channel Sales by Retailer Type

Retailer Type	Number of Retailers	Bulbs Sold	% of All Bulbs
Club	12	1,375,416	51%
DIY	49	577,444	21%
Big Box	72	469,775	17%
Discount	111	270,551	10%
Hardware	29	22,930	1%
Total	**273**	**2,716,116**	**100%**

Marketing

Light bulbs are a relatively small purchase. To influence those purchases, the program implementers utilized a combination of in-store and out of store marketing tactics. The following marketing activities were used to promote the Ameren Missouri Lighting Program outside of participating retailers:

- TV and radio: March to December
- Social media/digital marketing: March through December
- Paid search marketing: March through December
- E-mail promotion: November for Daylight Savings' Day
- Back of energy statements: July, September, and November
- Bottom of Home Energy Reports: October through December

The program also used in-store marketing to call attention to the program discounts on LEDs and their energy-saving benefits. Shelf stickers call attention to the special LED pricing, and that Ameren Missouri is the provider of the discount. The program conducts in-store lighting demonstrations and trains retailers on how to talk with customers about the benefits of energy-efficient lighting. The program also works with retailers to arrange special product placement to call even greater attention to the discounted LEDs. The spike in sales in October was due to the increased discounts but also the placement of discounted lighting products on end caps, aisle pallets, and bulk stacks at some retailers.

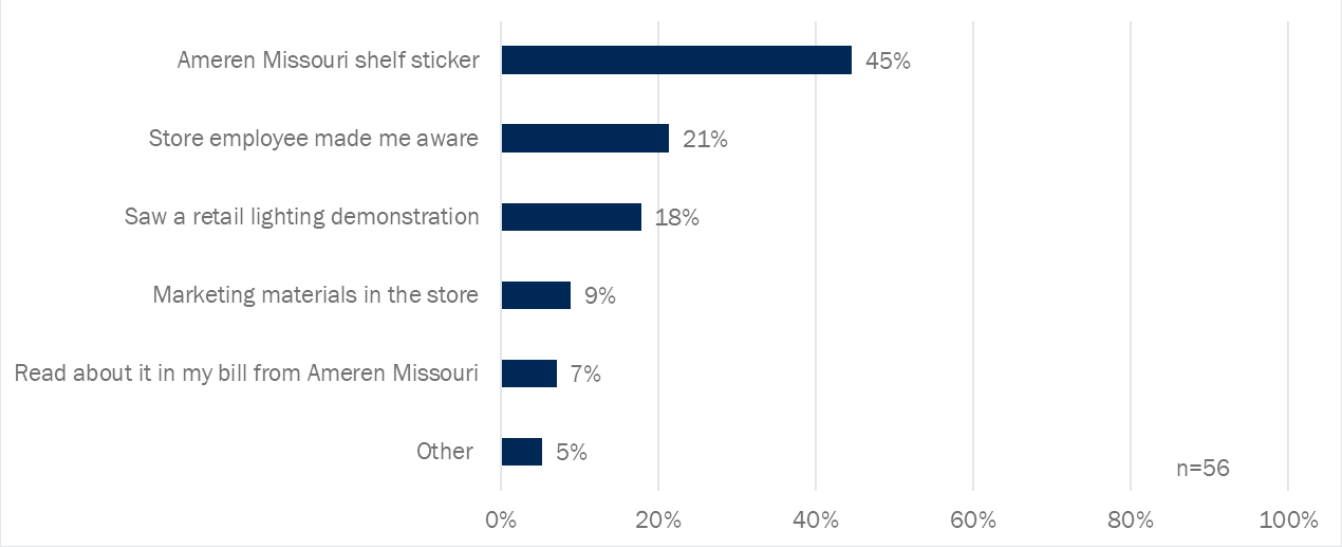
[20] The discount category includes 68 Dollar Tree stores. While these stores sell lighting outside of the program, the program brings in additional LED products that the stores do not typically sell.

Even with these in-store marketing efforts, our in-store intercept results show that just under one-third of lighting shoppers (31%) reported seeing information or displays about LEDs or energy-efficient light bulbs in the store (not necessarily just Ameren Missouri promotions). Of those customers, 61% reported that Ameren Missouri was a sponsor of the information that they saw, compared to 8% that claimed the store was a sponsor. About one-quarter (28%) did not know who the sponsor of the information was.

In addition, many customers who purchased program-discounted LEDs were not aware that they were purchasing discounted LEDs. During our in-store intercepts, we asked all shoppers who were purchasing at least one program LED bulb whether they were aware that the product was discounted, and if so, who provided the discount. Just over half (51%) of customers said they were aware of the discount and, of that group, slightly over half (56%) knew that the discount was from Ameren Missouri. These results reflect customer awareness of marketing, not the discount's impact on purchase behavior. Customers who are unaware of the discount can still be price sensitive and influenced by the lower price. But the results do indicate that the in-store marketing materials may not be that visible.

Despite the limitations of in-store marketing, it appears to be reaching more customers than out-of-store marketing. Of customers who were aware that they were purchasing LEDs discounted by Ameren Missouri, we asked how they first found out about the discounts (see Figure 3-2). By far the most common response was that they had found out from Ameren Missouri stickers on the shelves (45%). This was followed by help from a store employee (21%) and retail lighting demonstrations (18%). Less common responses included marketing materials in the store (9%) and reading about the discounts in a bill from Ameren Missouri (7%). Notably, only 5% of customers who purchased program-discounted LEDS reported that they had come to the store to specifically buy Ameren-discounted light bulbs.

Figure 3-2. How Shoppers First Heard about Discounts

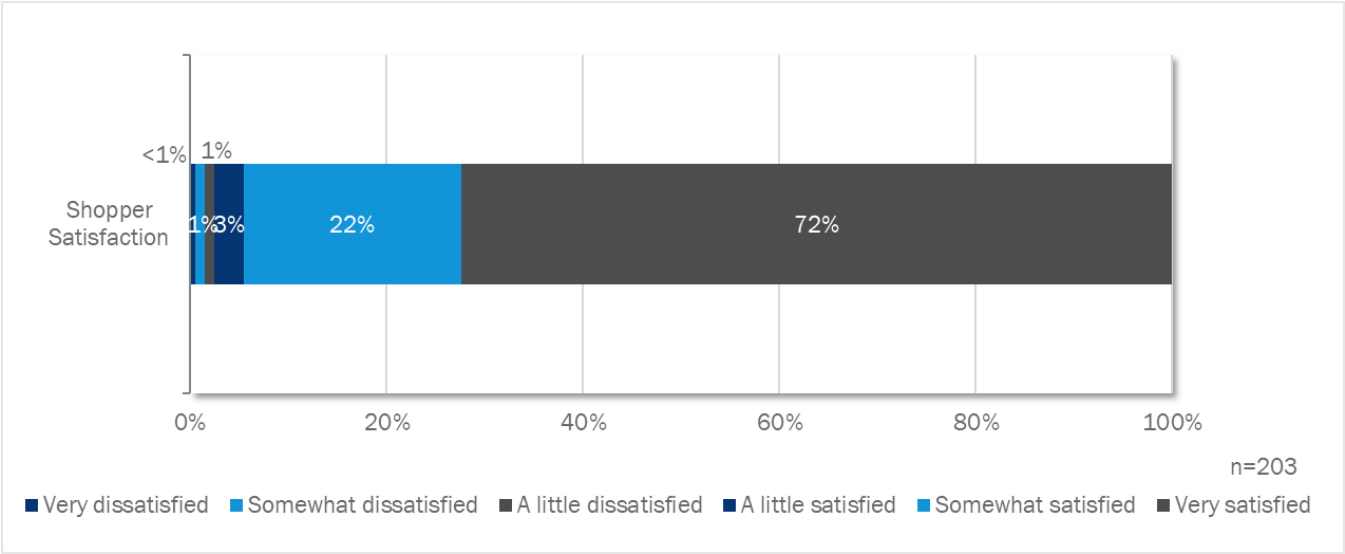


Satisfaction

The shoppers we spoke with during the in-store intercepts were generally quite satisfied with Ameren Missouri. (Figure 3-3). Almost three-quarters (72%) reported being very satisfied, and almost another quarter

(22%) said they were somewhat satisfied (in total, 94% very or somewhat satisfied). This compares to just under 2% of shoppers that mentioned they were very or somewhat dissatisfied.

Figure 3-3. PY2019 Lighting Program Intercept Shopper Satisfaction with Ameren Missouri



Because it is an upstream program, retailers and manufacturers play unique roles in program delivery, and they too are very satisfied with the program. As part of our interviews with retail and manufacturer contacts, we asked them about their satisfaction with various aspects of the Ameren Missouri Lighting Program. Most interviewees were satisfied with the program overall. In particular, nearly all (5 of 6) reported being very satisfied (5 on a 0 to 5 scale) with the communication with program staff and the program tracking and invoicing process. Program staff received particular praise for being very attentive and quick to respond to any questions or concerns.

The only concerns voiced (2 of 6 interviewees) were about the variety and types of products being discounted through the program. The interviewees hoped that Ameren Missouri would be able to include more products like fixtures and specialty bulbs that have been offered in other programs.

Online Store

Program Participation

Like with the upstream channel, the primary driver of Online Store sales in PY2019 was standard bulbs (Table 3-13). Standard LEDs accounted for nearly three quarters (72%) of all sales with reflector LEDs at 19% and specialty LEDs at just 9%.

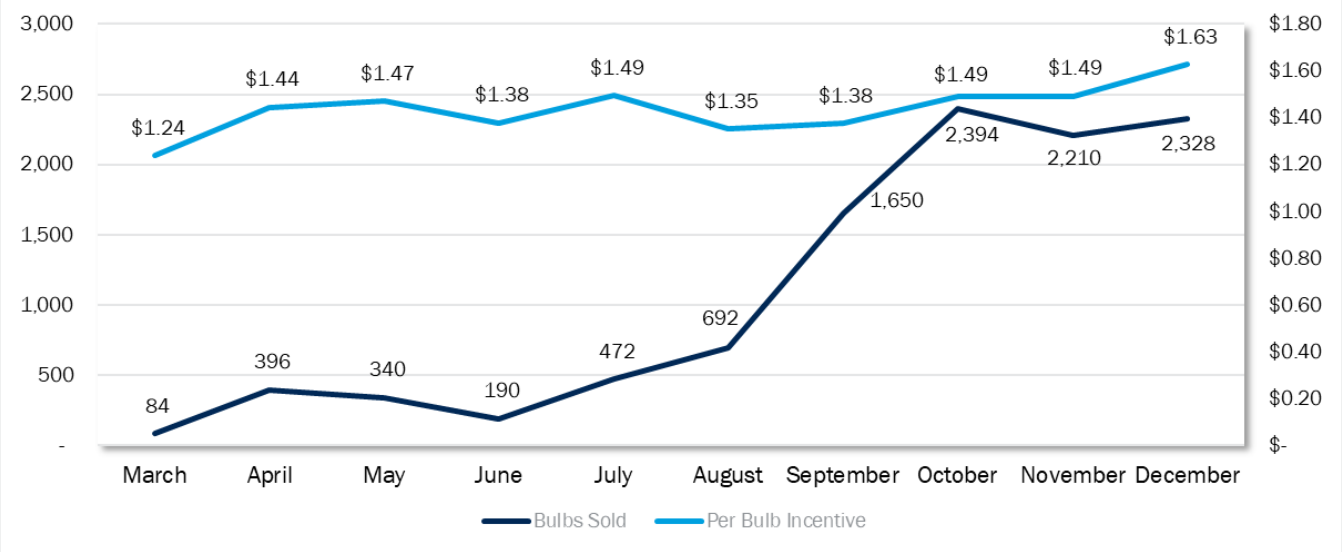
Table 3-13. PY2019 RL Online Store Sale Quantity and Ex Ante Gross Savings by Bulb Type

Bulb Type	Customers		Bulb Sales	
	Number	%	Number	%
Standard LED	458	62%	7,728	72%
Reflector LED	156	21%	2,026	19%

Bulb Type	Customers		Bulb Sales	
	Number	%	Number	%
Specialty LED	123	17%	1,002	9%
Total	**737**	**100%**	**10,756**	**100%**

The Ameren Missouri Online Store launched in March 2019, and traffic steadily increased throughout the year as marketing activities ramped up. Figure 3-4 shows that sales of bulbs through the Online Store were slow to start with the total number of bulbs sold not reaching 2,000 bulbs until August. Only a small incentive level change was detected in October through December, which is unlikely to explain the notable spike in September and October. Rather, the spike is likely the effect of the promotional activities surrounding the October sales push.

Figure 3-4. PY2019 Lighting Program Online Store Sales by Week



Marketing

Throughout PY2019, Ameren Missouri employed a variety of marketing tactics aimed at informing customers about the new Online Store, as well as lighting-specific marketing. The following tactics were used:

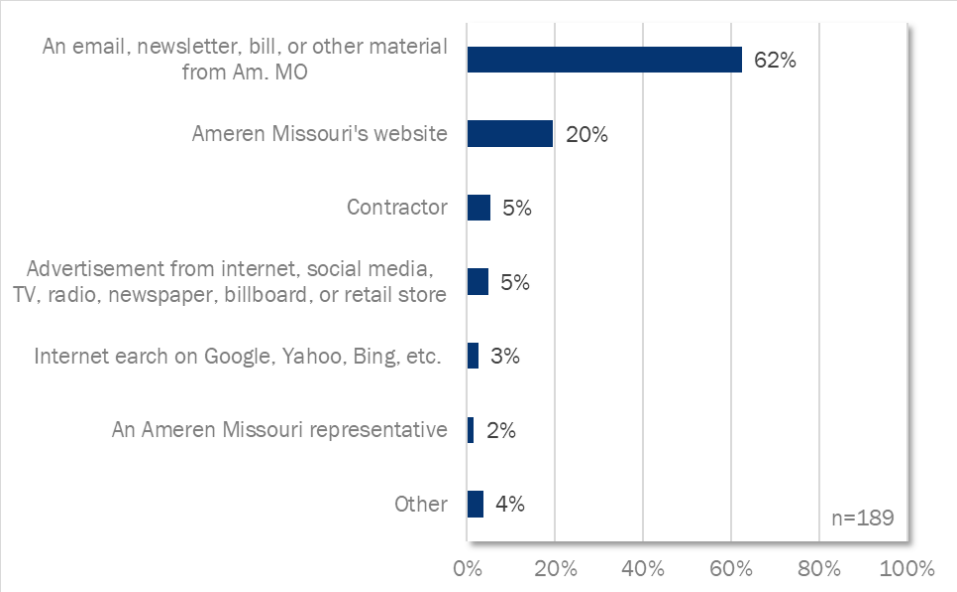
- TV and radio: March to December
- Social media/digital marketing: March through December
- Paid search marketing: March through December
- E-mail promotion: November for Daylight Savings' Day
- Back of energy statements: July, September, and November
- Bottom of home energy reports: October through December.

Because the program used so many marketing activities at once, and we do not have marketing data at a fine degree of granularity, we cannot assess the relative impacts of different marketing activities. What was evident, however, was the generally increasing rate of sales in March through August, followed by a large

spike in sales starting in September and lasting until the end of the program year. The increase in the size of the discount was relatively small so that the sales increase is likely to due to increased promotional efforts and not changes in pricing.

In addition to examining the connection between marketing activities and sales over time, we know how surveyed participants first learned about the Online Store (Figure 3-5). Direct outreach from Ameren Missouri (e-mail, newsletter, bill or other materials) appear to have had the greatest impact with close to two-thirds (62%) of participants recalling learning about the store from Ameren Missouri communication. One-fifth (20%) learned about the store through Ameren Missouri's website. Around 5% of participants said that they had first heard about the Online Store through an advertisement. Of this small group of people, nearly four-fifths of them described the advertisement as being from either a website on the internet or from a social media platform. Another 5% learned of the store from a contractor.

Figure 3-5. Sources of Program Awareness



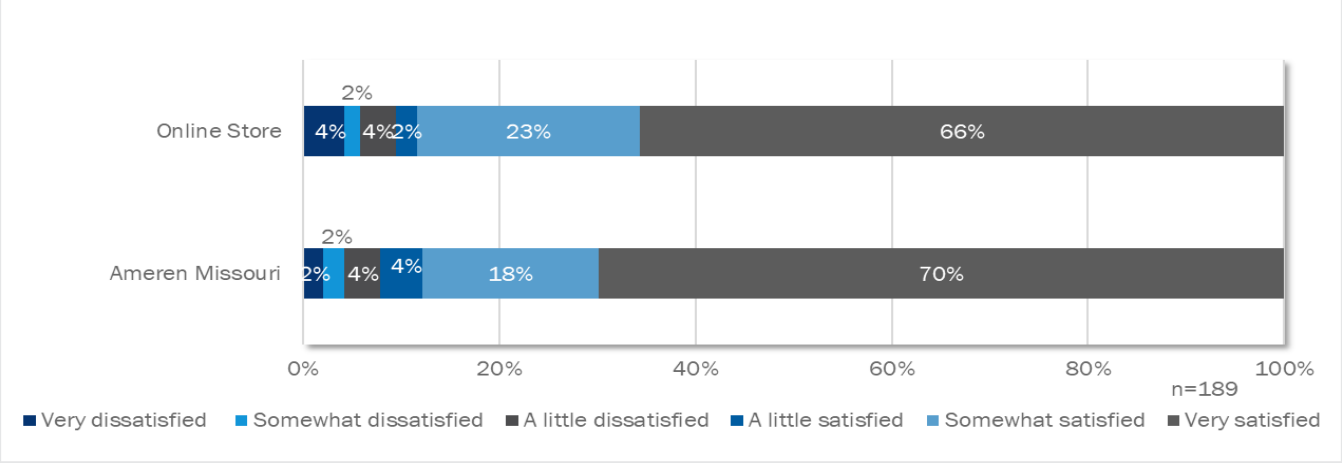
Customer Satisfaction

Online stores or marketplaces are unique intervention strategies as far as energy efficiency programs go. Maintaining satisfaction with an online offering requires that programs focus on some traditional areas such as rebate levels and the information they may be providing customers. But satisfaction with online offerings also requires focus on other concepts such as delivery times and the quality of products sold.

For the PY2019 Residential Lighting Program, Online Store participants generally expressed high levels of satisfaction with the program (see Figure 3-6). Two-thirds (66%) of surveyed participants reported being very satisfied with their Online Store experience with another quarter (23%), indicating they were somewhat satisfied. Only 6% indicated they were very or somewhat dissatisfied. These results closely parallel overall satisfaction with Ameren Missouri, where more than two-thirds (70%) of participants reported being very satisfied with Ameren Missouri overall and 18% saying they were somewhat satisfied. Only a few (4%) indicated dissatisfaction (very or somewhat) with Ameren Missouri. Notably, a majority of surveyed participants (59%) reported that their experience purchasing LEDs from the Online Store has made them

feel more favorable to Ameren Missouri, suggesting that the store has a positive influence on overall satisfaction. Also, most surveyed participants (83%) claimed that they were very or somewhat likely to purchase bulbs from the Ameren Missouri Online Store again in the future.

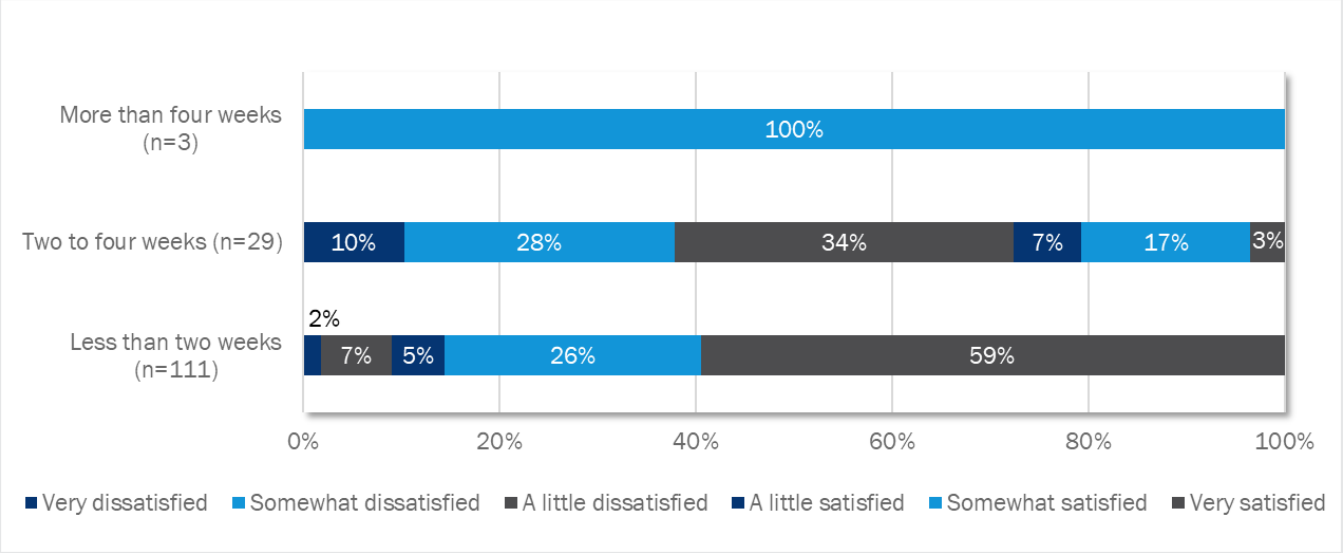
Figure 3-6. Online Store Participants' Satisfaction with Ameren Missouri



The evaluation team asked survey participants that reported any level of dissatisfaction (very, somewhat, or a little) (n=16), in an open-ended format, why they were dissatisfied. The most common concerns included delivery speed/issues (n=4), poor experiences with customer service (n=3), and cost (n=2). Relatedly, we also asked customers if they needed to contact Ameren Missouri about their order, and only a small number of the surveyed participants said they did (7%, n=12). Half (n=6) of those participants claimed that the number of bulbs was incorrect or that they never received any. When asked about their communications with Ameren Missouri, about a quarter (n=4) of these participants were at least a little dissatisfied with their communication experience; two of those four reported not receiving a response to their e-mails. While in general, it appears that customers are largely satisfied with the Online Store, and there are few complaints, the complaints that do arise need to be addressed.

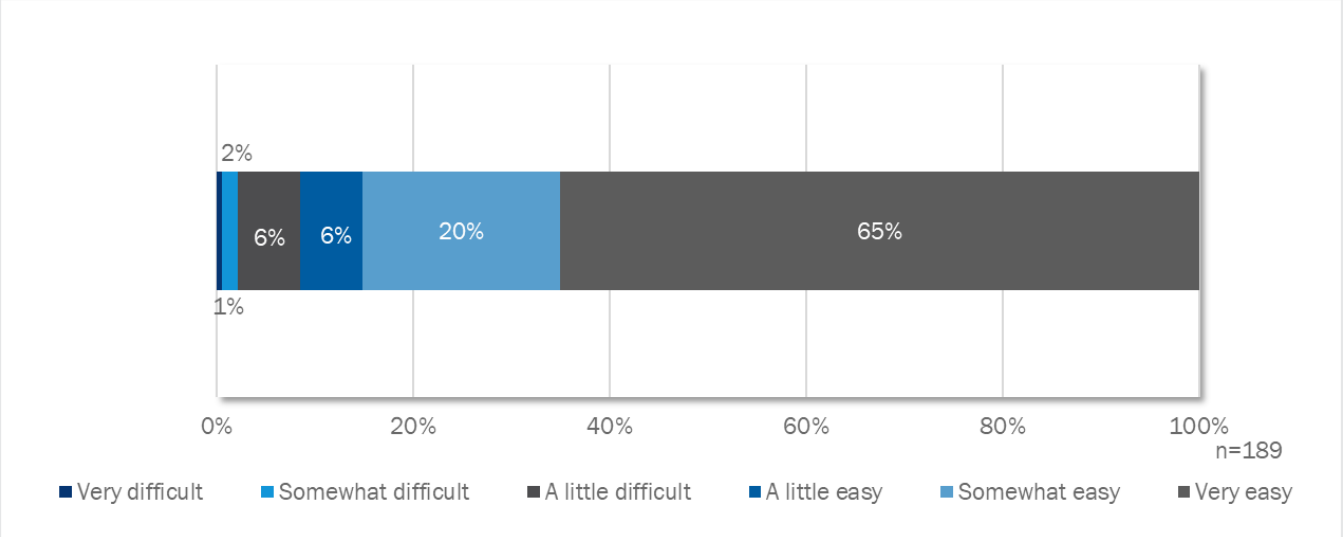
In this Amazon.com world, customer expectations about online order delivery times are rather stringent. Even though 78% of orders were delivered in less than two weeks, only about half (59%) of these surveyed participants were very satisfied (see Figure 3-7). In fact, about one-tenth (9%) of those that received their order in less than two weeks were very or somewhat dissatisfied. When we look at the 20% of surveyed customers that received their bulbs in two to four weeks, three-quarters (72%) indicated some level of dissatisfaction (very, somewhat, or a little) with the delivery time. And of the 2% of the surveyed participants that received their orders in more than four weeks, all (100%) were dissatisfied with the delivery time. Though attaining Amazon.com delivery times may not be realistic, measuring delivery times for online orders in terms of days instead of weeks will likely become the norm. For Ameren Missouri to operate successfully as an online retailer, prompt delivery of online sales will be key for retaining high satisfaction levels.

Figure 3-7. Satisfaction with Online Store Delivery Times



In general, participants found the purchase experience with the Ameren Missouri Online Store a smooth and easy process (Figure 3-8). Nearly two-thirds (65%) of surveyed participants found it very easy to make the purchase, and an additional one-fifth (20%) found it to be somewhat easy. Few respondents said that they found it difficult (3% very or somewhat). Of the participants that did find the process difficult at all (very, somewhat, or a little), and provided input (n=15), the only consistent concern was that the Online Store website was not intuitive or straight forward to use (n=7).

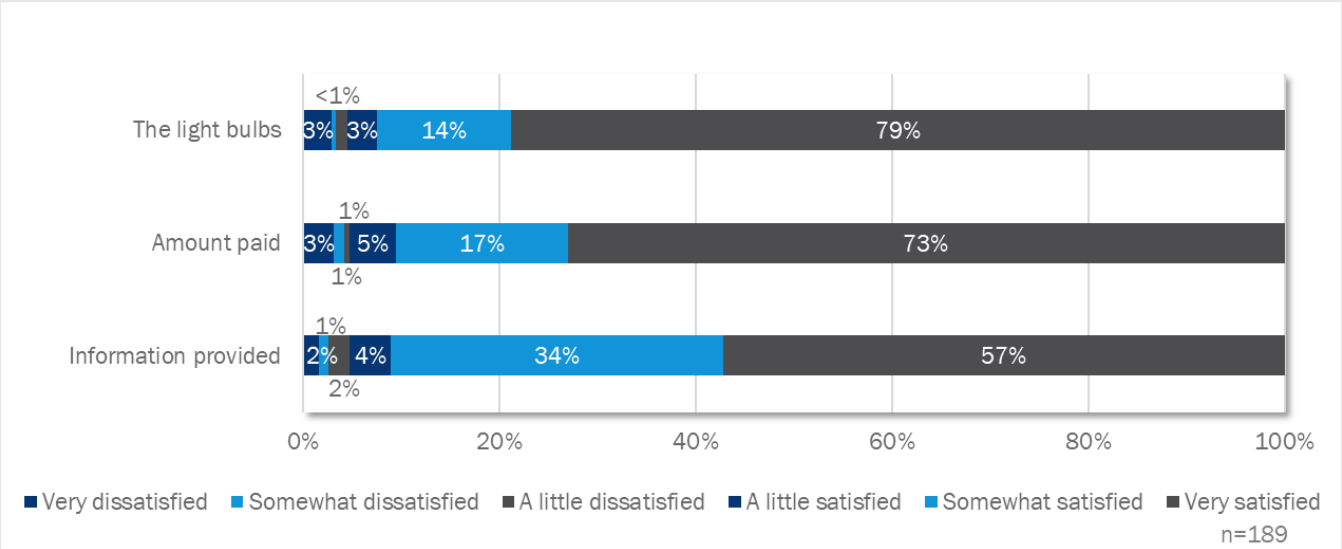
Figure 3-8. PY2019 Lighting Program Online Store Purchase Experience



Customers were also largely satisfied with the quality of the bulbs they purchased through the Online Store, the amount they paid, and the information the store provided about the light bulbs (Figure 3-9). Just more than three-quarters (79%) of Online Store participants reported being very satisfied with the bulbs; another 14% reporting they were somewhat satisfied. We see similar satisfaction levels with the amount paid for the

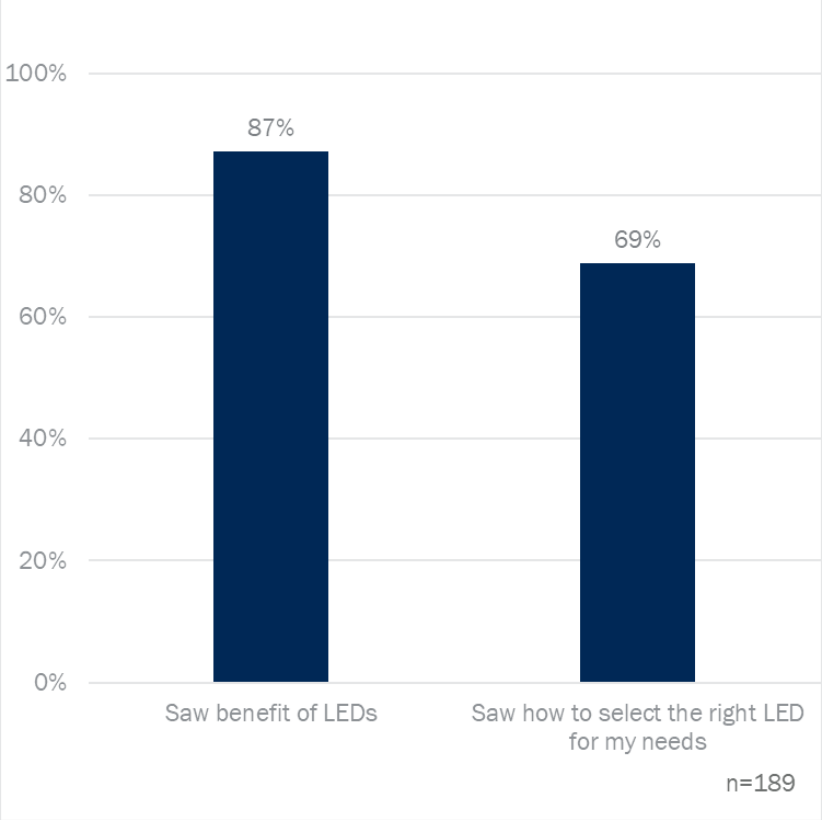
bulbs, with just under three-quarters (73%) saying they were very satisfied and another 17% saying they were somewhat satisfied. While fewer surveyed participants said they were very satisfied with the information provided about the light bulbs (57%), a higher percentage were somewhat satisfied (34%), so that dissatisfaction rates between the program items do not really differ.

Figure 3-9. PY2019 Lighting Program Satisfaction with Program Interventions



In terms of the website content, it is memorable to customers (Table 3-10). The majority of participants (87%) recalled that the website provided information about the benefit of LEDs, and just over two-thirds (69%) recalled information about how to select the right LED for their needs.

Figure 3-10. Information on the Ameren Missouri Website



3.3.2 The State of the Lighting Market

We conducted several research activities that provide information on the state of the residential lighting market. The results of our retailer shelf-stocking study, in-store customer interviews, and in-home lighting audits, which we conducted as part of the Ameren Missouri baseline study, reveal a market that is increasingly dominated by LEDs. In short, LEDs are the most common product on retailers' shelves, in customers' shopping carts, and installed in customers' homes. However, we see differences in market progress by bulb type and customer segment.

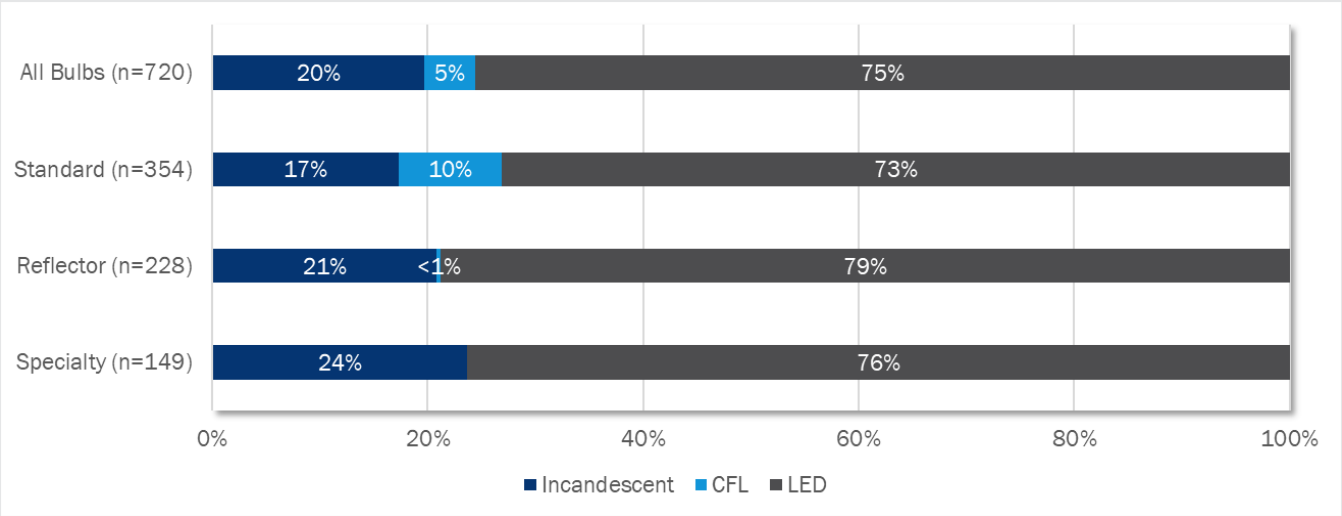
Lighting Product Stocking

Results from our in-store lighting stocking study show that LEDs are the majority of lighting products for sale in retail lighting aisles. Figure 3-11 shows the percentage of unique products by technology by bulb type at four stores where we conducted shelf surveys.[21] We find little difference in products stocked by bulb type. Approximately three-quarters of bulb models are LEDs across all bulb types. We found a slightly lower percentage of standard bulbs were LEDs (73%) compared to reflectors (79%) and specialty bulbs (76%), but

[21] We excluded two discount stores (St. Vincent De Paul and Habitat Restore) from this analysis because they do not sell lighting except for program-discounted LEDs. The purpose of this analysis is to gauge product stocking practices at lighting retailers. The four retailers were DIY and big box retailers that represent 38% of all program-discounted bulbs. We were unable to conduct intercepts and stocking studies at club stores, which sold 51% of program LEDs. The club stores, Costco and Sam's Clubs, only stock LEDs per corporate policy.

this is only because a greater percentage of CFLs remain on shelves in the standard category (10% compared to less than 1% for reflectors). CFLs have largely disappeared from the market. That said, there is still some potential for improvement in efficiency for the market as 20% of lighting products are incandescents.[22]

Figure 3-11. Lighting Product Shelf Stocking by Bulb Type



Lighting Purchase Behaviors

The shelf-stocking study provided information about the bulb technologies that retailers are stocking and showed that more LED products are stocked than any other bulb type. In this section, we review results from the in-store customer interviews, interviews with retailers and manufacturers, and survey results from the Ameren Missouri baseline study to learn how customers are responding to market changes. The results show an equally strong market shift in customer purchases of LEDs.

Table 3-14 shows market share from in-store intercepts that we conducted at 8 DIY and big-box retailers.[23] The results show that, overall, LEDs represented nearly three-quarters (71%) of all bulbs purchased – 39% of all bulbs purchased were program-discounted LEDs; just under one-third (32%) were non-program LEDs. Incandescent bulbs represented 28% of purchased bulbs. The shift away from CFLs seems to be almost complete, as only 1% of the purchased bulbs were CFLs. Our retailer/manufacturer interviews confirmed CFL technology is nearly dead, with CFLs being largely removed from production.

While many more shoppers purchased LEDs than the less efficient options, it appears that the average LED shopper purchased slightly fewer bulbs (4.84) than did the average incandescent customer (5.14) (see Table 3-14). But when we look just at program-discounted LEDs, the average customer purchased nearly the same number (5.17) as incandescent bulbs and more than customers who purchased non-discounted LEDs

[22] We do not distinguish between incandescent and halogen lamps in reporting results from our shelf stocking, intercepts, and in-home lighting audits. We find that even with extensive training, field staff confuse the two bulb types. Customers also cannot distinguish between the two technologies, so we find it better to refer to all halogens as incandescents, which customers recognize.
[23] Like the stocking study results, we exclude interviews conducted at discount stores because customers could only purchase program-discounted LEDs. The purpose of this analysis is to examine purchase behavior at lighting retailers where customers have a choice of products to purchase.

(4.46). The results suggest that the program discount may have encouraged customers to buy more LEDs than they might have without the discount.

Table 3-14. In-Store Intercept Lighting Product Market Share

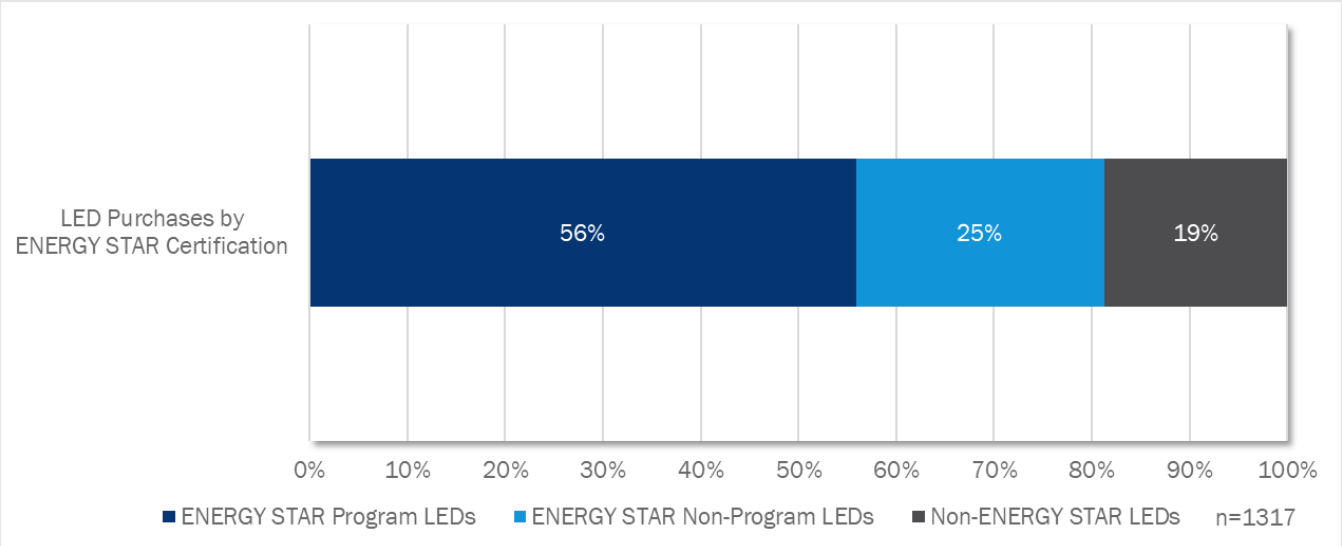
	Customers		Bulbs		
Bulb Type	#	%	#	%	Average Bulbs
Program LED	135	41%	698	39%	5.17
Non-Program LED	127	38%	567	32%	4.46
CFL	7	2%	23	1%	3.29
Incandescent	97	29%	499	28%	5.14
Total	**332**	**110%**	**1787**	**100%**	**4.88**

The market shares by bulb technology in Table 3-14 are from customer interviews conducted in retail stores selling program-discounted LEDs as well as other products. Therefore, it would be incorrect to conclude that LED market share is 71% without the Ameren Missouri program. When we asked customers who were purchasing program-discounted LEDs if they would have purchased the same number of LEDs if they had not been discounted, roughly one-quarter (24%) said they would have purchased none of the bulbs, 14% said they only would have purchased some of the bulbs. In comparison, half (50%) said they would have purchased all the LEDs.

We find a different result from the interviews we conducted in discount stores that serve low-income customers and do not typically sell lighting. In discount stores, 61% of customers reported that they would have purchased none of the bulbs without the discount, just over one-tenth (12%) said that they would purchase some and only 27% said that they would have purchased all the LEDs.

While the program discounts only ENERGY STAR-labeled LEDs, non-ENERGY STAR LEDs, which typically cost less, are also available for shoppers to purchase at lighting retailers. Nearly one-fifth (19%) of LEDs bulbs purchased were non-ENERGY STAR LEDs (see Figure 3-12). When shoppers were purchasing ENERGY STAR LEDs, they were twice as likely to purchase a program bulb than they were to purchase a non-program bulb.

Figure 3-12. LED Purchases by ENERGY STAR Certification Status



The in-store interviews at non-discount stores also allow us to compare LED market share for different bulb types. We find that LEDs are dominating the market for standard and reflector bulbs at over 80% of bulbs sold (see Table 3-15). LEDs have not gained the same traction in the specialty market, where they made up just over one-third of bulbs sold (36%). The market shares in Table 3-15 are in the presence of program discounts on LEDs. LED market share would likely be lower across all categories without the discounts. But even with discounts, customers are not purchasing specialty LEDs at the same rate as other bulb types.

Table 3-15. In-Store Intercept Lighting Product Market Share by Bulb Type

Bulb Type	Bulb Technology	Bulbs Sold %
Standard	LED	83%
	CFL	2%
	Incandescent	14%
Reflector	LED	80%
	CFL	0%
	Incandescent	20%
Specialty	LED	36%
	CFL	0%
	Incandescent	64%

Our interviews with manufacturer and retailer representatives also provided information about the state of the market and customer decision making. Lighting industry representatives agreed that there had been a steady shift in customer preferences over the last few years (6 of 6 interviewed). Not only have LED prices been dropping significantly, helped along by utility programs, but CFLs have also almost entirely been removed from manufacturing processes in favor of LEDs. However, they too argue the market has not yet finished its transition away from incandescents and halogens and is, therefore, at least a few years away from being completely transformed.

Results from a residential customer survey that we conducted to support the 2019 Ameren Missouri potential study provide additional evidence of a maturing lighting market.[24] Survey results indicate that customers are price-sensitive when purchasing lighting, but they do not automatically purchase the least expensive bulb on the shelf. Just 13% of customers always purchase the cheapest bulb whereas nearly one-third (32%) consider other factors such as energy efficiency, light quality, and longevity. Slightly over half (55%) consider both price and other factors. The same survey found that nearly half of customers (45%) said they were extremely likely to look for an LED instead of other bulb types the next time they purchased lighting; another 23% were moderately likely; only 9% said they were not at all or slightly likely to look for an LED.

On both survey questions, the responses of low-income customers indicate that they continue to lag other customers in the adoption of efficient lighting. Low-income customers are more likely to purchase the least expensive bulb being sold (23%) and are less likely to look for an LED the next time they need to purchase lighting (38% extremely likely and 21% moderately likely).

[24] Opinion Dynamics conducted a survey with 1,395 residential customers between July 31 and August 24, 2019.

Figure 3-13. Purchase Factors

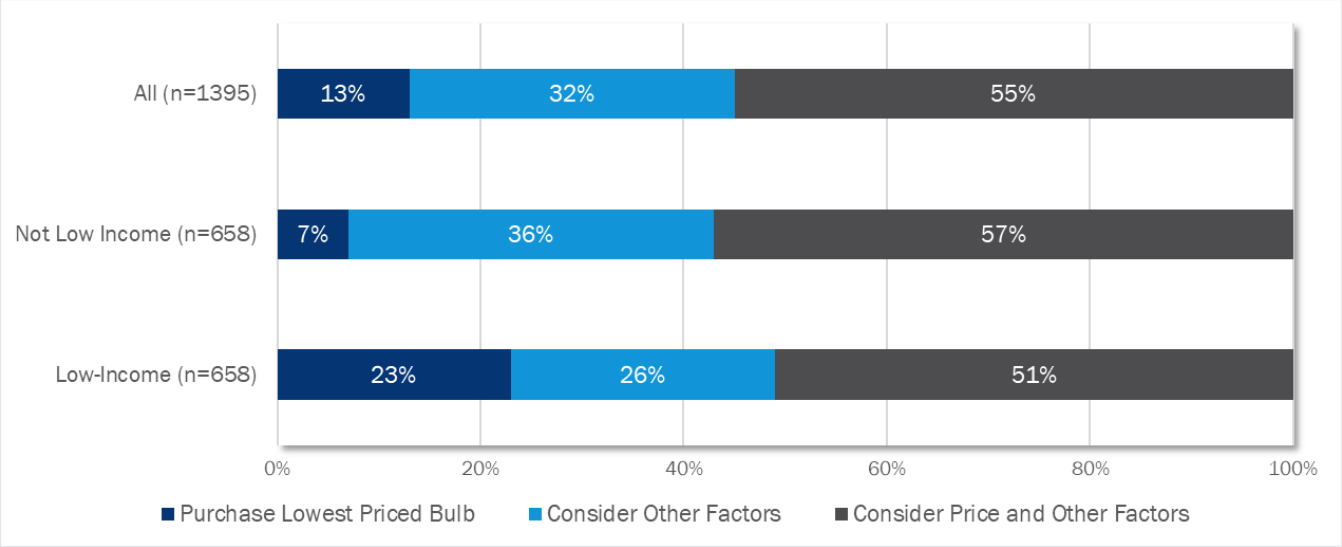
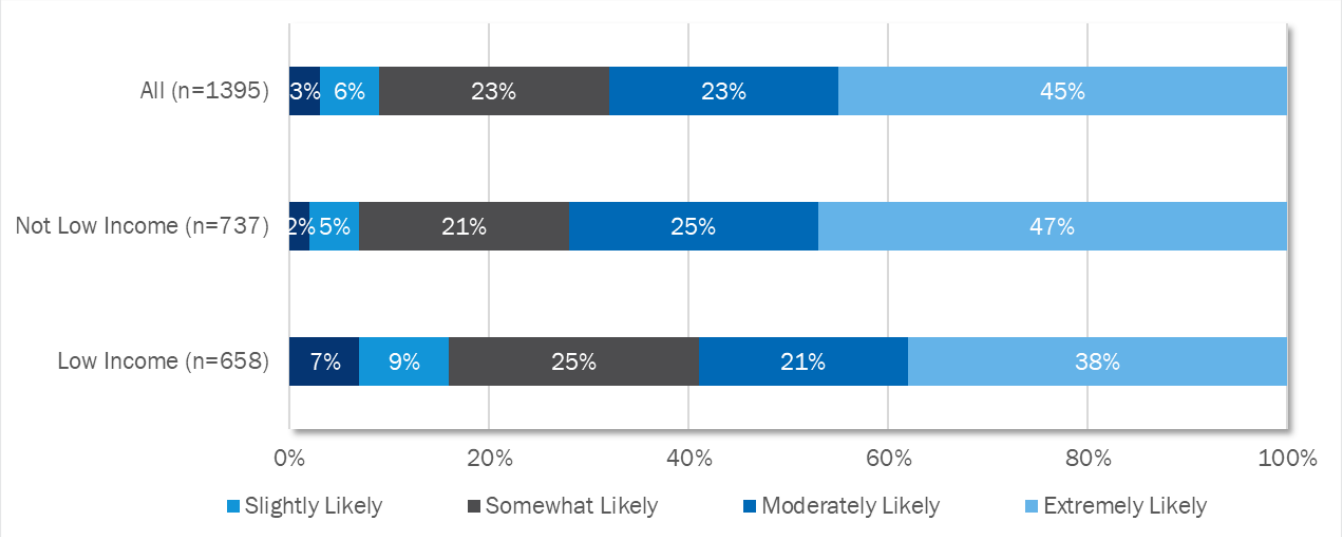


Figure 3-14. Likelihood to Look for LED in Next Purchase



Lighting Use

Ameren Missouri's long-running residential lighting program and the advancing lighting market are evident in the lighting technologies that Ameren Missouri customers have installed in their homes. In support of the 2019 Ameren Missouri potential study, we conducted in-home audits of energy-using equipment in 120 residential customer homes.[25] The audits included an inventory of all lighting installed in customer homes.

A large majority of customers have at least one LED or CFL installed in their homes (80% and 86%, respectively), indicating that customers have been willing to purchase new lighting technologies (see Table

[25] Opinion Dynamics completed in-home audits with a subsample of 120 baseline survey respondents between August 14 and September 25, 2019.

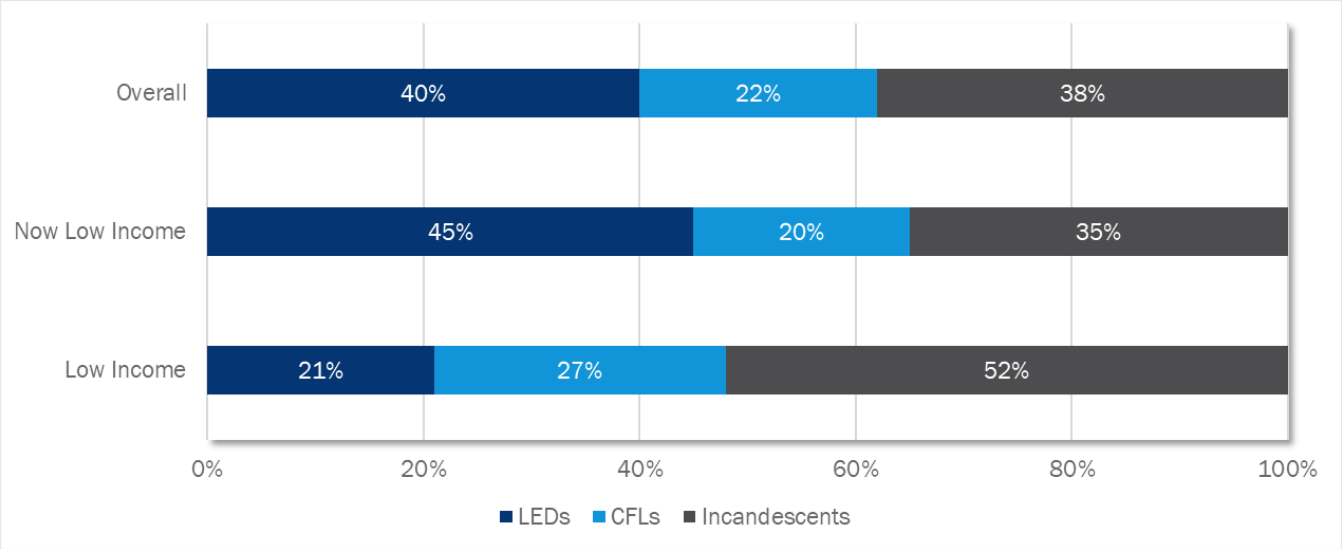
3-16). Moreover, a majority of the bulbs installed in customer homes (62%) are either an LED or CFL (40% and 22%, respectively) (see Figure 3-15). LEDs have overtaken CFLs despite their shorter time on the market, which shows customer appreciation for the technology. Only 38% of light sockets contain an incandescent or halogen bulb.

Despite this market progress, low-income customers lag other customers in their use of efficient lighting. Fewer have at least one LED or CFL installed (21% and 27% respectively), and a slight majority (52%) of the light sockets in low-income homes still contain an incandescent or halogen. Low-income customers have more CFLs in use than LEDs (27% compared to 21%), which is the opposite of other customers.

Table 3-16. Bulb Penetration (% of households that have at least one bulb of each type)

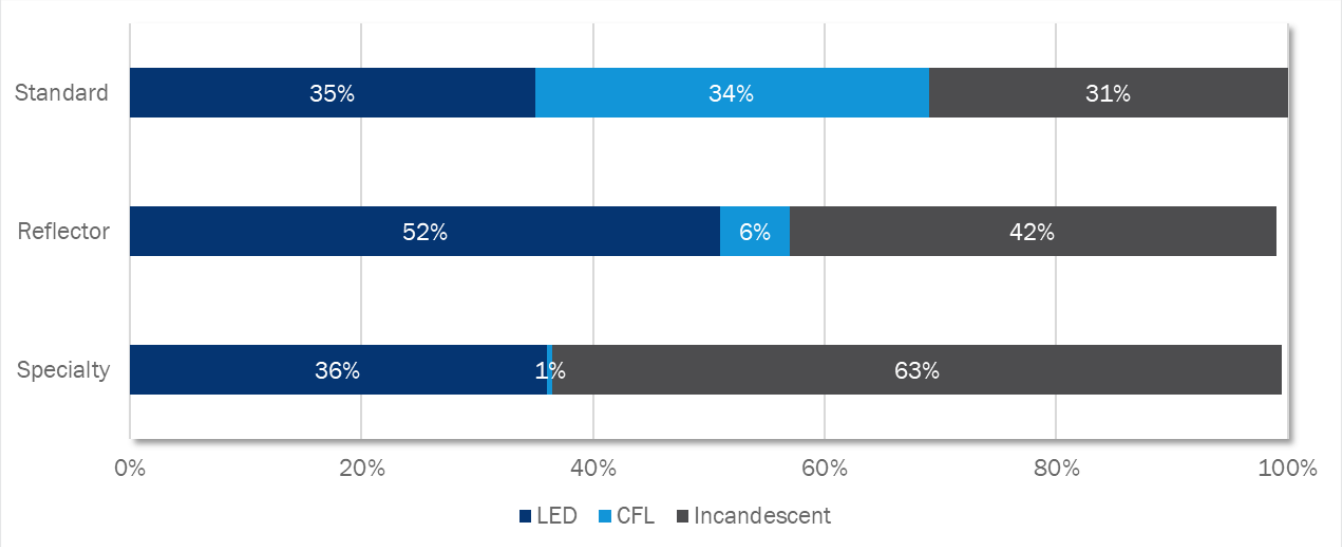
Bulb Type	Overall	Not Low Income	Low Income
LEDs	80%	87%	69%
CFLs	86%	88%	83%
Incandescent	96%	97%	95%

Figure 3-15. Bulb Saturation (of all bulbs in territory, % of each type)



The lighting audit data shows that the saturation of efficient bulb technologies varies by socket type. A majority of standard and reflector sockets contain either an LED or CFL. Standard sockets are the only lighting uses where CFLs are still in use in large numbers; 34% of standard sockets contain a CFL compared to 35% for LEDs. Only 6% of reflector sockets contain a CFL compared to 51% with an LED. The reflector market has seen a particularly rapid transformation due to the superior nature of LED technologies compared to CFLs. Customers have yet to install large numbers of efficient bulbs in their specialty sockets. Nearly two-thirds still contain an incandescent bulb.

Figure 3-16. Bulb Saturation by Bulb Type



3.3.3 Gross Impact Results

The evaluation team calculated ex post gross electric and demand savings for both the upstream and Online Store channels as well as overall. The evaluation team developed ex post savings estimates by examining all measures contained in the program-tracking database and applying algorithms and savings assumptions based on the Ameren Missouri TRM.[26] We also collected information from Online Store customers and in-store intercept shoppers to calculate ISRs, leakage, and the proportion of bulbs installed in residential applications, which are explained in detail in Appendix A.

The PY2019 Lighting Program achieved 98,634 MWh and 15.30 MW in first year (and last year) ex post gross savings (Table 3-17). The realization rate for demand savings is slightly higher, at 117.5%, than for energy savings (114.0%). For last year savings, the realization rate is lower at 97% because some bulbs purchased through the upstream channel were installed in business applications which had no ex ante gross savings because the program team planned for all bulbs to be installed in residential applications.

[26] Ex ante applied Revision 2.0 (dated 12/21/2018) of the Ameren Missouri 2019-21 MEEIA Energy Efficiency Plan Appendix I – TRM: Residential Measures (referred to as the "Ameren Missouri TRM"). Ex post applied Revision 3.0 (released November 2019) of the Ameren Missouri TRM.

Table 3-17. PY2019 Lighting Program Gross Impact Summary

	Ex Ante	Realization Rate	Ex Post
First Year Savings			
Energy Savings (MWh)	86,553	114.0%	98,634
Demand Savings (MW)	13.02	117.5%	15.30
Last Year Demand Savings			
< 10 EUL (MW)	0.00	NA	2.69
10-14 EUL (MW)	0.00	NA	0.00
15+ EUL (MW)	13.02	96.8%	12.61

The realization rates varied by bulb type and channel (Table 3-18). The highest realization rate (189%) was associated with reflector bulbs sold through the upstream channel; the lowest associated with specialty bulbs sold through the Online Store. In general, the realization rates are higher for the upstream channel than they are for the Online Store.

- The realization rate is over 100% for the upstream lighting program. This is primarily due to having a larger than expected share of bulbs going to commercial applications, where the savings assigned to the measures are much higher than residential.
- Upstream reflector bulbs have a realization rate of 189% for energy savings. A baseline adjustment for BR30 bulbs primarily drives this -- we set to incandescent because these reflectors are EISA exempt.
- For the Online Store, the first-year ISR is really driving the weighted-average channel realization rate of 89%.

Table 3-18. PY2019 Lighting Program Annual First Year Gross Impacts

Channel	Measure Category/Enduse	Energy Savings			Demand Savings		
		Ex Ante (MWh)	Realization Rate	Ex Post (MWh)	Ex Ante (MW)	Realization Rate	Ex Post (MW)
Upstream	Standard	69,106	104.4%	72,136	10.40	107.6%	11.19
	Reflector	10,004	183.5%	18,355	1.51	189.1%	2.85
	Specialty	7,059	110.5%	7,800	1.06	113.9%	1.21
Online Store	Standard	256	87.8%	225	0.04	87.1%	0.03
	Reflector	95	94.1%	89	0.01	93.3%	0.01
	Specialty	33	86.7%	29	0.00	86.0%	0.00
Program Total		**86,553**	**114.0%**	**98,634**	**13.02**	**117.5%**	**15.30**

Table 3-19 presents ex ante gross and ex post gross last-year demand impacts.

Table 3-19. PY2019 Lighting Program Annual Last Year Gross Demand Impacts

Channel	Bulb Type	Ex Ante (MW)			Realization Rate	Ex Post (MW)		
		<10	10-14	15+		<10	10-14	15+
Upstream	Standard	0.00	0.00	10.40	88.6%	1.97	0.00	9.22
	Reflector	0.00	0.00	1.51	1255.8%	0.50	0.00	2.35
	Specialty	0.00	0.00	1.06	93.8%	0.21	0.00	1.00
Online Store	Standard	0.00	0.00	0.04	87.2%	0.00	0.00	0.03
	Reflector	0.00	0.00	0.01	93.2%	0.00	0.00	0.01
	Specialty	0.00	0.00	0.00	86.0%	0.00	0.00	0.00
Program Total		**0.00**	**0.00**	**13.2**	**96.8%**	**2.69**	**0.00**	**12.61**

3.3.4 Net Impact Results

Net-To-Gross Ratio Results

For the Online Store channel, we used the Online Store participant surveys to collect information for estimating FR and PSO. For the upstream channel, we used the in-store intercepts to collect information for estimating FR, PSO, and NPSO; we combined results from the price elasticity modeling to adjust upstream FR. Details about the development and estimation of FR, PSO, and NPSO are included in Appendix A.

Overall, the evaluation team computed an NTGR for the program of 64%, though there was variation across channels (Table 3-20). The NTGR for the upstream channel (64%) was quite a bit lower than the Online Store (90%). Much of this was driven by the FR values: 44% for upstream; 13% for Online Store. This difference could be due to several factors, including differences in the types of customers that purchased LEDs through the Online Store versus at brick and mortar retailers, the information provided on the Online Store site, or differences in estimation methods. We discuss these factors in greater detail in Appendix A.

Table 3-20. PY2019 Residential Lighting Net-to-Gross Ratios

Channel	Free-Ridership	Participant Spillover	Non-Participant Spillover	NTGR	% Ex Post Gross
	(FR)	(PSO)	(NPSO)	(1-FR+PSO+NPSO)	
Upstream	43.8%	0.0%	7.4%	63.6%	99.7%
Online	12.8%	1.7%	0.0%	88.9%	0.3%
Overall Program	43.7%	0.0%	7.4%	63.7%	100.0%

As was shown in Table 3-20, the evaluation team detected a small amount of PSO for the Online Store (from responses to the participant survey). Table 3-21 shows the PSO measures associated with the Online Store.

Table 3-21. PY2019 Lighting Program Participant Spillover Measures and Savings

ODCID	Measure	Quantity	Total kWh
11755	Ceiling insulation	1	68
	Storm windows	1	113
10447	Advanced Tier 1 Power Strips	1	31
	ENERGY STAR Dishwasher	1	18
	Heating Equipment	1	415
	Storm Windows	1	89
11833	Air Sealing	1	97
	Ceiling Insulation	1	109
	Clothes Washer	1	30
12070	Advanced Thermostat	1	238
Total		**10**	**1,207**

Dividing the estimated total PSO in our sample (1,207 kWh) by total program ex post gross savings of the overall participant sample (70,295 kWh) yields a PSO rate of 1.7%, as shown below:

$$PSO\ \%_{Energy} = \frac{Total\ participant\ sample\ SO\ (kWh)}{Total\ participant\ sample\ savings\ (\mathrm{kWh})} = \frac{1{,}207\ Wh}{70{,}295\ \mathrm{kWh}} = 1.7\%$$

To compute NPSO from the intercepts, we first found the ratio of respondents that had qualified for NPSO in our survey and the total number of respondents that had purchased any non-discounted LEDs (see Table 3-22). We then extrapolated the results the Ameren Missouri customer base based on the average number of spillover bulbs and the number of customers in the Ameren Missouri service territory. That number was then divided by the total number of program discounted bulbs from the entire upstream channel to come up with the final NPSO rate of 7.4%.

Table 3-22. PY2019 Lighting Program Upstream Channel Non-Participant Spillover

Calculation Input	Sample	Population
Total Customers	414	935,186
Non-participating customers purchasing non-discounted LEDs	208	469,852
Non-participating customers purchasing non-discounted LEDs influenced by the program	15	33,884
Average number of spillover bulbs per customer		5.9
Total number of spillover bulbs	88	199,913
Total number of program discounted bulbs		2,716,116
Non-Participant Spillover Rate		**7.4%**

Net Impacts

The evaluation team applied the PY2019 NTGRs to determine net impacts for the PY2019 Residential Lighting Program (Table 3-23). Ex post net energy savings totaled 62,818 MWh and ex post net demand

savings totaled 9.74 MW. As noted elsewhere, the vast majority (99.7%) of total ex post savings is associated with the upstream channel; only 0.3% associated with the Online Store.

Table 3-23. PY2019 Lighting Program Annual First Year Net Impacts

Channel	Energy Savings			Demand Savings		
	Ex Post Gross (MWh)	NTGR	Ex Post Net (MWh)	Ex Post Gross (MW)	NTGR	Ex Post Net (MW)
Upstream	98,291	63.6%	62,513	15.25	63.6%	9.70
Online Store	343	89.9%	305	0.05	88.9%	0.05
Total	**98,634**	**63.7%**	**62,818**	**15.30**	**63.7%**	**9.74**

Finally, Table 3-24 presents ex post gross and ex post net last-year demand impacts.

Table 3-24. PY2019 Lighting Program Annual Last Year Net Demand Impacts

Channel	Bulb Type	Ex Post Gross (MW)			NTGR	Ex Post Net (MW)		
		<10	10-14	15+		<10	10-14	15+
Upstream	Standard LED	1.97	0.00	9.22	63.6%	1.25	0.00	5.86
	Reflector LED	0.50	0.00	2.35	63.6%	0.32	0.00	1.49
	Specialty LED	0.21	0.00	1.00	63.6%	0.14	0.00	0.63
Online Store	Standard LED	0.00	0.00	0.03	89.9%	0.00	0.00	0.03
	Reflector LED	0.00	0.00	0.01	89.9%	0.00	0.00	0.01
	Specialty LED	0.00	0.00	0.00	89.9%	0.00	0.00	<0.01
Total		**2.69**	**0.00**	**12.61**	**63.7%**	**1.71**	**0.00**	**8.03**

4. Heating Ventilation and Air Conditioning (HVAC)

This section summarizes the PY2019 evaluation methodology and results for the HVAC Program. Additional details on the methodology are presented in Appendix A.

4.1 Evaluation Summary

4.1.1 Program Description

The Heating, Ventilation, and Air Conditioning (HVAC) Program obtains energy and demand savings through improvements in the operating performance of existing residential cooling units or replacement of central air conditioning (CAC) units and heat pumps. A key source of program savings is early replacement/early retirement (ER) of CACs and heat pumps. These ER projects, which compare the efficient unit energy consumption to the consumption of the existing unit, results in substantially greater first year and life cycle savings than from replace-on-fail (ROF) projects, which compare the efficient unit energy consumption to the consumption of a federal minimum efficiency standard unit.

The HVAC Program target market consists of single- and multifamily residential homeowners within the Ameren Missouri service territory with CACs or heat pumps. The HVAC Program improves the efficiency of CAC systems, air-source heat pumps (ASHPs), ground source heat pumps (GSHPs), and ductless mini-split heat pumps (DMSHPs), by providing incentives for new high-efficiency systems. The HVAC Program also provides incentives for electronically commutated motors (ECMs) installed as part of new furnaces and advanced thermostats.

Trade allies play a critical role in delivering the Ameren Missouri HVAC Program to the target market. Trade allies install energy-efficient equipment, complete and submit customer rebate applications, and market the program to customers. To become a participating trade ally in the Ameren Missouri HVAC Program, trade allies must complete the program training course as well as the Contractor Participation Agreement (CPA) before they may start offering rebates. Trade allies must also submit a minimum of three qualifying applications a year to remain an active trade ally within the program.

Program Changes

At the beginning of PY2019, the HVAC Program underwent a number of key design and implementation changes:

- Program administration shifted to a new implementer (Franklin Energy), while the associated sub-contractor (ICF) remained the same. Franklin Energy serves as the new Ameren Missouri residential portfolio implementer, and ICF serves as the day-to-day implementer of the HVAC Program.
- The program started claiming savings from advanced thermostats installed by customers receiving HVAC system upgrades.[27]
- Program staff ended incentives for Seasonal Energy Efficiency Ratio (SEER) 14 CACs but added incentives for a higher tier of CACs and ASHPs (SEER 18+).

[27] These savings were previously claimed under the Efficient Products Program.

- Program staff removed incentives for CAC and heat pump tune-ups.
- From August 15th to November 30th, 2019, the program offered a promotional bonus incentive of $100 for ducted ASHP measures and CAC measures to drive participation.

4.1.2 Participation Summary

Throughout PY2019, 11,024 unique customers completed 11,218 HVAC projects (Table 4-1). A majority of projects (82%) included at least one ECM upgrade. CACs and ASHPs were the largest contributors to program savings, collectively accounting for two-thirds of the HVAC Program's ex ante gross energy savings (67%). Notably, 94% of the CAC and ASHP ex ante savings came from ER projects.

Table 4-1. PY2019 HVAC Participation Summary

Enduse	Participants		Projects		Measures		Ex Ante Savings	
	Number	%[a]	Number	%[a]	Number	%	MWh	%
ECMs	9,049	82%	9,162	82%	9,719	41%	9,109	23%
CACs	8,633	78%	8,721	78%	9,226	39%	15,734	40%
Advanced Thermostats	2,911	26%	2,939	26%	3,178	13%	1,323	3%
ASHPs	1,164	11%	1,180	11%	1,216	5%	10,517	27%
DMSHPs	193	2%	196	2%	214	1%	974	2%
GSHPs	110	1%	111	1%	129	1%	1,991	5%
Total	**11,024**	**NA**	**11,218**	**NA**	**23,682**	**100%**	**39,647**	**100%**

[a] Percents do not sum to 100 due to participants receiving multiple measures and unique projects associated with multiple measures.

4.1.3 Key Impact Results

As shown in Table 4-2, the program achieved 66% and 72% of Ameren Missouri's net energy savings and demand savings goals, respectively. The HVAC Program fell short of its goal net savings due to lower than expected participation in PY2019 and differences between ex ante and ex post savings estimates.

Table 4-2. PY2019 HVAC Program Savings Summary

	Ex Ante Gross	Gross RR	Ex Post Gross	NTGR	Ex Post Net	Goal/Target Net	% of Goal/Target
First Year Savings							
Energy Savings (MWh)	39,647	97.2%	38,531	76.0%	29,275	44,361	66%
Demand Savings (MW)	22.15	106.3%	23.54	71.2%	16.75	23.28	72%
Last Year Demand Savings							
< 10 EUL (MW)	0.00	NA	0.00	NA	0.25	0.00	NA
10-14 EUL (MW)	0.57	99.7%	0.56	211.3%	1.19	0.00	NA
15+ EUL (MW)	9.15	79.8%	7.31	73.0%	5.34	14.51	37%

The HVAC Program was the second-largest program in the PY2019 residential portfolio, accounting for 25% of ex post net residential portfolio energy savings and 46% of ex post net residential portfolio demand savings.

4.1.4 Key Process Findings

Key process findings from the PY2019 HVAC Program include:

- Overall, participants and trade allies are highly satisfied with the HVAC Program. Nearly all responding participants (97%) and trade allies (96%) said they were satisfied.
- The HVAC program theory/logic model (PT/LM) does not currently list any programmatic activities designed to induce the early replacement of operational cooling equipment, nor does it include reference to activities that would identify viable ER participants or clearly eliminate customers that engaged the market intent of replacing existing equipment.
- Trade allies seem highly influenced by the program to recommend replacement versus repair. However, despite the program's strong influence on trade allies, nearly half of program participants (45%) were already predisposed to replace their equipment and had intentions of doing so without the program. These findings contradict the implicit program assumption regarding CAC market function and customer decision making – if the existing unit is operational, customers would always choose to service the unit, not replace it.

To meet the requirements of Missouri Code of State Regulations (CSR) for demand-side process evaluations, we provide responses to the five required process evaluation questions in Table 4-3.

Table 4-3. Summary of Responses to CSR Process Evaluation Requirements

CSR Required Process Evaluations Questions	Findings
What are the primary market imperfections that are common to the target market segment?	The primary market imperfections include high upfront cost of high-efficiency HVAC equipment and a lack of customer awareness regarding the benefits of such systems (i.e., energy and utility bill savings). Trade allies play an important role in addressing these market imperfections by educating customers and promoting program incentives that reduce the cost of high-efficiency equipment so that is closer to the price of standard efficiency equipment.
Is the target market segment appropriately defined, or should it be further subdivided or merged with other market segments?	The HVAC Program's target market segment includes single family and multifamily residential homeowners with central cooling systems that are older or in need of replacement due to their operating conditions. The HVAC Program's overall target market segment is appropriately defined. The program also targets and claims incrementally higher savings for early replacement/early retirement projects. A project is considered ER if the trade ally 1) verifies that the outdoor compressor was in working condition and 2) the unit produces a measured temperature drop across the indoor coil (measuring entering and leaving temperature). While these requirements are important in establishing that a unit is operational, it is not sufficient for determining if the equipment provides adequate cooling, or if the program has induced the early retirement of the equipment. Rather, ER should be determined based on the customers' intentions before their involvement with a trade ally/program, in addition to the operating condition of the existing unit.

CSR Required Process Evaluations Questions	Findings
Does the mix of enduse measures included in the program appropriately reflect the diversity of enduse energy service needs and existing enduse technologies within the target market segment?	The HVAC Program offers incentives for heating and cooling equipment at various efficiency levels. The HVAC Program also correctly accounts for market and federal code changes, phasing out offerings (i.e., ECMs) when they are no longer effective under evolved market conditions. With the removal of ECMs as a program offering, Ameren Missouri should consider including other enduse technologies such as high-efficiency water heaters. Based on the trade ally survey, about a fifth (22%) of respondents reported that in addition to HVAC, their companies are specialized in plumbing and hot water heating services. As such, Ameren Missouri could leverage its existing trade ally network to recruit contractors who already sell/install high-efficiency water heating equipment.
Are the communication channels and delivery mechanisms appropriate for the target market segment?	The HVAC Program is primarily driven by trade allies, and a majority of participants (68%) report having first heard about the program through trade allies. Ameren Missouri also promotes the HVAC Program through other forms of outreach, including e-mails, newsletters, bill inserts, Ameren Missouri website, home energy reports, and mass media advertising. Collectively, these channels are effectively reaching the target market segment and are, therefore, the appropriate communication and delivery mechanisms. Notably, the HVAC Program is the most well-known program of all Ameren Missouri residential programs, with 60% of general population survey respondents reporting awareness of the program. We found even higher awareness among the program's target market. Homeowners who have replaced their cooling system within the past three years are more likely to be aware of the HVAC Program than other homeowners (76% compared to 61%).
What can be done to more effectively overcome the identified market imperfections and to increase the rate of customer acceptance and implementation for select enduses/measure groups included in the Program?	Even though the program offers various marketing support for trade allies (e.g., co-op marketing program, account manager, market collateral, and co-branded materials), almost half of trade allies (48%) said they do not use any of the program marketing support. Since trade allies play such an important role in promoting and delivering the HVAC Program, we recommend that Ameren Missouri and their implementation team work directly with trade allies to better understand the format, content, and features of marketing materials that trade allies would be more likely to use. A deeper understanding of what is needed by the HVAC technicians who are out in the field and interacting with customers face-to-face will enable the program to develop more effective promotional and educational materials to increase the sale of high-efficiency equipment.

4.1.5 Conclusions and Recommendations

The evaluation team offers the following conclusions and recommendations for the HVAC Program based on the results of the PY2019 evaluation:

- Conclusion #1: Overall, participants and trade allies are highly satisfied with the HVAC Program. Nearly all responding participants (97%) and trade allies (96%) said they were satisfied. A few participants were dissatisfied due to the longer-than-expected time it took for them to receive the incentive. Two allies that provided low satisfaction ratings noted that the application process could be simplified and updated to allow users to edit applications once they are submitted.

- Recommendation: While prompt delivery of the incentive will be key for retaining high levels of customer satisfaction, we also recommend that Ameren Missouri send routine updates to customers to inform them about the status of their rebate. Ameren Missouri could also help maintain trade ally satisfaction by making the rebate application tool more user-friendly.

- Conclusion #2: The HVAC Program PT/LM does not currently list any programmatic activities designed to induce the early replacement of operational cooling equipment, nor does it include reference to activities that would identify viable ER participants or clearly eliminate customers that engaged the market intent of replacing existing equipment.
  - Recommendation: The logic model should outline a theory of how the HVAC market currently functions around the replacement of existing equipment without program intervention. Additionally, the logic model should be revised to include the specific programmatic activities that identify customers whose first interaction with the market is not for replacing existing equipment (operational or otherwise), and the strategies for inducing these customers to replace functioning or repairable existing CAC equipment earlier than they otherwise would have. Programmatic activities should include trade ally training on activities to intervene in the market and verification of these activities. Lastly, the model should also establish the theoretical causal linkage between these activities and the desired change in customer behavior (e.g., that customers will replace functional equipment rather than simply servicing it). This will help explicate the program's influence of the early replacement of HVAC equipment and substantiate claimed savings.
- Conclusion #3: Currently, a project is considered ER if the trade ally 1) verifies that the outdoor compressor was in working condition and 2) the unit produces a measured temperature drop across the indoor coil (measuring entering and leaving temperature). Per the program's "Cold Weather Rule," the trade ally is only required to certify that the outdoor compressor is operational when ambient temperatures are below 65 degrees Fahrenheit. While these requirements are important in establishing that a unit is operational, it is not sufficient for determining if the equipment provides adequate cooling, or if the program has induced the early retirement of the equipment. Rather, ER should be determined based on the customers' intentions prior to their involvement with a trade ally/program, in addition to the operating condition of the existing unit.
  - Recommendation: Starting in 2020, gather data on why the customer engaged the trade ally/program initially (e.g., whether the customer was looking for a quote on repair, replacement, or both when they first called). To reduce the amount of burden placed on customers and trade allies to collect this new information, the evaluation team and the implementation team agreed to remove the temperature drop measurement beginning in 2020, and instead, rely on the operation of the compressor to determine if a unit is functioning. The evaluation team will use data on compressor operation, as well as customer intent to classify a project as ER in 2020.
- Conclusion #4: Nearly half (46%) of trade ally respondents said they do not use any of the marketing support offered by the program.
  - Recommendation: Trade allies play an integral role in promoting and delivering the HVAC Program to the target market. Ameren Missouri should engage with trade allies to develop marketing strategies or materials that are the most useful to them. Ameren Missouri should also consider developing marketing materials and mass media campaigns to educate residential customers about the phase-out of Freon (or Refrigerant-22) beginning in 2020. Since Freon will

no longer be produced or imported into the US, it will be very difficult and expensive for customers with R-22 systems to repair their existing unit. This presents an opportunity for the program to influence these customers to replace their unit before a repair is needed.

- Conclusion #5: Only 33% of HVAC Program participants had e-mail addresses in the program tracking data.
  - Recommendation: E-mails have become an increasingly common method for utilities to engage with customers. As such, Ameren Missouri should encourage trade allies to collect customer e-mail information and develop e-mail-based marketing efforts to drive meaningful engagement with participants. Ameren Missouri can leverage this new outreach method to send customers regular updates on the status of their rebate – which was a common source of customers' dissatisfaction with the HVAC Program. Since a majority of HVAC participants (81%) are very likely to recommend the program to others, Ameren Missouri could consider running a "refer a friend" e-mail campaign to promote awareness among other customers in the target market.
- Conclusion #6: While the implementer correctly applied ex ante assumptions based on the Ameren Missouri TRM Appendix F for all HVAC Program measures, these assumptions did not reflect the most recent version, dated November 2019, of Appendix F.
  - Recommendation: Continue to adopt findings from the year-end evaluation reports into the TRM Appendix F tables and provide those updates to the implementation and evaluation teams as soon as they are finalized. This will enable the implementation team to adopt those updates earlier in the program year and minimize discrepancies at the end of the program year.
- Conclusion #7: Ex ante savings calculations did not use program tracking data when available, opting instead to rely on Appendix F deemed values for all measure parameters.
  - Recommendation: Use actual tracked parameter values, such as equipment capacities and efficiencies, when available, to calculate ex ante savings. While use of Appendix F values are appropriate for planning purposes, the application of actual tracked measure parameters is recommended by the TRM and will improve overall program performance.
- Conclusion #8: The program tracking database provides a single installed capacity value for heat pump measures, but heating and cooling capacities potentially differ for a given heat pump, as observed through the desk review process. Additionally, the Ameren Missouri TRM includes both heating and cooling capacity parameters in its heat pump savings algorithm. Both heating and cooling capacities, in Btu/hr, are available for measures through AHRI certificates.
  - Recommendation: Update the tracking database to include both heating and cooling capacities to make savings calculations more accurate. These capacities are available through the Air-Conditioning, Heating, & Refrigeration Institute (AHRI) certification directory.[28]

[28] Heating and cooling capacities for heat pumps can be found by searching the AHRI certification number in the AHRI directory at http://www.ahrinet.org/Certification/Directory

4.2 Evaluation Methodology

As described in Section 4.1, the evaluation team performed both impact and process evaluation activities to assess the performance of the HVAC Program in PY2019. In addition to the overarching research objectives outlined for the Residential portfolio, the evaluation team explored the following HVAC specific objectives:

- Characterize program participation with respect to the number and characteristics of participants and installed measures;
- Characterize trade ally participation with respect to the number of participating trade allies, the number of customers served by each, and trade ally service territory;
- Assess the effectiveness of the trade ally training program;
- Assess the effectiveness of program marketing and customer targeting strategies;
- Measure customer and trade ally satisfaction with program processes and motivations for participating; and
- Provide evaluation results that can be used to improve the design and implementation of the HVAC Program.

Table 4-4 provides an overview of the HVAC Program evaluation activities. Following the table, we outline program-specific aspects of key evaluation methodologies.

Table 4-4. PY2019 Evaluation Activities for the HVAC Program

Evaluation Activity	Description
Program Manager and Implementer Interviews	▪ Conducted one interview with program staff to gain a detailed understanding of program design and delivery.
Program Material Review	▪ Reviewed all program materials to inform evaluation activities.
Program Theory/ Logic Model Review	▪ Reviewed implementer's program theory/logic model to understand program activities and their expected outputs and outcomes, including expected impacts on the market.
Tracking System Review	▪ Reviewed implementer's tracking system to ensure that the data required for the evaluation is being collected.
Participant Survey	▪ Conducted three waves of online surveys with program participants to collect data to inform NTG (free ridership and participant spillover) and yield process-related insights.
Participating Trade Ally Survey	▪ Conducted an online survey with trade allies to inform NTG (trade ally spillover) and yield process-related insights.
Engineering Analysis	▪ Verified that ex ante savings use correct deemed savings values. ▪ Estimated overall and measure-level ex post gross impacts using TRM algorithms, deemed savings assumptions, and evaluation-estimated parameters.
Engineering Desk Reviews	▪ Reviewed supporting project documentation to ensure that original data was correctly entered from invoices and other documentation. ▪ Verify measure installation and collect data to inform estimation of ex post gross impacts.
NTGR/Net Impact Analysis	▪ Developed estimates of free ridership and participant and non-participant spillover ▪ Applied portfolio-level non-participant spillover ▪ Estimated PY2019 net impacts

Participant Survey

The evaluation team conducted three rolling web surveys with program participants throughout PY2019 to minimize the time between program participation and survey date. The goals of the survey were to verify measure installation, as well as measure participant satisfaction with program processes, the installed HVAC measure, trade ally interactions, and program informational materials. We also asked questions to estimate participant free ridership and spillover. Additionally, the participant survey explored customer decision making concerning the early replacement of functioning HVAC equipment. We conducted cognitive testing of these ER questions with nine participants before the full survey roll out (Wave Two) to ensure that customers easily understood the questions' meanings and were able to provide accurate responses.

We attempted a census of participants with e-mail addresses. Of the 11,024 unique participants, only 33% had e-mail addresses (n=3,620). We sent an e-mail invitation to all participants and two follow-up e-mail reminders. We fielded the surveys to recent participants in September, October, and December. In total, 656 participants completed the survey.

Table 4-5 provides the final participant survey disposition summary. The evaluation team calculated the survey response rate using the Response Rate 3 (RR3) methodology specified by the American Association of Public Opinion Research (AAPOR). The overall response rate for the HVAC participant survey across three waves was 20%.

Table 4-5. Participant Survey Disposition Summary

Disposition	Count
Completed Surveys	656
Partial Complete - survey eligibility confirmed	69
Partial Complete - survey eligibility unknown	67
No response	2,505
Screened out	21
Bounced e-mail	302
Total Participants in Sample	**3,620**

Trade Ally Survey

We conducted an online survey with trade allies (TA) who had completed at least one project through the HVAC Program in 2019. The goals of this survey were to support the estimation of TA SO attributable to the HVAC Program, and to gather trade ally feedback on program requirements, processes, and design, including satisfaction with trade ally training and program materials and resources. The survey was administered in January 2020.

A total of 355 trade allies completed at least one project through the HVAC Program in PY2019. We sent an e-mail invitation and reminder e-mails to 344 companies that had an e-mail address (97% of the total population). The evaluation team offered an incentive of $50 to every trade ally who completed the survey. Overall, 117 trade allies completed the survey, achieving a response rate of 36% (Table 4-6).

Table 4-6. Trade Ally Survey Disposition Summary

Disposition	Count
Completed Surveys	117
Partial Complete - survey eligibility confirmed	8
Partial Complete - survey eligibility unknown	10
No response	198
Screened out	3
Bounced e-mail	8
Total Participants in Sample	**344**

Impact Analysis

Gross Impact Analysis

The impact analysis consisted of a program tracking database review to identify database errors and duplicate records, as well as ensure that the implementer applied savings algorithms and assumptions outlined in the Ameren Missouri TRM[29] and Appendix F deemed savings tables. Additionally, the evaluation

[29] Ex ante applied Revision 2.0 (dated 12/21/2018) of the Ameren Missouri 2019-21 MEEIA Energy Efficiency Plan Appendix I – TRM: Residential Measures (referred to as the "Ameren Missouri TRM"). Ex post applied Revision 3.0 (released November 2019) of the Ameren Missouri TRM.

team developed program-specific parameters through participant research, validated early replacement classifications for CAC and ASHP measures, applied de-rating factors for existing equipment efficiency values, and conducted desk reviews for a sample of CAC and ASHP measures.

Measure Verification

We relied on the participant survey to estimate "in-service rates" (ISR) for the HVAC Program. We asked program participants how many of their respective HVAC equipment were currently installed. We then calculated ISR by dividing the number of HVAC equipment currently installed by the total number of equipment reported in the program tracking database.

Early Replacement Validation

As previously noted, 94% of the CAC and ASHP measures were classified as early replacement (ER) in the program tracking database. Since the baseline for early replacement measures is the continued operation of existing equipment, the current program requires that the contractor demonstrate the existing equipment is operational by measuring a temperature drop (or increase during heating season) across the indoor coil. If outdoor temperature is below 65 degrees Fahrenheit, the program's "Cold Weather Rule" allows contractors to indicate that they are unable to measure a temperature drop and, instead, just verify the equipment is operational. The evaluation team used a combination of the temperature measurements and contractor verification data in the program tracking database to validate the ER classifications or, where data were insufficient, to reclassify measures to ROF. Specifically, we reclassified measures that did not show valid temperature measurements, indicate the cold weather rule, or have contractor verification of existing equipment operation. In total, we reclassified 188 CACs and 46 ASHP units from ER to ROF.

Note that the evaluation team has recommended a change in the early replacement validation for future years, incorporating data about the customer's intent in engaging the market. Future ER validation procedures will rely on a combination of data to validate that the existing equipment is functional, as well as data on customer intent.

Derating Existing Equipment Efficiency

For early replacement measures, the baseline is represented by the existing equipment that would continue to operate in absence of the new equipment incentivized by the program. To account for the performance degradation of the existing equipment compared to nameplate efficiency values, we applied a derating factor to the nameplate efficiency value reported in the program tracking data (SEERexist). We calculated the derating factor based on the following algorithm and the reported age of the existing equipment:

Derating Factor = $(1\text{-}1.44\%)^{Age}$, where "Age" is the age of the existing equipment in years. When the age of the existing equipment was missing, we used a default of 12 years,[30] and we did not de-rate baseline efficiency (SEERexist) values that were below a minimum threshold of 8 SEER.

Engineering Desk Reviews

To supplement the engineering analysis, we performed 50 desk reviews for a sample of CAC and ASHP projects. We prioritized CACs and ASHPs because these measures collectively accounted for 66% of the PY2019 HVAC Program ex ante gross energy savings. To select projects for desk reviews, we used a non-

[30] The 12-year default value is based on the difference between the 18-year measure life for CAC and ASHP measures and the default 6-year remaining useful life (RUL) of existing equipment.

proportional stratified random sample by project savings with stratum quotas for CAC and ASHP projects. The non-proportional stratified random sample is calculated by first using the Dalenius and Hodges[31] method to determine stratum boundaries (i.e., ranges of project savings) and then applying an allocation scheme known as the Neyman allocation[32], which allocates sample quota for a given stratum that produces the lowest variance for the fixed population size. The team selected this sample design methodology as it allows for the greatest certainty of impacts with the fewest sample points from the PY2019 participant population.

For the selected projects, we reviewed all program documents, including applications, invoices, and specification sheets. We used the desk reviews to verify the accuracy of data in the program tracking database and ultimately use the updated data to estimate gross impacts. Table 4-7 provides a summary of the desk review sample for the HVAC Program.

Table 4-7. Summary of Desk Reviews

Measure Category	Count of Projects (Population)	Sum of Ex Ante Gross Energy Savings (kWh) for Population	Desk Review Projects (Sample)	Sum of Ex Ante Gross Energy Savings (kWh) for Sample	% of Total Savings in Sampled Projects
CAC	8,721	15,734,258	30	65,143	0.4%
ASHP	1,180	10,516,927	20	196,553	1.9%
Total	**9,901**	**26,251,185**	**50**	**261,696**	**1.0%**

Following the completion of the engineering desk reviews, the evaluation team calculated a project realization rate for each project, by taking the ratio of ex post desk review energy savings to ex post engineering analysis desk review savings.

Equation 4-1. Desk Review Realization Rate

$$Desk\ Review\ Realization\ Rate = \frac{Ex\ Post\ \text{Desk Review}\ Energy\ Savings}{Ex\ Post\ Engineering\ Analysis\ Energy\ Savings}$$

We used the stratified ratio estimator adjustment method to extrapolate results for the sampled projects back to the overall population.[33] We applied the realization rate to ex post engineering analysis impacts to develop final ex post results.

Attribution/Net Impact Analysis

The net-to-gross (NTG) analysis for the HVAC Program includes the consideration of free ridership (FR), participant spillover (PSO), trade ally spillover (TA SO), and non-participant spillover (NPSO). FR and PSO are based on the participant survey; TA SO is based on the trade ally survey, and NPSO is based on the portfolio-level NPSO analysis. The NTG ratio (NTGR) for the HVAC Program is calculated as follows:

$$NTGR = 1 - FR + PSO + TA\ SO + NPSO$$

[31] Dalenius, T. and Hodges, J. L. (1959), "Minimum Variance Stratification," *Journal of the American Statistical Association*, 54, 88-101.
[32] Neyman allocation, after Neyman (1934) as described in Cochran, W. G. (1977), *Sampling Techniques* (Third Edition), John Wiley and Sons, New York
[33] Appendix A provides further detail on extrapolation methods

Trade Ally Spillover

TA SO refers to non-incented energy efficiency upgrades made by customers who were influenced by a participating trade ally who was, in turn, influenced by Ameren Missouri's HVAC Program. We identified spillover candidates through questions asked in the TA survey and determined savings for qualifying TAs to develop a quantitative estimate of spillover relative to total program savings.

4.3 Evaluation Results

4.3.1 Participant Process Results

The participant process results include customer program awareness, and satisfaction with Ameren Missouri, the HVAC Program, and various HVAC Program components. Additionally, the participant survey explored customer decision making with respect to the early replacement of functioning HVAC equipment.

Program Awareness

The Ameren Missouri HVAC Program is the most well-known program of all Ameren Missouri residential programs. When provided a description of the program, 60% of surveyed residential customers said they were aware of the HVAC Program (Table 4-8).[34] We found even higher awareness among the program's target market (i.e., homeowners with central cooling systems that are older or in need of replacement due to their operating condition). Homeowners who have replaced their cooling system within the past three years are more likely to be aware of the HVAC Program than other homeowners (76% compared to 61%).

Table 4-8. Awareness of Ameren Missouri Residential Programs

Program	Residential Customers (n=4,804)
HVAC (Heating and Cooling)	60%
Appliance Recycling	41%
Efficient Lighting	40%
Efficient Products	36%
Low Income	32%
Peak Time Savings	27%
Multifamily Market Rate	22%
School Kits	15%

Customer-trade ally interaction is critical for bolstering program participation, as evidenced by the fact that most participants (69%) first learned of the HVAC Program through their contractor/trade ally. Ameren Missouri also markets the HVAC Program to customers through e-mails, newsletters, bill inserts, home energy reports, and the Ameren Missouri website. About a fifth of respondents (21%) learned of the program through Ameren Missouri marketing materials (Table 4-9).

[34] Results are drawn from a survey of 4,804 Ameren Missouri residential customers conducted between January 13 and 27, 2020. Appendix A on non-participant spillover contains additional information on survey methods.

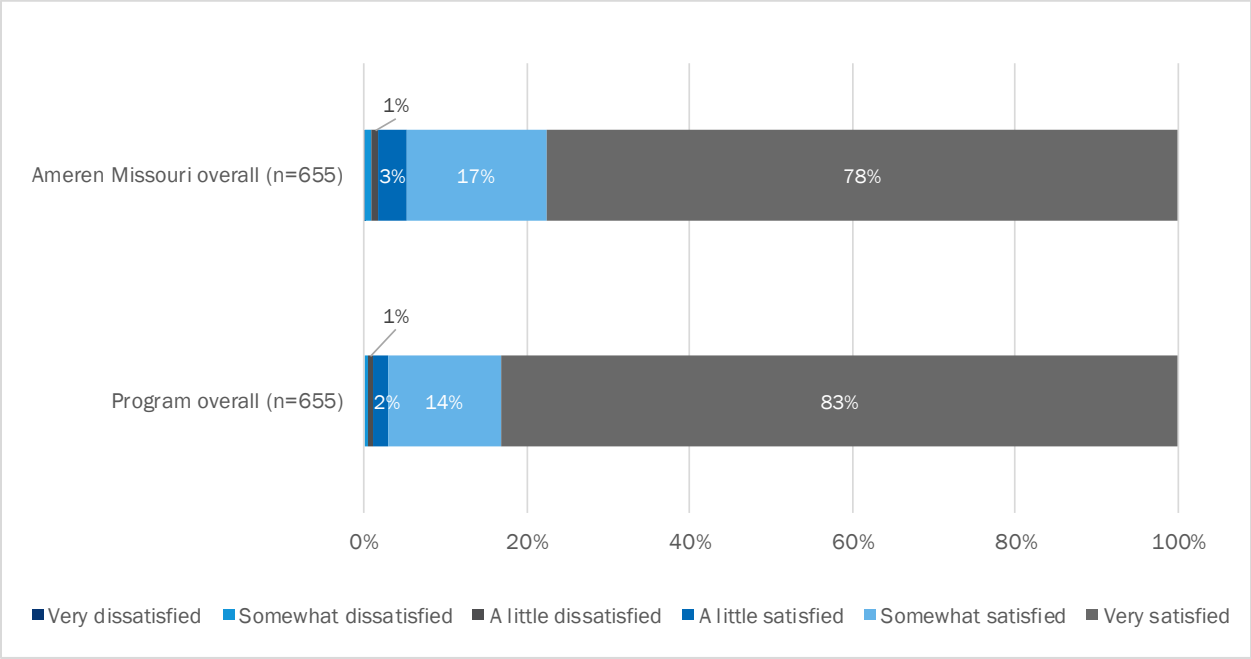
Table 4-9. How Participants First Heard About the HVAC Program

First Heard About the HVAC Program	Percent of Participants (n=650)
A contractor/trade ally	69%
An e-mail, newsletter, bill, door hanger, or other material from Ameren Missouri	10%
Ameren Missouri's website	6%
Ameren Missouri Home Energy Reports	5%
An advertisement from the internet, social media, TV, radio, newspaper, billboard, or retail store	4%
A family member, friend, and/or colleague	4%
Other	2%

Program Satisfaction

Feedback collected from surveyed participants indicates high satisfaction with Ameren Missouri and the HVAC Program overall. The majority of participants were very satisfied with Ameren Missouri and the HVAC Program, with 77% and 83% of respondents reporting they were very satisfied (Figure 4-1). In addition, about 72% of participants reported a favorable perception of Ameren Missouri due to their participation in the program. Given the high levels of customer satisfaction with the HVAC Program, it is not surprising that 60% of respondents reported being very likely to recommend the program while 21% said that they had already recommended it to others.

Figure 4-1. Participant Satisfaction with Ameren Missouri and HVAC Program



When asked why they had given a low rating for their overall experience with Ameren Missouri or the HVAC Program, respondents noted that they haven't received their rebate (n=3) or that they received less of an incentive than they were expecting (n=3). Below are a few representative quotations from customers with a "dissatisfied" or "neutral" satisfaction rating:

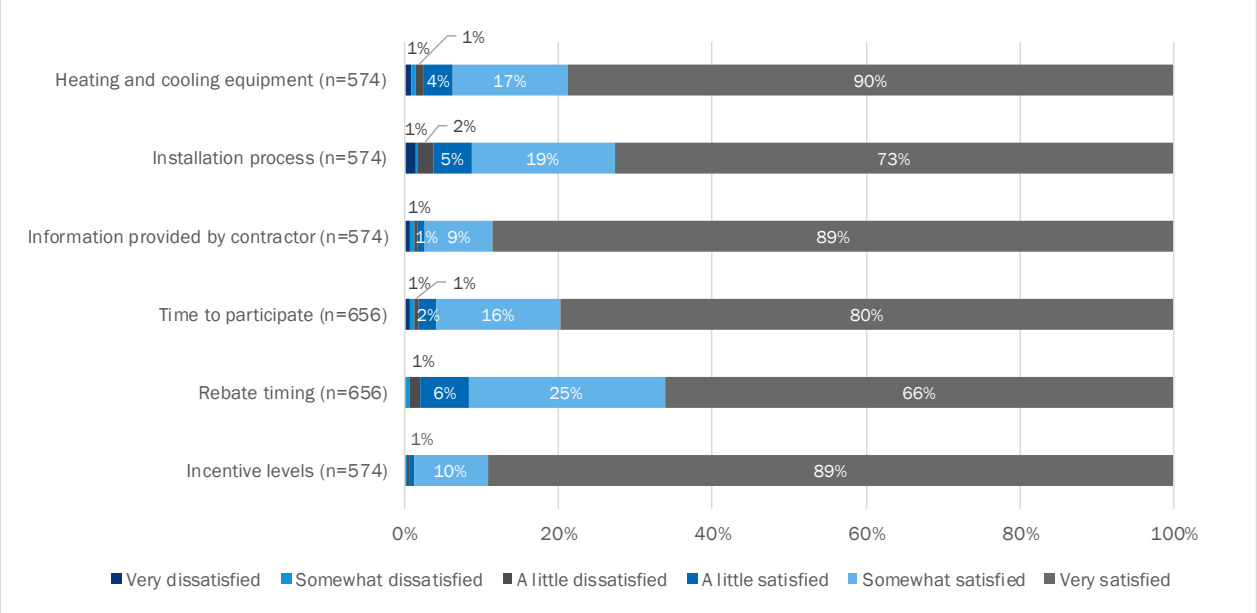
> *"I applied for the rebate on furnace, water heater, and thermostat in June. I still have not received any rebates. All paperwork and rebate forms are completed and have been sent in. They were all new efficiency products that qualified for rebates. No response or rebates, and it's been almost five months."*

> *"The rebate should have been greater to become a significant influence on the decision to purchase high-efficiency equipment."*

Overall, a majority of participants (79%) found the HVAC Program very easy to participate in. A small share of respondents rated the program participation process as being difficult (3%). They attributed this to difficulty in applying for the rebate (n=3), the rebate taking a long time to process (n=3), and dissatisfaction with the process having to go through a trade ally rather than being discounted at the point of purchase (n=1).

HVAC Program participants also generally expressed high levels of satisfaction with individual components of the program. As can be seen in Figure 4-2, participants are most satisfied with the heating and cooling equipment they received (90% very satisfied).

Figure 4-2. Participant Satisfaction with Program Components



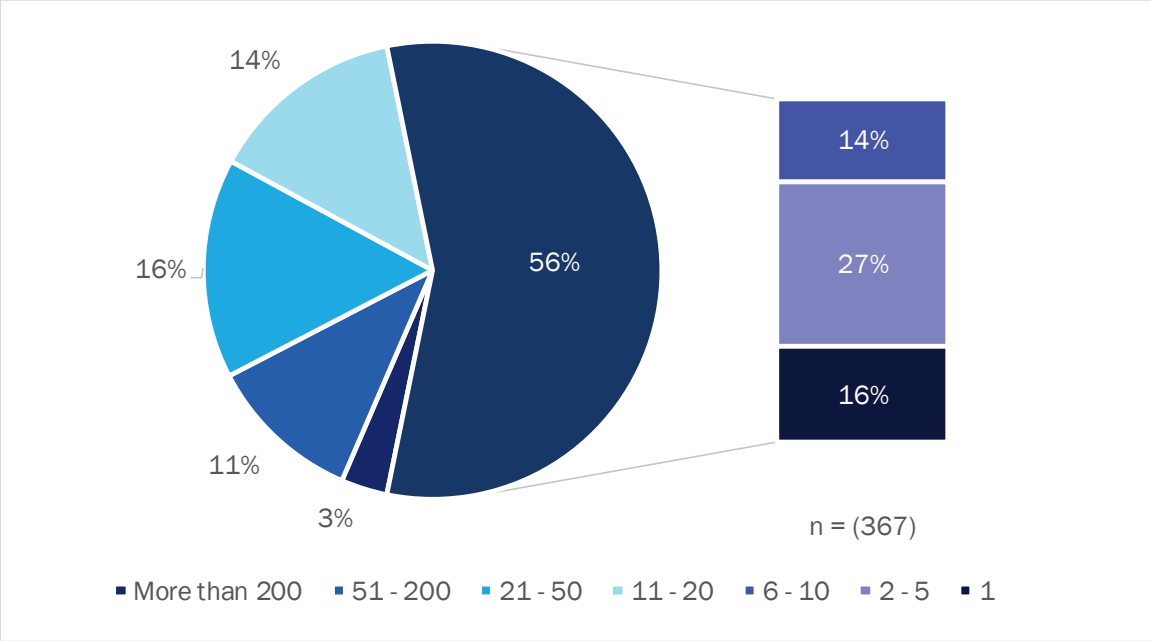
4.3.2 Trade Ally Process Results

The trade ally process results include trade ally characteristics, and their feedback on training, marketing, satisfaction with Ameren Missouri and HVAC Program components, and influence on trade ally business practices.

Characterizing Trade Allies

Throughout 2019, 367[35] unique trade allies completed 11,218 projects through the HVAC Program. Collectively, they served 11,024 unique residential customers. As seen in Figure 4-3, most trade allies tend to serve a small number of customers, with 16% serving just one customer and 56% serving less than ten customers in PY2019. The results of the trade ally survey further characterize most participating trade allies as small companies (less than ten employees) that are local in size and have considerable experience delivering services to residential markets in Missouri.

Figure 4-3. Number of Customers Served by Trade Allies



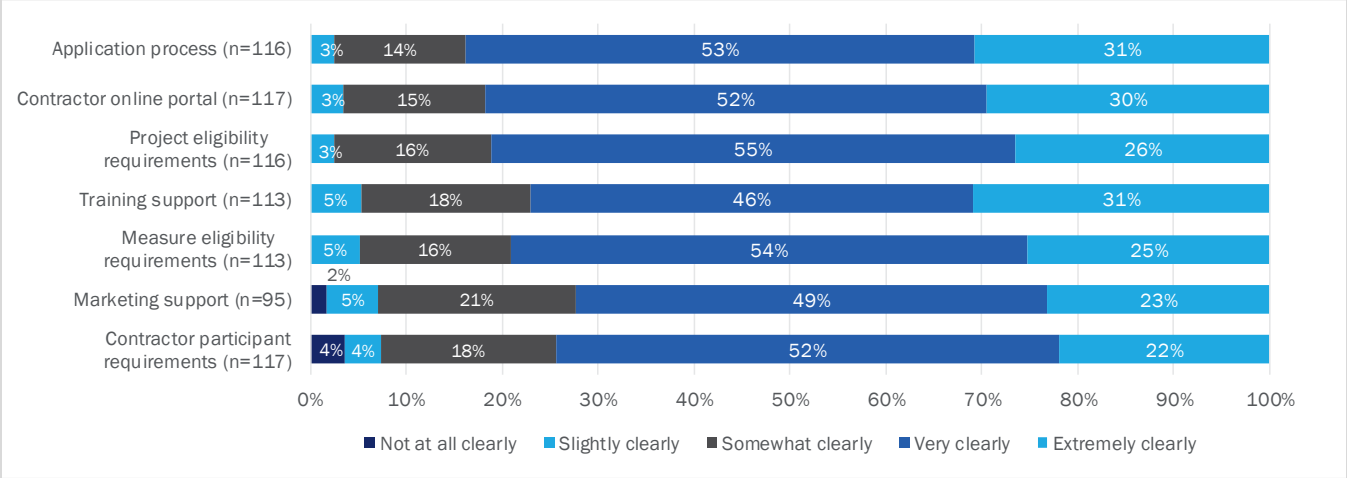
Training

Similar to PY2018, the HVAC Program required two types of mandatory training for participating trade allies: an initial enrollment training session, and an annual refresher training at the beginning of each program year. During the training, the implementation team provided trade allies with updates about program changes. In addition to the annual mandatory training, the program offered individual training to trade allies that requested assistance, as well as ride-alongs.

Over two-thirds of trade allies (69%) were very satisfied with the training that they attended. Trade allies were also asked to rate how clearly key program requirements and information were communicated to them during the training. As seen in Figure 4-4, trade allies reported that the application process, online contractor portal, and project eligibility requirements were the most clearly communicated components.

[35] Based on the number of unique contractor master ids.

Figure 4-4. Clarity of Program Information Communicated During Trade Ally Training



Trade allies identified additional information that they needed but were not provided during the trade ally training including training on installing ductless mini splits and air source heat pumps and cold weather requirements. Trade allies also hoped that training would include updates to eligible products, changes to rebates, and assistance in filling out program applications, as well as editing applications that had incomplete or incorrect customer information.

Marketing

Ameren Missouri provided various marketing support and co-branding opportunities to help trade allies market the program to customers. Still, survey feedback suggests trade allies are not taking full advantage of this support. Only a small percentage of trade allies report using marketing support, with nearly half (46%) reporting that they do not use any of the marketing support offered by the program (Table 4-10). The co-op marketing program is the marketing support most frequently used by trade allies. Ameren Missouri also advertised the HVAC Program through mass media marketing strategies, including the Ameren Missouri website, radio and television ads, digital advertisements, etc.

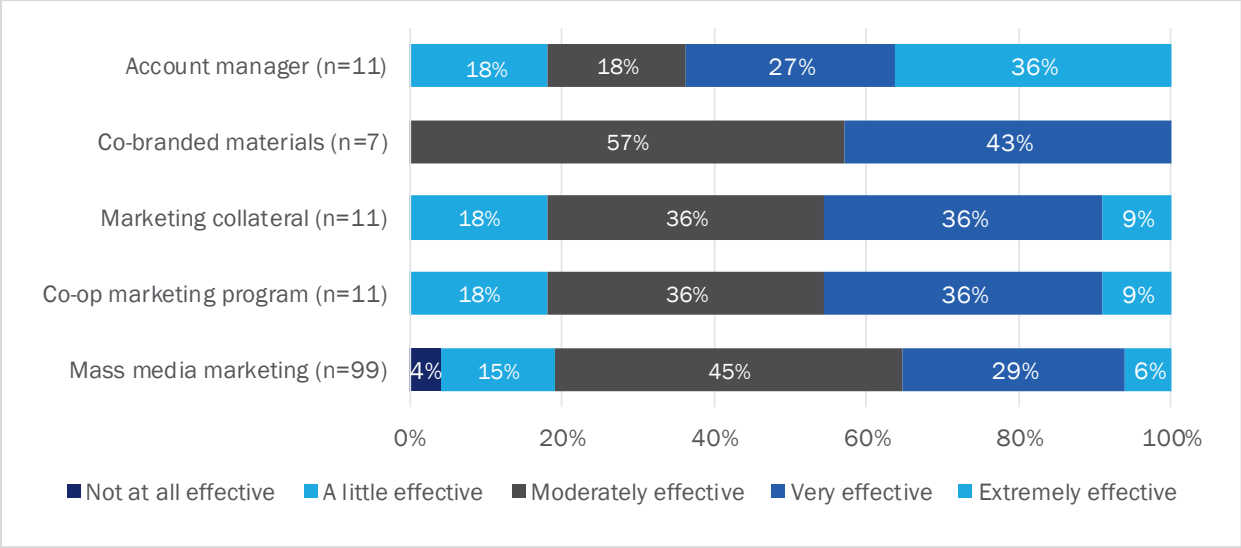
Table 4-10. Percentage of Trade Allies Using Marketing Support

Types of Marketing Support	Percent of Trade Allies (n=117)
Co-op marketing program	10%
Account manager	9%
Marketing collateral	7%
Co-branded materials	6%
None	46%

Trade allies rated the ICF account manager as the most effective marketing tool for getting customers to participate in the program, with an average effectiveness rating of 3.8 (on a scale of 1 to 5 where 1 is "not at all effective" and 5 is "extremely effective"). Figure 4-5 summarizes trade allies' effectiveness ratings for various marketing tools offered by the HVAC Program. Consistent with data collected from the broader

residential market, trade allies reported that approximately 55% of their customers were already aware of the discount offered through the program before they provided them with that information.

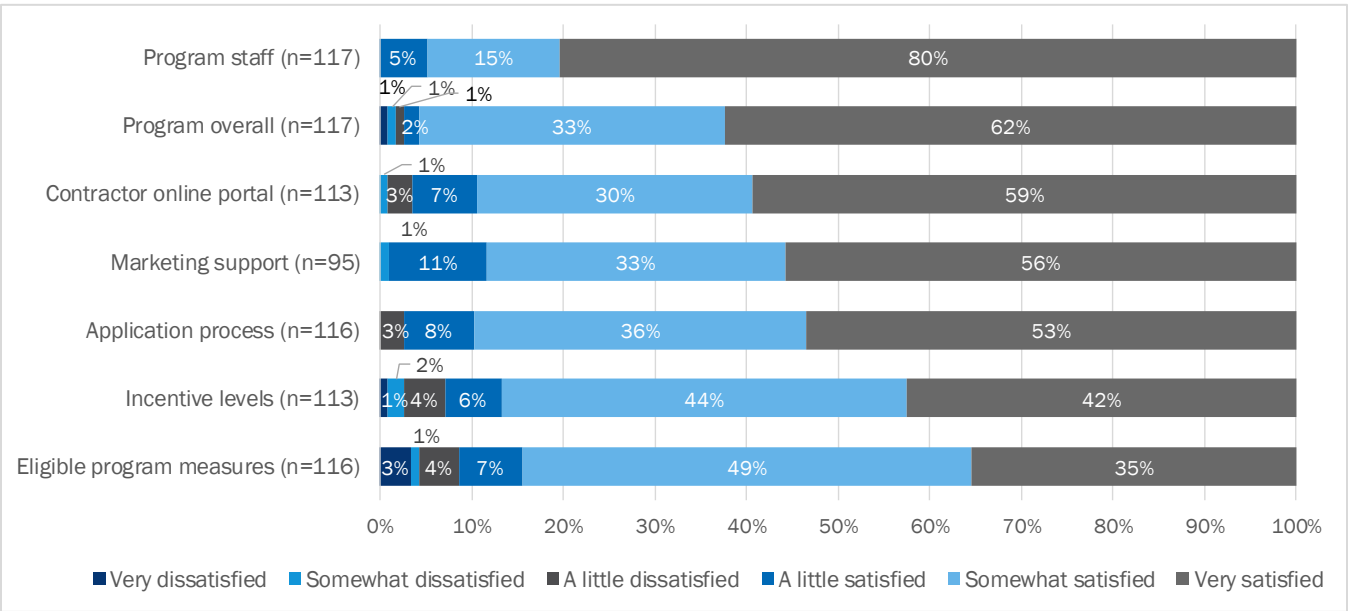
Figure 4-5. Effectiveness of Marketing Tools



Program Satisfaction

In general, trade allies are quite satisfied with the program. Over three-quarters of trade allies (80%) are very satisfied with the HVAC Program staff, and over half (62%) are very satisfied with the program overall. Figure 3-5 below outlines trade ally satisfaction with various program components.

Figure 4-6. Trade Ally Satisfaction with Program Components



Additional findings related to trade ally satisfaction include:

- The lowest rated feature was eligible measures through the program, with 8% of trade allies reporting dissatisfaction. The most cited issues were related to the removal of the SEER 14 CAC incentives in PY2019 (n=4). Trade allies noted that due to this change, customers were more likely to repair and retrofit their existing equipment rather than replace it.
- "I think you should bring back the 14 SEER option for AC units. With the new furnaces, the combination ratings are tougher to get 15 and 16 SEER. We saw a dramatic decline in people eligible last year."
- "The current 3-year cycle for rebate customer eligibility and the amount of customer rebate has diminished compared to the previous cycle. Due to the higher hurdle rate and lower rebates available, we have seen our client conversion to rebate qualifying purchases decline under the current program."
- Trade allies also reported dissatisfaction with incentive levels provided by the program, with 7% reporting dissatisfaction. Trade allies once again cited the increase in SEER levels as being a main driver of decreasing incentives for their customers. Due to this increase in SEER requirement, they noted that many customers would not upgrade to SEER level 15 since the incentive was not enough to justify the additional cost.
- "The need of lower-income customers to be able to upgrade to more efficient equipment was hampered by the removal of rebates for 14 seer units. The 15 SEER units were just not doable money wise for a lot of our customers."
- "The SEER level should be back to 14 to qualify. The price jump to hit 15 SEER often times doesn't justify the cost, even with the rebate from a customer's perspective."

Program Influence on Trade Ally Business Practices

Because trade allies are a primary driver of program promotion as a result of having direct contact with customers at the time of equipment selection and installation, our research explored the influence that the program has on them. In support of the trade ally spillover (TA SO) analysis, we asked trade allies questions about how their participation in the HVAC program had affected their energy-efficiency related business practices. Responses to these questions were used as qualifying conditions for the TA SO analysis (see Appendix A). Still, they also provided insights into how the program has influenced trade ally business practices.

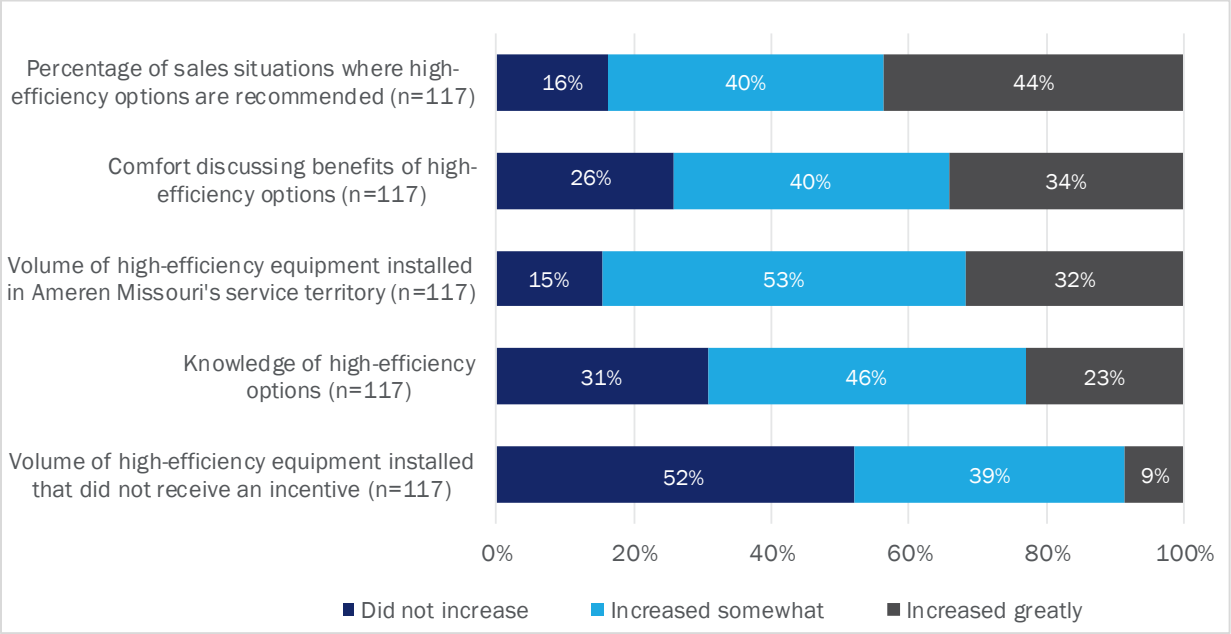
We asked trade allies two sets of questions about their energy-efficiency related business practices. The first set of questions asked if any of their business practices had changed since the trade ally started participating in the HVAC Program; the second set asked to what degree the program influenced that change. The energy-efficiency related business practices are:

- Their knowledge of high-efficiency equipment options
- Their comfort discussing the benefits of high-efficiency equipment with customers
- The percentage of sales situations in which they recommend high-efficiency equipment
- The total volume of high-efficiency equipment installed in Ameren Missouri's service territory

- The total volume of high-efficiency equipment installed in Ameren Missouri's service territory that did not receive incentives

Trade allies reported increases across all five of these business practices due to participation in the HVAC Program. The most common changes were to the percentage of sales situations where they recommend high-efficiency equipment in which 84% of trade allies reported an increase. Only 6% of trade allies reported that none of the five aspects had increased since they began participating in the program. Figure 4-7 summarizes these responses.

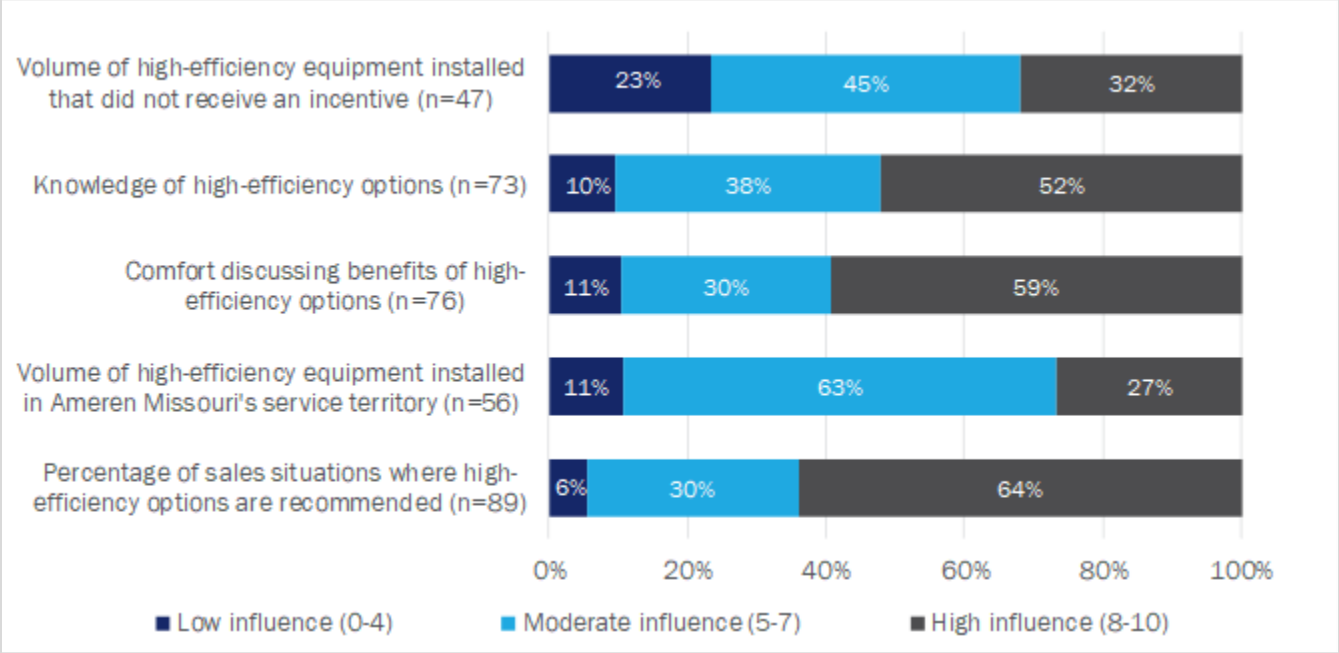
Figure 4-7. Trade Ally Increases in Energy Efficiency-Related Business Practices



Trade allies attributed the most program influence to increases in the total volume of high-efficiency equipment installed that did not receive an incentive (mean rating of 8.0, on a scale from 0 to 10). Trade allies said the HVAC Program's marketing tactics increased customer awareness of the program, and the training they received helped them get their foot into the door and start conversations with customers. The program had similar levels of self-reported influence on trade ally's knowledge of high-efficiency options (mean rating of 7.5), comfort discussing benefits of high-efficiency options (mean rating of 7.4), and volume of high-efficiency equipment in installed in Ameren Missouri's territory (mean rating of 7.1). These results are not surprising, given that the incentive provides trade allies with a strong sales proposition.

Trade allies report that the program is least influential on the percentage of sales situations where they recommend high-efficiency options (mean rating of 5.9). Trade allies also named several non-program factors that contributed to the uptick in their energy efficiency-related business practices, including increased customer interest, manufacturer rebates, tax rebates, and increasing affordability of high-efficiency equipment. Figure 4-8 summarizes trade ally responses on the influence of the HVAC Program on the changes to their business practices.

Figure 4-8. Trade Ally Attribution of Business Practice Changes to Program



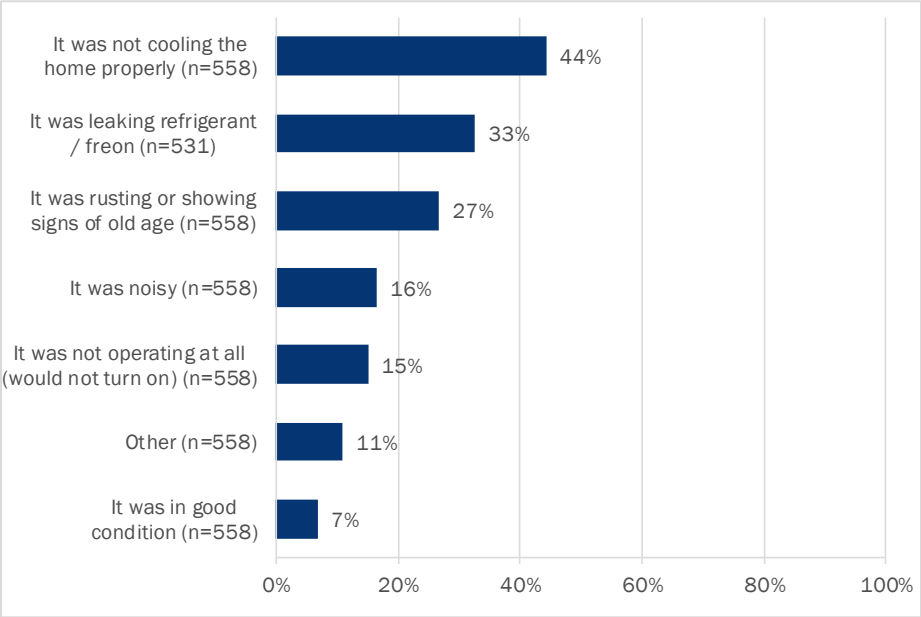
4.3.3 Customer Decision-Making Regarding Early Replacement

A key source of savings for the HVAC Program is early replacement (ER) of CACs and heat pumps. As such, we explored customer decision-making around ER of functioning HVAC equipment through a review of the program PT/LM, as well as a participant survey and trade ally survey. These results help to clarify the program's influence of the early replacement of HVAC equipment and substantiate claimed ER savings.

In terms of program design, the HVAC Program PT/LM does not currently contain any programmatic activities designed to induce the early replacement of operational cooling equipment, nor does it include a reference to activities that would distinguish viable ER participants from customers that first engaged the market with the intent of replacing existing equipment. As such, the underlying program theory appears to assume that if the existing unit is operational, customers would always choose to service the unit, not replace it. The participant survey results indicate that this assumption is not reflective of customer decision-making around equipment replacement.

A key factor influencing customers' decision-making around the replacement of their HVAC equipment is the current condition of their existing unit. As seen in Figure 4-9, nearly half of participants (44%) said their unit was not cooling the home properly at the time of replacement, and a third (33%) said it was leaking refrigerant/freon. Approximately 7% of respondents reported no issues with their HVAC unit, noting that it was in good condition. Respondents also reported an average age of 20 years for their existing unit.

Figure 4-9. Condition of Existing HVAC Unit



The participant survey results also indicate that customers often first engaged their contractors with the intent of replacing their existing equipment, counter to the implicit program assumption regarding CAC market function and customer decision making. As seen in Table 4-11, nearly half (45%) of respondents reported that they had already decided to replace their old unit and sought a quote on a new unit when they first contacted the trade ally. This is consistent with the trade ally perspective, with 40% of trade allies reporting that customers typically contact them for quotes to replace their equipment. Prior to contacting their trade ally, 58% of participants who had already decided to replace their unit contacted more than one contractor for quotes, and 45% researched prices on different units.

Table 4-11. Customer Intentions Prior to Engagement with Trade Allies

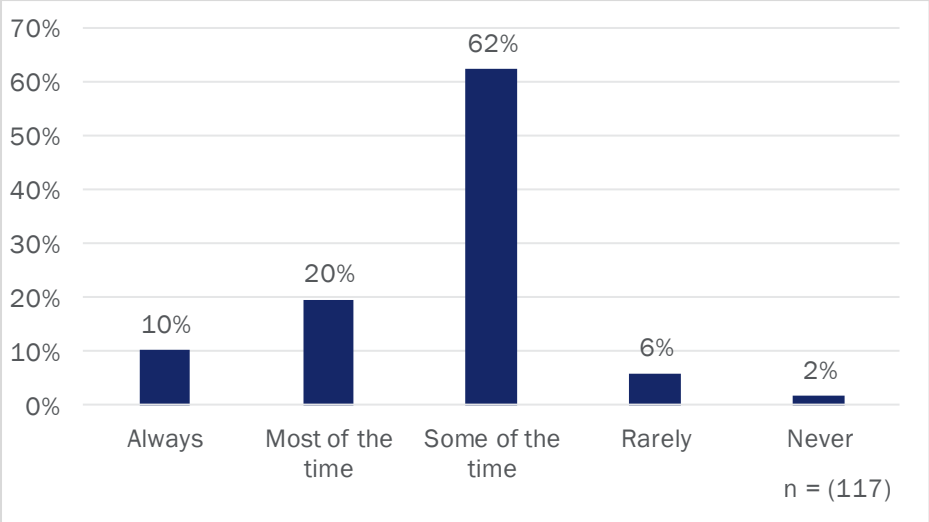
Customer Intentions	Percent of Customers (n=558)
Had decided to replace the old unit and reached out for a quote on a new unit	45%
To determine whether old unit could be serviced/repaired or should be replaced	30%
To schedule service/repair of old unit and wasn't considering replacing it	19%
Other	6%

The HVAC Program has the opportunity to influence customers who are initially considering equipment repair to replace their equipment instead earlier than they normally would have absent the program. Of the customers who were considering repair when they contacted their contractor, 51% noted that their contractor recommended replacement over repair. This indicates that the contractor's recommendation is very important to encouraging the replacement rather than repair of old units.

To gain an additional perspective on early replacement behaviors, we explored contractor sales practices related to recommending equipment replacement versus repair. For equipment that can be repaired, a majority of trade allies (92%) recommend that customers replace existing equipment instead of repairing it

at least some of the time, while 2% never recommend a replacement for equipment that can be repaired (Figure 4-10).

Figure 4-10. Frequency of Recommending Replacement for Equipment



The Ameren Missouri HVAC Program appears to be a key driver in trade ally behavior in this area. For example, of the trade allies that report recommending replacement over repair, nearly half (40%) said they are much more likely to recommend replacements instead of repairs because of their participation in the Ameren Missouri HVAC Program. In particular, trade allies cited the HVAC Program rebates as a key driver in their increased likelihood to recommend equipment replacements instead of repairs. They noted that rebates could help offset replacement costs, which makes the replacement more affordable compared to the repair. Only three trade allies said they were less likely to recommend replacements instead of repairs. When asked why one trade ally said the rebate is not sufficient in offsetting the initial cost of repair, one trade ally said they recommend replacement only if the CO2 levels are above 50ppm. One trade ally said it depends on the type, condition, and age of the existing equipment.

Table 4-12. Likelihood to Recommend Equipment Replacements Instead of Repairs

Likelihood	Percentage of Trade Allies (n=58)
I am much more likely to recommend replacements instead of repairs	40%
I am somewhat more likely to recommend replacements instead of repairs	55%
I am somewhat less likely to recommend replacements instead of repairs	2%
I am much less likely to recommend replacements instead of repairs	3%

Overall, our research findings show that contractors seem highly influenced by the program to recommend replacement versus repair. However, despite the program's strong influence on contractors, nearly half of program participants (45%) were already predisposed to replace their equipment and had intentions of doing so without the program. These findings contradict the implicit program assumption regarding CAC market function and customer decision making – if the existing unit is operational, customers would always

choose to service the unit, not replace it. The program should continue to influence trade ally to recommend replacement over repair, but also target customers who are not predisposed to replace before engaging the program.

4.3.4 Gross Impact Results

The following sections summarize the gross impact results for the PY2019 HVAC Program. The assessment of gross impacts involved survey-based measure verification, as well as desk reviews and engineering analysis. We present the detailed findings from this analysis below.

Measure Verification

As part of our evaluation, we calculated ISRs for each measure based on responses to the participant survey. The evaluation team found an ISR of 100% across all measures (Table 4-13).

Table 4-13. PY2019 HVAC ISR Results

Measure Category	ISR
CAC	100%
Heat Pumps (ASHPs, GSHP, DMSHP)	100%
ECMs	100%
Advanced Thermostats	100%
Program	**100%**

Gross Impact Results

As presented in Table 4-14, the PY2019 HVAC Program achieved 38,531 MWh and 23.54 MW in ex post gross savings, representing a 97% energy savings realization rate and 106% demand savings realization.

Table 4-14. PY2019 HVAC Program Annual Savings

	Ex Ante Gross	Gross RR	Ex Post Gross
First Year Savings			
Energy Savings (MWh)	39,647	97.2%	38,531
Demand Savings (MW)	22.15	106.3%	23.54
Last Year Demand Savings			
< 10 EUL (MW)	0.00	NA	0.00
10-14 EUL (MW)	0.57	99.7%	0.56
15+ EUL (MW)	9.15	79.8%	7.31

Table 4-15 summarizes the total PY2019 HVAC Program ex ante and ex post energy savings and realization rates by measure. Central air conditioner measures are the largest contributor (49%) to the program's ex post gross energy savings, followed by air source heat pumps (ASHP) (26%), and electronically commutated motors (ECM) (15%), with ground source heat pumps (GSHP), advanced thermostats, and ductless mini-split heat pumps (DMSHP) accounting for the remaining 11%.

Table 4-15. PY2019 HVAC Program First Year Gross Electric Energy Savings by Measure

Measure Category	Ex Ante Gross Savings (MWh)	Gross Realization Rate	Ex Post Gross Savings (MWh)
CAC	15,734	119.4%	18,783
ASHP	10,517	94.2%	9,905
ECM	9,109	62.4%	5,686
GSHP	1,991	104.7%	2,084
Advanced Thermostat	1,323	107.4%	1,421
DMSHP	974	67.0%	653
Total	**39,647**	**97.2%**	**38,531**

Table 4-16 summarizes the total ex ante and ex post last year demand savings and realization rates for the PY2019 HVAC Program, by measure. CAC measures account for the majority (51%) of the program's gross demand savings, followed by ECM (34%) and advanced thermostats (7%), with ASHP, GSHP, and DMSHP accounting for the remaining 8%.

Table 4-16. PY2019 HVAC Program Last Year Gross Electric Demand Savings by Measure

Measure Category	Ex Ante Gross Savings (MW)				Gross Realization Rate	Ex Post Gross Savings (MW)			
	<10	10-14	15+	Total		<10	10-14	15+	Total
CAC	0.00	0.00	4.17	4.17	96.0%	0.00	0.00	4.00	4.00
ECM	0.00	0.00	4.25	4.25	62.4%	0.00	0.00	2.65	2.65
ASHP	0.00	0.00	0.44	0.44	94.3%	0.00	0.00	0.41	0.41
Advanced Thermostat	0.00	0.57	0.00	0.57	99.7%	0.00	0.56	0.00	0.56
GSHP	0.00	0.00	0.17	0.17	100.1%	0.00	0.00	0.17	0.17
DMSHP	0.00	0.00	0.13	0.13	53.7%	0.00	0.00	0.07	0.07
Total	**0.00**	**0.57**	**9.15**	**9.72**	**81.0%**	**0.00**	**0.56**	**7.31**	**7.87**

Early Replacement Measures

As previously noted, 94% of the ex ante savings for CAC and ASHP measures came from early-replacement projects. The ex post evaluation verified the ER data in the program tracking database and reclassified 188 (2%) of the CAC and 46 (4%) of the ASHP ER measures to replace on fail (ROF). Table 4-17 shows the ex ante and ex post savings for CAC and ASHP measures based on the ER and ROF classification. Early replacement projects account for 97% of the ex post electric energy gross savings for CAC and 85% of the ex post electric energy gross savings for ASHP.

Table 4-17. PY2019 HVAC Program Early Replacement vs Replace on Fail Classification

Replace Type	Ex Ante Gross			Ex Post Gross					
	Qty	Annual MWh	Peak MW*	Qty	Annual MWh	Peak MW*	% Qty	% Total kWh Savings	% Total kW Savings
Central Air Conditioners (CAC)									
ER	8,243	15,285	14.48	8,055	18,257	17.30	87.3%	97.2%	97.2%
ROF	983	450	0.43	1,171	526	0.50	12.7%	2.8%	2.8%
Total	**9,226**	**15,734**	**14.91**	**9,226**	**18,783**	**17.80**	**100.0%**	**100.0%**	**100%**
Air Source Heat Pumps (ASHP)									
ER	1,100	9,334	1.90	1,054	8,449	2.07	86.7%	85.3%	96.8%
ROF	116	1,182	0.05	162	1,456	0.07	13.3%	14.7%	3.2%
Total	**1,216**	**10,517**	**1.95**	**1,216**	**9,905**	**2.14**	**100.0%**	**100.0%**	**100.0%**

* Peak kW refers to the first year summer peak kW savings; for early-replacement measures, the first year savings (existing condition baseline) are greater than last year savings (code baseline) due to a difference in the baseline assumption. Reasons for Discrepancies

Desk Review Results

The evaluation team also performed 50 desk reviews for a sample of 30 CAC and 20 ASHP projects. For the selected projects, we reviewed all program documents, including applications, invoices, and specification sheets. We used the desk reviews to verify the accuracy of data in the program tracking database and ultimately use the updated data to estimate gross impacts. Following the completion of the engineering desk reviews, the evaluation team calculated a project realization rate for each project, by taking the ratio of ex post desk review energy savings to ex post engineering analysis desk review savings. As seen in Table 4-18, the realization rate from this desk review for first year savings is 98.3% for CACs and 90.2% for ASHPs and, for last year savings is 96.6% for CACs and 90.3% for ASHPs.

Table 4-18. PY2019 HVAC Program Desk Review Results

Measure Category	Ex Post kWh Savings from Engineering Analysis	Ex Post kWh Savings from Desk Review	Realization Rate	Relative Precision at 90% Confidence
CAC	73,432	72,212	98.3%	2.9%
CAC (Last Year)	20,074	19,393	96.6%	1.1%
ASHP	188,633	170,056	90.2%	5.0%
ASHP (Last Year)	157,477	142,252	90.3%	5.3%

The evaluation team identified one overarching difference between ex ante program tracking data and project documentation, leading to differences in ex post engineering analysis energy savings and ex post desk review energy savings. The Ameren Missouri TRM algorithm for ASHPs includes separate parameters for heating and cooling capacity. The program tracking data provide a single installed capacity for use as both cooling and heating capacity. The evaluation team used project documented certification numbers from the Air-Conditioning, Heating, & Refrigeration Institute (AHRI) directory,[36] to apply measure-specific heating and cooling capacities. We found differences between heating and cooling capacity in 19 of 20 ASHP

[36] Heating and cooling capacities for heat pumps can be found by searching the AHRI certification number in the AHRI directory at http://www.ahrinet.org/Certification/Directory

records with heating capacities lower than cooling capacities in 12 records (60%). Because AC measures are only for cooling enduses, this finding only affected ASHP ex post desk review energy savings. The typically lower capacity values obtained from project documentation is the key driver for the lower desk review realization rate for ASHP measures.

Engineering Analysis

Retroactive updates to the 2019 Ameren Missouri TRM Appendix F deemed savings tables were a primary contributor to realization rates below 100%. Additionally, as previously discussed, the evaluation team observed measure-specific discrepancies based on results of desk reviews and the evaluation team's use of program tracking data in contrast to the program implementer's use of Appendix F deemed savings values. In particular, measure-level energy and demand realization rates are caused by the following differences:

- Electronically Commutated Motors (ECM): The gross electric energy and demand realization rates for ECMs are 62.4%.
  - Updated Version of Appendix F: The November 2019 Appendix F update included changes to two ECM parameters: runtime factor (RT) and percentage of homes with new central cooling. The change to the RT factor-- applying the RT factor (8.8%) used in the auto fan mode algorithm to the continuous fan mode algorithm as well based on the assumption that all ECM motors run in auto fan mode-- was used in the ex post calculations and accounts for the majority of the discrepancies between ex ante and ex post.
  - Program Tracking Data: Ex post used actual program tracking data to apply values of 100% or 0% to the parameters "% of homes with new central cooling" and "% of homes with new ASHP," when available, with an observed program average 82% and 10% for homes with new central cooling and ASHPs, respectively. Ex ante applied default percentages of 80% and 16% for the percentage of homes with new central cooling and ASHP, respectively, from Appendix F (January 2019) for all measures.
- Central Air Conditioners (CAC): The gross electric energy and demand realization rates for CACs are 119.4%.
  - Desk Review Realization Rates: The evaluation team applied a realization rate of 98.3% to all CAC measures based on results from the desk reviews conducted as a part of this evaluation. When not applied, gross electric energy and demand realization rates are 121.4%.
  - Updated Version of Appendix F: November 2019 updates to Appendix F incorporated results from the PY2018 evaluation for the CAC parameters capacity and efficient SEER. Appendix F was also updated to incorporate the Evaluation Team's recommended updates to effective full load hours (EFLH). While ex ante savings correctly applied the savings assumptions from an older version of Appendix F (January 2019), ex post impacts relied on inputs in the most recently released version (November 2019).
  - Program Tracking Data: Ex post applied actual existing SEER, efficient SEER, and capacity values from the program tracking database when available, whereas ex ante applied defaults from Appendix F (January 2019). Ex post de-rated existing SEER values based on the tracked age of the removed equipment, when available, or otherwise by a default of 12 years.

  - Replacement Type: Ex post reclassified 188 measures (2%) from early replacement (ER) to replace on fail (ROF) in ex post because sufficient data were unavailable to verify the status of the existing equipment. This reclassification reduced verified savings.

- Air Source Heat Pumps (ASHP): The gross electric energy and demand realization rates for ASHPs are 94.2% and 109.5%, respectively.
  - Desk Review Realization Rates: The evaluation team applied a realization rate of 90.2% to all ASHP measures based on results from the desk reviews conducted as a part of this evaluation. When not applied, gross electric energy and demand realization rates are 104.5% and 121.4%, respectively.
  - Updated Version of Appendix F: November 2019 updates to Appendix F incorporated results from the PY2018 evaluation for the following ASHP parameters: capacity, existing HSPF, efficient HSPF, and efficient SEER. While ex ante savings correctly applied the savings assumptions from an older version of Appendix F (January 2019), ex post impacts relied on inputs in the most recently released version (November 2019).
  - Program Tracking Data: Ex post applied actual efficiency and capacity values from the program tracking database when available, whereas ex ante applied defaults from Appendix F (January 2019) for all measures. For example, actual efficient SEER values were available in 99.8% of measures, and actual capacities were available in 100% of measures. Ex post de-rated existing SEER values based on the age of the removed equipment, or otherwise by a default of 12 years when tracked age was not available. Actual values were both higher and lower than Appendix F defaults, increasing realization rates for some measures while decreasing rates for others. Average actual capacities are lower than Appendix F default values, while actual efficient SEER values are higher.
  - Replacement Type: The evaluation team reclassified 46 measures (4%) from early replacement (ER) to replace-on-fail (ROF) because sufficient data were unavailable to verify the status of the existing equipment. This reclassification reduced verified savings.
- Advanced Thermostats: The gross electric energy and demand realization rates for advanced thermostats are 107.4% and 99.7%, respectively.
  - Updated Version of Appendix F: The November 2019 Appendix F updates changed the following advanced thermostat parameters: effective full load hours (EFLH), efficiency, capacity, electric heating consumption, heating reduction, household factor (HF), %ElectricHeat, and %FossilHeat. Compared to the previous TRM values used in the ex ante savings calculations, these updated parameters had minimal impact on overall verified measure savings, as some increased savings. In contrast, others decreased savings on a project-by-project basis.
  - Secondary Thermostats: The Ameren Missouri TRM calculates advanced thermostat savings at the household level, providing no additional savings for participants that purchased more than one thermostat. Ex ante multiplied savings by the quantity of thermostats installed. Ex post did not give additional savings for participants who purchased multiple advanced thermostats, resulting in lower ex post savings. This impacted one advanced thermostat measure.
- Ground Source Heat Pumps (GSHP): The gross electric energy and demand realization rates for GSHPs are 104.7% and 107.4%, respectively.

- Updated Version of Appendix F: November 2019 updates to Appendix F incorporated results from the PY2018 evaluation for the following GSHP parameters: capacity, efficient SEER, and efficient HSPF. Appendix F was also updated to incorporate the Evaluation Team's recommended updates to effective full load hours (EFLH). While ex ante savings correctly applied the savings assumptions from an older version of Appendix F (January 2019), ex post impacts relied on inputs in the most recently released version (November 2019). The update to Appendix F lowered heating EFLH values by approximately 26%, reducing verified savings. This update to heating EFLH is further detailed in the memorandum "PY2019 TRM Update Recommendations" dated October 31, 2019.
- Program Tracking Data: Ex post applied actual existing SEER, efficient SEER, and capacity values from the program tracking database when available, whereas ex ante applied defaults from Appendix F (January 2019). Ex post de-rated existing SEER values based on the tracked age of the removed equipment, when available, or otherwise by a default of 12 years. Ex post observed an average de-rated existing efficiency of 7.9 SEER, compared to an average of 11 SEER when using defaults from the November 2019 Appendix F. Lower existing efficiencies raised verified savings.
- Replacement Type: Ex post reclassified 17 measures (12%) from early replacement (ER) to replace on fail (ROF) because coil temperature readings were unavailable to verify the status of the existing equipment. This reclassification reduced verified savings.

- Ductless Minisplit Heat Pumps (DMSHP): The gross electric energy and demand realization rates for DMSHPs are 67.0% and 54.9%, respectively.
  - Updated Version of Appendix F: November 2019 updates to Appendix F incorporated results from the PY2018 evaluation for the DMSHP parameters baseline SEER and efficient SEER. Appendix F was also updated to incorporate the Evaluation Team's recommended updates to effective full load hours (EFLH). While ex ante savings correctly applied the savings assumptions from an older version of Appendix F (January 2019), ex post impacts relied on inputs in the most recently released version (November 2019). The update to Appendix F lowered both heating and cooling EFLH values to account for DMSHPs being typically smaller in capacity and used in zonal—rather than whole-house—conditioning. EFLH recommendations are further detailed in the memorandum "PY2019 TRM Update Recommendations" dated October 31, 2019. Lower EFLH values were the largest contributor to reduced verified savings.
  - Program Tracking Data: Ex post applied actual existing SEER, efficient SEER, and capacity values from the program tracking database when available, whereas ex ante applied defaults from Appendix F (January 2019). Ex post de-rated existing SEER values based on the tracked age of the removed equipment, when available, or otherwise by a default of 12 years.
  - Replacement Type: Ex post reclassified 15 measures (7%) from early replacement (ER) to replace on fail (ROF) because coil temperature readings were unavailable to verify the status of the existing equipment. This reclassification reduced verified savings.

4.3.5 Net Impact Results

Net-To-Gross Ratio Results

The evaluation team developed the NTGRs using self-reported information from web-based surveys with 656 program participants and 117 trade allies. In particular, we used participant survey responses to develop estimates of FR and PSO, and a survey with participating trade allies to estimate TA SO. In addition, we fielded a survey with nonparticipants to estimate NPSO.[37] Table 4-19 presents the results of our NTG analysis.

Table 4-19. PY2019 HVAC Program NTGR

Measure/Enduse	Free-Ridership (FR)	Participant Spillover (PSO)	Trade Ally Spillover (TASO)	NTGR (1-FR+PSO+TASO)
CACs	36.8%	0.85%	0.31%	64.3%
ASHP	41.9%	0. 85%	0.31%	59.3%
GSHP	41.9%	0. 85%	0.31%	59.3%
DMSHP	41.9%	0. 85%	0.31%	59.3%
ECMs [a]	31.8%	0.2%	NA	68.4%
Advanced Thermostats	38.8%	0. 85%	0.31%	62.4%
Overall Program	**37.8%**	**0.76%**	**0.31%**	**63.2%**

[a] Used PY2018 NTG results since ECMs will not be offered beyond PY2019.

Based on results from the participant survey, we identified 25 respondents who had installed measures that qualified for PSO. Our engineering analysis of SO measures for these participants yielded total spillover savings of 21,810 kWh (see Table 4-20).

[37] Detailed net impact results are provided in Appendix A.

Table 4-20. HVAC Program Participant Spillover Measures and Savings

Spillover Measure	Number of Unique Participants	Total kWh
Heat Pump Water Heater	5	12,905
Air Purifier/Cleaner	3	2,602
Pool Pump	1	1,800
Dehumidifier	4	1,203
Ceiling Insulation	7	694
Air Sealing	7	622
Refrigerator	9	504
Water Heater Wrap	4	378
Tier 2 Advanced Power Strip - Residential Audio Visual	1	324
Clothes Washer	7	208
Storm Windows	2	178
Clothes Dryer	1	160
Advanced Tier 1 Power Strips	4	124
ENERGY STAR Dishwasher	6	108
Total	**25**[a]	**21,810**

[a] Represents total number of participants reporting spillover.

Dividing the estimated total SO in our sample (21,810 kWh) by total program ex post gross savings of the overall participant sample (2,556,060 kWh) yields a SO rate of 0.85%, as shown in Equation 4-2.

Equation 4-2. PY2019 HVAC Program Participant Spillover Rate

$$PSO\ \%_{Energy} = \frac{Total\ participant\ sample\ SO\ (kWh)}{Total\ participant\ sample\ savings\ (\mathrm{kWh})} = \frac{21{,}810\ kWh}{2{,}556{,}060\ \mathrm{kWh}} = 0.85\%$$

Net Impacts

The evaluation team applied the PY2019 NTGRs to determine net impacts for the PY2019 HVAC Program. Table 4-21 presents the net impacts for PY2019 HVAC Program.

Table 4-21. PY2019 HVAC Program Annual First Year Net Impacts

	Energy Savings			Demand Savings		
	Ex Post Gross Savings (MWh)	NTGR	Ex Post Net Savings (MWh)	Ex Post Gross (MW)	NTGR	Ex Post Net (MW)
CACs	18,783	64.3%	12,086	17.80	64.3%	11.45
ASHPs	9,905	59.3%	5,869	2.14	59.3%	1.27
ECMs [a]	5,686	68.4%	3,889	2.65	68.4%	1.81
GSHP	2,084	59.3%	1,235	0.26	59.3%	0.15
Advanced Thermostats	1,421	62.4%	886	0.56	62.4%	0.35
DMSHP	653	59.3%	387	0.13	59.3%	0.08
Non-Participant Spillover	NA	NA	4,924	NA	NA	1.64
Total	**38,531**	**76.0%**	**29,2875**	**23.54**	**71.2%**	**16.75**

[a] Used PY2018 NTG results since ECMs will not be offered beyond PY2019.

Table 4-22. PY2019 HVAC Program Annual Last Year Net Demand Impacts

	Ex Post Gross Savings (MW)				NTGR	Ex Post Net Savings (MW)			
	<10	10-14	15+	Total		<10	10-14	15+	Total
CACs	0.00	0.00	4.00	4.00	64.3%	0.00	0.00	2.57	2.57
ASHPs	0.00	0.00	0.41	0.41	59.3%	0.00	0.00	0.25	0.25
ECMs[a]	0.00	0.00	2.65	2.65	68.4%	0.00	0.00	1.81	1.81
Advanced Thermostats	0.00	0.56	0.00	0.56	62.4%	0.00	0.35	0.00	0.35
GSHP	0.00	0.00	0.17	0.17	59.3%	0.00	0.00	0.10	0.10
DMSHP	0.00	0.00	0.07	0.07	59.3%	0.00	0.00	0.04	0.04
Nonparticipant Spillover	NA	NA	NA	NA	NA	0.25	0.84	0.56	1.64
Total	**0.00**	**0.56**	**7.31**	**7.87**	**86.0%**	**0.25**	**1.19**	**5.34**	**6.77**

[a] Used PY2018 NTG results since ECMs will not be offered beyond PY2019.

5. Home Energy Reports (HER)

This section summarizes the PY2019 evaluation methodology and results for the Home Energy Reports (HER) Program. We provide additional details on the methodology used to estimate impacts in Appendix A.

5.1 Evaluation Summary

Ameren Missouri designed the HER Program to promote changes in energy consumption behaviors that result in reduced electricity usage. The target market consists of residential customers in the Ameren Missouri service territory. This program is deployed as a randomized controlled trial (RCT), where customers are randomly assigned to a treatment or control group. Home Energy Reports provide the treatment customers with a comparison of their energy usage to the usage of similar homes based on home size and location. At the same time, the implementer identifies and maintains a control group of non-participation customers.

The PY2019 HER Program is an ongoing program from MEEIA Cycle II. Ameren Missouri initiated the program in PY2016 when the program team began to send paper reports to the first wave of treatment group customers. Since then, Ameren Missouri added waves of customers, and in PY2018, the program team launched a wave of customers who received paper reports and another that received e-mailed HER reports only.

At the beginning of PY2019, the program underwent a number of key design and implementation changes. Program administration shifted to a new implementer and associated sub-contractor. Franklin Energy served as the new Ameren Missouri residential portfolio implementer and contracted with Uplight to serve as the day-to-day implementer of the HER Program. Uplight's program implementation activities included mailing paper and electronic HERs and sending out high usage alerts to program participants. In addition, Franklin Energy developed an energy portal to provide customers with access to information found in the HERs. This portal launched late in PY2019. Previously, the implementation of the HER Program did not include high usage alerts or access to an energy portal.

In PY2019, Uplight organized HER participants into three waves of treatment and control customers. Wave 1 was comprised of a subset of the first customers who were part of the HER Program when Ameren Missouri launched it in August 2016. Wave 2 included a subset of a smaller wave that the program team first added in March 2018. For Waves 1 and 2, Uplight included customers in the top two quartiles of consumption from the original waves. Wave 3 launched in PY2019, and treatment customers in this wave received their first HERs beginning in late April and early May of 2019. Uplight sent paper and electronic HERs (eHERs) April, May, July, August, September, and November. It sent eHERs to customers as long as they had valid e-mail addresses and had not opted out of receiving them. All HERs for PY2019 had a new look and design. Some of the updates to the home energy report include the following:

- Remove the star rating
- Quantify home comparison, and show with which groups a customer is being compared
- Home comparison is monthly rather than seasonal
- Disaggregated forecast of energy usage using a breakdown of home energy use by category
- Savings tips are selected and quantified based on customer's home characteristics

- Added space to promote other energy efficiency programs on each report
- Added a 13-month comparison graph, with personalized analysis
- Opportunity for customers to update their home profiles to improve report accuracy

5.1.1 Participation Summary

Table 5-1 presents participation in the HER Program during PY2019, including the start date and length of time that each wave participated in the HER Program. The most recent wave included in the program is the largest in terms of customer participation. Note that because the evaluation team relies on an intention-to-treat approach, the number of customers included in the table below reflects the number of treatment and control customers that Ameren Missouri included at the beginning of PY2019 and does not remove customers who opted out of the program or moved out of the service territory.[38]

Table 5-1. PY2019 HER Participation Summary

Wave	Number of Customers		Start Date	Length of Time in HER Program
	Treatment	Control		
Wave 1	76,282	25,523	August 2016	3 years and 5 months
Wave 2	33,625	9,302	March 2018	1 year and 10 months
Wave 3	189,943	75,939	April 2019	9 months
Total	**299,850**	**110,764**		

5.1.2 Key Impact Results

Table 5-2 presents the annual savings achieved in PY2019. The savings calculated using a consumption analysis are unadjusted net savings given that the program framework is an RCT (i.e., incorporates any free-rider or spillover estimates). To arrive at adjusted net savings, the evaluation team calculated an uplift adjustment via a joint savings analysis to ensure that any actions taken by participants claimed by other energy efficiency programs are not double-counted. To calculate demand savings, the evaluation team applied a coincidence factor to both the unadjusted and adjusted savings. While the team did not calculate a separate uplift adjustment for demand savings, the adjusted demand savings do reflect the savings uplift as we used adjusted energy savings to estimate adjusted demand savings. The PY2019 HER Program realized 138% of ex ante energy and demand savings and 43% of Ameren Missouri's energy and demand savings goals.

[38] To estimate program savings, the evaluation team multiplies the annual per household energy savings estimated from the consumption analysis by the number of customers who Ameren Missouri intended to treat. The only exception is that for customers who moved out of the service territory, the savings are pro-rated for the number of days the customers resided in their homes before moving.

Table 5-2. PY2019 HER Savings Summary

	Ex Ante Program Savings [a]	Unadjusted Ex Post Net Savings	Uplift Adjustment [b]	Adjusted Ex Post Net Savings	Net Realization Rate	Goal Net	% of Goal
Energy Savings (MWh)	11,016	15,632	391	15,241	138.0%	35,250	43%
Demand Savings (MW)	5.13	7.29	NA	7.10	138.0%	16.43	43%

[a] According to Ameren Missouri, the ex ante program savings are based on 39.1 kWh and 0.000466081 kW annual savings per home and a participant count of 281,000. Note that the evaluation team used these same values and arrived at ex ante program savings of 10,987 MWh and 5.12 MW. It is unclear if the slight difference is due to rounding error.

[b] To arrive at the adjusted ex post net demand savings, the kW savings factor is applied to the adjusted ex post net energy savings. As such, we did not calculate a separate uplift adjustment for demand savings, though adjusted kW savings reflect kWh uplift adjustments.

Overall, the HER Program was the third-largest program in the PY2019 residential portfolio, accounting for 13% of ex post net residential portfolio energy savings and 20% of ex post net residential portfolio demand savings.

5.1.3 Key Process Findings

Key process findings from the PY2019 HER Program evaluation include the following:

- Virtually all treatment customers reported satisfaction with the HERs and their frequency, content, and program overall. The mean ratings on how often they received HERs, the energy savings tips they received, and the program overall were 5.39, 5.20, and 5.20, respectively, on a scale where 1 was “very dissatisfied” and 6 was “very satisfied.”
- The annual electric savings estimated per household from the consumption analysis was lower for Wave 3 relative to Waves 1 and 2. This lower savings value likely stems from the higher proportion of multifamily customers included in Wave 3 (about 25%) compared to the proportions in the legacy waves (about 5%).

To meet the requirements of Missouri Code of State Regulations (CSR) for demand-side process evaluations, we provide responses to the five required process evaluation questions in Table 5-3.

Table 5-3. Summary of Responses to CSR Process Evaluation Requirements

CSR Required Process Evaluations Questions	Findings
What are the primary market imperfections that are common to the target market segment?	Survey responses from the treatment and control customers indicate that they have a general understanding of how behavioral changes lead to reductions in energy usage. A market imperfection common to both customer groups is a more nuanced awareness of how their actions to reduce energy consumption impact their utility bills. Reports sent through the HER Program are designed to address this market imperfection for treatment customers by providing them with information about energy efficiency program opportunities and recommendations to modify behaviors to reduce energy consumption in their homes.
Is the target market segment appropriately defined, or should it be	The PY2019 target market requires modification if Ameren Missouri wants to maximize program savings. Three waves of customers were included in the HER Program in PY2019, and the two legacy waves were appropriately defined.

CSR Required Process Evaluations Questions	Findings
further subdivided or merged with other market segments?	The program implementer included the top two quartiles in terms of energy consumption in the program from the legacy waves. These customers were virtually all single family customers. The newest wave that joined the program in PY2019 was by far the largest. Unlike the legacy waves, the program implementer did not explicitly exclude multifamily customers, and therefore close to 25% of the treated customers fell into this category. Since multifamily customers generally have lower baseline consumption than their single family counterparts, their potential to reduce their energy consumption is smaller and, therefore, may not result in similar energy savings. In the future, if Ameren Missouri includes multifamily customers for equity reasons, it should explicitly state this as a program goal. Otherwise, Ameren Missouri should target single family customers with the highest baseline consumption in the following year to generate greater savings from the program.
Does the mix of enduse measures included in the program appropriately reflect the diversity of enduse energy service needs and existing enduse technologies within the target market segment?	The main form of treatment for customers is the HER. The HERs reflect the diversity of enduse energy service needs of residential homes, which is the target market. They include information related to the last 13 months of electric consumption, load that is disaggregated by home area, as well as comparisons of monthly energy usage to similar homes. Reports also include customized tips aimed at modifying behavior related to the installation of LED lighting to replace less efficient lighting, installing programmable or advanced thermostats, and adjusting the way customers operate their washers/dryers, dishwashers, and HVAC equipment. In addition, HERs include information about applicable energy efficiency rebate programs that may lead customers to retrofit aging inefficient equipment.
Are the communication channels and delivery mechanisms appropriate for the target market segment?	The communication channels and delivery mechanisms are appropriate for the target market, given that a majority of survey respondents are satisfied with the way they receive HERs, and with the information they contain. Additionally, the HERs make customers aware of the energy efficiency programs Ameren Missouri offers. Late in PY2019, Ameren Missouri also launched an online portal that provides similar information as the HERs, but on a continual basis. These forms of communication are used to inform customers about how much energy they use as well as about equipment upgrade opportunities and behavioral changes they can make to reduce electricity usage.
What can be done to more effectively overcome the identified market imperfections and to increase the rate of customer acceptance and implementation for select enduses/measure groups included in the Program?	HERs increased awareness of energy saving opportunities. Treatment customers were more likely to be aware of energy savings opportunities compared to control customers (64% compared to 53%). However, a higher percentage of treatment customers reported feeling like they do not have control over the amount of household energy that is used relative to control customers. Since treatment customers receive HERs, Ameren Missouri should consider providing information about how much energy various enduses and behavioral changes are projected to save for the average home. One potential way to communicate this is to monetize the energy savings so that treatment customers gain some understanding of how much money they can save by replacing old equipment and/or making changes to how they use energy.

5.1.4 Conclusions and Recommendations

The evaluation team offers the following conclusions and recommendations for the HER Program moving forward.

- Conclusion #1: Per household energy savings from treatment, customers in Waves 1 and 2 are larger than those from Wave 3. Waves 1 and 2 targeted customers with higher baseline consumption values and almost exclusively included single family customers. While Wave 3 was the largest in terms of number of participants, multifamily customers made up close to one-quarter of Wave 3 and had lower average baseline consumption. Based on our experience evaluating HER programs, lower baseline consumption typically leads to less potential for reductions in energy usage.
  - Recommendation: If future waves are selected for the HER Program, Ameren Missouri and its implementers should explicitly define whether its program goals are to maximize savings or to broaden eligibility beyond high usage customers. Moving forward, Ameren Missouri should consider refining its customer approach to target 1) customers with higher baseline consumption or 2) single family customers who tend to have fewer split incentives that limit changes to energy practices within the home to maximize savings.
- Conclusion #2: Based on the web survey conducted for this evaluation, HER Program treatment customers are more aware of Ameren Missouri residential programs than control customers. Treatment customers were significantly more aware of the HVAC, Energy Efficiency Products, and Home Energy Audit programs compared to control group participants (see Section 5.3.1). Notably, almost half of the treatment customers who were aware of these programs reported learning about them through HERs. While awareness is high, the participation uplift analysis showed that treatment customers are not participating in programs more than control customers, except for the HVAC Program.
  - Recommendation: Ameren Missouri should continue to promote its energy efficiency programs in HERs as they impact customer awareness of its residential energy efficiency programs. As customers continue to receive HERs over time, they may eventually choose to participate in these programs as a way to save energy.
- Conclusion #3: Treatment customers reported taking certain actions to save energy more than control customers. There was no reported difference between treatment and control customers in making behavioral changes to reduce energy usage and making energy-efficient home purchases. However, treatment customers more often read their bills to understand energy usage, visited the Ameren Missouri website, learned about new ways to save energy, and contacted Ameren Missouri about ways to save more energy than control customers.
- Conclusion #4: Several treatment customers reported that the energy usage comparisons of similar homes were not valid, as they felt the characteristics of their homes led to higher consumption of energy.
  - Recommendation: The program team should emphasize to customers that they have the ability to update their home profiles which will improve the comparison of energy usage by similar homes. Additionally, provide more information about the factors used to identify comparison homes that make them similar. If possible, it may be beneficial to compare different elements of homes instead of comparing full homes to provide more granular details.

- Conclusion #5: Ameren Missouri currently assumes an EUL of one year for HERs, which implies that there are no persisting savings once customers stop receiving HERs. Based on a review of persistence studies, the evaluation team found that an EUL assumption of greater than one year is consistent with how customers' savings decay after they stop receiving HERs. However, annual savings decay rates vary widely across studies and are dependent on geographic region, length of treatment, and other factors.
  - Recommendation: The evaluation team does not recommend making changes to the one-year EUL for HERs in the Missouri TRM without first conducting a service territory specific study. Should Ameren Missouri indicate a desire to conduct persistence research for this program, the evaluation team recommends conducting a study that calculates both cohort-specific annual savings decay rates and overall annual average decay rates over multiple years.

5.2 Evaluation Methodology

The evaluation team performed both impact and process evaluation activities to assess the performance of the HER Program in PY2019. In addition to the overarching research objectives outlined for the residential portfolio, the evaluation team explored the following HER Program-specific objectives:

- Confirm treatment and control groups in each wave are equivalent;
- Estimate unadjusted and adjusted ex post net energy and demand savings;
- Assess how well customers understand the HERs and other interventions;
- Measure customer satisfaction with the elements of the program and motivations for participating;
- Identify opportunities for improvement in customer experience; and
- Provide evaluation results that can be used to improve the design and implementation of the HER Program.

Table 5-4 provides an overview of the HER Program evaluation activities. Following the table, we outline program-specific aspects of key evaluation methodologies.

Table 5-4. PY2019 Evaluation Activities for the HER Program

Evaluation Activity	Description
Program Manager and Implementer Interviews	▪ Conducted interviews (1) before program launch to inform evaluation planning and (2) in the middle of PY2019 to understand program staff's perspective on program performance.
Program Material Review	▪ Reviewed available program materials to inform evaluation activities.
Program Theory / Logic Model Review	▪ Reviewed implementer's program theory/logic model to understand program activities and their expected outputs and outcomes, including expected impacts on the market.
Tracking System Review	▪ Reviewed implementer's tracking system to ensure that the data required for the evaluation is being collected.
Participant Survey	▪ Collected data through a web survey from treatment and control customers to assess participant satisfaction, awareness of Ameren Missouri programs, changes in behavior in response to HERs, and gather suggestions to improve customer engagement.
Attribution / Net Impact Analysis	▪ Confirmed comparability of treatment and control groups using an equivalency analysis. ▪ Conducted consumption analysis to quantify the changes in energy use among the treatment and control groups. ▪ Determined savings from participation in other Ameren Missouri residential programs using a joint savings analysis. ▪ Estimated PY2019 net adjusted impacts.
Assessment of Savings Persistence and Effective Useful Life (EUL)	▪ Reviewed research on savings decay rates and EULs for similar programs across the country.

Participant Survey

In December 2019, Opinion Dynamics conducted a web survey that asked questions of a sample of both HER treatment and control customers. The overarching goal of this survey was to understand treatment customers' engagement and satisfaction with the HERs and the influence of the HERs on motivating energy-saving actions and behaviors. The survey also inquired about participation in other Ameren Missouri residential programs to assess whether the HERs led treatment customers towards cross-program participation. Ameren Missouri was particularly interested in assessing whether treatment customers had higher participation rates in Ameren Missouri's upstream lighting program when compared to control customers.

The primary objectives of the customer survey were to seek answers to the following research questions:

- Do reports increase customer awareness or engagement with Ameren Missouri and its programs?
- How satisfied are participants with the HERs?
- What, if any, changes in energy use behavior have customers made based on recommendations included in the HERs?
- What improvements can Ameren Missouri make to increase customer engagement with HERs such that it leads to reductions in energy use?

The evaluation team selected a random sample of 20,000 customers, split evenly between treatment and control groups. Our sample also included a proportional number of customers from each of the three waves (see Table 5-5 and Table 5-6).

Table 5-5. HER Customer Participation by Wave and Treatment Type

Wave	Treatment	Control	Total
Wave 1	76,282 25%	25,523 23%	101,805 25%
Wave 2	33,625 11%	9,302 8%	42,927 10%
Wave 3	189,943 63%	75,939 69%	265,882 65%
Total	**299,850**	**110,764**	**410,614**

We fielded the survey from December 10, 2019 to December 26, 2019. During the fielding dates, we sent two reminder e-mails to customers who had not yet responded to encourage a higher survey response rate. In total, 989 respondents completed the survey, including enough recipients from each of the three waves of the program to make statistical comparisons across waves where necessary (see Table 5-6). We provide detailed responses to the survey in Appendix F.

Table 5-6. HER Survey Sample Size and Number of Completes by Wave and Treatment Type

Wave	Treatment Sample	Control Sample	Total Sample	Treatment Completes	Control Completes	Total Completes
Wave 1	2,544 25%	2,300 23%	4,844 24%	132 29%	177 33%	**309** **31%**
Wave 2	1,121 11%	840 8%	1,961 10%	66 14%	52 10%	**118** **12%**
Wave 3	6,335 63%	6,860 69%	13,195 66%	261 57%	301 57%	**562** **57%**
Total	**10,000**	**10,000**	**20,000**	**459**	**530**	**989**

Table 5-7 provides the final survey disposition summary. The evaluation team calculated the survey response rate using the Response Rate 3 (RR3) methodology specified by the American Association of Public Opinion Research (AAPOR). We achieved a 5.3% survey response rate. We do not report a cooperation rate—the proportion of participants who completed the survey out of all eligible participants contacted. While we recorded the number of bounced e-mail invitations, we cannot say with certainty that qualified participants both received and opened all e-mails that we sent. Therefore, we do not have an accurate number of eligible contacted participants to use to calculate a cooperation rate.

Table 5-7. HER Survey Disposition Summary

Disposition	Count
Completed Surveys	**989**
Partial Surveys	**172**
Partial Complete - survey eligibility confirmed	172
Undetermined Survey Eligibility	**17,411**
Partial Complete - survey eligibility unknown	111
Refused	21
No response	17,279
Survey Ineligible	**0**
Partial Complete - survey ineligible	0
Not Eligible	**1,428**
Bounced e-mail	1,428
Total Participants in Sample	**20,000**

Equivalency Analysis

The evaluation team performed an equivalency analysis between the treatment and control groups for all three waves that participated in the HER Program in PY2019. We compared average daily consumption (ADC) of electricity between treatment and control groups to assess whether these groups were equivalent based on consumption data from the year prior to program participation. We relied on consumption data for different time periods since each of the three waves began participation at different times.

In the year before the start of the program, ADC for the Wave 1 was 47 kWh/day for households (see Table 5-8). For Wave 2, the ADC was 65 kWh/day, and for Wave 3 it was 42 kWh/day. This analysis illustrates that treatment and control groups had equivalent energy usage for each of the waves. We provide detailed results showing the equivalency of the treatment and control groups for all waves in Appendix A.

Table 5-8. Pre-Participation Average Daily Consumption of HER Program Treatment and Control Groups by Wave

Wave	Treatment (Pre-Participation) Consumption	Control (Pre-Participation) Consumption
Wave 1	47.02	46.94
Wave 2	64.66	64.82
Wave 3	42.36	41.71

Consumption Analysis

The evaluation team performed a consumption analysis to assess any changes in energy consumption as a result of receiving HERs. We conducted a statistical analysis of monthly electric billing data for all Ameren Missouri customers who received a HER (the treatment group) and a randomly selected group of customers who did not receive a HER (the control group). The evaluation team used an intent-to-treat (ITT) approach in

PY2019.[39] We estimated savings using a lagged dependent variable (LDV) model, which relies on a difference-in-differences (DID) approach. Generally speaking, DID refers to a model's implicit comparison of consumption before and after the treatment of both treatment and control group customers. The model includes customer-specific intercepts (i.e., fixed effects) to capture unobserved differences between customers that do not change over time and affect customers' energy use. We used an LDV model to provide impact estimates for the program. When then used a simple DID analysis to validate our results. We present further details about the consumption analysis in Appendix A.

Demand Reductions

We calculated demand impacts based on the Missouri TRM, which applies a peak adjustment factor to modeled energy savings results. The factor value used to arrive at PY2019 HER demand savings is 0.000466081 kW.[40]

Joint Savings Analysis

The evaluation team also determined whether the Ameren Missouri HER Program generated participation uplift in PY2019—that is, an increase in participation in other energy efficiency programs in PY2019 as a result of the Ameren Missouri HER Program. To complete this joint savings analysis, we calculated whether more treatment than control group customers participated in other residential energy efficiency programs after receiving HERs. We cross-referenced the HER Program database—both treatment and control groups—with the databases of other residential energy efficiency programs offered by Ameren Missouri in PY2019, including:

- Appliance Recycling
- Efficient Products
- Peak Time Savings
- Single Family Low-Income
- Multifamily Low-Income
- Multifamily Market Rate
- Heating, Ventilation, and Air Conditioning
- Online Retail Lighting
- Upstream Lighting

To estimate participation uplift, we calculated the number of customers that participated in both the HER Program and other energy efficiency programs in PY2019. To ensure participation in other programs is attributable solely to the HER Program, we calculate participation uplift using a post-only difference estimator and tested the results for statistical significance. To do so, we identified the total number of

[39] Intent-to-treat (ITT) estimates the impacts of the initiative for a group of customers the initiative intended to treat, (i.e., customers AIC intended to receive HERs or eHERs). An alternative approach is the average treatment effect of the treated (ATT), which estimates the impacts of the initiative for the group of customers that received HERs and/or eHERs. These approaches differ in the number of customers used in the analysis.

[40] Revision 2.0 (dated 12/21/2018) of the Ameren Missouri 2019-21 MEEIA Energy Efficiency Plan Appendix F – Deemed Savings Table, Home Energy Report Deemed Table (referred to as the "Ameren Missouri TRM").

treatment and control customers who participated in an Ameren Missouri energy efficiency program in PY2019. Any positive difference between the treatment and control population that is statistically significant is the net participation due to the HER Program.

One notable exception is the Upstream Lighting Program. Because the is no systematic way to track Ameren Missouri customer account numbers associated with purchases of upstream lighting measures, the evaluation team used the participant survey to gather information about whether treatment and control customers purchased bulbs at locations that offered LEDs discounted by Ameren Missouri. An analysis of the data we collected showed no difference in the number of treatment and control customers purchasing upstream LEDs. The team, therefore, determined that participation uplift due to the HER Program was zero for this program.

5.3 Evaluation Results

In the remainder of this section, we present the results of both impact and process evaluations.

5.3.1 Process Results

To complete the process evaluation of the HER Program, we relied primarily on data gathered through the participant web survey (see Section 0). To supplement survey data, we also conducted in-depth interviews with program staff and implementers, reviewed program materials, and reviewed the HER program theory logic model. Below we discuss findings related to the role of HERs in customer awareness of other Ameren Missouri programs, the resonance of energy efficiency tips and recommendations in HERs, the actions and behavior changes treatment customers made based on the information included in the HERs, and customer satisfaction with Ameren Missouri and various aspects of the HER program.

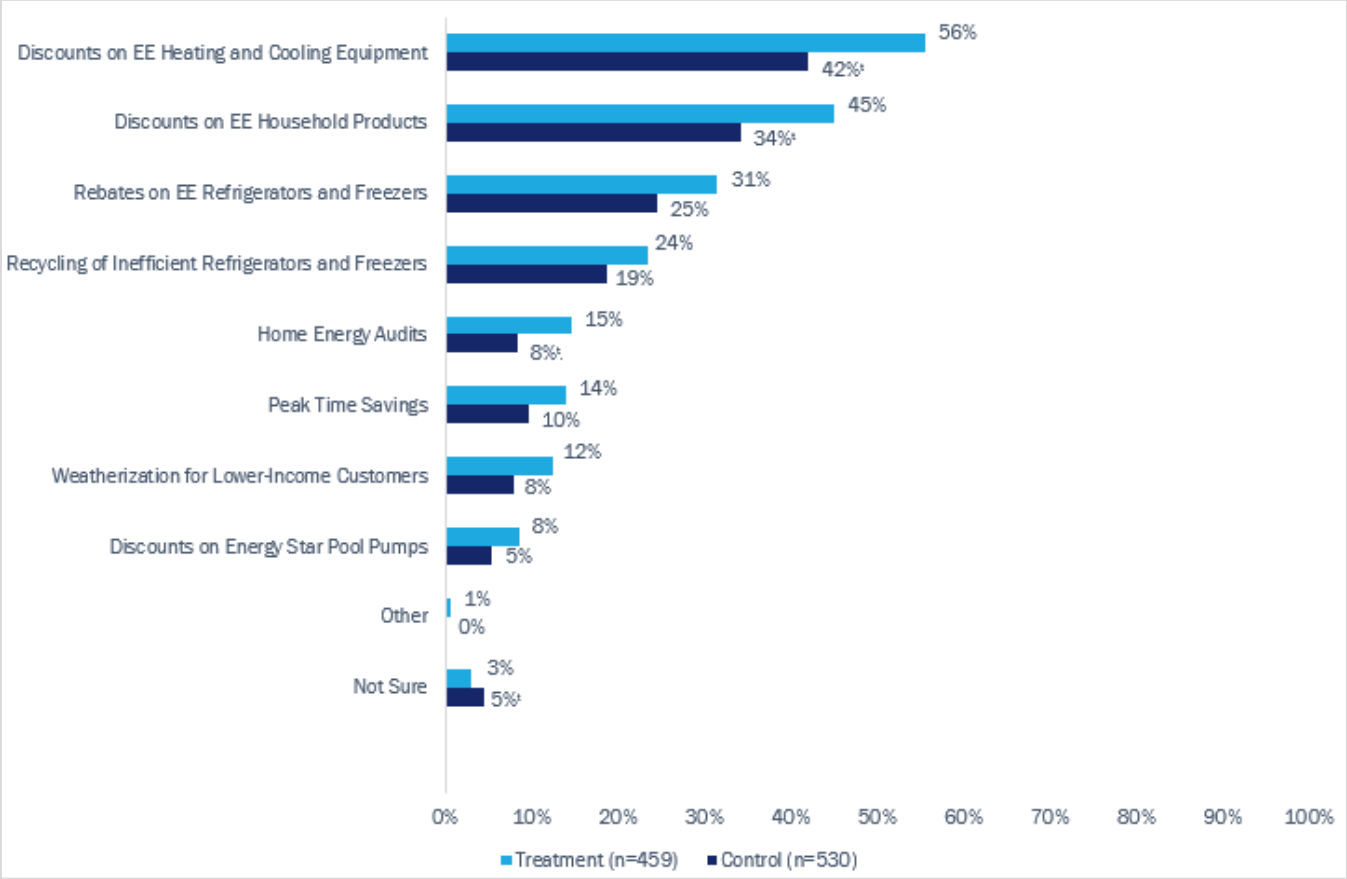
Residential Program Awareness

Through an analysis of the customer survey data, the evaluation team found that the majority of Ameren Missouri HER customers (58%, n=574 out of 989) were aware of at least one other program, incentive, or rebate that Ameren Missouri offers to its residential customers. Those receiving HERs were significantly more aware of these other offerings, with 64% (n=292 out of 459) of treatment customers reporting an awareness as opposed to 53% (n=282 out of 530) of the control group customers. This is consistent with program theory as the HERs sent to treatment customers in PY2019 included information about applicable residential programs.

This pattern of increased awareness is clear when considering several specific programs. As Figure 5-1 shows, 56% of treatment customers reported awareness of the discounts on energy-efficient heating and cooling equipment, and 45% were aware of energy-efficient household products. Control group customers were aware of these discount programs 42% and 34% of the time, respectively. Notably, the HVAC Program was the only one to show a statistically significant difference in participation by treatment customers compared to control customers (see the joint savings analysis discussion in Section 5.3.3). The other program showing a statistically significant difference in program awareness between treatment and control customers was the Home Energy Audit (HEA) Program. In this case, 15% of treatment customers who reported awareness of Ameren Missouri programs and/or incentives were aware of the HEA program compared to only 8% of control group customers.

It is important to note that the customizable nature of HERs allows the program implementer to select which energy saving programs, tips, and recommendations to include in different customer's reports. Therefore each Ameren Missouri program may not have equal representation in the reports that go out to customers. This likely impacts what program treatments customers are aware of.

Figure 5-1. Treatment and Control Customer Awareness of Ameren Missouri Energy Efficiency Programs

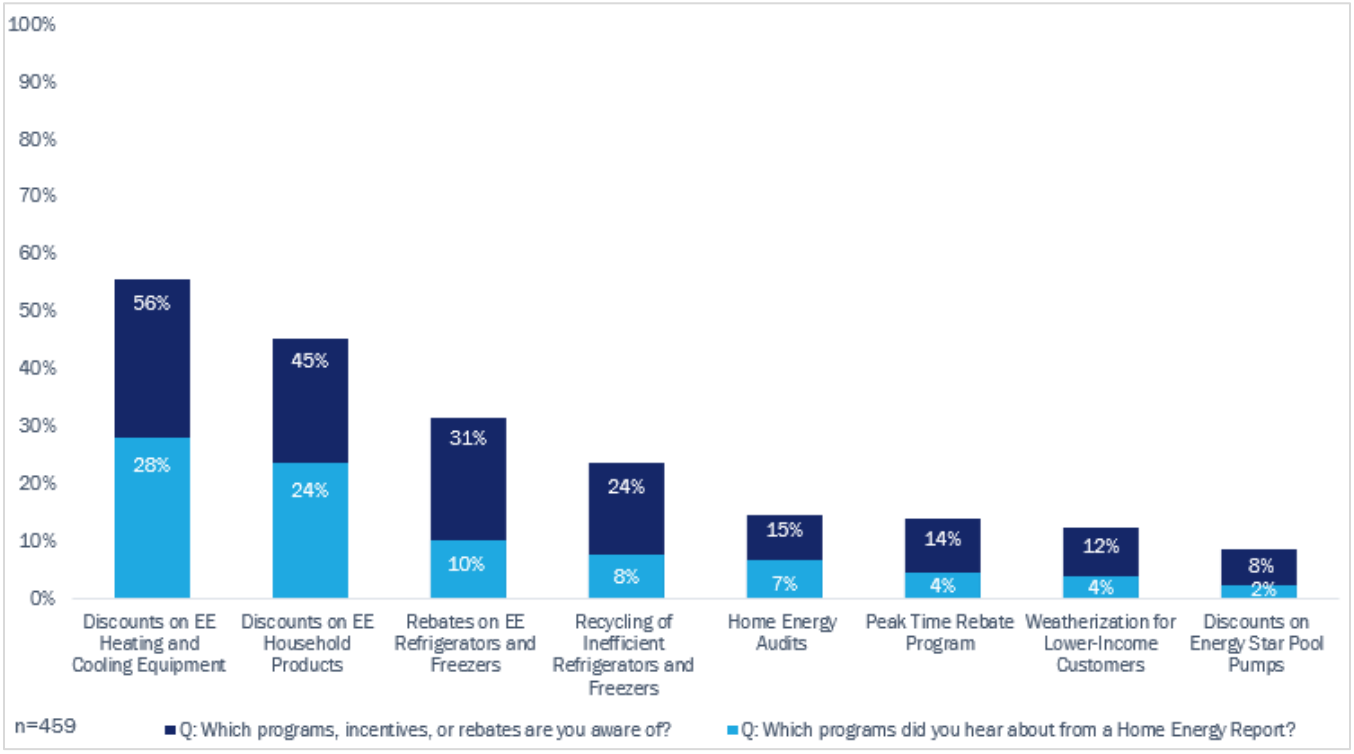


Notes: This question allowed for multiple responses so the number of responses may exceed the number of respondents and the percentage total across all programs may be greater than 100%.

[t] Results are statistically significantly different at the 90% level across treatment and control groups.

Figure 5-2 illustrates that the HER Program effectively spreads awareness of other Ameren Missouri energy efficiency programs. For example, of the 45% of treatment customers who were aware of discounts on energy efficiency household products, more than half noted that they learned about this offering from HERs (24%). Similarly, half of the treatment customers who were aware of discounts on heating, ventilation, and air conditioning equipment and the HEA Program learned about these programs through HERs as well.

Figure 5-2. Treatment Customer Awareness of Programs through HERs



Notes: The second question only included the list of programs that treatment customers indicated they were aware of from the first question.

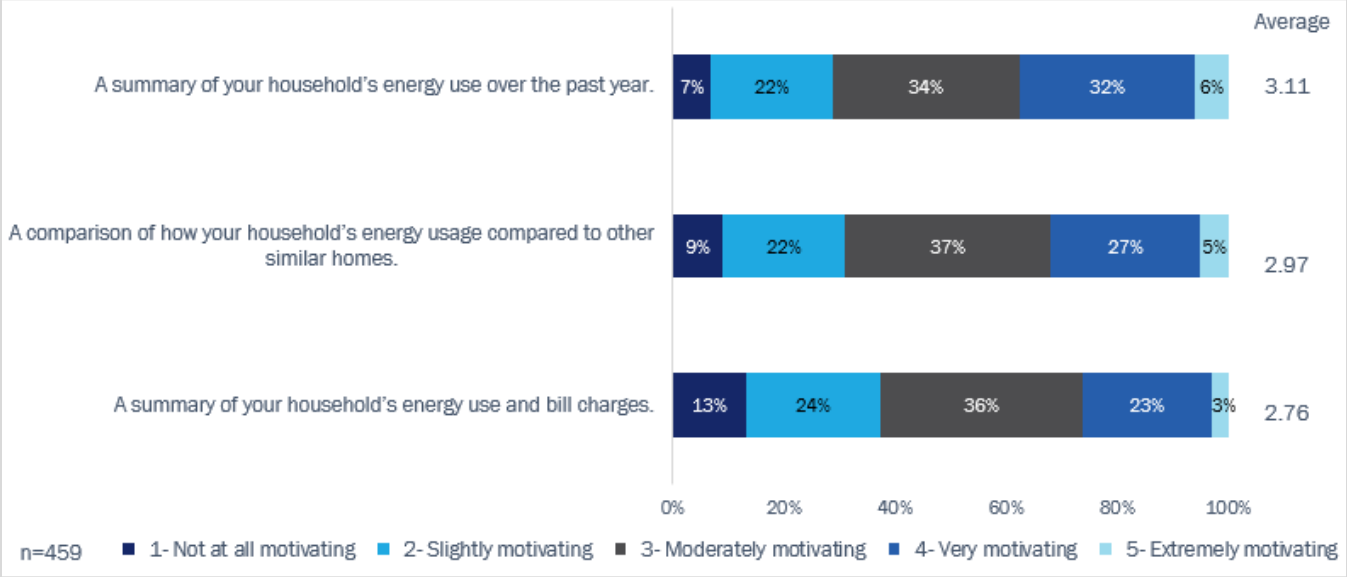
These questions allowed for multiple responses so the number of responses may exceed the number of respondents and the percentage total across all programs may be greater than 100%.

Resonance of HER Messaging and Content

The majority of treatment customers (i.e. those that received HERs) recalled receiving their reports (91%, n=419 out of 459) and reading at least one HER (84%, n=389 out of 459). With this high degree of engagement, HER recipients reported experiencing different degrees of motivation to use less energy in the home due to various components of the HERs (Figure 5-3). The largest share of respondents (72%) were at least moderately motivated by the summary of the household's energy use over the past year.

HER comparisons of household electricity usage to those of other similar houses was at least moderately motivating to a slightly smaller share of customers (69%). Common responses for individuals who did not find this aspect of the reports motivating suggested that participants did not feel that the comparison homes were actually comparable (for example: "our home is much larger than the surrounding homes," and "we are not able to compare our energy usage because we have a very large in-ground swimming pool.") Ameren Missouri addressed this concern by providing HER recipients with a way to update their home profiles to improve the accuracy of these comparisons. The HER component considered at least moderately motivating by the smallest share of customers was the summary of the customer's household energy use and bill charges (62%).

Figure 5-3. Degree of Motivation to Use Less Energy from HER Components

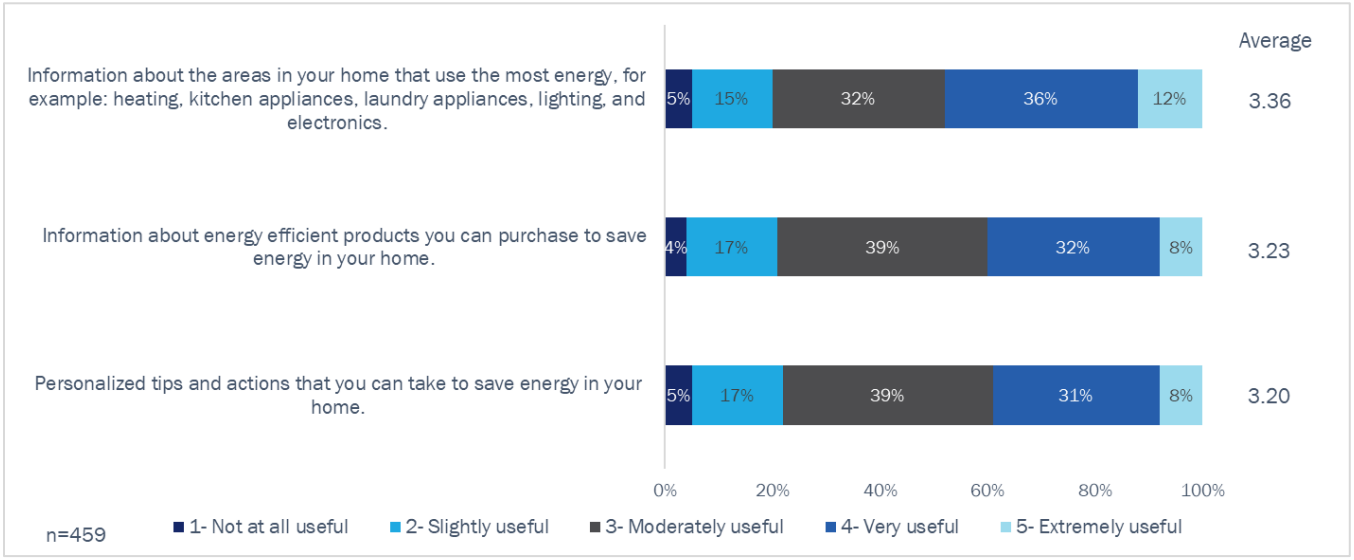


Note: This question was only asked of treatment group customers.

Treatment customers were also asked how useful three different HER components were to them in helping find ways to reduce energy. These components include information about the areas in the home that use the most energy; information about energy-efficient products that are available to purchase to save energy; and personalized tips and actions to save energy in their homes. As shown in Figure 5-4, treatment customers found each to be moderately useful. On a 5 point scale, where 1 was "not at all useful," and 5 was "extremely useful," respondents provided mean scores of 3.36, 3.23, and 3.20, respectively for each HER Program component. Notably, almost half of treatment customers (48%) found the information about the areas of the home that use the most energy very or extremely useful. Based on these responses, this component of the HERs helps customers understand where in their homes to target their energy use reduction behaviors.

Forty-two percent (n=195 out of 459) of all treatment customers reported acting on personalized energy-saving tips provided in their HERs. Ten percent of treatment customers reported that they responded to lighting tips specifically (i.e., switching to LEDs and turning things off when not in use), 8% (n=47 out of 459) responded to home temperature regulation tips (i.e., using optimal thermostat settings), and 8% (n=39 out of 459) responded to home weatherization tips (i.e., adding weather stripping and conducting window repair).

Figure 5-4.Usefulness of HER Components



Note: This question was only asked of treatment group customers.

Actions and Behaviors

When considering the difference between treatment and control customers in taking certain energy-saving behaviors in the recent past, results were mixed. As Table 5-9 shows, treatment and control customers reported taking several actions over the past six months to save energy in their homes at the same rate. These actions include making behavioral changes to reduce energy (65% of treatment and 63% of control customers), making small energy efficient home purchases (55% of treatment and 54% of control customers), and making large energy-efficient home purchases (12% of treatment and 12% of control customers). Upon closer examination of Table 5-9, we see a smaller share of treatment and control customers in Wave 3 made both large and small energy-efficient home purchases compared to customers in both Waves 1 and 2.

Table 5-9. Actions Taken In Past Six Months to Reduce Energy Usage

Response	Wave 1		Wave 2		Wave3		Total	
	Treatment	Control	Treatment	Control	Treatment	Control	Treatment	Control
Behavioral changes to reduce energy use	86 65%	116 66%	51 W1 77%	34 65%	162 W2 62%	185 61%	**299** **65%**	**335** **63%**
Small energy efficient home purchases	76 58%	106 60%	49 W1 74%	35 67%	128 W2 49%	145 W1 W2 48%	**253** **55%**	**286** **54%**
Large energy efficient home purchases	21 16%	25 14%	9 14%	10 19%	23 W1 9%	26 W1 W2 9%	**53** **12%**	**61** **12%**
No, none of these.	18 14%	26 15%	3 W1 t 5%	7 13%	51 W2 20%	57 19%	**72** **16%**	**90** **17%**

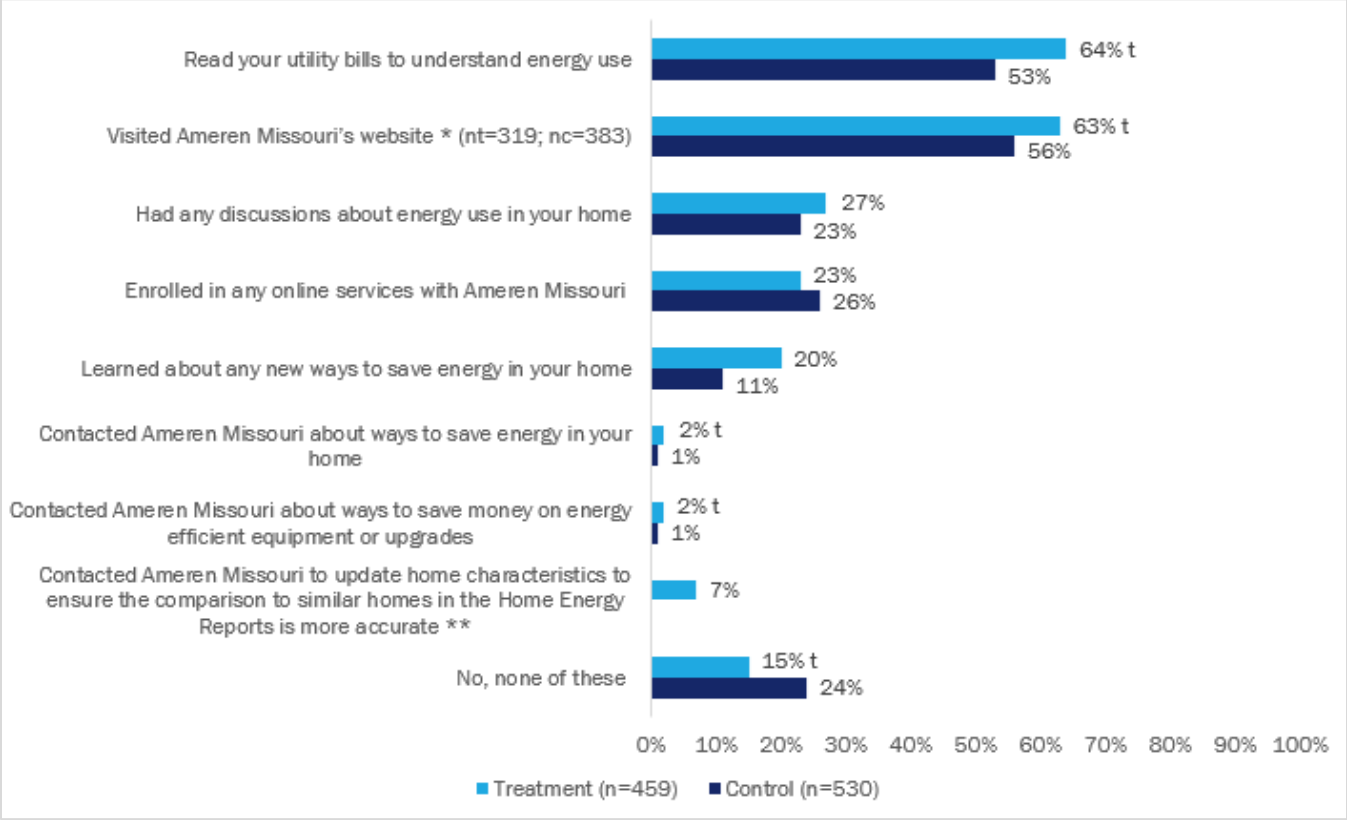
Note: This is a multiple response question so the number of responses may exceed the number of respondents and the percentage total may be greater than 100%.

W1, W2 Results are statistically significantly different at the 90% level from Wave 1 and Wave 2, respectively.

t Results are statistically significantly different at the 90% level across treatment and control groups within each wave.

A significantly larger share of treatment than control customers engaged more in other energy-saving behaviors. These included reading their utility bill to understand energy usage, visiting the Ameren Missouri website, learning about new ways to save energy, and contacting Ameren Missouri about ways to save more energy (see Figure 5-5).

Figure 5-5. Energy Saving Actions Taken in the Last Six Months



Note: This is a multiple response question so the number of responses may exceed the number of respondents, and the percentage total may be greater than 100%.

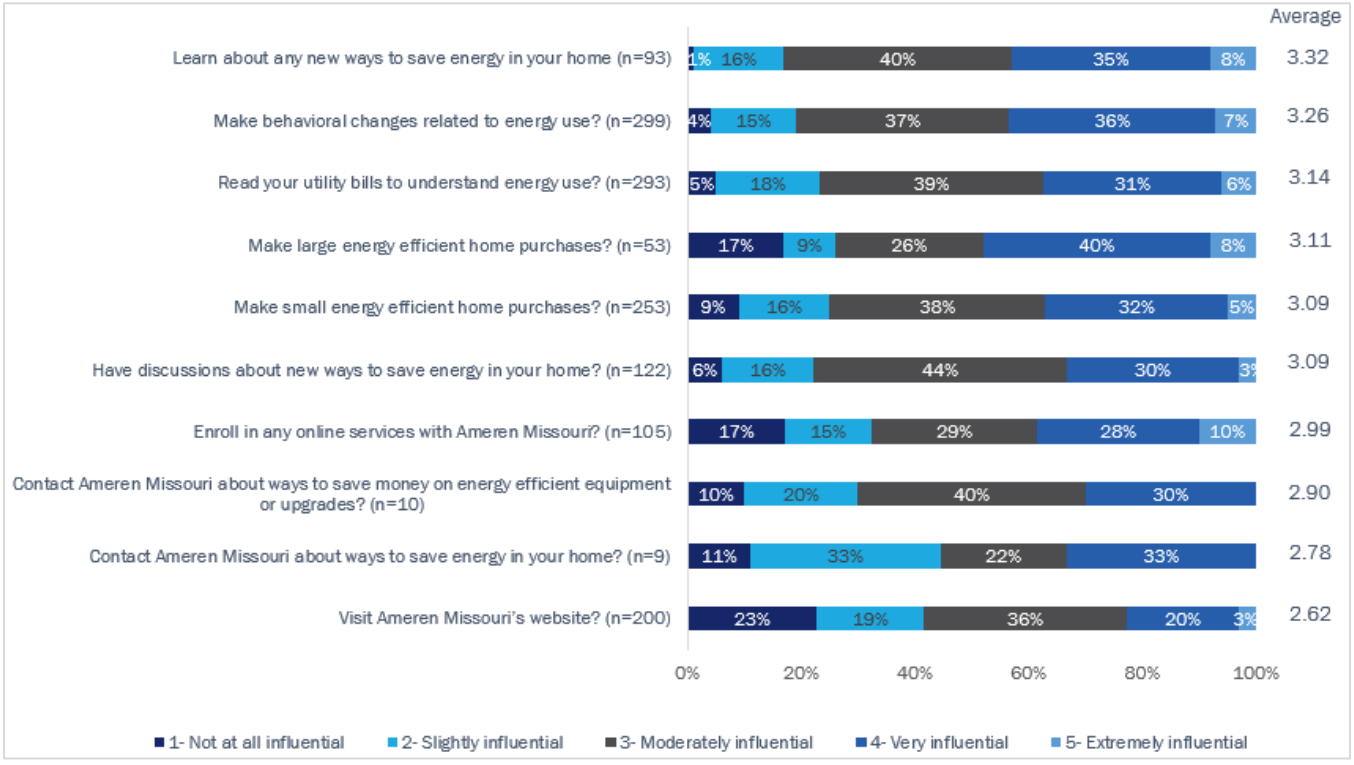
[t] Results are statistically significantly different at the 90% level across treatment and control groups.

* This option was only presented to those who had reported visiting Ameren Missouri's website in the past.

** This option was only asked of customers who receive Home Energy Reports.

HERs also influenced energy-related decisions made by treatment customers. Most commonly, respondents indicated that their HER helped them learn about new ways to save energy (mean rating of 3.32 out of 5), make behavioral changes related to energy use (3.26), read their utility bills (3.14), and influenced their decisions to make large and small energy-efficient purchases for their homes (3.11 and 3.09, respectively). Additionally, treatment customers reported their HERs had an influence on their discussions regarding new ways they could save energy in their homes (3.09) (see Figure 5-6).

Figure 5-6. Influence of HERs on Energy-Related Decisions



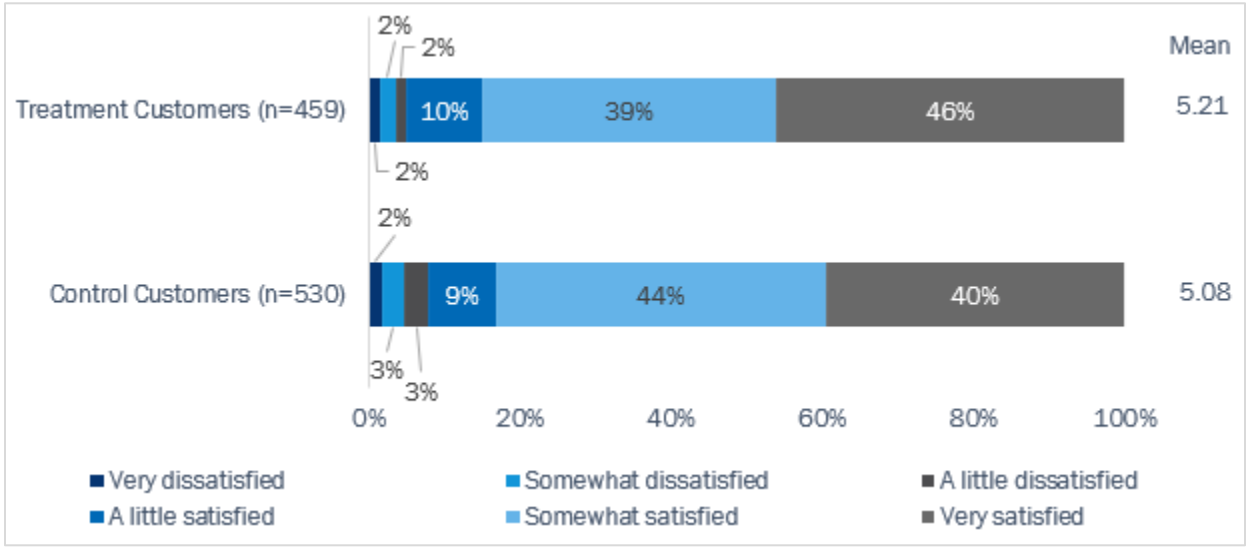
Note: Each option for this question was only asked of those from the treatment group who selected the option in a previous question.

Sixty-nine percent (n=315 out of 459) reported feeling more knowledgeable about ways to save energy in the home since receiving the reports. Despite treatment customers feeling significantly more knowledgeable about ways to save energy in the homes (mean rating of 3.15 out of 5, where 1 was "not at all knowledgeable" and 5 was "extremely knowledgeable") when compared to control customers (2.91), treatment customers were less likely to feel in control over how much energy the household uses. The majority of control customers (51%) said that they have quite a bit to a great deal of control over the amount of household energy used while proportionately less treatment customers (45%) feel that same level of control.

Program Satisfaction

The majority of customers (84%) were somewhat to very satisfied with Ameren Missouri. Overall, customers rated their satisfaction a 5.14 out of 6 on a scale where 1 was "very dissatisfied," and 6 was "very satisfied." Customers from the treatment group, however, were significantly more satisfied than control customers rating their satisfaction a 5.21 and 5.08, respectively (see Figure 5-7).

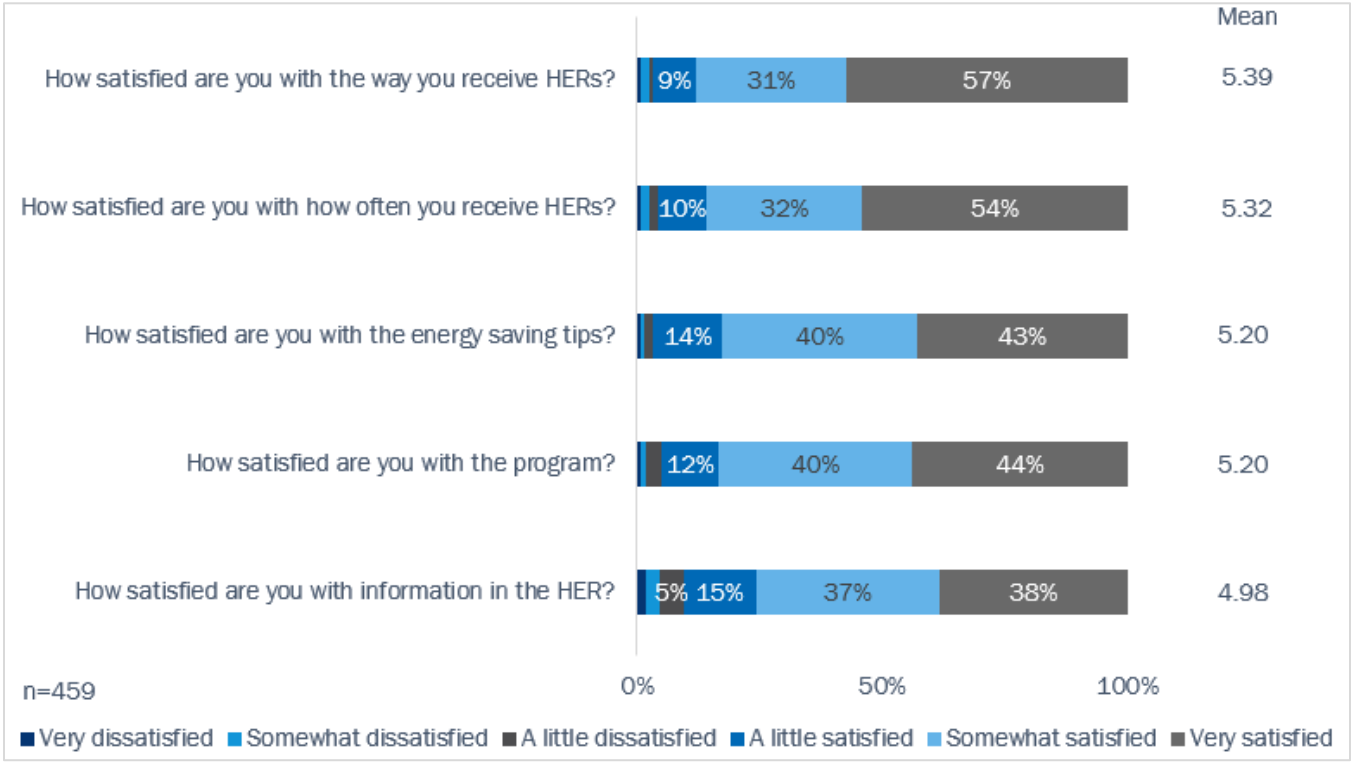
Figure 5-7. Satisfaction with Ameren Missouri



Mean satisfaction scores are statistically significantly different at the 90% level across treatment and control groups.

Virtually all treatment customers reported that they were somewhat to very satisfied with each of the HER elements (see Figure 5-8). Treatment customers rated their satisfaction with how they received their HERs (mean rating of 5.39 out of 6, where 1 was “very dissatisfied” and 6 was “very satisfied”), how often they received their HERs (5.32), the energy-saving tips they received (5.20), and the program overall (5.20). Treatment customers were slightly less satisfied with the information included in their HER (4.98), though the majority (75%) were still somewhat to very satisfied with this aspect of the program.

Figure 5-8. Satisfaction with HER Elements



Note: This question was only asked of treatment group customers.

Suggestions for Improvement

The survey included a question allowing respondents to provide general feedback to Ameren Missouri. Out of all respondents, 86% (n=855 out of 989) had no feedback. Of the 14% that did have feedback (n=134), 13 respondents (about 1% of the total) were disappointed with increasing electric costs, and 17 respondents (about 2% of the total) expressed confusion over their bills. Some of the responses surrounding Ameren's prices included participants saying to "quit raising the prices," and "rates [are] too high, [I] can barely afford to pay the bills." One customer was specific in their concern and offered a recommendation: "When looking at the discount items on the website, I found most to be overpriced. I would love to see [incentives] aimed at a lower income bracket or to a struggling population". Participants, on the other hand, who had comments surrounding their bills often cited reasons such as: the "electric bill is confusing to understand "and "[I am] uncertain whether [the] budget billing is truly saving me money. [I am] curious as to why, if I'm using less electric[ity] this year, my budget monthly expenses have gone up twice."

5.3.2 Net Unadjusted Impact Results

The evaluation team estimated unadjusted annual net savings using a consumption analysis (see Section 5.2). Unadjusted annual net savings are the savings derived from the consumption analysis and include savings from other energy efficiency programs in which treatment customers participated in PY2019. The PY2019 HER Program achieved 15,632 MWh and 7.29 MW in ex post unadjusted net savings (see Table

5-10). Note that the effective useful life of HERs is 1 year, and, for this reason, the tables below do not present demand savings by different EUL categories.

Table 5-10. PY2019 HER Program Unadjusted Ex Post Net Annual Savings

Savings	Number of Customers Treated in PY2019	Unadjusted Net Savings (% per household)[a]	Unadjusted Net Savings (per household)[b]	Unadjusted Net Program Savings
Energy Savings (MWh)	299,850	0.35%	52	15,632
Demand Savings (MW)		NA	0.02	7.29

Notes: The unadjusted net savings per household in the above tables (% and kWh) are weighted averages across the three waves.

[a] Because the demand savings rely on demand savings factor applied to energy savings, we do not present ex post net demand savings as a % per household.

[b] The unadjusted net demand savings per household is rounded to two decimal places but is equal to 0.0243 kW. To arrive at 7.29 MW for the unadjusted net program savings, multiply the number of customers by 0.0243 kW.

Notably, the per-household energy and demand savings vary by wave, as shown in Table 5-11 and Table 5-12 below. In an effort to understand the differences, the evaluation team plotted the pre-period ADC for the treatment customers in each wave to examine the differences in baseline consumption. Figure 5-9 shows the pre-period monthly average daily consumption (ADC) for each wave in 2015, a common year of pre-period for all three waves. Wave 3 has lower ADC values for every month, which is likely due to its higher composition of customers living in apartments and low-income customers. As detailed in Appendix A, 95% of Waves 1 and 2 are comprised of single family customers, and only 63% of Wave 3 are single family customers.

Figure 5-9. Annual Pre-Period ADC per Month by Wave (for 2015)

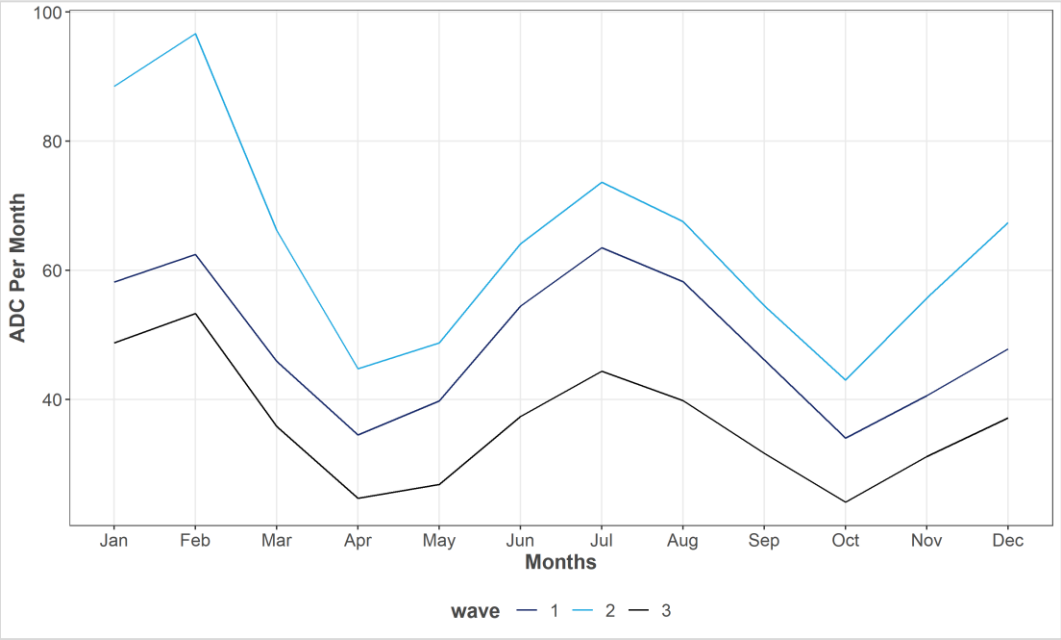


Table 5-11. PY2019 HER Program Unadjusted Ex Post Net Annual Electric Energy Savings by Wave

Wave	Number of Customers Treated in PY2019	Unadjusted Net Savings (% per household)	Unadjusted Net Savings (kWh per household)	Unadjusted Net Program Savings (MWh)
Wave 1	76,282	0.56%	81	6,167
Wave 2	33,625	0.69%	128	4,291
Wave 3	189,943	0.20%	27	5,174

Table 5-12. PY2019 HER Program Unadjusted Ex Post Net Annual Electric Demand Savings by Wave

Wave	Number of Customers Treated in PY2019	Unadjusted Net Savings (% per household)	Unadjusted Net Savings (kW per household)	Unadjusted Net Program Savings (MW)
Wave 1	76,282	NA	0.04	2.87
Wave 2	33,625	NA	0.06	2.00
Wave 3	189,943	NA	0.01	2.41

[a] Because the demand savings rely on a demand savings factor applied to energy savings, we do not present net demand savings as a % per household.

[b] The unadjusted net demand savings per household is rounded to two decimal places but is equal to 0.037678 kW for Wave 1, 0.059484 kW for Wave 2, and 0.012696 kW for Wave 3. To arrive at the unadjusted net program demand savings presented in the table, we multiply the number of customers treated by the more precise unadjusted net program demand savings per wave.

5.3.3 Joint Savings Analysis

We considered energy savings that resulted from energy-efficient actions taken through other Ameren Missouri residential energy efficiency programs in our joint savings analysis. While we would expect a base rate of participation in these program from both the treatment and control groups, it is possible that the HER program resulted in an increase, or "uplift," in participation in other Ameren Missouri residential energy efficiency initiatives among the members of the treatment group by promoting these programs to treated customers.

Table 5-13 presents a summary of the participation uplift for the Ameren Missouri residential programs that were active during PY2019. The evaluation team found a statistically significant difference in program participation between treatment and control customers for the HVAC Program only, which is consistent with findings from the participant survey (see Table 5-6). The evaluation team deducted approximately 395 MWh of unadjusted energy savings due to this analysis, which represents 2.50% of the program's unadjusted ex post net energy savings.

Table 5-13. PY2019 HER Program Savings Uplift Results

Savings	PY2019 Savings Uplift	
	Savings	%[a]
Energy Savings (MWh)	391	2.50%
Demand Savings (MW)[b]	NA	NA

[a] The savings uplift percentage is a percentage of the program unadjusted savings.

[b] Since a demand savings factor is applied to the estimate of energy savings, the evaluation team does not use the joint savings analysis to estimate demand savings uplift. Instead we apply the demand savings factor to the adjusted ex post net

energy savings to arrive at the adjusted ex post net demand savings for the program.

5.3.4 Net Adjusted Impact Results

The total PY2019 adjusted net impacts for the HER Program were 15,241 MWh and 7.10 MW, which reflect the results of the joint savings analysis (Table 5-14). Table 5-15 and Table 5-16 present the ex post adjusted net impacts for each of the waves in PY2019.

Table 5-14. PY2019 HER Program Adjusted Annual Net Annual Savings

Savings	Unadjusted Net Program Savings	Savings Uplift [a]	Final Adjusted Net Program Savings
Energy Savings (MWh)	15,632	391	15,241
Demand Savings (MW)	7.29	NA	7.10

[a] Because the demand savings rely on a demand savings factor applied to energy savings, we do not present savings uplift for demand savings and instead apply the kW peak factor ratio to the final adjusted net program energy savings.

Table 5-15. PY2019 HER Program Adjusted Annual Net Electric Energy Savings by Wave

Wave	Unadjusted Net Program Savings (MWh)	Savings Uplift (MWh)	Final Adjusted Net Program Savings (MWh)
Wave 1	6,167	0	6,167
Wave 2	4,291	391	3,900
Wave 3	5,174	0	5,174
Total	**15,632**	**391**	**15,241**

Table 5-16. PY2019 HER Program Adjusted Net Electric Demand Savings by Wave

Wave	Unadjusted Net Program Savings (MW)	Savings Uplift (MW)[a]	Final Adjusted Net Program Savings (MW)
Wave 1	2.87	NA	2.87
Wave 2	2.00	NA	1.82
Wave 3	2.41	NA	2.41
Total	**7.28**	**NA**	**7.10**

[a] Because the demand savings rely on a demand savings factor applied to energy savings, we do not present savings uplift for demand savings and instead apply the kW peak factor ratio to the final adjusted net program energy savings for each wave.

5.3.5 Assessment of Savings Persistence and Effective Useful Life

As part of the evaluation of the HER Program, the evaluation team reviewed several studies conducted across the United States on the rate at which energy savings decay after treatment customers enrolled in a HER program stop receiving reports. This review, included in Appendix E, provides Ameren Missouri staff with key information regarding the persistence of savings from HERs and their implications on effective useful life (EUL) assumptions worth considering should they choose to conduct a persistence study. Given that Ameren Missouri has offered this program to a range of customers for varied durations, the evaluation team paid

special attention to studies of HER programs that relied on a selective stoppage of treatment to estimate decay rates. This means that the treatment of a subset of a cohort ceased, thereby allowing greater power to estimate savings decay rates since a portion of the same cohort continued to receive HERs. This method has a great deal of power to estimate savings persistence as the selective stoppage of a subset of treatment customers provides ideal comparisons of customers who began treatment at the same time.

From the literature review, the evaluation team provides estimates of decay, persistence, and annual incremental savings. We also provide a characterization of evaluation of best practices and summarize findings across the studies conducted to date on rates of savings decay. We conducted a review of studies to answer the following questions with respect to HER programs targeting electric energy savings:

- What are the methods that have been used to estimate incremental annual savings, including savings persistence, for HER programs in the United States?
- What annual savings decay rates have been observed?

While we observed a fair amount of variation in the methods and models used to estimate incremental savings and decay rates, all the studies used a selective stoppage of treatment approach to estimate avoided savings decay. This was true regardless of the number of customers in the program, the location of the customers, or any other observed differences in program design or context.

Studies indicate that an EUL assumption of greater than one year is consistent with how customers' savings decay after stoppage in treatment. However, annual savings decay rates vary widely across studies (from 1% to 60%). However, the unweighted average annual decay rate across studies was 20%, and nine of the twelve studies that we reviewed yielded an average annual decay rate between 10% and 30%. Further, the Illinois TRM assumes savings persist up to five years, and use an EUL assumption of 5 years for electric savings.

Key findings from the review also include the following:

- Across the studies, there is no clear pattern in terms of first-year decay rate as a function of how long customers participated in the HER program prior to stoppage of treatment.
- Results are also mixed as to whether decay rate over a period of years after stoppage of treatment is linear or curved.
- Savings tend to persist to some degree beyond the first year, thus suggesting an assumption of an EUL greater than 1. Note however, that changing the EUL assumption has implications, particularly on program design.

Based on this review, the evaluation team does not recommend making changes to the one-year EUL for HERs in the Missouri TRM without first conducting a service territory-specific study. Should Ameren Missouri decide to pursue additional research, the evaluation team recommends conducting a study that calculates both cohort-specific annual savings decay rates and overall annual average decay rates over multiple years. This approach would selectively stop treatment for subsets of cohorts, providing Ameren Missouri with evidence to better inform the persistence of savings of its HER Program and consequently, a potential EUL adjustment.

6. Energy Efficient Products (REP)

This section summarizes the PY2019 evaluation methodology and results for the Residential Efficient Products (REP) Program. Additional details on the methodology are presented in Appendix A.

6.1 Evaluation Summary

The REP Program is designed to raise customer awareness of the benefits of high-efficiency products and to educate residential customers about energy use in their homes and to offer information, products, and services to residential customers to save energy cost-effectively. The target market consists of all residential customers within the Ameren Missouri service territory.

The REP Program is designed to be an umbrella program, incorporating various program partners, products, and program delivery strategies. The REP is intended to be flexible, and as it evolves and evaluation activities track program performance, Ameren Missouri may revise the assortment of eligible measures, incentive amounts, or qualification criteria as the market dictates.

In PY2019, four measures were included in the program:

- Advanced thermostats - $50 rebate per unit; limited to one thermostat per system and up to three thermostats per residential electric account
- Tier 2 power strips - $25 rebate per unit; limited to three power strips per residential electric account
- Variable speed pool pumps - $200 rebate per unit; limited to two pool pumps per residential electric account
- Heat pump water heaters - $350 rebate per unit; limited to two rebates per residential electric account

In PY2019, the REP Program used two delivery channels:

- Advanced thermostats and power strips were sold directly to customers through Ameren Missouri's Online Store where the rebates were applied immediately at checkout[41,42]
- Customers could purchase program-qualified heat pump water heaters, and pool pumps anywhere, and then submit a rebate application via e-mail or mail-in

The PY2019 REP Program ran the entire program year from March 1, 2019, through December 31, 2019, with no mid-year program changes.

[41] In addition to advanced thermostats and power strips, the Online Store offers discounts on LEDs. We are evaluating the LEDs as part of the Residential Lighting Program evaluation. The store also sells other products without a discount including water saving products, HVAC air filters, and smart home devices. We are not evaluating these other products.
[42] The current Online Store lighting main page can be viewed here: https://amerenmissouristore.com/.

6.1.1 Participation Summary

The Online Store channel provided the most participants, sold the most measures, and generated the greatest savings for the REP Program. Participants purchased nearly 90% of program measures through the Online Store. Overall, about two-thirds (64%) of ex ante gross program savings were associated with the Online Store delivery channel; about one-third (36%) with mail-in rebates (see Table 6-1).

Table 6-1. PY2019 REP Program Participation Summary

Delivery Channel	Participants		Measures		Ex Ante Savings	
	Number	%	Number	%	MWh	%
Online Store	5,871	88%	6,866	89%	3,200	64%
Mail-in	832	12%	844	11%	1,781	36%
Total	**6,703** [a]	**100%**	**7,710**	**100%**	**4,981**	**100%**

[a] Note that a total of 6,685 unique account numbers participated in the program. This differs from the value of 6,703 shown in the table because 18 account numbers purchased products from more than one enduse.

Advanced thermostats were the most popular product that the REP Program offered (88% of measures) followed by pool pumps (10%); very few purchased heat pump water heaters and Tier 2 power strips (Table 6-2). Accordingly, nearly all program savings came from sales of advanced thermostats and pool pumps.

Table 6-2. PY2019 REP Program Participation Summary

Enduse	Channel	Participants		Measures		Ex Ante Savings	
		Number	%	Number	%	MWh	%
Advanced Thermostats	Online Store	5,831	87%	6,806	88%	3,190	64%
Tier 2 Power Strips		40	1%	60	1%	10	<1%
Pool Pumps	Mail-in	721	11%	733	10%	1,503	30%
Heat Pump Water Heaters		111	2%	111	1%	278	6%
Total		**6,703** [a]	**100%**	**7,710**	**100%**	**4,981**	**100%**

[a] Note that a total of 6,685 unique account numbers participated in the program. This differs from the value of 6,703 shown in the table because 18 account numbers purchased products from more than one enduse.

6.1.2 Key Impact Results

Table 6-3 presents annual savings achieved in PY2019. As shown, the program achieved 51% of Ameren Missouri's net energy savings goal. Realization rates were virtually 100%, but the program attained just over half of its energy savings goals. As the program used similar NTGRs for planning purposes than our evaluation found (roughly 82% compared to 85% for energy),[43] failure to attain the program goals is not entirely due to the lower NTGRs. Rather, given ex ante gross savings were only 61% of the goal values, participation rates are the main reason the program did not achieve its goal net savings, which is a common theme throughout this report.

[43] NTGRs were calculated at the measure level (details in 6.3.3). Advanced thermostats (planning = 82%, evaluation = 75%), pool pumps (planning = 80%, evaluation = 68%), heat pump water heaters (planning = 82%, evaluation = 64%), and power strips (planning = 70%, evaluation 87%).

Table 6-3. PY2019 REP Program Savings Summary

	Ex Ante Gross	Realization Rate	Ex Post Gross	NTGR	Ex Post Net	Goal/Target Net	% of Goal/Target
First Year Savings							
Energy Savings (MWh)	4,981	99.8%	4,922	84.7%	4,170	8,222	51%
Demand Savings (MW)	1.57	99.9%	1.57	79.6%	1.25	2.14	58%
Last Year Demand Savings							
< 10 EUL (MW)	0.00	NA	0.00	NA	0.02	0.03	55%
10-14 EUL (MW)	1.57	99.9%	1.57	75.9%	1.19	2.11	56%
15+ EUL (MW)	0.00	NA	0.00	NA	0.04	0.00	NA

Overall, the REP Program was the fourth-largest program in the PY2019 residential portfolio, accounting for 4% of ex post net residential portfolio energy savings and 3% of ex post net residential portfolio demand savings.

6.1.3 Key Process Findings

Key process evaluation findings from the PY2019 REP Program evaluation include:

- Participants are quite satisfied with the REP Program and their experiences. For the Online Store, 92% of surveyed participants reported being very or somewhat satisfied; for the mail-in channel, 93% reported being very or somewhat satisfied. Regardless of channel, a majority of participants reported that their experiences with the program have made them feel more favorable towards Ameren Missouri (68% Online Store, 58% mail-in).
- In terms of the Online Store, surveyed participants found it easy to use, were satisfied with the prices, the products they purchased, and the information available on the site, and felt they received their orders in a reasonable time. However, customers tend to be very sensitive to the delivery time, and ensuring prompt delivery of orders will be necessary for maintaining satisfaction levels. Also, improving Online Store customer service would likely boost satisfactions rates even higher.
- For the mail-in channel, surveyed participants were quite satisfied with the application process, the amount of the rebates offered, and with the amount of time, it took to receive the rebate. Nevertheless, the sooner customers get their rebate, the more satisfied they are, so reducing turnaround time on rebates could improve satisfaction.
- Awareness of the REP Program is relatively low with just over one-third of residential customers (36%) saying they were aware of the program when read a program description. Considering the array of marketing efforts implemented in PY2019 to promote the Online Store and its products, more participants recall learning about the program from direct communications from Ameren Missouri (e-mail, bill, or other materials) than any other marketing activity. Given the effectiveness of the direct communications from Ameren Missouri, they should be emphasized in tactical marketing moving ahead.
- Overall, based on the high levels of participant satisfaction, the PY2019 REP Program is running smoothly. However, given how much the program fell short of its goals, participation is the biggest challenge. Increasing program awareness will help, but the current measure mix may be a bigger impediment to participation. This is especially true for the mail-in channel, which has only two

measures, one of which (pool pumps) has a small target market. While more contractor-focused marketing could help boost participation rates for the mail-in channel, the addition of new measures and more targeted marketing is likely needed to boost participation in the program overall.

To meet the requirements of Missouri Code of State Regulations (CSR) for demand-side process evaluations, we respond to the five required process evaluation questions in Table 6-4.

Table 6-4. Summary of Responses to CSR Process Evaluation Requirements

CSR Required Process Evaluations Questions	Findings
What are the primary market imperfections that are common to the target market segment?	The primary market imperfections for the REP Program are customer awareness of energy efficient product options and their benefits, and the higher price of efficient products. In terms of knowledge, many customers are not aware of energy efficiency and energy-efficient technologies. And even those that are aware are often not informed of actual energy savings opportunities available in their homes. For programs like the REP Program, customer awareness of the availability of the rebate is paramount. Customers need to either be proactive and search out the rebates, or they need to be informed of them via marketing or a contractor. Only 36% of residential customers were aware of the REP program, which limits participation. Other market imperfections are measure specific and generally apply to the market potential: ▪ Only 4% of homes in the Ameren Missouri service territory have inground pools. This is a limited market and the product selection is largely driven by contractor recommendations. ▪ While nearly every home has at least one thermostat, thermostats do not routinely fail, so customers will need another reason to replace existing thermostats. The desire for advanced technology is a factor driving advanced thermostat uptake. Thermostats have become a consumer product, and like other advanced technologies, many people appreciate and want the technology. Still, others do not and could view advanced thermostats as overly complicated or expensive. Greater customer awareness of new thermostat technology and its energy savings potential could help drive customers to advanced thermostats.
Is the target market segment appropriately defined, or should it be further subdivided or merged with other market segments?	Officially (per MEEIA III), the target market for the REP Program is all residential customers within the Ameren Missouri service territory. However, when the measure mix is considered (heat pump water heaters, pool pumps, and advanced thermostats), the actual market is predominantly homeowners. That said, virtually all residences (even rentals) could benefit from advanced Tier 2 power strips. Obviously, some measures like pool pumps should be targeted at residences with pools, but no further subdivision seems needed.

CSR Required Process Evaluations Questions	Findings
Does the mix of enduse measures included in the program appropriately reflect the diversity of enduse energy service needs and existing enduse technologies within the target market segment?	The REP Program currently offers only four measures: (1) advanced thermostats, (2) Tier 2 power strips, (3) heat pump water heaters, and (4) pool pumps. When one considers the diversity of energy-consuming items in the typical residence (the target market), a very wide range of other enduse measures appear potentially applicable to the REP Program. Of course, cost-effectiveness and overlap with other programs needs to be considered.
Are the communication channels and delivery mechanisms appropriate for the target market segment?	n PY2019, program marketing activities included TV/radio ads, social media ads, paid search optimization, e-mail campaigns, including rebate information on energy statements or Home Energy Reports, and location-based ads and promotions. Most participants who purchased products through the Online Store learned about the program through direct communication from Ameren Missouri or the Ameren Missouri website. Mass marketing does not appear to have been that effective. Customers who purchased pool pumps pool pumps and heat pump water heaters were more likely to learn about the program through a contractor than other communication channels. Increasing outreach to contactors to increase their involvement with the program could increase participation for these measures.
What can be done to more effectively overcome the identified market imperfections and to increase the rate of customer acceptance and implementation for select enduses/measure groups included in the Program?	Customers seem largely satisfied with both the Online Store and mail-in channels. However, increased participation can likely be attained by expanding the breadth of measures rebated under the program, focusing additional marketing efforts on contractors, and increasing general customer awareness of the energy efficiency opportunities as well as available rebates.

6.1.4 Conclusions and Recommendations

Based on the results of this evaluation, the evaluation team offers the following conclusions and recommendations for the REP Program moving forward:

- Conclusion #1: Customers are largely satisfied with the REP Program overall and program components such prices, rebate amounts, the information provided, the application process, etc. Both delivery channels have high customer satisfaction. It is evident that Ameren Missouri is running the REP Program in a way that meets customers wants and needs. However, steering more people to the program and increasing participation are the current and future challenges. In PY2019, only 36% of residential customers were aware of the REP Program, and the program only attained 43% of its energy savings goals and 54% of demand savings goals.
  - Recommendation #1: Consider introducing new measures when cost-effective. Two of the measures rebated through the program are generally replacement-on-burnout measures that are serviced by contractors (pool pumps and heat pump water heaters). Such measures offer a limited ability to stimulate increased participation.

  - Recommendation #2: While the product assortment is likely the biggest impediment to increasing participation, any broadening of the assortment should be done with careful consideration of marketing. Marketing is clearly needed to promote these products and steer customers to the rebates and the Online Store, thus increasing participation. The program should focus on increasing customer awareness of the availability of the rebates for all products, but increasing contractor awareness will also help for contractor-serviced measures.
- Conclusion #2: While ex ante assumptions were correctly applied based on the Ameren Missouri TRM Appendix F, these assumptions did not reflect the most recent version of Appendix F.
  - Recommendation: Update ex ante savings to reflect the November 2019 Appendix F. Appendix F was updated in November 2019 to incorporate findings from the Ameren Missouri Efficient Products Program Impact and Process Evaluation PY2018 and PY2018 program tracking data. This update affected parameters for all heat pump water heater and advanced thermostat measures.

6.2 Evaluation Methodology

As described in Section 6.1, the evaluation team performed both impact and process evaluation activities to assess the performance of the PY2019 Ameren Missouri Residential Efficient Products Program. In addition to the overarching research objectives outlined for the residential portfolio, the evaluation team explored the following REP Program-specific objectives:

- Characterize program participation based on products discounted through the program by type and by distribution channel;
- Assess customer knowledge of energy efficient products discounted through the program;
- Evaluate the effectiveness of program marketing materials in informing customers about the benefits of program-supported efficient products and their impact on customer purchases;
- Measure customer satisfaction, with program processes, discounted products, and motivations for participating;
- Provide evaluation results that can be used to improve the design and implementation of the REP Program.

Table 6-5 provides an overview of the HVAC Program evaluation activities. Following the table, we outline program-specific aspects of key evaluation methodologies.

Table 6-5. PY2019 Evaluation Activities for the REP Program

Evaluation Activity	Description
Program Manager and Implementer Interviews	▪ Conduct interviews towards the end of PY2019 to understand program staff's perspective on program performance.
Program Material Review	▪ Review all program materials to inform evaluation activities.
Program Theory/ Logic Model Review	▪ Review the implementer's program theory/logic model to understand program activities and their expected outputs and outcomes, including expected impacts on the market.
Tracking System Review	▪ Review the implementer's tracking system to ensure that data required for the evaluation is being collected.
Participant Survey	▪ Collect data to inform gross impact analysis (e.g., in-service rates), NTG (i.e., free ridership and participant spillover), and yield process-related insights
Gross Impact Analysis: Database Review	▪ Review the program database to check that program data are complete and that program-installed measures meet all program requirements.
Gross Impact Analysis: Engineering Analysis	▪ Verify that ex ante savings use correct deemed savings values.
NTGR/Net Impact Analysis	▪ Estimate overall and measure-level ex post gross impacts using TRM algorithms deemed savings assumptions, and evaluation-estimated parameters.

Participant Survey

The evaluation team conducted two waves of an online survey with PY2019 program participants. The surveys covered a range of topics including verification of purchase, installation, and persistence of program measures; assessment of program processes; measurement of participant satisfaction with program processes, informational materials, and measures offered, and estimation of participant free ridership and spillover.

To aid recall, we aimed to conduct the surveys close to the time that the customers participated in the program. However, at the same time, we had to balance against the need for some time to go by to assess PSO effects accurately and first year ISRs as participants need time to install the products and take additional program-induced actions. We administered the first wave in October 2019 (covering program activity March 1, 2019, through July 31, 2019) and the second wave in January 2020 (covering program activity August 1, 2019, through November 31, 2019).

For each wave of the survey, we compiled sample frames consisting of all program participants with an e-mail address during the relevant time period. Table 6-6 shows the sampling details by measure. The population file across all products had a total of 6,703 unique purchases by electric account number. Overall, 97% of all cases in the population file had e-mails addresses (100% for thermostats and power strips; 77% for pool pumps; 75% for heat pump water heaters).

When developing the sample frame from the population files, we first removed any cases missing e-mail addresses. We then deduplicated by e-mail address to ensure a customer only received a single invite to the survey. For customers that showed up in the data associated with more than one purchased measure, we deduplicated by e-mail address prioritizing measures with the lowest participation rates.[44] For customers

[44] For example, if someone purchased an thermostat and a power strip, we retained the record for the power strip.

that showed up in the data associated with more than one purchase of the same measure, we retained the most recent record. Ultimately, our sample frame consisted of a total of 6,391 unique records.

We sent e-mail invites to all members of the sample frame (i.e., we attempted a census). We sent participants the initial e-mail invite as well as two reminders to complete the survey. In the end, a total of 1,063 REP participants completed the survey throughout both waves. The overall population-weighted response rate was for the PY2019 REP Program was 17%.

Table 6-6. PY2019 REP Program Survey Sampling Details by Measure

Measure	Population	Have E-mails	% With E-mails	Bad E-mails	Valid Sample Frame	Completes	Response Rate
Learning Thermostats	5,731	5,731	100%	34	5,697	931	16%
Power Strips	39	39	100%	2	37	11	30%
Pool Pumps	721	553	77%	30	513	100	19%
Heat Pump Water Heaters	111	83	75%	4	74	21	28%
Total	**6,602**	**6,406**	**97%**	**70**	**6,321**	**1,063**	**17%**

6.3 Evaluation Results

6.3.1 Process Results

The results of the PY2019 REP Program are presented thematically, aimed at addressing the portfolio-wide research objectives. In general alignment with this, the summary of process evaluation results includes the following sections:

- Program Participation
- Marketing
- Customer Satisfaction

For each of the topics other than Program Participation, the two delivery channels are discussed separately as the design and implementation differ so dramatically.

Program Participation

In PY2019, the Ameren Missouri REP Program incented products through two separate channels:

- Advanced thermostats and Tier 2 power strips were sold and incented entirely through the Ameren Missouri Online Store. Customers visited the website and chose from a selection of efficient models, and rebates were applied instantly at checkout.
- Heat pump water heaters and pool pumps could be purchased anywhere (though customers typically go through contractors for these types of equipment), and then the customer needed to fill out a rebate application and submit it via paper mail or e-mail.[45]

[45] We use the term “mail-in” throughout this report to refer to those applications submitted via e-mail as well as those submitted through the mail.

The Online Store channel dominated the REP Program incenting 89% of all program products (Table 6-7). Advanced thermostats alone represented 88% of all units incented through the program, and Tier 2 power strips accounted for <1%. Pool pumps were the primary driver of the mail-in channel (87% of channel; 10% of total), while heat pump water heaters represented little of the program (13% of channel, 1% of total).

Table 6-7. PY2019 REP Program Sale Quantity and Ex Ante Gross Savings by Measure Type

Measure	Channel	Product Quantity	Share of Sales	Ex-Ante Savings	% of Ex Ante Savings
Advanced Thermostat	Online Store	6,806	88%	3,190	64%
Tier 2 Power Strips		60	<1%	10	<1%
Pool Pumps	Mail-in	733	10%	1,503	30%
Heat Pump Water Heaters		111	1%	278	6%
Total		**7,710**	**100%**	**4,981**	**100%**

Marketing

For nearly all energy efficiency programs, marketing and promotion are key as they raise awareness among utility customers of the program, help educate customers to the importance of energy efficiency, and typically point customers to specific opportunities for energy savings. The PY2019 REP Program used a wide-ranging tactical marketing plan to promote the Online Store and the mail-in rebates.

The results of a January 2020 general population survey suggest that customer awareness of the REP Program is still relatively low, and the program could benefit from additional marketing efforts. In the survey, we measured customer awareness of Ameren Missouri residential and low-income programs. When provided a description of the program, 36% of surveyed residential customers said they were aware of the REP Program (Table 6-8).[46]

Table 6-8. Awareness of Ameren Missouri Residential Programs

Program	Residential Customers (n=4,804)
HVAC (Heating and Cooling)	60%
Appliance Recycling	41%
Efficient Lighting	40%
Retail Efficient Products	**36%**
Low Income	32%
Peak Time Savings	27%
Multifamily Market Rate	22%
School Kits	15%

The evaluation team conducted a comprehensive inventory of the program's PY2019 tactical marketing efforts, which were largely designed to be product-specific. Nevertheless, many activities promoted multiple

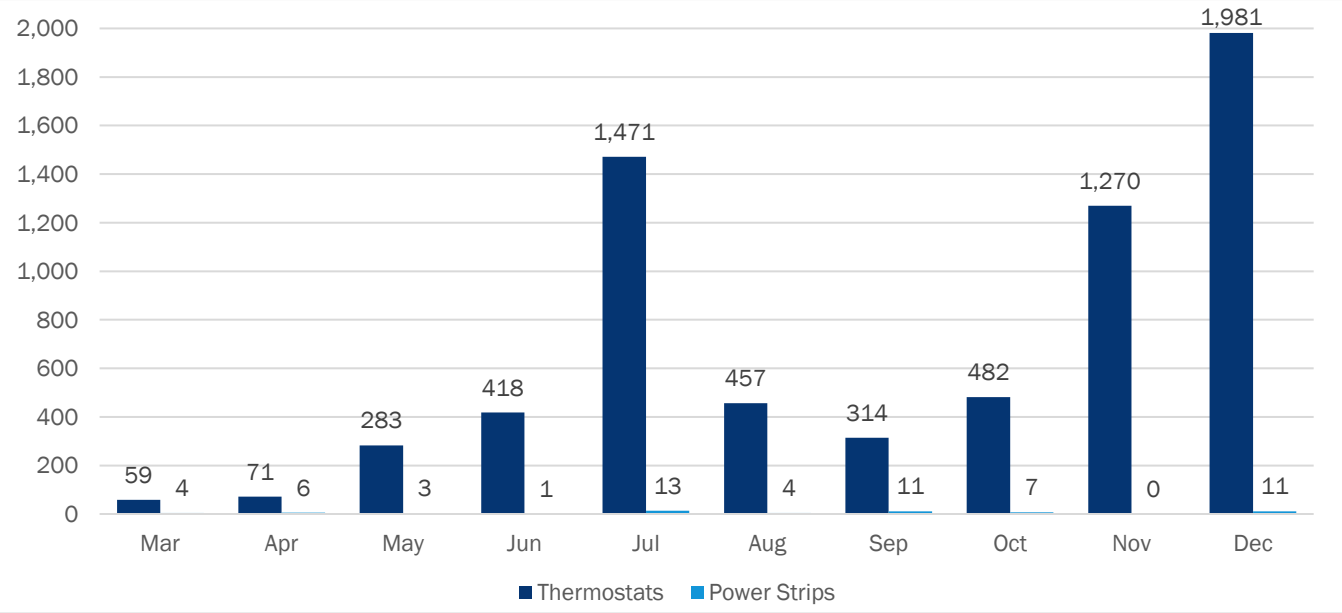
[46] Results are drawn from a survey of 4,804 Ameren Missouri residential customers conducted between January 13 and 27, 2020. Appendix A on non-participant spillover contains additional information on survey methods.

programs and products and were used throughout the year such as TV ads (March - June, and August - September), St. Louis Cardinals Sponsorship radio ads (March – September), and paid search optimization (April – December). A single Ameren Missouri e-mail campaign was conducted in the last week of March to announce the launch of the Online Store; the implementer conducted additional e-mail campaigns each month, starting in June, to promote the store. In the following sections, we provide a review of the marketing activities by channel and assess their impact on program participation.

Online Store

The Online Store channel was a little slow to take off, with sales spikes showing evidence of marketing efforts (see Figure 6-1). Advanced thermostats clearly dominate the online channel (as well as the program overall). Tier 2 power strip sales were very low (only 60 total units were sold in PY2019) and relatively flat throughout PY2019. It is important to emphasize that the Online Store launched at the start of the program year, and it likely took time for awareness to grow, so it was not operating at its fullest potential for much of the year. Thus, barring measure changes, the channel will likely represent an even larger share of overall REP Program savings next year with additional marketing.

Figure 6-1. PY2019 REP Program Sales Over Time – Online Store



The program heavily promoted advanced thermostats in PY2019, and sales spikes of the product in Figure 6-1 can be linked to specific marketing efforts. In addition to the cross-product marketing efforts, the following specific promotions were conducted for thermostats:

- Ameren Missouri direct mail: June and July
- Ameren Missouri E-mail campaign: March, May, July
- Mentioned in Energy Statement: May and July
- Manufacturer promos: July

- Promotion on Home Energy Report: July
- Implementer e-mail campaign: June, July, August, and September
- Social media: May, July, November, and December

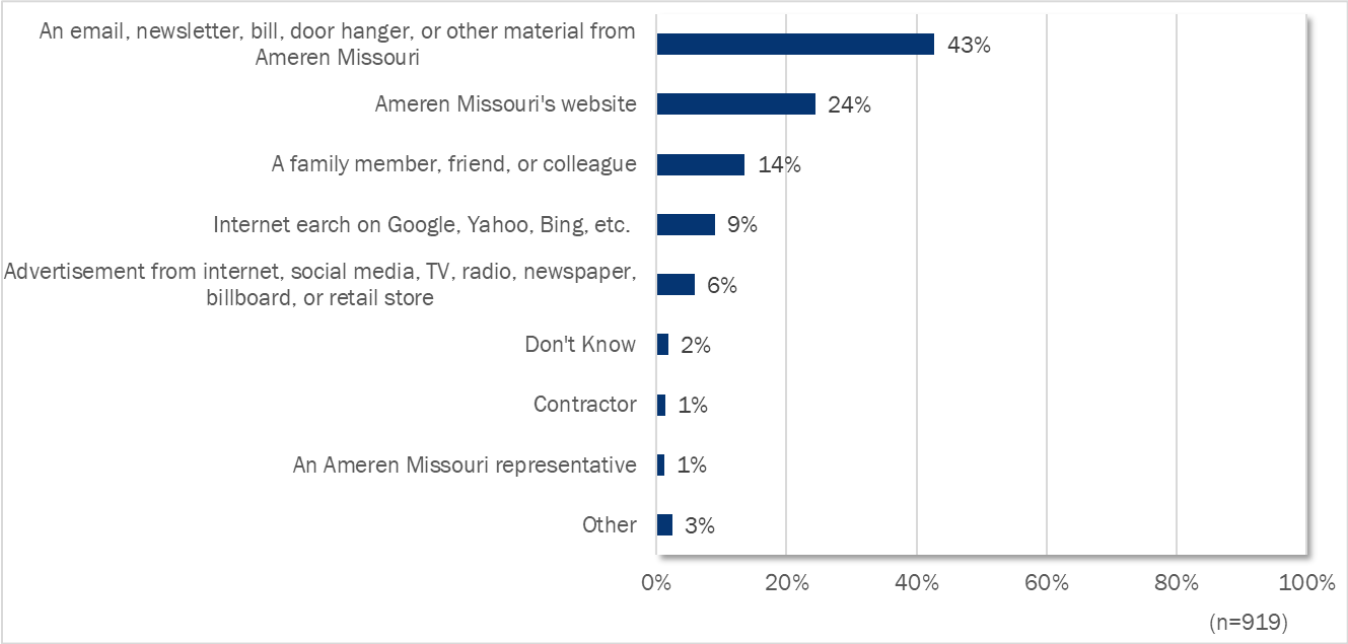
There was very little promotion of advanced Tier 2 power strips throughout the program year. In addition to the cross-product marketing, product-specific marketing was limited to an implementer e-mail campaign in July.

The marketing activities centered around July had a dramatic impact on sales of advanced thermostats. In fact, July is the second-highest volume month (1,471 units sold) of the entire program year. The November Black Friday promotion also had a positive impact on sales that carried through December. It appears that advanced thermostats are a popular holiday item. Since the program used so many activities at the same time, it is impossible to better understand the relative influence of the individual marketing activities to determine which were most effective by linking activities to program sales. That said, it does seem the e-mail campaign (and possibly mention on the energy statement) likely boosted sales from March and April.

There is evidence to suggest that the July e-mail campaign for power strips had a positive effect on sales. Also, customers who were driven to the site by advanced thermostat marketing may have then learned about power strips. But any conclusions need to be tempered with the fact that only a small total number of power strips were sold during the program year (n=60), making it difficult to draw overall conclusions. Nevertheless, substantial customer-facing marketing will almost certainly be needed to drive sales of power strips beyond the <1% of overall program savings.

In addition to examining the connection between marketing activities and sales over time, we know how surveyed participants first learned about the Online Store (see Figure 6-2). Direct outreach from Ameren Missouri (e-mail, newsletter, bill, or other materials) appears to have had the greatest impact, with 43% of participants recalling learning about the store from Ameren Missouri communication. About a quarter of surveyed participants (24%) learned about the store through Ameren Missouri's website. Other participants learned through word of mouth from their family members and friends (14%), through internet search engines (9%), and advertisements (6%). For participants that actually first heard of the program through an advertisement (n=23), a social media platform was the most commonly reported source of the advertisement (9 out of 23), followed by a website on the internet (6 out of 23) and on TV (6 out of 23). One participant each also claimed that they heard about on the advertisement on the radio and in the retail store.

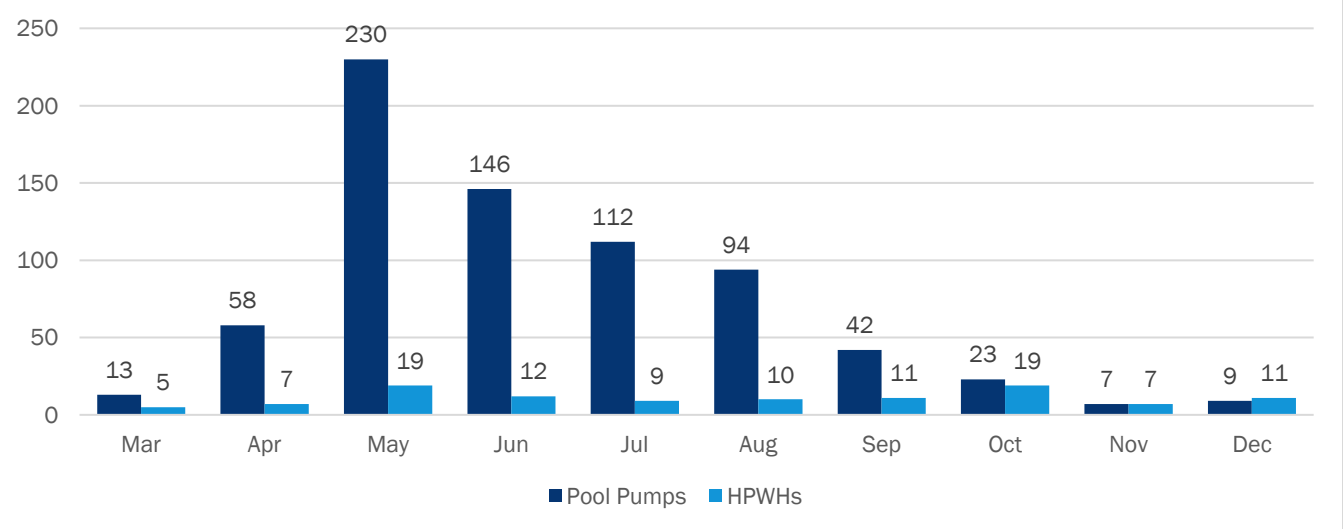
Figure 6-2. PY2019 REP Program Sources of Program Awareness – Online Store



Mail-In

The mail-in channel Figure 6-3 plots sales volumes over time by measure by month for the mail-in channel. Here we see the overwhelming influence of pool pumps on the channel, as well as the expected summer-season dominance of rebates for this seasonal measure. Heat pumps water heater rebates, though much lower in volumes, were relatively steady throughout PY2109.

Figure 6-3. PY2019 REP Program Sales Over Time – Mail-in Rebates



Pool pumps were not heavily promoted in PY2019. In addition to the cross-product marketing efforts, the following specific promotions were conducted for pool pumps:

- Direct mail: August
- Location-based displays: June-September
- Promotion on Home Energy Report: June
- Social media: August

It is important to note that pool pumps are typically a replace-on-burnout type of product and are largely seasonal. Sales patterns of pool pumps show a notable spike in May, as people discovered issues with their pump when preparing their pools for the summer. The fact that they are generally replace-on-burnout is also likely why rebate submission rates do not seem very responsive to promotions. Because contractors highly drive the pool pump market, marketing efforts such as location-based displays to inform contractors are likely to be more effective marketing tactics for pool pumps than direct promotions to customers. That said, additional marketing efforts that explain the value of ENERGY STAR® certified pool pumps could make customers more likely to purchase one when their existing pool pump fails.

Heat pump water heaters were not heavily promoted in PY2019. In addition to the cross-product marketing efforts, the following specific promotions were conducted for water heaters:

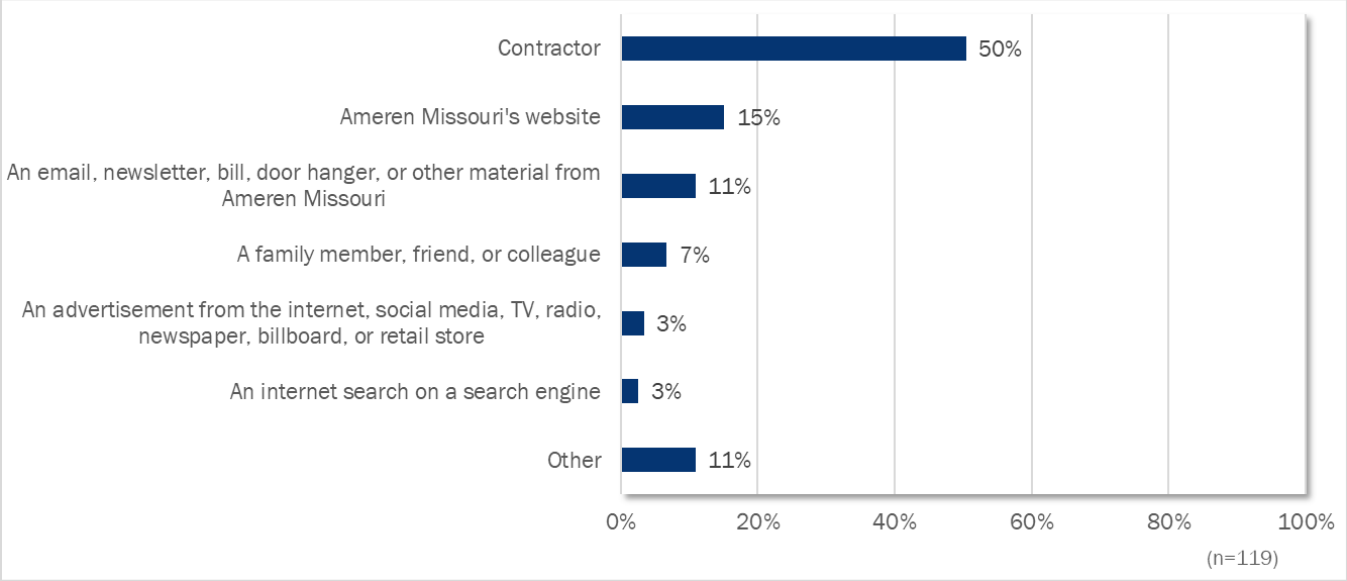
- E-mail campaign: October
- Mentioned in Energy Statement: October-November
- Location-based displays: June through the remainder of the year

Looking at sales patterns across the year for heat pump water heaters, it is obvious where the October e-mail campaign likely had an impact, but it is not clear what drove the relative spike in sales in May.

Similar to pool pumps, heat pump water heater sales are largely driven by contractors. Most water heater replacements are replacement-on-burnout of old standard tanked water heaters. However, a growing number of replacements are heat pump water heaters as more people become aware of the technology and its advantages. The notable benefits of heat pump water heaters are also motivating some people to conduct early replacements. Thus, while promoting rebates to contractors should certainly be part of a marketing strategy for heat pump water heaters, customer-focused promotions can also be effective.

As we have discussed, the products eligible for mail-in rebates operate in a somewhat different market. Instead of customers going out and actively reviewing and purchasing a product, with the mail-in channel, contractors often have a significant influence on the product installed, as well as informing customers of available rebates. Results from our participant survey support the important role that contractors play in the sale of these products. Half (50%) of the surveyed participants reported hearing about the rebates through a contractor (see Figure 6-4). About one-sixth of participants (15%) said they learned about the program through the Ameren Missouri website. Other, less common responses included material from Ameren Missouri (e.g., e-mail, newsletter, bill, or other materials) (11%), friends and family (7%), an advertisement (3%), and searches on an internet search engine (3%). Of the four total respondents that recalled hearing about the program through advertisements, the ads mentioned were on the internet and an advertisement in a retail store.

Figure 6-4. PY2019 REP Program Sources of Program Awareness – Mail-In



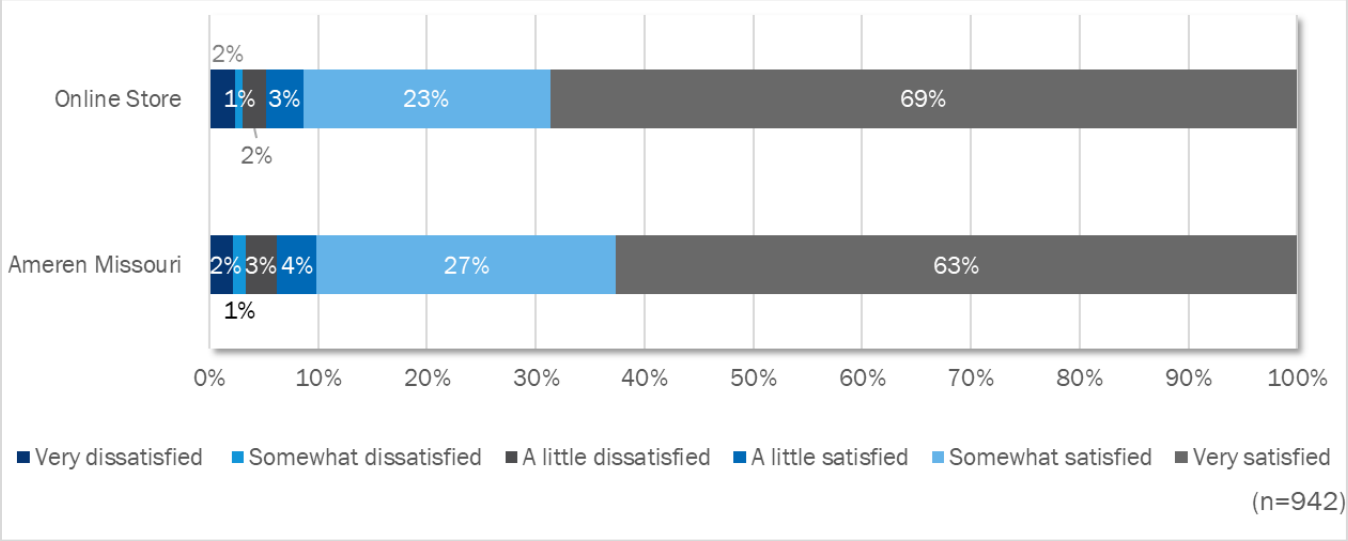
Customer Satisfaction

Overall, both Online Store and mail-in customers are highly satisfied with their respective REP Program channels. Furthermore, most tend to feel more favorable towards Ameren Missouri after their experience, suggesting the REP Program is having a positive effect on overall Ameren Missouri customer satisfaction.

Online Channel

By and large, surveyed participants were quite satisfied with the Online Store (Figure 6-5). More than two-thirds (69%) reported they were very satisfied, and an additional quarter (23%) indicated they were somewhat satisfied; very few indicated they were dissatisfied (3% very or somewhat dissatisfied). These results closely parallel overall satisfaction with Ameren Missouri, where almost two-thirds (63%) reported being very satisfied and just over one-quarter (27%) saying they were somewhat satisfied. Few indicated dissatisfaction (3% very or somewhat dissatisfied). In fact, over two-thirds of surveyed Online Store participants (68%) reported feeling *more* favorable towards Ameren Missouri after their Online Store experience (just 3% claimed they felt less favorable), suggesting that the Online Store experience is having a positive effect on overall satisfaction.

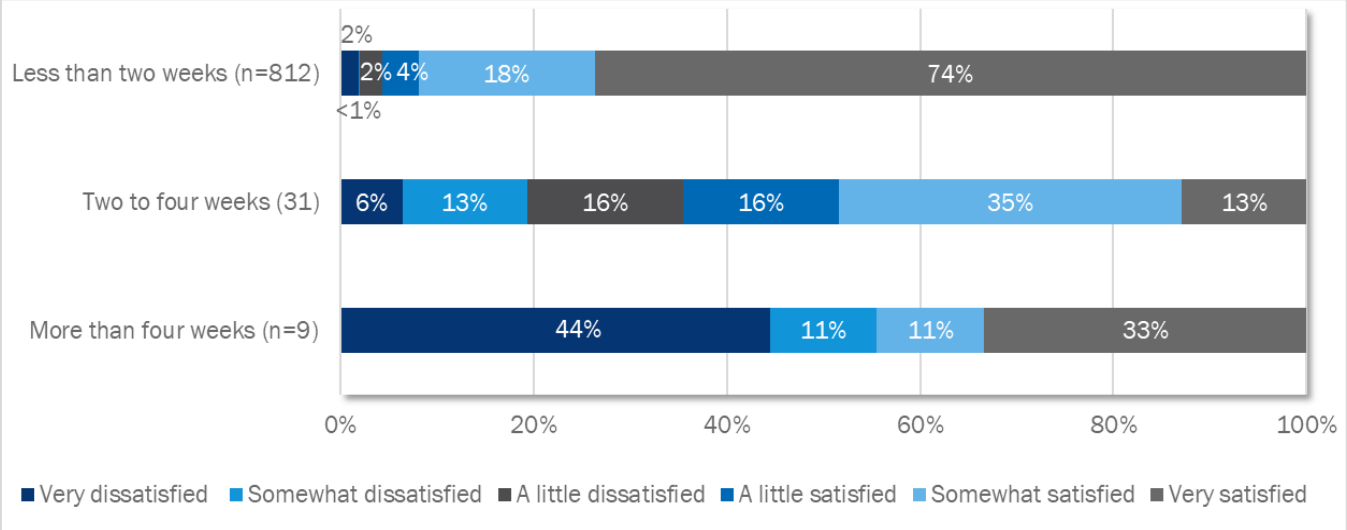
Figure 6-5. PY2019 REP Program Satisfaction - Online Store



In the survey, respondents who indicated they were dissatisfied with the Online Store (very, somewhat, or a little) were asked, in an open-ended format, to explain their reasons. Of the 45 respondents that expressed dissatisfaction with the Online Store and provided input, a relatively common concern (n=11) was customer service issues. Other concerns included receiving a defective or problematic product (n=4), the high cost of the product (n = 3), and shipping issues (n=3). We also asked a follow-up question of customers who said they were dissatisfied with Ameren Missouri. The vast majority of the responses paralleled the responses for the Online Store dissatisfaction. This is notable as it suggests that overall satisfaction (or dissatisfaction) can be so easily affected by each and every interaction a utility has with its customers, so working to ensure the complete customer journey meets their needs and expectations is important to retaining high satisfaction rates.

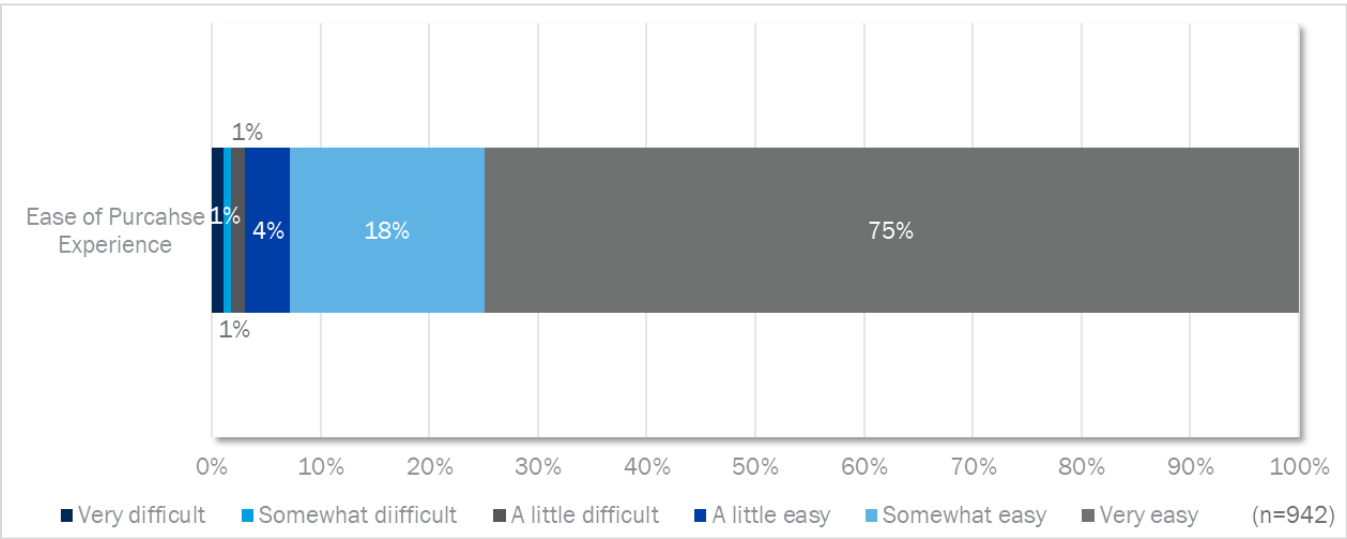
With the Online Store, one of the main factors that could affect customer satisfaction was how long it took to receive their products after ordering. The vast majority of Online Store participants (95%) received their order in less than two weeks and were rather satisfied with the amount of time it took (74% very satisfied, 18% somewhat satisfied) (see Figure 6-6). Online Store participants, however, tended to be very sensitive to the time it took to receive their product as we see sharp increases in dissatisfaction the longer it took to get the order. For the surveyed participants that took two to four weeks to get their order (4%), about one-in-five (19%) reported being very or somewhat dissatisfied; for the very small number of customers where it took more than four weeks (1%), over half (55%) indicated they were very or somewhat dissatisfied. Customers are accustomed to prompt shipping of products purchased through Amazon and other online retailers. For Ameren Missouri to operate successfully as an online retailer, prompt delivery of online sales will be key for retaining high channel satisfaction levels.

Figure 6-6. PY2019 REP Program Satisfaction with Rebate Delivery Time – Online Store



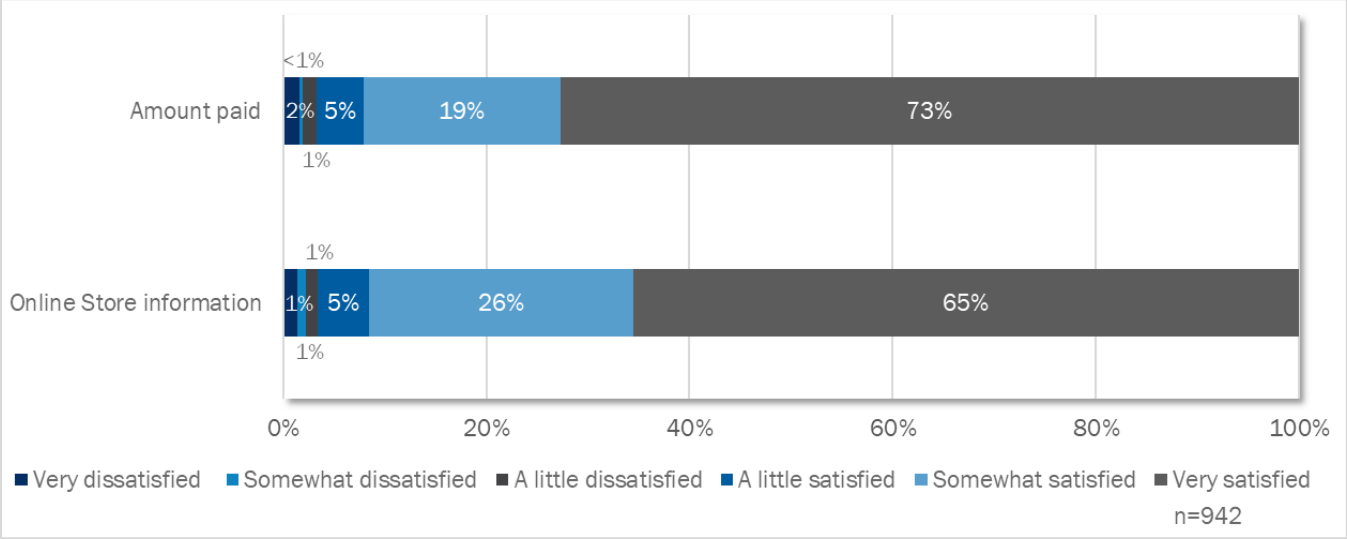
Ameren Missouri has developed an Online Store that customers generally find very easy to use (see Figure 6-7). Three-quarters of the surveyed participants (75%) found it very easy to make their purchase; about one-in-five (18%) said it was somewhat easy. Few respondents said they found it difficult (2% very or somewhat). Of the 27 people that found the process at all difficult (very, somewhat, or a little) and provided input, having trouble communicating with customer service (n=5) and shipping issues (n=3) were the most common issues mentioned.

Figure 6-7. PY2019 REP Program Experience with Purchasing – Online Store



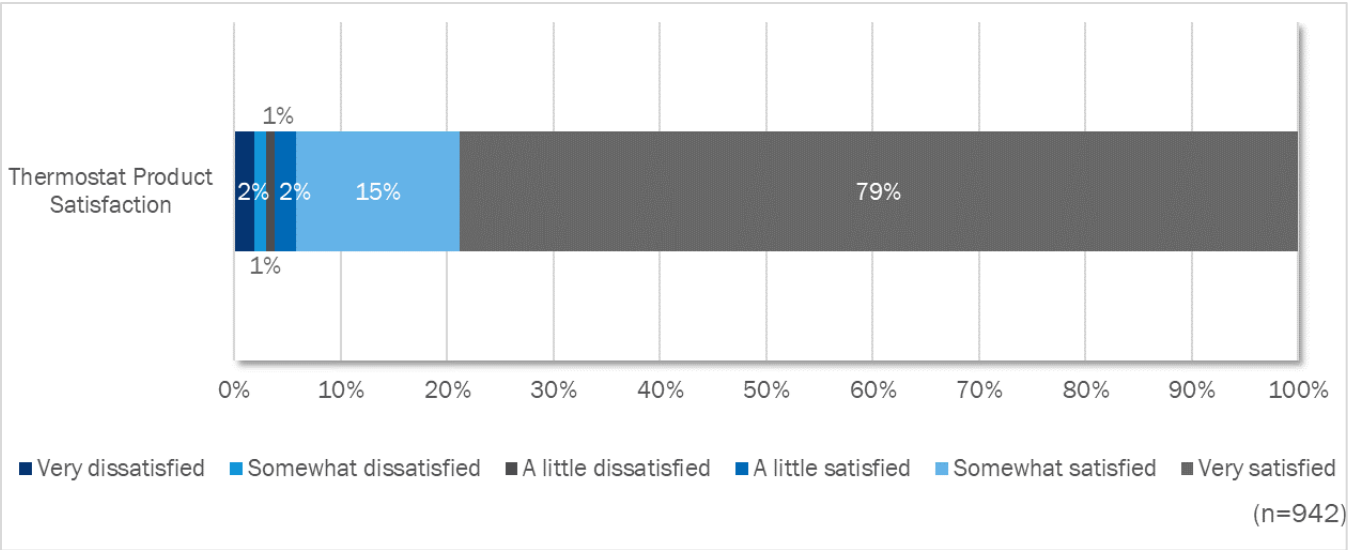
Surveyed customers were also quite satisfied with the prices on the website as well as the information that was available (see Figure 6-8). Almost three-quarters (73%) of customers were very satisfied with the amount paid, and roughly one-fifth (19%) reported being somewhat satisfied. As for the information on the site, about two-thirds (65%) reported being very satisfied and just over one-quarter (26%) being somewhat satisfied.

Figure 6-8. PY2019 REP Program Satisfaction with Program Interventions – Online Store



The quality of the products offered through the Online Store also have the potential to affect satisfaction, and with advanced thermostats, this seems to be the case. Most surveyed participants who have installed their advanced thermostats reported being rather satisfied with them (79% very satisfied, 15% somewhat satisfied) (see Figure 6-9). Only a few reported dissatisfaction (3% very or somewhat). Of those who were dissatisfied with their thermostat (very, somewhat, or a little) (n = 33), no systematic issue emerged. However, the most common concerns include the need for improved functionality, inconsistent temperature readings, and a desire for more capabilities (n = 6)) – all common issues with advanced thermostats in general. Other issues mentioned included a lack of effect on their energy bills (n = 3), and poor customer service experiences (n = 2). Also (not shown in the figure), the majority of surveyed participants reported being rather satisfied with the instructions they received on how to install their product (91% very or somewhat satisfied).

Figure 6-9. PY2019 REP Program Advanced Thermostat Product Satisfaction



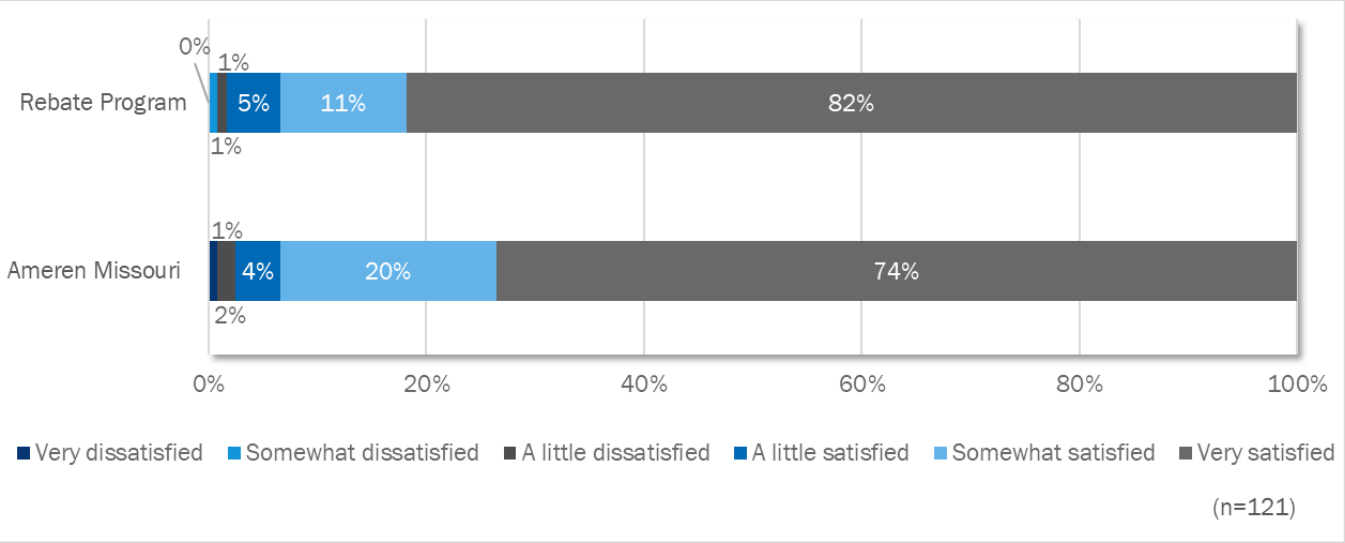
The evaluation team received 11 survey completes with customers that purchased an advanced Tier 2 power strip through the Online Store, and only eight of these reported having already installed it.[47] Of those that have installed it, four reported being very satisfied, and two were somewhat satisfied. One person reported being very dissatisfied and another a little dissatisfied. In both cases, they reported issues with the power strip turning things off when they did not want them to.

Mail-In Channel

Many of the general findings for the Online Store channel parallel the findings for the mail-in channel, though there are a few key differences.

Overall, the mail-in channel customers we surveyed were quite satisfied with the REP Program and Ameren Missouri overall (Figure 6-10). Like with the Online Store channel, participants reported being largely satisfied with the program (82% very satisfied, 11% somewhat satisfied), with only a few indicated dissatisfaction (1% somewhat dissatisfied). The majority of these participants also indicated satisfaction with Ameren Missouri overall (74% very satisfied, 20% somewhat satisfied); only a few indicated dissatisfaction (3% very or somewhat dissatisfied). Also like the prior results, over one-half (58%) of mail-in participants reported that they felt more favorable towards Ameren Missouri after participating in the program (only 3% claiming that they now felt less favorable), so the REP Program is positively affecting overall customer satisfaction.

Figure 6-10. PY2019 REP Program Mail-in Channel Satisfaction



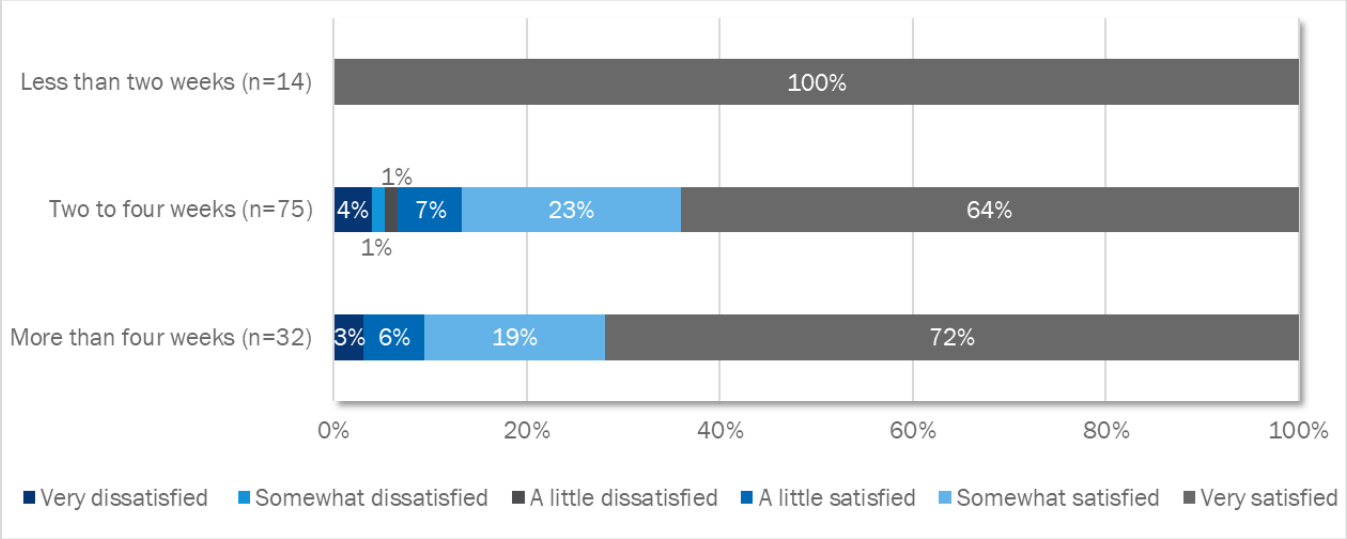
Of the small number of surveyed mail-in customers that reported being dissatisfied with the rebate program (n = 3), two of the respondents claimed that they had yet to receive their rebates (the third respondent did not provide a reason).

However, despite the small number of complaints, most mail-in participants were quite satisfied with the time it took to receive their rebates (see Figure 6-11). About one-tenth (12%) of surveyed participants

[47] Note that only 60 total power strips were sold through the REP Program in PY2019 and these 60 were purchased by 40 total customers.

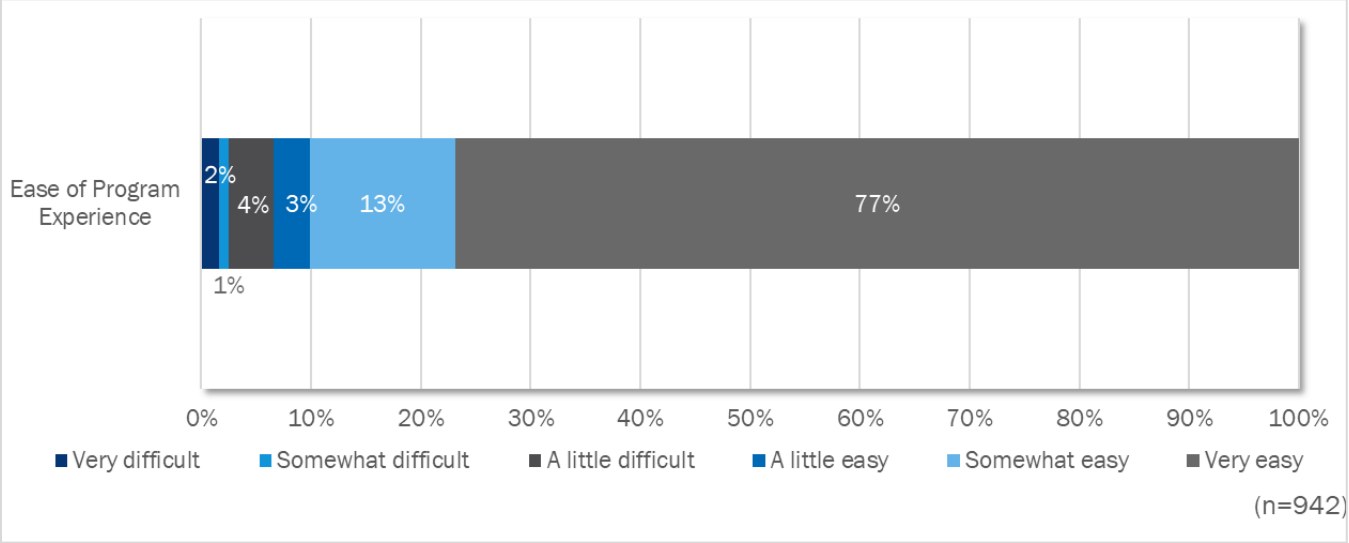
received their rebate in less than two weeks, and all (100%) were very satisfied. Roughly two-thirds of the survey participants (64%) received their rebate in two to four weeks, and the vast majority (87%) were very or somewhat satisfied; about one-quarter (25%) said they received their rebate in more than four weeks but were still quite satisfied (91% very or somewhat satisfied). Providing rebates to customers as quickly as possible should be a goal, but overall, it does not appear customers are waiting an unreasonable amount of time.

Figure 6-11. PY2019 REP Program Satisfaction with Rebate Delivery Time – Mail-in Participants



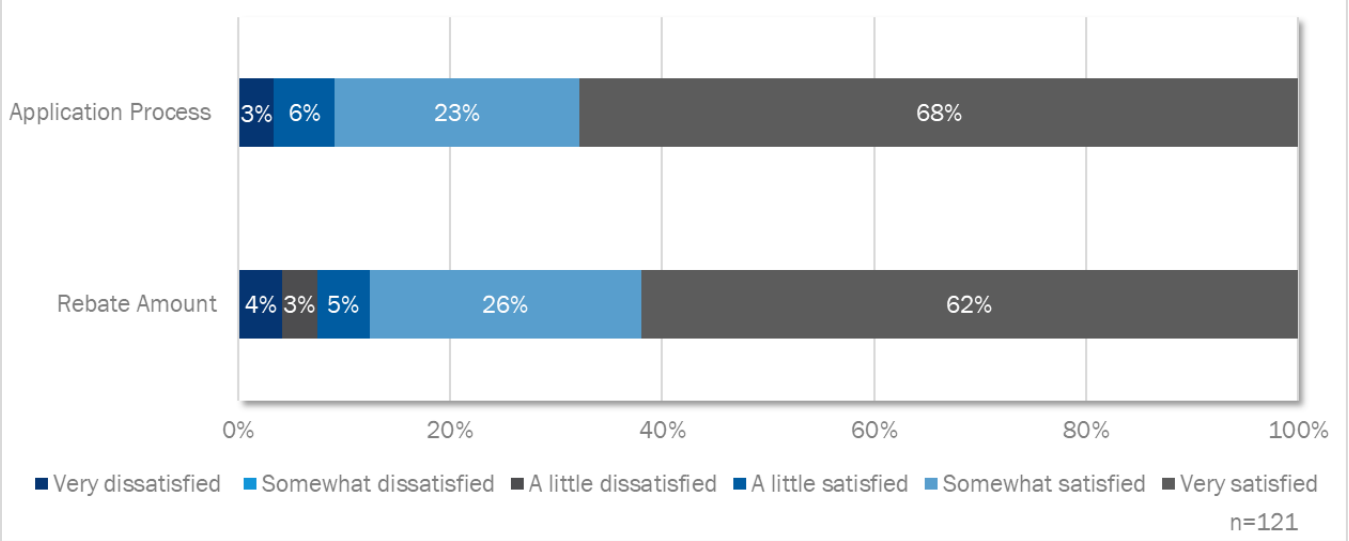
Customers generally found the mail-in rebate process very easy (see Figure 6-12). Over three-quarters of the surveyed participants (77%) found it very easy; about 13% said it was somewhat easy. Few respondents said they found participating in the program to be difficult (3% very or somewhat). Of the few people (n=8) that found the mail-in rebate process at all difficult (very, somewhat, or a little), a few participants (n=3) thought that there was too much paperwork to get together and that it was too complicated. One participant also thought there was no information on how the rebate would be provided, and another thought that the website was not easy to use.

Figure 6-12. PY2019 REP Ease of Program Experience Process - Mail-In Rebate



For the mail-in channel, customers typically work through a contractor to get a new pool pump or heat pump water heater and then submit the rebate application themselves. By and large, surveyed participants are quite satisfied with the application process as well as the size of the rebates offered. Just over two-thirds (68%) of the mail-in participants were very satisfied with the application process; almost another quarter (23%) were somewhat satisfied (see Figure 6-13). Likewise, when it comes to the rebate amount, just under two-thirds (62%) were very satisfied and about a one-quarter (26%) somewhat satisfied.

Figure 6-13. PY2019 REP Program Mail-In Miscellaneous Satisfaction



6.3.2 Gross Impact Results

Overall, the process evaluation results reveal a program that is running smoothly. Customers are largely satisfied, and processes seem to be functioning as planned. Now we transition to the energy savings side of the evaluation and present the impact evaluation findings.

As part of our evaluation, we calculated ISRs for each measure based on responses to the participant survey (see Table 6-9). The ISRs were 100% for the pool pumps and heat pump water heaters. A few surveyed customers reported having not installed their advanced thermostats (ISR = 98.8%) or power strips (ISR = 93.8%) (and did not plan to have them installed within the next six months). We weighted measure-level ISRs by ex post gross savings to derive the overall program-level ISR of 98.8%.

Table 6-9. PY2019 REP Program In-Service Rates by Measure

Measure	ISR
Advanced Thermostat	98.8%
Pool Pump	100.0%
Heat Pump Water Heater	100.0%
Power Strip	93.8%
Total	**98.8%**

The PY2019 REP Program achieved 4,922 MWh and 1.57 MW in ex post gross savings, resulting in 99.8% and 99.9% realization rates, respectively (see Table 6-10). The realization rates are just under 100% for the following reasons:

- Ex ante gross savings in the program tracking data for thermostats were computed using deemed savings values from an older version of Appendix F of the Missouri TRM. For ex post gross savings, we used the updated TRM Appendix F (dated 11/07/2019).[48]
- The evaluation team applied measure level in-service rates (ISRs) based on the results of the participant surveys. Advanced thermostats had an ISR of 98.8%, and power strips had an ISR of 93.8%. The ISRs for pool pumps and heat pump water heaters were both 100%.

Table 6-10. PY2019 REP Gross Impact Summary

	Ex Ante	Realization Rate	Ex Post
First Year Savings			
Energy Savings (MWh)	4,981	99.8%	4,922
Demand Savings (MW)	1.57	99.9%	1.57
Last Year Demand Savings			
< 10 EUL (MW)	0.00	NA	0.00
10-14 EUL (MW)	1.57	99.9%	1.57
15+ EUL (MW)	0.00	NA	0.00

[48] Note that there are actually six advanced thermostat measure types that were rebated through the program based on heating and cooling system types. This update affects five parameters for these thermostats (EFLH, SEER, Capacity, Electric Heating Consumption, and Heating Reduction) used for computing the deemed savings values.

[A] All program measures offered in PY2019 have a measure life between 10-14 years (13 years for heat pump water heaters, and ten years for advanced thermostats, pool pumps, and tier 2 power strips).

Ex post gross savings by measure are similar to ex ante gross savings (see Table 6-11). The realization rates range from 100.0% for advanced thermostats to 91.6% for heat pump water heaters. Advanced thermostats account for the majority (64%) of the program's ex post gross energy savings followed by pool pumps (31%), heat pump water heaters (5%), and Tier 2 power strips (<1%).

Table 6-11. PY2019 REP Program Annual First Year Gross Impacts

Measure Category/Enduse	Energy Savings			Demand Savings		
	Ex Ante (MWh)	Realization Rate	Ex Post (MWh)	Ex Ante (MW)	Realization Rate	Ex Post (MW)
Advanced Thermostats	3,190	98.9%	3,155	1.19	100.1%	1.19
Pool Pumps	1,503	100.0%	1,503	0.35	100.0%	0.35
Heat Pump Water Heaters	278	91.6%	255	0.02	91.6%	0.02
Tier 2 Power Strips	10	93.8%	9	<0.01	93.8%	<0.01
Total	**4,981**	**99.8%**	**4,922**	**1.57**	**99.9%**	**1.57**

Table 6-12 summarizes the total PY2019 last-year ex ante and ex post electric demand savings and realization rates by measure by EUL class. Advanced thermostats contribute to the majority (64%) of the program's gross demand savings followed by pool pumps (31%), heat pump water heaters (5%), and Tier 2 power strips (<0.1%). With regards to demand savings, advanced thermostats contribute the majority (76%) of the savings, followed by pool pumps (23%), heat pump water heaters (1%), and power strips (<1%).

Table 6-12. PY2019 REP Program Annual Last Year Gross Demand Impacts

Measure Category	Ex Ante (MW) Total				Gross Realization Rate	Ex Post (MW) Total			
	<10	10-14	15+	Total		<10	10-14	15+	Total
Advanced Thermostats	0.00	1.19	0.00	1.19	100.1%	0.00	1.19	0.00	1.19
Pool Pumps	0.00	0.35	0.00	0.35	100.0%	0.00	0.35	0.00	0.35
Heat Pump Water Heaters	0.00	0.02	0.00	0.02	91.6%	0.00	0.02	0.00	0.02
Tier 2 Power Strips	0.00	<0.01	0.00	0.00	93.8%	0.00	<0.01	0.00	0.00
Total	**0.00**	**1.57**	**0.00**	**1.57**	**99.9%**	**0.00**	**1.57**	**0.00**	**1.57**

[a] All program measures offered in PY2019 have a measure life between 10-14 years (13 years for heat pump water heaters, and 10 years for advanced thermostats, pool pumps, and tier 2 power strips).

While individual savings inputs may increase savings, others may decrease savings, both having an effect on realization rates. The electric energy and demand realization rates for the PY2019 REP Program are driven by the following differences:

- **Advanced Thermostats:** The realization rates for advanced thermostats is 100.1%.
  - **Updated Version of Appendix F:** The Evaluation Team submitted updates to Appendix F which were later released in November 2019. Appendix F was updated to incorporate results from the PY2018 evaluation for the following advanced thermostat parameters: effective full load hours (EFLH), efficiency, capacity, electric heating consumption, and heating reduction. While ex ante savings correctly applied the savings assumptions from an older version of Appendix F (January 2019), ex post impacts relied on inputs in the most recently released version (November 2019).

- **In-service Rate (ISR):** Ex post analysis applied an ISR of 98.8% to all advanced thermostat measures, replacing the Appendix F deemed effective ISR value of 100%. The ISR was developed using self-reported results from participant surveys completed in PY2019.

- **Heat Pump Water Heaters (HPWH):** The realization rate for heat pump water heaters is 91.6%.
  - **Updated Version of Appendix F:** The Evaluation Team submitted updates to Appendix F which were later released in November 2019. Appendix F was updated to incorporate results from the PY2018 evaluation for the following HPWH parameters: baseline energy factor (EFBase), efficient energy factor (EFEE), number of household members, latent multiplier (LM), location factor (LF), and market saturation by electric space heating equipment type (e.g., electric resistance, heat pump). While ex ante savings correctly applied the savings assumptions from an older version of Appendix F (January 2019), ex post impacts relied on inputs in the most recently released version (November 2019).

- **Tier 2 Power Strips:** The realization rates for tier 2 power strips is 93.8%.
  - **In-service Rate (ISR):** Ex post analysis applied an ISR of 93.8% to all tier 2 power strip measures, replacing the Appendix F deemed effective ISR value of 100%. The ISR was developed using self-reported results from participant surveys completed in PY2019.

6.3.3 Net Impact Results

Net-To-Gross Ratio Results

The evaluation team surveyed 1,063 total REP Program participants to develop individual FR and PSO scores. Table 6-13 presents the results of our NTG analysis.

Table 6-13. PY2019 REP Program NTGR

Measure/Enduse	Free-Ridership (FR)	Participant Spillover (PSO)	NTGR (1-FR+PSO)
Advanced Thermostats	29.3%	2.8%	73.5%
Pool Pumps	35.6%	2.8%	67.2%
Heat Pump Water Heaters	40.4%	2.8%	62.4%
Tier 2 Power Strips	16.6%	2.8%	86.2%
Overall Program	**31.8%**	**2.8%**	**71.0%**

Program free ridership varies by measure. Advanced thermostats, which contributed the majority of gross savings to the program (64% of ex post gross), had the second lowest free ridership rate (29.3%). Pool pumps, which contributed the bulk of the remaining gross savings (31% of ex post gross), had a free ridership rate of 40.4%.

Based on results from the participant survey, we identified 31 respondents who had installed a combined 74 measures that qualified for PSO. Our engineering analysis of SO measures for these participants yielded total spillover savings of 19,997 kWh (see Table 6-14).

Table 6-14. PY2019 REP Program Participant Spillover and Savings

Measure	Qty	Savings
Ceiling Insulation	9	1,084
Advanced Thermostat	8	1,903
Refrigerator	7	377
Low Flow Faucet Aerator	2	0
Low Flow Showerhead	5	0
Storm Windows	2	154
Air Sealing	8	826
Advanced Tier 1 Power Strips	4	124
Clothes Washer	7	208
Water Heater Wrap	3	284
Heat Pump Water Heater	4	10,324
Cooling Equipment	2	465
Heating Equipment	3	1,245
Pool Pump	1	1,800
Dehumidifier	1	301
Air Purifier/Cleaner	1	867
ENERGY STAR Dishwasher	2	36
Other	5	0
Total	**74**	**19,997**

We divided our estimate of PSO savings from our survey respondents (19,997 kWh) by total program ex post gross savings of all surveyed participants (722,759 kWh), which yields a SO rate of 2.8%, as shown in Equation 6-1.

Equation 6-1. PY2019 Efficient Products Program Participant Spillover Rate

$$PSO\ \%_{Energy} = \frac{Total\ participant\ sample\ SO\ (kWh)}{Total\ participant\ sample\ savings\ (\mathrm{kWh})} = \frac{19{,}997\ kWh}{722{,}759\ \mathrm{kWh}} = 2.8\%$$

Net Impacts

The evaluation team applied the PY2019 NTGRs as well as the portfolio-wide energy NPSO rate of 13.7% and the demand NPSO of 7.7% to ex post gross savings values to determine net impacts for the PY2019 REP Program (see Table 6-15). Overall, the PY2019 REP Program delivered a total of 4,1670 MWh of ex post net energy savings.

Table 6-15. PY2019 REP Program Annual First Year Net Energy and Demand Savings

Measure Category	Energy Savings			Demand Savings		
	Ex Post Gross (MWh)	NTGR	Ex Post Net (MWh)	Ex Post Gross (MW)	NTGR	Ex Post Net (MW)
Heat Pump Water Heaters	255	62.4%	159	0.02	62.4%	0.01
Learning Thermostats	3,155	73.5%	2,317	1.19	73.5%	0.88
Pool Pumps/Franklin	1,503	67.2%	1,010	0.35	67.2%	0.24
Tier 2 Power Strips	9	86.2%	8	0.00	86.2%	0.00
Non-Participant Spillover	NA	NA	675	NA	NA	0.12
Total	**4,922**	**84.7%**	**4,170**	**1.57**	**79.6%**	**1.25**

Finally, Table 6-16 shows the last-year demand savings by measure by EUL class. The PY2019 REP Program delivered 1.19 MW of 10-14 year last-year ex post net demand savings.

Table 6-16. PY2019 REP Program Annual Last Year Net Demand Impacts

Measure Category	Ex Post Gross (MW)				NTGR	Ex Post Net (MW)			
	<10	10-14	15+	Total		<10	10-14	15+	Total
Advanced Thermostats	0.00	1.19	0.00	1.19	73.5%	0.00	0.88	0.00	0.88
Pool Pumps	0.00	0.35	0.00	0.35	67.2%	0.00	0.24	0.00	0.24
Heat Pump Water Heaters	0.00	0.02	0.00	0.02	62.4%	0.00	0.01	0.00	0.01
Tier 2 Power Strips	0.00	<0.01	0.00	0.00	86.2%	0.00	<0.01	0.00	0.00
Nonparticipant Spillover	NA	NA	NA	NA	NA	0.02	0.06	0.04	0.12
Total	**0.00**	**1.57**	**0.00**	**1.57**	**79.6%**	**0.02**	**1.19**	**0.04**	**1.25**

7. Energy Efficiency Kits (EEK)

This section summarizes the PY2019 evaluation methodology and results for the Energy Efficiency Kits (EEK) Program. Additional details on the methodology, including data collection instruments and sampling plans, are presented in Appendix A.

7.1 Evaluation Summary

The Energy Efficiency Kits (EEK) Program is designed to increase customer awareness of the benefits of high-efficiency products, educate residential customers about energy consumption in their homes, and offer information, products, and services to residential customers to encourage cost-effective energy savings. The target market includes all residential customers within the Ameren Missouri service territory. EEK includes a range of small energy-efficient products, such as LED light bulbs, hot water pipe wrap, low-flow showerheads, and faucet aerators.

The EEK Program provides energy efficiency kits and education materials to customers through an educational channel that targets, but is not limited to, sixth-grade students. The program combines a set of classroom activities with projects in the home to install energy-efficient products. PY2019 marketing activities included as needed mailings and e-mails to teachers.

The EEK Program accounts for 6% of planned incremental net energy savings and 2% of planned residential portfolio demand savings.

7.1.1 Participation Summary

In PY2019 238 schools participated in the EEK Program and distributed 21,478 kits to their students. See Table 7-1. In PY2019 the Education Kits program distribution surpassed the MEEA Program estimated annual installations of 18,000 kits for 2019. Adjusting the 21,478 distributed kit total by the 88% of parents that reported installing at least one bulb results in roughly 18,000 kits distributed with at least one kit measure installed in PY2019.

Table 7-1. PY2019 EEK Participation Summary

Enduse/Channel	Schools		Work Orders [a]		Measures		Ex-Ante Savings	
	Count	%	Count	%	Count	%	MWh	%
Bathroom Faucet Aerator	238	100%	409	100%	21,478	9%	149	2%
Dirty Filter Alarm (Single Family)	238	100%	409	100%	21,478	9%	1,380	22%
Kitchen Faucet Aerator	238	100%	409	100%	21,478	9%	875	14%
LED – 10W (Halogen Baseline)	238	100%	409	100%	85,912[b]	36%	2,382	38%
Low Flow Showerhead	238	100%	409	100%	21,478	9%	1,276	20%
Pipe Insulation	238	100%	409	100%	64,434[c]	27%	217	3%

[a] The Work Order is a unique ID assigned to each class in which the kits are distributed. Each teacher can have multiple Work Orders, one for each class where they distribute kits. Therefore, an individual school and teacher can have multiple Work Orders.

[b] This is the total lamps from 21,478 kits, which is 4 lamps per kit (21,478*4 lamps = 85,912 lamps).

[c] This is the total square feet of pipe insulation, 3 feet per kit (21,478*3=64,434).

7.1.2 Key Impact Results

The EEK Program offers six measures to participants. Program staff use measure-specific equations and variables sourced from the Ameren TRM[49] to estimate ex-ante savings for each. In PY2019 the evaluation team conducted a participant survey to collect self-reported values to update the following savings equation inputs: measure in-service rates, household occupancy, percentage of homes with electric hot water heaters, and leakage out of the Ameren Missouri territory.

As shown in Table 7-2, the EEK Program achieved 65% of Ameren Missouri's net energy savings goal. Upon review of the program database and included savings values, the evaluation team could not trace the ex-ante energy efficiency kit savings (especially peak savings) to their original savings inputs. The implementer provided several input scenarios to the evaluation team without indicating which inputs they had used. The data accuracy issues directly correlate to the gross realization rates presented in Table 7-2 below.

Table 7-2. PY2019 EEK Impact Summary

	Ex Ante Gross	Realization Rate	Ex Post Gross	NTGR	Ex Post Net	Goal/Target Net	% of Goal/Target
First Year Savings							
Energy Savings (MWh)	6,280	87.8%	5,512	77.5%	4,274	6,551	65%
Demand Savings (MW)	1.22	84.3%	1.03	79.1%	0.82	1.16	70%
Last Year Demand Savings							
< 10 EUL (MW)	0.00	NA	0.00	NA	0.01	0.00	NA
10-14 EUL (MW)	0.87	86.1%	0.75	90.2%	0.67	0.76	89%
15+ EUL (MW)	0.36	80.1%	0.28	45.9%	0.13	0.40	33%

Overall, the EEK Program was the fifth-largest program in the PY2019 residential portfolio, accounting for 4% of ex-post net residential portfolio energy savings and 3% of ex-post net residential portfolio demand savings.

7.1.3 Key Process Findings

The evaluation team identified the following key process findings based on the PY2019 evaluation:

- Both parents and teachers rate their satisfaction with the program as high, with 96% of parents and 97% of teachers rating the program a 5 or 6 on a 1-6 scale.[50] Additionally, 69% of parents reported that their child demonstrated or told them what they learned in class about saving energy. Ninety-seven percent of parent's report feeling the lessons received as part of the program are a good use of the child's education time.
- LED's are the most frequently installed item, with 88% of parents reporting having installed at least one LED bulb. Installation rates of the non-lighting kit items range from 56% for hot water pipe insulation to 40% for the kitchen faucet aerator. The primary reasons parents state for not installing

[49] Ameren TRM – Appendix I, 2019-11-07
[50] 1= Very Dissatisfied, 2 = Somewhat Dissatisfied, 3 = A Little Dissatisfied, 4 = A little Satisfied, 5 = Somewhat Satisfied, 6 = Very Satisfied

the kitchen faucet aerators are 1) they haven't had time yet, and 2) the provided faucet aerator did not fit.

- Furnace whistles are the most novel item, with 29% of respondents stating they were not aware of the tool prior to their student's involvement in the program.
- The main suggestion for improvement from a minority of parents references feelings of guilt with wasted materials (6% of responding parents mentioned this). Parents who, for whatever reason, could not use their kit items (either they already had efficient items installed in their home or the items did not fit), did not like the feeling that their receiving the kit was contributing to waste of useful items. A few teachers also report they would appreciate opportunities to reduce waste in what they view to be an otherwise "environmentally friendly" program.
- Ten percent of teachers reported difficulty implementing the lessons and handing out the kits in the required timeframe. They would like more lead time and would like to be able to implement the program curriculum at the time they choose in the school year cycle. While 51% of teachers state they used the entire curriculum, 49% did not. Of the 49% that did not use the entire curriculum, the most frequently used lesson is "Forms of Energy" at 80% of teachers, and the least is Wrap Up (20% of teachers).

As a key part of the evaluation, we explored a set of evaluation questions required by 4 CSR 240-22.070(8). Table 7-3 shows the related findings for each.

Table 7-3. Summary of Responses to CSR Process Evaluation Requirements

CSR Required Process Evaluations Questions	Findings
What are the primary market imperfections that are common to the target market segment?	The primary market imperfection that the program addresses is the lack of consumer awareness about (or the reluctance to purchase) the energy-saving kit items. The program addresses these two barriers to installation by providing the kit items free and educating the children (and, indirectly, household members) about the energy savings potential of installing the items. All potential housing stock characteristics may be included in kit product distribution due to the program being offered to all sixth-grade students. The 2019 residential baseline study results indicate shrinking opportunity for the standard LEDs included in the kit. Nearly 70% of light sockets that take a standard bulb contain an efficient bulb (either CFL or LED).LEDs also had a higher FR than other kit measures suggesting that many families were already using LEDs and would purchase them on their own. Faucet flow rate data from the baseline study indicate somewhat more opportunity for high-efficiency faucet aerators (39% of customers have aerators with flow rates greater than 2.2 GPM).
Is the target market segment appropriately defined, or should it be further subdivided or merged with other market segments?	Yes. The program targets residential customers with children in the sixth grade. The intent is to increase awareness of energy efficiency and Ameren Missouri's energy efficiency programs and achieve energy savings through the installation of kit items. However, the program does distribute kits in schools that are near Ameren Missouri's territory border so that 28% of kits went to households that are not Ameren Missouri customers.
Does the mix of enduse measures included in the program appropriately reflect the diversity of	Yes. Since the residential customer enduse technologies can vary so widely in age, make, model, and pre-existing efficiencies, kit programs like this, in particular, must carefully weigh the cost of included items and the potential for the items not to be installed by the customer. Survey results indicate the following installation rates: at least

CSR Required Process Evaluations Questions	Findings
enduse energy service needs and existing enduse technologies within the target market segment?	one LED bulb (88%), hot water pipe insulation (56%), showerhead (54%), bathroom faucet aerator (48%), furnace filter whistle (44%), and kitchen faucet aerator (40%). Customer responses indicate a desire to avoid wasting items. Faucet aerators appear to be the most likely to "not fit," and adaptors have been requested for inclusion in the kits by customers for this so that more may be utilized.
Are the communication channels and delivery mechanisms appropriate for the target market segment?	Yes, though adjustments could be made to better align the program with teachers' unique needs. The program provides teachers with teaching materials, student education worksheets, the kit materials, and installation instructions. While program satisfaction is very high, the most frequent suggestion for program improvement from the teachers is a preference for being provided with an electronic version of all paper materials prior to receiving the kits so that they could print only the materials they would use and reduce the waste from un-used printed materials.
What can be done to more effectively overcome the identified market imperfections and to increase the rate of customer acceptance and implementation for select enduses/measure groups included in the Program?	Some participants suggest an opt-in system could reduce waste and increase adoption rates. Also, adding adapters to the faucet aerators so they fit a greater range of faucets. Ameren Missouri is considering adding residential and business kit distribution channels to further address the market imperfections for households without school-aged children.

7.1.4 Conclusions and Recommendations

Based on the results of this evaluation, the evaluation team offers the following conclusions and recommendations for the EEK Program moving forward:

- Conclusion #1: The implementation team is claiming savings for all kits distributed to teachers, regardless of whether the teachers handed out the kits to students in that program year. We identified 70 kits in the tracking data that teachers did not hand out to students this program year (see Table 7-4).
  - Recommendation: The evaluation team recommends that the program should not claim savings for measures that were not distributed to students. Savings from kits should be claimed in the program year that the students receive the kits.

Table 7-4. Kits students had not received in PY2019.

Workorders that were distributed to Children	Workorders that were not distributed to children	Total Workorders claimed, PY2019
409	70	479

- Conclusion #2: The tracking database uses negative quantities to delete kits that were incorrectly documented as having been distributed to teachers from being counted towards the total program savings.

- Recommendation: In PY2019 the implementation team inserted a negative quantity in the "Quantity" field to indicate kits that were incorrectly quantified, while the "Measure Status" field says "Installed." For increased clarity, the "Measure Status" field should match the savings field with a status such as "not distributed" or "returned." This will lead to less confusion and a higher accuracy of calculated ex-post savings.

- Conclusion #3: The evaluation team's participant survey revealed there is larger percentage of kits distributed outside the Ameren territory than previously assumed.
  - Recommendation: The leakage out of the Ameren territory is a contributor to the Realization Rates in Table 7-5. The leakage rate used in the ex-ante calculations is from the Ameren Missouri deemed input tables (which sources a PY2018 survey). The PY2018 value is lower than what was found in the PY2019 participant survey by 20%. Due to the magnitude of the difference, we recommend performing an annual leakage study to update the leakage rates, as there are significant differences year to year. See Table 7-5for updated values.

Table 7-5. Updated Leakage Rates

Ex-Ante Leakage Rate	Ex-Post Leakage Rate	Difference
92%	72%	20%

- Conclusion #4: While teachers are satisfied, the program could be improved by giving teachers more time to plan for and incorporate the curriculum.
  - Recommendation: *Let teachers know in* August when the kits will be shipped so they can plan this in their curriculum. To plan appropriately, they would like a) the timeline for receiving the kit; b) the timeline for teaching the material, handing out the kits, and requesting materials back from the students; c) and electronic copies of all handouts, surveys, etc. so they can plan their curriculum accordingly and request or print only the materials they will use.
  - Recommendation: Allow the teachers to be flexible with the times they schedule implementing the program. Some suggest moving the due date to March or April because this is after core testing when teachers will have more flexibility. Ameren Missouri may consider shifting this program to an implementation and evaluation cycle that parallels the school year calendar. This would allow teachers more flexibility in the timing of including the kit program materials.

7.2 Evaluation Methodology

The evaluation team performed both impact and process evaluation activities to assess the performance of the EEK Program in PY2019. In addition to the overarching research objectives outlined for the residential portfolio, the evaluation team explored the following EEK specific objectives:

- Characterize program participation based on the number of kits distributed, location of participating schools, single family customers receiving kits, and community events where kits were distributed;
- Evaluate the effectiveness of classroom and/or kit educational materials and installation instructions;
- Measure customer satisfaction with kit items;

- Measure teacher satisfaction with program processes and educational materials; and
- Provide evaluation results that can be used to improve the design and implementation of the EEK Program.

The evaluation team addressed these research objectives by completing a review of program materials (implementation plans, teacher materials, and student take-home worksheets), the program theory and logic model, and the implementer's data-tracking system. We also conducted a survey with a sample of participating teachers, administrators, students, and parents.

Table 7-6 provides an overview of the EEK Program evaluation activities. Following the table, we outline program-specific aspects of key evaluation methodologies.

Table 7-6. PY2019 Evaluation Activities for the EEK Program

Evaluation Activity	Description
Program Manager and Implementer Interviews	▪ Conducted interviews (1) before program launch to inform evaluation planning and (2) towards the end of PY2019 to understand program staff's perspective on program performance.
Program Material Review	▪ Reviewed available program materials to inform evaluation activities.
Program Theory/ Logic Model Review	▪ Reviewed implementer's program theory/logic model to understand program activities and their expected outputs and outcomes, including expected impacts on the market.
Tracking System Review	▪ Reviewed implementer's tracking system to ensure that data required for the evaluation is being collected.
Participant Survey	▪ Conducted a parent survey to collect data to inform NTG (free ridership and participant spillover), in-service rates of kit equipment, and yield process-related insights. ▪ Conducted a teacher/administrator survey to yield satisfaction and process-related insights. ▪ Reviewed the student take-home survey to inform in-service rate, satisfaction, and process-related insights.
Engineering Analysis	▪ Reviewed program database to check that program data are complete and that program-installed measures meet all program requirements. ▪ Verified that ex-ante savings use correct TRM values and algorithms. ▪ Developed ex-post savings using TRM values and algorithms, program tracking data, and any updated evaluation-estimated parameters.
NTGR/Net Impact Analysis	▪ Developed estimates of participant free ridership and spillover. Estimated PY2019 net impacts.

Participant Survey

The evaluation team collected data through three surveys:

- Students received a take-home paper worksheet from the program implementer, which they completed and returned to the implementer. The implementer scanned and shared copies of these completed worksheets with the evaluation team.

- The bottom of the take-home student worksheet contained a web address for the evaluation team's online parent survey to inform NTG, in-service rates, and process-related insights.

- The evaluation team e-mailed a request to teachers and administrators to reply to an online survey to yield satisfaction and other process-related insights.
- Ameren Missouri distributed a paper survey form for teachers or administrators to complete and return with the extra kits that the implementer collected and returned to Ameren Missouri.

A census of available participants received each evaluation survey form. Table 7-7 below shows the response rates to the two evaluation surveys.

Table 7-7. Evaluation Survey Response Rates by Population

Survey Subject and Mode	Administered by	Participant Count (2019)[a]	Response Count (completed surveys)	Response Rate
Parent Online Survey	Evaluation Team	3,169 Home Energy Worksheets Returned (Spring and Fall)	118 Parents (includes Spring and Fall)	3.7% of Returned HEWs
Teacher or Administrator Online Survey	Evaluation Team	284 Unique Schools 430 Unique E-mails	104 Schools 118 E-mails	37% 27%

[a] 2019 participants are considered those which the teachers distributed to students in 2019. Some teachers received kits in 2019 but did not distribute these kits to students until 2020 (these will be considered 2020 participants and are not included in this evaluation).

7.3 Evaluation Results

In the remainder of this section, we present the results of both impact and process evaluations.

7.3.1 Process Results

To complete the process evaluation of the EEK Program, we drew upon several different research activities—i.e., interviews with program staff, program tracking data review, and surveys with participating students, parents, teachers, and school administrators.

Program Tracking Data Review

As part of the engineering analysis (see Table 7-6), we completed a thorough review of program tracking data provided by the EEK Program implementation team. Through this review, the evaluation team identified several instances where the program database tracked negative measure quantities or an unknown or not distributed status. As a result of these issues, our analysis of gross impacts included 85% of the original measures tracked in the EEK program tracking database (see Table 7-8). This table shows 70 of the kits were listed as No or NA Designation, and three had a negative savings associated with them.

Table 7-8. Kits with Negative Savings or a Not Distributed Status

Description	Kit Quantity	Percentage
Total Count	477	100%
No or NA Designation (removed from analysis)	70	15%
Negative Savings	3	1%
Total Count Included in Analysis	**404**	**85%**

Our review of program tracking data also found the following:

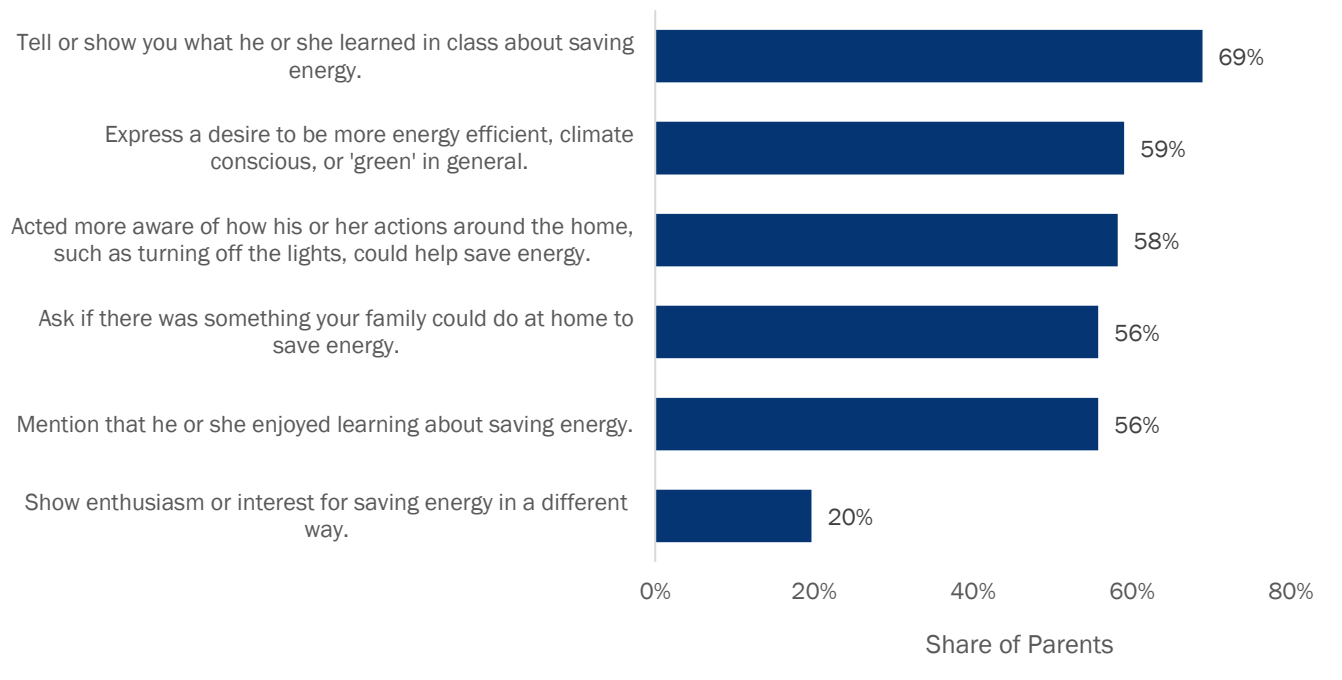
- The method the implementation team used in PY2019 to remedy kit values incorrectly distributed is to input a negative quantity in the "Quantity" field, while the "Measure Status" field says "Installed." For increased clarity, the "Measure Status" field should match the savings field with a status such as "not distributed" or "returned." This will lead to less confusion and a higher accuracy of calculated ex-post savings.
- The implementation contractor included savings for units that had been distributed to the teachers, but that the teachers had not yet distributed the kits to the students. This was the result of an end of year push to get additional kits out to participating teachers. However, because of the timing of kit delivery, not all teachers were able to distribute the kits to their students before the end of the program year. It is important to note that the implementation team and Ameren Missouri alerted the evaluation team to the inclusion of these kits in the tracking data at the close of the program year.

Participant Experience

Through the parent survey, we assessed how the EEK Program might have taught participating households about ways they could save energy in their homes and encouraged students to seek more information about energy efficiency, or related topics. According to survey responses, the majority of participating students engaged with their parents at home and shared what they learned about saving energy. The parents report students most frequently told or showed their household what they learned in class about saving energy (Figure 7-1).

ONE PARENT STATED, "MY CHILD WAS SO EXCITED ABOUT THE KIT SHE INSISTED WE INSTALL THE GIFTED ITEMS THAT DAY SHE BROUGHT IT HOME."

Figure 7-1. Share of Parents Observing These Behaviors in Their Child (n=121)



Measure In-Service Rates

Though the measure-specific ISRs factor into the impact evaluation (see Section 7.3.2), through this research, we identified several pertinent process issues described in the subsections below.

While 69% of parents reported installing all four of the LEDs bulbs distributed in the kit, the remaining 31% installed three or fewer. When asked why the family didn't install all the LED bulbs, the primary reason (noted by 71% of respondents that did not install all bulbs) is that the family is saving the bulbs for when others burn out. Only four respondents reported removing the LED bulbs they did install. One removed the bulb because it burned out, and the other three reported not liking the light quality (hue or brightness) of the bulb.

Similar to the method used to estimate the ISR for LEDs purchased through Ameren Missouri's online store (see Section 3.2), we estimated both the first year ISR and the cumulative ISR over a six year period. As we assume that participants install LEDs received through the EEK Program in subsequent years, we used the cumulative ISR to estimate gross savings for the program.

Table 7-9. UMP Calculated ISRs for LED Bulbs

First Year ISR	Cumulative ISR
0.77	0.92

Forty to fifty-six percent of respondents reported installing other non-lighting measures included in their kits (see Table 7-10). Once participating households installed the non-lighting measures, they removed less than 2% of the equipment. Parents that did not install non-lighting measures most often reported that they still intend to but have not had time to do so since receiving their kits.

Table 7-10. Non-lighting Kit Measure In-Service Rates and Rationale for Not Installing

Measure	Percent of Parents Reported Installed	Second most commonly mentioned rationale for not installing [a]
Hot Water Pipe Insulation	56%	Already insulated (7%)
Showerhead	54%	Already have efficient one (6%)
Bathroom Faucet Aerator	48%	Doesn't fit (11%)
Furnace Whistle	44%	Don't need it (5%)
Kitchen Faucet Aerator	40%	Doesn't fit (18%)

[a] The primary reason for not installing for all measure types is "have not had time to yet."

Teachers use of provided lesson plans and materials

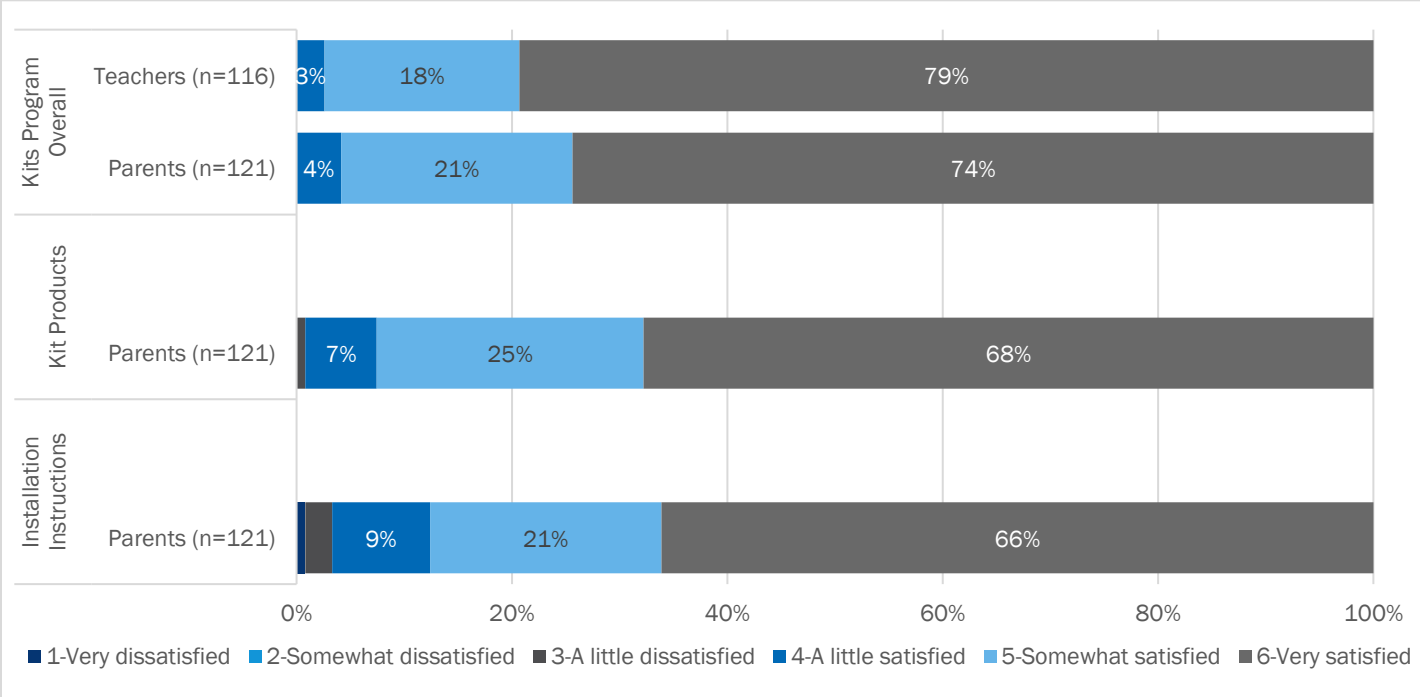
Fifty-one percent of teachers stated they used the entire curriculum. The most frequently used lesson is 'Forms of Energy' at 80% of those who did not use the entire curriculum, followed by natural Resources (76%) and Using Electricity / Conserve at Home (71%). Using Natural Gas / Conserve at Home (46%), Peak Time and Demand Response (29%), and Wrap Up (20%) were less frequently used. When teachers did not use all the material, the majority (64% of total respondents) stated the reason to be lack of time to incorporate the curriculum into their classroom.

Program Satisfaction

Parents were highly satisfied with the EEK Program, the measures they received in their kits, and how the program encouraged their children to learn about household energy use and energy efficiency. Ninety-seven percent of parents that responded to the survey indicated that the lessons their student received as part of the program were a good use of the child's educational time. Both parents and teachers rate their satisfaction with the program high, with 96% of parents and 97% of teachers rating the program a 5 or 6 on a 1-6 scale,[51] and teachers averaging 5.8. Parents also rate the instructions on how to install the products as a 5.5 on the same scale, and the products in the kit as a 5.6 (Figure 7-2).

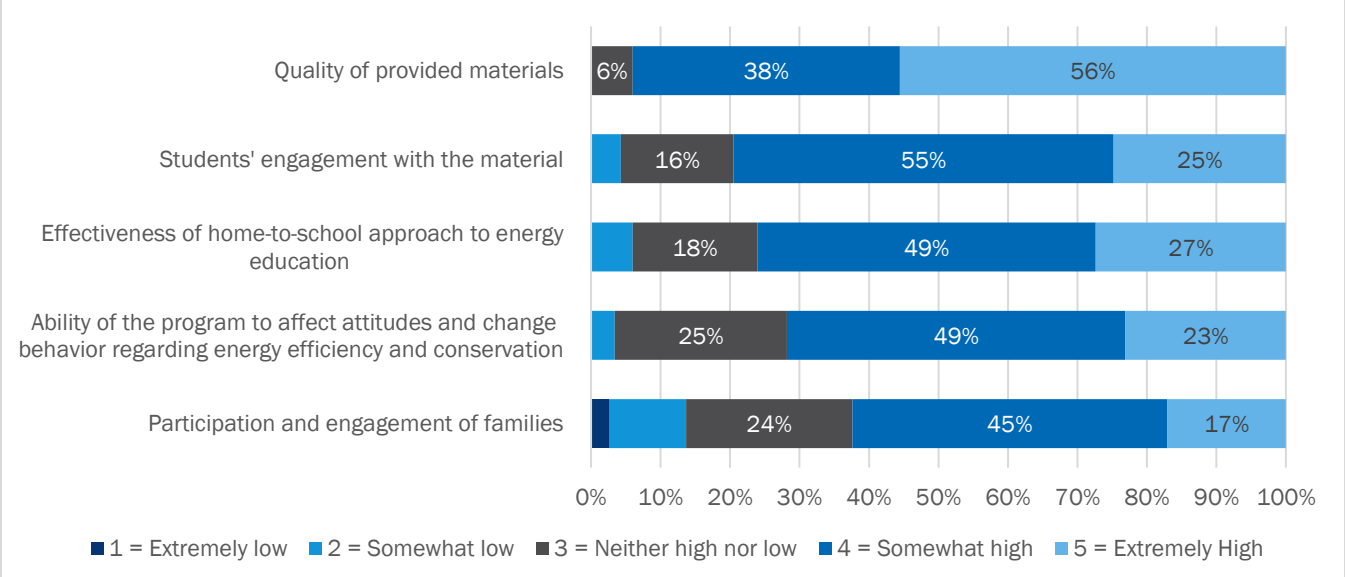
[51] 1= Very Dissatisfied, 2 = Somewhat Dissatisfied, 3 = A Little Dissatisfied, 4 = A little Satisfied, 5 = Somewhat Satisfied, 6 = Very Satisfied

Figure 7-2. Parent and Teacher Survey Satisfaction Results



Teachers that responded to the survey also found the materials provided though the EEK Program to be of high quality. Additionally, teachers noted that, for the most part, students engaged with the material and found the EEK Program to be an effective way of encouraging families to learn more about how to save energy in their homes (see Figure 7-3).

Figure 7-3. "Please rate the following aspects of the program"



Most teachers that responded to the survey also found the materials clear and easy to teach to their students.

Table 7-11. Responses to clarity and appropriateness of program components

Question	% Yes	% No
Were the instructions provided for you clear and easy to understand?	100%	-
Were the instructions provided for your students clear and easy to understand?	99%	1%
Was the energy content within the program grade level appropriate?	97%	3%

Finally, ninety-eight percent of teachers that responded to the survey said they would participate in the program again, and 99% stated they would recommend the program to other teachers.

Suggestions for Program Improvement

While both participating teachers and parents reported high satisfaction with the EEK Program, a minority offered suggestions for improving the program. Both parents and teachers expressed concerns with the waste generated by this program (particularly since they view it as having an environmentally conscious purpose) and would appreciate opportunities to be involved in reducing that waste. Teachers could be involved to reduce waste by having electronic materials they could opt to use and/or print the ones they will use, and parents could be involved by opting into the kit materials they can use or having a mechanism to return unused kit items.

- Six percent of responding parents mentioned reported that they felt guilt about the amount of waste that the kits generated. Parents, who for whatever reason, could not use their kit items (either they already had efficient items installed in their home, or the items did not fit), did not like that they're receiving the kit was contributing to waste of useful items. They would prefer to a) either opt-in to the items they need or b) be able to return un-used items so others can use them. Another 2% of responding parents mention it would be helpful to include an adapter for faucet aerators that fit a variety of faucet heads. An additional 11% of parents responded with individual suggestions for improvement. These individual suggestions include adding products (such as LED night lights, a water thermometer, window, and door air seal kits), help with installation, and more materials about financing energy-saving projects.
- When responding to an open-ended question about recommendations for program improvement, 10% of responding teachers reported having trouble implementing the lessons and handing out the kits in the required timeframe, and several offered suggestions that would help with this:
  - Let the teachers know in August when the kits will be shipped so they can plan around this in their curriculum planning. In order to be able to plan appropriately they would like to a) know timeline for receiving the kit, b) the timeline for teaching the material, handing out the kits, and requesting materials back from the students, and c) see electronic copies of all handouts, surveys, etc. far ahead of time (in August) so they can plan their curriculum accordingly.
  - Allow the teachers to be flexible with when during the school year they implement the program. Some suggest moving the due date to March or April would be helpful as this is after core testing, and teachers will have more flexibility.

- An additional five percent of responding teachers suggest altering the content of the lessons. While satisfaction is high, there were comments related to the waste produced by the paper materials (3% of respondents), which would be resolved by either a) making the required surveys electronic or b) creating more engaging materials that incorporate games or puzzles. One teacher stated they do not send the worksheets home with the students as they feel the home energy worksheet is too complicated for the grade level. Three percent recommend including a video with key information on energy for the students and how to install the kit items. An additional 2% of teachers responded with suggestions that were not expressed by others.

7.3.2 Gross Impact Results

The PY2019 EE School Kits achieved 5,512 MWh and 1.03 MW in ex-post gross savings (see Table 7-12).

Table 7-12. PY2019 EEK Gross Impact Summary

	Ex Ante	Realization Rate	Ex Post
First Year Savings			
Energy Savings (MWh)	6,280	87.8%	5,512
Demand Savings (MW)	1.22	84.3%	1.03
Last Year Demand Savings			
< 10 EUL (MW)	0.00	NA	0.00
10-14 EUL (MW)	0.87	86.1%	0.75
15+ EUL (MW)	0.36	80.1%	0.28

To reach the ex-post savings shown above, the evaluation team completed a review of ex-ante savings calculations for each of the six measures included in the EEK Program and updated inputs as required with primary data collected through the participant surveys. At the measure-level, ex-post realization rates for energy and demand savings ranged from 73% to 121% (see Table 7-13 and Table 7-14). In the remainder of this section, we provide detailed reasons why ex-ante gross savings deviated from ex-post for each measure.

Table 7-13. PY2019 EEK Annual First Year Gross Impacts

Measure Category	Energy Savings			Demand Savings		
	Ex-Ante (MWh)	Gross Realization Rate	Ex-post (MWh)	Ex-Ante (MW)	Gross Realization Rate	Ex-Post (MW)
LED 10W	2,382	80%	1,909	0.36	80%	0.28
Dirty Filter Alarm	1,380	82%	1,129	0.64	82%	0.53
Low Flow Showerhead	1,276	121%	1,539	0.11	121%	0.14
Kitchen Faucet Aerator	875	73%	639	0.08	73%	0.06
Pipe Insulation	217	75%	163	0.02	75%	0.01
Bathroom Faucet Aerator	149	89%	133	0.01	89%	0.01
Total	**6,280**	**88%**	**5,512**	**1.22**	**84%**	**1.03**

Table 7-14. PY2019 EEK Annual Last Year Gross Demand Impacts

Measure Category	Ex-Ante Gross Savings (MW)				Gross Realization Rate	Ex-post Gross Savings (MW)			
	<10	10-14	15+	Total		<10	10-14	15+	Total
Dirty Filter Alarm	-	0.64	-	0.64	82%	-	0.53	-	0.53
LED 10W	-	-	0.36	0.36	80%	-	-	0.28	0.28
Low Flow Showerhead	-	0.11	-	0.11	121%	-	0.14	-	0.14
Kitchen Faucet Aerator	-	0.08	-	0.08	73%	-	0.06	-	0.06
Pipe Insulation	-	0.02	-	0.02	75%	-	0.01	-	0.01
Bathroom Faucet Aerator	-	0.01	-	0.01	89%	-	0.01	-	0.01
Total	**-**	**0.87**	**0.36**	**1.22**	**84%**	**-**	**0.75**	**0.28**	**1.03**

Table 7-15. Reasons for Discrepancy in Gross Realization Rate

Measure Category	Ex-Ante gross Savings (MWh)	Gross Realization Rate	Ex-Post Gross Savings (MWh)	Reason for Discrepancy (If RR is not 100%
LED 10W	2,382	80%	1,909	The gross realization rate for LED 10W is 80%. Similar to Dirty Filter Alarms, the realization rate is driven by differences in leakage rate and ISR between ex-ante and ex-post calculations.
Dirty Filter Alarm	1,380	82%	1,129	The difference between ex-ante and ex-post results is driven by leakage rates and ISR values updated as part of the PY2019 evaluation.
Low Flow Showerhead	1,276	121%	1,539	The gross realization rate for Low Flow Shower Heads is 121%. The realization rate is driven by differences in homes with electric hot water heaters, leakage rate, installation rate, household members, showerheads per home, and showers taken per day between the ex-ante and ex-post calculations.
Kitchen Faucet Aerator	875	73%	639	The gross realization rate for Kitchen Faucet Aerator is 73%. The realization rate is driven by differences in homes with electric hot water heaters, leakage rate, installation rate and household members between the ex-ante and ex-post calculations
Pipe Insulation	217	75%	163	The gross realization rate for Pipe Insulation Wrap is 78%. The realization rate is driven by differences in homes with electric hot water heaters, leakage rate, and installation rate between the ex-ante and ex-post calculations.
Bathroom Faucet Aerator	149	89%	133	The gross realization rate for Bathroom Faucet Aerator is 89%. The realization rate is driven by differences in homes with electric hot water heaters, leakage rate, installation rate and household members between the ex-ante and ex-post calculations

7.3.3 Net Impact Results

Net-To-Gross Ratio Results

The evaluation team developed NTGRs for the PY2019 kit products based on surveys with 129 parents. We developed the NTGRs using self-reported information from web-based surveys with the parent or guardian of the students who received kits. We used participant survey responses to develop estimates of FR and PSO (see Table 7-16).

Table 7-16. PY2019 EEK Net-to-Gross Ratio

Measure/Enduse	Free-Ridership (FR)	Participant Spillover (PSO)	NTGR (1-FR+PSO)
Bathroom Faucet Aerators	21.55%	3.47%	81.92%
Dirty Filter Alarm	14.83%	3.47%	88.65%
Kitchen Faucet Aerators	19.22%	3.47%	84.25%
LED Light Bulbs	63.64%	NA	36.36%
Low Flow Showerheads	32.02%	3.47%	71.46%
Pipe Insulation (Hot Water)	31.16%	3.47%	72.31%
Overall Program	**38.2%**	**2.2%**	**64.0%**

Two percent of survey respondents (3 surveyed parents) reported PSO measures (see Table 7-17). Our engineering analysis of SO measures for these participants yielded total spillover savings of 1.90 MWh and 0.00 MW for the participant sample.

Table 7-17. PY2019 EEK Participant Spillover Measures and Savings

Spillover Measure	Measure Quantity	Total kWh
Advanced Power Strips	1	59.20
EE Heating and Cooling Equipment	1	415.06
EE Refrigerator or Freezer	1	58.20
Upgraded Insulation	3	773.07
Window and Door Weather-stripping	2	604.07
Total	**10**	**1,909.60**

To estimate total SO for the PY2019 participant population (3.47% as shown in Table 7-16), we divided the estimated total SO in our sample (1,909.60 kWh) by total program ex-post gross savings of the overall participant sample (54,962.94 kWh), as shown in (see Equation 7-1).

Equation 7-1. PY2019 EEK Participant Spillover Rate

$$PSO\ \%_{Energy} = \frac{Total\ participant\ sample\ SO\ (kWh)}{Total\ participant\ sample\ savings\ (\mathrm{kWh})} = \frac{1{,}909.60\ kWh}{54{,}962.94\ \mathrm{kWh}} = 3.47\%$$

Net Impacts

The evaluation team applied the researched NTGRs to determine net impacts for the EEK Program for PY2019. In 2019, the EEK Program saved 4,274 MWh and 1.03 MW of net energy and demand (see Table 7-18 and Table 7-19).

Table 7-18. PY2019 EEK Annual First Year Net Impacts

	Energy Savings			Demand Savings		
	Ex-post Gross Savings (MWh)	NTGR	Ex-post Net Savings (MWh)	Ex-Post Gross (MW)	NTGR	Ex-Post Net (MW)
LED 10W	1,909	36%	694	0.28	36%	0.10
Low Flow Showerhead	1,539	71%	1,100	0.14	71%	0.10
Dirty Filter Alarm	1,129	89%	1,001	0.53	89%	0.47
Kitchen Faucet Aerator	639	84%	538	0.06	84%	0.05
Pipe Insulation	163	72%	118	0.01	72%	0.01
Bathroom Faucet Aerator	133	82%	109	0.01	82%	0.01
Nonparticipant Spillover	NA	NA	714	NA	NA	0.08
Total	**5,512**	**78%**	**4,274**	**1.03**	**79%**	**0.82**

Table 7-19. PY2019 EEK Annual Last Year Net Demand Impacts

	Ex-post Gross Savings (MW)				NTGR	Ex-post Net Savings (MW)			
	<10	10-14	15+	Total		<10	10-14	15+	Total
Dirty Filter Alarm	0.00	0.53	0.00	0.53	89%	0.00	0.47	0.00	0.47
LED 10W	0.00	0.00	0.28	0.28	36%	0.00	0.00	0.10	0.10
Low Flow Showerhead	0.00	0.14	0.00	0.14	71%	0.00	0.10	0.00	0.10
Kitchen Faucet Aerator	0.00	0.06	0.00	0.06	84%	0.00	0.05	0.00	0.05
Pipe Insulation	0.00	0.01	0.00	0.01	72%	0.00	0.01	0.00	0.01
Bathroom Faucet Aerator	0.00	0.01	0.00	0.01	82%	0.00	0.01	0.00	0.01
Nonparticipant Spillover	NA	NA	NA	NA	NA	0.01	0.04	0.03	0.08
Total	**0.00**	**0.75**	**0.28**	**1.03**	**79%**	**0.01**	**0.67**	**0.13**	**0.82**

8. Multifamily Market Rate (MFMR)

This section presents the PY2019 evaluation summary, methodology, and results for the MFMR Program. Additional details on the methodology are presented in Appendix A.

8.1 Evaluation Summary

Ameren Missouri introduced the Multifamily Market Rate (MFMR) Program in PY2019 as a new offering designed to provide a one-stop-shop approach to assist owners and operators of multifamily Market Rate properties to overcome barriers to completing comprehensive retrofits. The program serves multifamily properties that have three or more tenant units and receive electric service from Ameren Missouri. The program is designed to target multifamily property managers and owners in this segment and to encourage them to complete a comprehensive package of upgrades and retrofits, moving them beyond direct install measures to deeper savings. The MFMR Program was expected to achieve 2,292 MWh of electric savings in PY2019.

Franklin Energy administers the program; in that role, Franklin developed program marketing (in collaboration with Ameren Missouri and ICAST), provides engineering oversight, processes incentive payments, performs field verification on a sample of projects, holds regular status updates and is responsible for providing program forecasts to Ameren Missouri. ICAST implements the program, conducting direct customer outreach and custom project development. ICAST implemented direct customer outreach and marketing using the materials which Franklin Energy developed, leading pre-launch informational events, providing printed and emailed outreach materials, and holding in-person meetings with potential customers. ICAST also engages several local program allies who complete all of the program's upgrades as direct-install projects.

As part of the one-stop-shop approach to promote deeper savings, ICAST implemented a custom—rather than prescriptive—approach to recommending upgrades, calculating ex ante site savings, and providing customer incentives. In this approach, ICAST calculated all measure savings and customer incentives against site-specific baselines. The MFMR Program completed lighting upgrades (Lighting BUS, Lighting RES), advanced thermostats (HeatCool), bathroom faucet aerators, kitchen faucet aerators, and showerheads (Water Heating Res).

PY2019 evaluation activities for the MFMR Program included reviewing program materials and the program tracking database, an impact evaluation, and interviews with program manager and implementation staff.

8.1.1 Participation Summary

In PY2019, the program achieved savings projection expectations with 2,427 projects submitted ushering 17,155 energy-efficient measures into the multifamily market Rate housing market.

Table 8-1 presents participation in the MFMR during PY2019.

Table 8-1. PY2019 Multifamily Market Rate Program Participation Summary

End-Use	Unique Participants		Projects		Measures		Ex Ante Savings	
	Number	%	Number	%	Number	%	MWh	%
EXT Lighting BUS	4	0.4%	4	0.4%	186	1.1%	285.6	12.8%
HeatCool	737	80.9%	737	80.9%	740	4.3%	752.9	33.6%
Lighting BUS	46	5.0%	46	5.0%	642	3.7%	292.7	13.1%
Lighting Res	863	94.7%	863	94.7%	12,746	74.3%	309.5	13.8%
Water Heating Res	777	85.3%	777	85.3%	2,841	16.6%	599.2	26.8%

8.1.2 Key Impact Results

The program used a custom based calculation approach, which relies on collecting savings input values during the removal and installation process. After conducting an engineering analysis on the program database, the evaluation team could not recalculate program savings or verify all input values, due to incomplete program data lacking critical calculation parameters and references. The implementation and data management concerns are the primary drivers of the Realization Rates presented in Table 8-2 below.

Table 8-2. PY2019 Multifamily Market Rate Program Savings Summary

	Ex Ante Gross	Realization Rate	Ex Post Gross	NTGR	Ex Post Net	Goal/Target Net	% of Goal/Target
First Year Savings							
Energy Savings (MWh)	2,240	77.3%	1,731	90.0%	1,558	2,292	68%
Demand Savings (MW)	0.34	76.1%	0.26	90.0%	0.23	0.67	34%
Last Year Demand Savings							
< 10 EUL (MW)	0.059	5.0%	0.00	90.0%	0.00	0.11	2%
10-14 EUL (MW)	0.198	103.7%	0.21	90.0%	0.18	0.15	125%
15+ EUL (MW)	0.080	60.0%	0.05	90.0%	0.04	0.32	14%

In Fall 2019, program implementers noted several factors that may have contributed to the program's shortfall on energy and demand savings. Specifically:

- **Late start to implementation limited opportunities to complete larger projects.** Larger and longer-lived measures like mechanical measures and insulation take more time to scope and gain property manager approval for. Prospective participants may have already planned their property upgrade spending by the time the program approached them mid-2019. In the future, approaching properties early in the year (e.g., January or February) as the property is planning their capital expenditures and looking for financing may open up more of these opportunities.
- **Balancing tradeoffs in the measure mix.** High-impact measures with EULs beyond 15-years include CAC, heat pumps, and light bulbs. Other high-saving measures like thermostats, pool pumps, and other efficient products do not last that long. At the same time, HVAC equipment is more expensive. Thus, it

can be challenging to both meet the program's 15-year EUL demand target and achieve energy saving goals, as providing high-cost but long-lived measures diverts incentive budget from meeting energy savings goals. In-unit lighting does provide cost-effective and long-lasting savings, in the years before the baseline becomes more efficient.

Overall, the MFMR Program was the sixth-largest program in the PY2019 business portfolio, accounting for 1% of ex post net residential portfolio energy savings and 1% of ex post net residential portfolio demand savings.

8.1.3 Key Process Findings

Key process findings from the PY2019 MFMR Program include:

- The Multifamily Market Rate program was scheduled to launch in March 2019, but Franklin Energy, the program administrator, and ICAST, the program implementer, did not have well-established communication protocols, savings algorithm alignment and cohesive implementation systems between each other. This led to a delay in approvals, which further delayed the program launch until August 2019.
- The evaluation team found that the lack of a standardized data tracking system between ICAST and Franklin Energy caused challenges in tracking program progress during the year and exposed the program to errors in data handling. The evaluation team acknowledges the implementers plan to switch from a secure FTP site to an API based data transfer system and align on data storage and assumptions of multifamily units.
- Despite implementation delays, customer recruitment is meeting or exceeding savings projections.

To meet the requirements of Missouri Code of State Regulations (CSR) for demand-side process evaluations, we provide responses to the five required process evaluation questions in Table 8-3.

Table 8-3. Summary of Responses to CSR Process Evaluation Requirements

CSR Required Process Evaluations Questions	Findings
What are the primary market imperfections that are common to the target market segment?	Market imperfections specific to the multifamily sector include 1) the split incentive[1] for in-unit measures between property owners, managers, and residents, 2) awareness of the potential for saving money and energy through energy efficiency upgrades, 3) costs associated with larger non-lighting measure upgrades, 4) knowledgeable staff available to install energy-efficient upgrades, and 5) the time investment to plan, budget and implement energy efficiency upgrades.
Is the target market segment appropriately defined, or should it be further subdivided or merged with other market segments?	Yes, the target market is appropriately defined as a building including three or more units with Ameren Missouri electric service. This program addresses multifamily property needs, both common area, and in-unit upgrades.

[1] The split incentive occurs when the tenant pays the cost of the electricity use, but the owner is responsible for choices that affect building and equipment efficiency.

CSR Required Process Evaluations Questions	Findings
Does the mix of end-use measures included in the program appropriately reflect the diversity of end-use energy service needs and existing end-use technologies within the target market segment?	Yes, the program offers measures that cover all major multifamily common area and in-unit enduse needs: lighting, appliances, space cooling and heating, insulation, and water heating. The tracking data indicated that only 4.3% of participating customers installed both tenant and common area upgrades at their property. This indicates that there may be an opportunity for educating customer to take advantage of the "one-stop-shop" program offered.
Are the communication channels and delivery mechanisms appropriate for the target market segment?	For this initial program year launch the primary communication channel used was one-on-one contact between customers and implementation staff. The program does have a more varied marketing and communication plan they intend to employ in future program years, which includes conferences, promotional, and networking events.
What can be done to more effectively overcome the identified market imperfections and to increase the rate of customer acceptance and implementation for select enduses/measure groups included in the Program?	Ameren Missouri can consider promoting Green Leases.[2] Green Leases are contracts between landlords and tenant(s) that negotiate the mutual benefit of installing energy efficient or green measures in shared buildings. For shared buildings, owners are burdened with green upgrade costs, while tenants benefit from lower operating costs. Without green leases, there is little incentive for owners to make green upgrades. Green leases are designed to allow both parties financial benefits and incentives, and multifamily building types are ideal buildings. The rate of customer acceptance and implementation is currently above expectations, as the program met goals despite implementation delays.

8.1.4 Conclusions and Recommendations

The evaluation team offers the following conclusions and recommendations for the MFMR Program based on the results of the PY2019 evaluation:

- Conclusion #1: The coordination issues between the program implementer, Franklin Energy, and program administrator, ICAST, caused delays in processing customer rebates, engineering savings calculations, and evaluation activities.
  - Recommendation: The evaluation team acknowledges the plans to switch from FTP site to an API based data transfer system to align data storage and assumptions of multifamily units.
  - Recommendation: Ameren Missouri, ICAST, and Franklin Energy set and document clear protocols for data gathering, data quality assurance, and savings algorithm and savings projection alignment prior to onboarding new customers.
  - Recommendation: Ameren Missouri, ICAST, and Franklin Energy develop communication systems and quality control procedures to ensure critical program guidelines and changes are well-documented and communicated to stakeholders. These systems and procedures can include but are not limited to projected savings and costs, measure savings and assumptions, tracking database sources and inputs, rebate amounts, technical reference manuals, program timelines, and potential delay areas.

[2] http://cbei.psu.edu/split-incentives-and-green-leases/

- Conclusion #2: Ex ante savings for the following measures had omitted critical calculation parameters, including baseline values, and did not provide accommodating documentation for measures with various input values. The evaluation team had no way to determine if a district value was an error or a custom input; therefore, ex-post calculations used TRM savings assumptions and baselines to calculate savings when tracking data provided was not complete.
  - "BUS" (business) lighting measures, i.e., those installed in communal or exterior locations, are consistently and significantly higher than ex post savings.
  - Residential interior lighting measures (e.g., LED – 10W (Halogen baseline), Directional LED) and common area lighting
  - Kitchen, Bathroom and Showerhead Aerators
  - Recommendations #2: The tracking data should provide all fields necessary to recalculate ex-ante savings. The evaluation team recommends program implementers capture all calculation and custom inputs, including GPM baseline inputs for kitchen, bathroom, and showerhead aerators that follow the TRM Appendix I, and residential lighting, interior lighting, common area, and exterior lightings calculations should use an appropriate annual hours for each lamp type as verified in TRM Appendix I or Appendix H.
- Conclusion #3: The program data tracking and management systems differs between ICAST and Franklin Energy leading to errors, processing delays, and a static data transfer process.
  - Recommendations #3: Develop a dynamic system to better manage data across stakeholders, reducing errors and delays. The evaluation team understands this is underway.
  - Follow through with the plan to align savings calculations assumptions by moving all parties from FTP site to an API based data transfer system to align data storage. The evaluation team believes this efficient information transfer and streamlined approval process will minimize data discrepancies in the future.
  - ICAST should accurately record and store data after each project is completed and share program data with Franklin Energy at regular and timely intervals to avoid delays in claiming savings and payment of customer rebates.

8.2 Evaluation Methodology

The evaluation team performed both impact and process evaluation activities to assess the performance of the MFMR Program in PY2019. In addition to the overarching research objectives outlined for the Residential portfolio, the evaluation team explored the following MFMR Program-specific objectives:

Process specific evaluation objectives:

- Characterize program participation with respect to the number and characteristics of participants and installed measures
- Measure customer satisfaction, with program processes and implementers, and motivations for participating
- Identify opportunities for improvement in participant recruitment and customer experience

- Provide evaluation results that can be used to improve the design and implementation of the Multifamily Market Rate Program
- Estimate the first-year ex-post gross average percent energy (kWh) savings per participating property; and

Due to lower than expected program participation in PY2019, the evaluation team moved the customer satisfaction, customer characterization, property manager interviews, and net-to-gross research activities to the PY2020 evaluation cycle.

Table 8-4 provides an overview of the MFMR Program evaluation activities. Following the table, we outline program-specific aspects of key evaluation methodologies.

Table 8-4. PY2019 Evaluation Activities for the Multifamily Market Rate Program

Evaluation Activity	Description
Program Manager and Implementer Interviews	▪ Conducted interviews towards the end of PY2019 to understand program staff's perspective on program performance.
Program Material Review	▪ Reviewed all program materials to inform evaluation activities.
Program Theory/ Logic Model Review	▪ Reviewed the implementer's program theory/logic model to understand program activities and their expected outputs and outcomes, including expected impacts on the market.
Tracking System Review	▪ Reviewed implementer's tracking system to ensure that data required for the evaluation is being collected.
Database Review	▪ Review program database to check that program data are complete. ▪ Verified reasonableness of EUL assumptions for lighting measures.
Engineering Analysis	▪ Verified that ex ante savings use correct TRM values and algorithms. ▪ Developed ex post savings using TRM algorithms, deemed savings assumptions, and evaluation-estimated parameters.
NTGR/Net Impact Analysis	▪ Estimated PY2019 net impacts.

8.3 Evaluation Results

8.3.1 Process Results

In this section, the evaluation team presents the findings, recommendations, and suggestions for future evaluation activities based on the evaluation activities in Table 8-4. For ease of reference, we have summarized the evaluation results into the following categories:

- Implementation
- Program Data Tracking and Management
- Goal Projections, Customer Pipeline, and Customer Experience
- Marketing

Implementation

Ameren Missouri originally intended the program to launch in March 2019, but due to delays between the implementer and administrator, the program launched in August 2019. Additionally, program implementation was delayed due to misalignments between Franklin Energy and ICAST involving data savings, data storage, and protocols.

Regarding savings data, the implementer chose a custom savings approach, which relies on custom inputs, rather than a prescriptive approach for the program. The benefit of a custom approach is the opportunity for deep savings; however, the approach requires custom inputs to verify savings. Franklin Energy expressed concern with this custom approach during the first year of the evaluation. Furthermore, the evaluation team found that the year-end database did not include sufficient custom inputs to recalculate savings, as detailed in Section 8.3.2.

ICAST and Franklin Energy were misaligned on savings calculations for several weeks, which affected customers and the evaluation. ICAST reported that the savings misalignments between them and Franklin Energy was the cause for program launch delays and customer frustration with delayed approvals and rebates. The evaluation activities were also delayed for several months, preventing the completion of some evaluation activities.

The program started recruiting customers before developing protocols and quality control procedures for documenting baseline and efficient measures (processes for savings calculations and corresponding technical resource manual guidance documents). With trade allies and other parties involved, developing well-documented materials before implementation is a best practice to remove data errors and capture complete and accurate field information.

Implementation recommendations include aligning savings algorithms and necessary inputs for ICAST and Franklin Energy prior to onboarding new customers. Additional details are provided in the Data Management section. Ameren Missouri, ICAST, and Franklin Energy should also develop and communicate program protocols and procedures, including documentation expectations, rebate timelines, and customer-facing materials to all program representatives and trade allies. Finally, Ameren Missouri, ICAST, and Franklin should develop communication systems and quality control procedures to ensure critical program guidelines and changes are well-documented and communicated to stakeholders. These systems and procedures can include but are not limited to projected savings and costs, measure savings and assumptions, rebate amounts, technical reference manuals, program timelines, and potential delay areas.

Program Data Tracking and Management

Our initial research found that data storage and tracking systems differ between ICAST and Franklin Energy. ICAST provided sampled data that calculated multifamily units and common areas as one site or property in a spreadsheet. In contrast, Franklin Energy compiled data across multiple properties at the measure level. At the time of the ICAST interview, data was not able to be stored and shared between ICAST and Franklin Energy, causing delays in processing data and project completion. The data transfer process from the implementer to the administrator was a static process.

We recommend that ICAST and Franklin Energy continue to work together to establish an integrated data tracking system. The evaluation team believes this efficient information transfer and streamlined approval process will minimize data discrepancies in the future. Finally, ICAST should accurately record and store data

after each project is completed and share program data with Franklin Energy at regular and timely intervals to avoid delays in claiming savings and payment of customer rebates.

Goal Projections, Customer Pipeline, and Customer Experience

For PY2019, goal projections, reported by the project manager, were met or exceeded, indicating successful customer recruitment, even in the midst of delays. The evaluated savings determine if the ex ante savings estimations were reasonable projections. The program manager strives to meet several goals that define program success. The program achieved its projected savings goals in 2019, by achieving 90% of rebate goals, 397% of projected energy goals, and 258% of the 10-14 year demand projected savings target. However, the program did not achieve the 15+ year demand target. The program goals/targets and projection status at the end of 2019 are shown below in Table 8-5.

Table 8-5. PY2019 Multifamily Market Rate Annual Savings

Category	Projection Goal/Target	2019 Year-End Projection Status	% of Projected Goal/Target Achieved
Rebates	$ 411,621.00	$ 370,945.74	90%
Total Project Savings (kWh)	502,165.00	1,994,828.05	397%
10-14 year kW Target	69.00	178.29	258%
15+ year kW Target	48.65	353.00	14%

Interviews with ICAST and Franklin revealed opportunities to improve customer experience through clear communication, managing project expectations, implementation process requirements, and project timelines. In interviews with the evaluation team, the implementation contractor reported that customers were overall happy with the program, however, they were eager to start the projects which were delayed due to unexpected implementation challenges.

Customer Experience and Pipeline Recommendations include continuing recruiting to secure a robust customer pipeline for the program's future success.

Marketing

According to the marketing plan provided, Ameren Missouri planned a series of marketing activities including the development and distribution of promotional materials, one-on-one outreach to potential participants, and participation in industry conferences and events. However, according to Franklin and ICAST, program staff did not ultimately participate in industry conferences and trade ally trainings, given delays in approval Table 8-6shows the marketing plan for PY2019.

Table 8-6. PY2019 Multifamily Market Rate Marketing Activities

Planned Marketing Events and Materials	Description
Owner Manager E-mail	Pre-launch events describing the new program offered once a month post-launch
Trade Allies/Referral E-mail	
Program brochure, pre-launch education fryers, presentation and handouts	Education information on new program launch. Used at pre-launch events, and in-person meetings and events
Direct Marketing	One-on-one meetings with potential customers

Removing barriers for program staff to attend marketing activities should increase awareness and set up the program for continued success. For PY2019, the most effective strategy to increase program uptake was one-on-one meetings, according to the Ameren, ICAST and Franklin.

One marketing recommendation is for Ameren to work with ICAST and Franklin to plan, forecast, and participate in marketing activities in line with achieving annual program goals and reduce potential customer barriers. As this program continues to reach customers and mature, Ameren, ICAST and Franklin should think strategically about when and how to engage in marketing activities to yield the desired impact.

8.3.2 Gross Impact Results

Table 8-7 presents MFMR Program annual savings achieved in PY2019. The PY2019 Multifamily Market Rate program achieved 1,731 MWh and 0.26 MW in ex post gross savings.

Table 8-7. PY2019 Multifamily Market Rate Gross Impact Summary

	Ex Ante	Realization Rate	Ex Post
First Year Savings			
Energy Savings (MWh)	2,240	77.3%	1,731
Demand Savings (MW)	0.34	76.1%	0.26
Last Year Demand Savings			
< 10 EUL (MW)	0.06	5.0%	0.00
10-14 EUL (MW)	0.20	103.7%	0.21
15+ EUL (MW)	0.08	60.0%	0.05

The evaluation team completed analysis on the following program measures: lighting upgrades (Lighting BUS, Lighting RES), advanced thermostats (HeatCool), bathroom faucet aerators, and kitchen faucet aerators, and showerheads (Water Heating Res). Franklin Energy and ICAST had issues transferring data. Therefore, the evaluation team received an incomplete database to analyze, which omitted critical parameters for calculating program savings.

This report summarizes the evaluation team's ex-post analysis, which includes detailed assumptions for each omitted or unsourced parameter value found in the tracking data. All calculation methodology, parameters, and assumptions are detailed in the section and sourced in the Appendix A.

Table 8-8. PY2019 Multifamily Market Rate Annual First Year Gross Impacts

End-Use	Energy Savings			Demand Savings		
	Ex Ante (MWh)	Realization Rate	Ex Post (MWh)	Ex Ante (MW)	Realization Rate	Ex Post (MW)
HeatCool	753	84.9%	639	0.14	101.5%	0.15
Water Heating Res	599	80.2%	481	0.05	80.2%	0.04
Lighting Res	309	93.3%	289	0.05	93.3%	0.04
Lighting BUS	293	41.7%	122	0.05	43.4%	0.02
EXT Lighting BUS	286	70.2%	201	0.04	2.8%	0.00
Total	**2,240**	**77.3%**	**1,731**	**0.34**	**76.1%**	**0.26**

Table 8-9. PY2019 Multifamily Market Rate Program Annual Last Year Gross Demand Impacts

End-Use	Ex Ante (MW)			Realization Rate	Ex Post (MW)		
	<10	10-14	15+		<10	10-14	15+
HeatCool	0.00	0.14	0.00	101.5%	0.00	0.15	0.00
Water Heating Res	0.00	0.05	0.00	80.2%	0.00	0.04	0.00
Lighting Res	0.00	0.00	0.05	93.3%	0.00	0.00	0.04
Lighting BUS	0.02	0.00	0.03	43.4%	0.00	0.02	0.00
EXT Lighting BUS	0.04	0.00	0.00	2.8%	0.00	0.00	0.00
Total	**0.06**	**0.20**	**0.08**	**76.1%**	**0.00**	**0.21**	**0.05**

Table 8-10 details the ex ante savings, the gross realization rate, the ex-post savings, and an explanation for each discrepancy. The measure description column details how the energy-efficient measure is documented in the tracking database. There are items with BUS following their name, indicating a business measure or typically installed in a commercial space.

The evaluation team may update realization rates in the table below to reflect any newly provided information or assumptions.

Table 8-10. PY2019 Multifamily Market Rate Program Electric Energy Savings by Measure Description

Measure Description	Ex Ante Unit Gross Savings (kWh)	Gross Realization Rate	Ex Post Unit Gross Savings (kWh)	Reason for Discrepancy (If RR is not 100%)
Bathroom Faucet Aerator-MFMR	69	64%	44	Unclear. Ex post savings use custom GPMs from preliminary data (2.2 gpm baseline, 0.5 gpm efficient). No GPM baseline values were provided in final tracking data. Deemed savings table unit savings (33.5 kWh) do not match ex ante unit savings.
Common Areas Business Custom	676	37%	250	Ex post savings use 2,786 annual hours of use (TRM Appendix H - Mid-rise apartment). Ex ante savings likely use higher hours of use.

Measure Description	Ex Ante Unit Gross Savings (kWh)	Gross Realization Rate	Ex Post Unit Gross Savings (kWh)	Reason for Discrepancy (If RR is not 100%)
Measure Miscellaneous BUS[a]				
Directional LED-MFMR	194	72%	139	Unclear. Ex post savings use 728 annual hours of use. Ex ante savings likely use higher hours of use.
Exit Sign-MFMR	253	105%	266	Unclear. Ex post savings use 8,766 annual hours of use (TRM Appendix H).
Kitchen Faucet Aerator-MFMR	116	73%	85	Ex post savings use Household value of 1.56, L_base and L_low of 4.5, FPH of 1.19, SupplyTemp of 61.3 (TRM Appendix I). Ex ante savings, per deemed savings table, use Household value of 2.07, L_base and L_low of 3.7, FPH of 1, SupplyTemp of 61.3.
Learing Thermotat-Multifamily Market Rate	1017	85%	864	Ex post savings used 11456 HeatingConsumption which appears to be different from what the ex ante used, which is unclear.
LED - 10W (Halogen baseline)-MFMR	24	93%	22	Unclear. Ex post savings use 728 annual hours of use. Ex ante savings likely use higher hours of use. Ex post unit savings match deemed savings table value (22 kWh/unit).
LED - 12W (Halogen baseline)-MFMR	35	97%	34	Unclear. Ex post savings use 728 annual hours of use. Ex ante savings likely use higher hours of use.
LED Fixture-MFMR	1536	70%	1,079	Ex post savings use 728 annual hours of use (Appendix I). Ex ante savings likely use higher hours of use.
Low Flow Showerheads-MFMR	420	84%	354	Unclear. Ex post savings use custom GPMs from preliminary data (2.5 gpm baseline, 1.25 gpm efficient). No GPM baseline values were provided in final tracking data. Deemed savings table unit savings (204.7 kWh) do not match ex ante unit savings.
Omnidirectional LED-MFMR	62	113%	70	Ex post savings use 728 annual hours of use (Appendix I). Ex ante savings likely use lower hours of use.
TLED-MFMR	646	36%	230	Ex post savings use 2,786 annual hours of use (Appendix H - Mid-rise apartment). Ex ante savings likely use higher hours of use.

a: Based on review of program tracking data, the evaluation team classified this measure as a lighting upgrade for ex post analysis.

Based on the results discussed above, the evaluation team recommends the following updates to measure-specific assumptions for the MFMR Program:

- Ex ante savings for "BUS" (business) lighting measures, i.e., those installed in communal or exterior locations, are consistently and significantly higher than ex post savings. Common area lighting savings calculations should use the HOU prescribed in TRM Appendix H for Mid-rise apartment (2,786).
- Ex ante savings aerator savings inputs differ between ex ante and ex post calculations. Aerator savings should be calculated using a Household value of 1.66, L_base and L_low of 4.5, FPH of 1.18, and SupplyTemp of 61.3, per TRM Appendix I.
- Residential interior lighting measures (e.g., LED – 10W (Halogen baseline), Directional LED) ex ante savings are consistently, slightly higher than ex post savings. Residential interior lighting calculations should use 728 HOU, per TRM Appendix I.
- The tracking data lacked GPM baseline inputs for aerator and showerhead measures. The evaluation team used preliminary tracking data measure names to determine GPM baselines. 2.2 GPM baseline for bathroom aerators and 2.5 GPM baseline for showerheads – because the final tracking data did not provide GPM baseline values. Kitchen aerators used the same GPM input as bathroom aerators (2.2 GPM) because they lacked GPM baselines in the final tracking data and were not in the preliminary tracking data. The tracking data should provide GPM baseline inputs for aerator and showerhead measures, especially if the GPM baseline differs from the TRM's default value. This will allow the evaluator to better isolate the source of discrepancies between ex ante and ex post savings.
- The tracking data lacked hours of use inputs for lighting measures. The evaluation team used TRM Appendix I and Appendix H to determine HOU: 728 HOU for interior LEDs (e.g., Directional LED, LED – 10 W, LED Fixture) (Appendix I), and 2,876 HOU for common-area fixtures and exterior LEDs (Appendix H – Mid-rise apartment), and 8,766 HOU for Exit Signs (Appendix H – Exit Signs). The tracking data should provide HOU inputs for lighting measures, especially if the HOU differ from TRM default values. This will allow the evaluator to better isolate the source of discrepancies between ex ante and ex post savings.
- TRM Appendix H does not provide hours of use for exterior business lighting. The evaluation team used the hours of use for mid-rise apartment from TRM Appendix H (2,876) for exterior measures. Ameren should work with the implementer and administrator to update the TRM with an exterior business lighting HOU.

8.3.3 Net Impact Results

The evaluation team applied the NTGR used by the program implementation team in planning given its consistency with evaluation results we have seen for similar programs in other jurisdictions, and the fact that NTG research with PY2019 MFMR participants was postponed until 2020 due to limited participation (Table 8-11). In 2019, the MFMR Program saved 1,731 MWh and 0.23 MW of net energy and demand.

Table 8-11. PY2019 Multifamily Market Rate Annual First Year Net Impacts

Measure/Enduse	Energy Savings			Demand Savings		
	Ex-Post Gross Savings (MWh)	NTGR	Ex-Post Net Savings (MWh)	Ex-Post Gross Savings (MW)	NTGR	Ex-Post Net (MW)
HeatCool	639	90.0%	575	0.15	90.0%	0.13
Water Heating Res	481	90.0%	433	0.04	90.0%	0.04
Lighting Res	289	90.0%	260	0.04	90.0%	0.04
EXT Lighting BUS	201	90.0%	181	0.00	90.0%	0.00
Lighting BUS	122	90.0%	110	0.02	90.0%	0.02
Total	**1,731**	**90.0%**	**1,558**	**0.26**	**90.0%**	**0.23**

Finally, Table 8-12 shows the last-year demand savings by measure by EUL class. The PY2019 MFMR Program delivered 0.23 MW of total last-year ex post net demand savings.

Table 8-12. PY2019 Multifamily Market Rate Last Year Net Demand Impacts

Measure/Enduse	Ex Post Gross Savings (MW)				NTGR	Ex Post Net Savings (MW)			
	<10	10-14	15+	Total		<10	10-14	15+	Total
HeatCool	0.00	0.15	0.00	0.15	90.0%	0.00	0.13	0.00	0.13
Water Heating Res	0.00	0.04	0.00	0.04	90.0%	0.00	0.04	0.00	0.04
Lighting Res	0.00	0.00	0.04	0.04	90.0%	0.00	0.00	0.04	0.04
Lighting BUS	0.00	0.02	0.00	0.02	90.0%	0.00	0.01	0.00	0.02
EXT Lighting BUS	0.00	0.00	0.00	0.00	90.0%	0.00	0.00	0.00	0.00
Total	**0.00**	**0.21**	**0.05**	**0.26**	90.0%	**0.00**	**0.18**	**0.04**	**0.23**

9. Appliance Recycling (RAR)

This section summarizes the PY2019 evaluation methodology and results for the Residential Appliance Recycling Program (RAR). Additional details on the methodology, including data collection instruments and sampling plans, are presented in Appendix A.

9.1 Evaluation Summary

The primary goal of the Residential Appliance Recycling (RAR) Program is to promote the retirement and recycling of inefficient refrigerators, freezers, dehumidifiers, and room air conditioners from households by offering turn-in incentives, free pickup of working equipment, and information on the operating costs of inefficient units. The target market includes all residential electric customers with working refrigerators, freezers, dehumidifiers, or room ACs manufactured before a product-specific cutoff date. The focus of the program is refrigerators and freezers, and the program also includes pick-up of working dehumidifiers and room air conditioners in conjunction with the pick-up of a larger appliance.

The program also provides participants with energy-efficient kits that contain LEDs and hot water measures, such as faucet aerators and low flow showerheads. Ameren Missouri outsources kit implementation to a turnkey service provider that manages processes from eligibility verification to proper disposal or recycling of turned-in appliances and contributes to developing and implementing the program's marketing strategy.

The program emphasizes the savings associated with retiring older less efficient appliances as well as the benefits of proper disposal/recycling of those appliances. PY2019 marketing activities included:

- Rebate inserts throughout the year, and on-bill messaging in July 2019;
- Two discreet Facebook posts (4/26 and 6/17/2019); and
- An e-mail blast to Ameren Missouri territory 6/11/2019 and 10/9/2019.

The RAR Program accounts for 2% of planned incremental net energy savings and 1% of planned residential portfolio demand savings

9.1.1 Participation Summary

In PY2019 a total of 1,864 unique customers recycled appliances through the Ameren Missouri RAR Program. Out of these customers, 1,859 participants received Energy Efficiency Kits. All participants received kits besides five. There is no information as to why these customers did not receive Kits as part of the Appliance Recycling Program. The table below shows total kits and measures distributed.

Table 9-1 presents participation in the RAR Program during PY2019.

Table 9-1. PY2019 Appliance Recycling Participation Summary

Measure/Enduse	Participants		Measures Ex Ante Savings			
	Number	%	Number	%	MWh	%
Dehumidifier recycling	48	0.4%	49	0.2%	7	0.3%
Freezer recycling (pre 1990)	168	1%	168	0.7%	150	7
Freezer recycling (1990 and after)	214	2%	214	0.9%	191	9%
Refrigerator Recycling (pre 1990)	524	4%	525	2%	539	27%
Refrigerator Recycling (post 1990)	1,125	8%	1,126	5%	586	29%
Room AC recycling – Primary	38	0.3%	40	0.2%	12	1%
Dirty Filter Alarm	1,859	14%	1,859	8%	119	6%
Kit-Bathroom Faucet Aerator	1,859	14%	1,859	8%	13	1%
Kit-Kitchen Faucet Aerator	1,859	14%	1,859	8%	76	4%
LED – 10W (Halogen baseline)[a]	1,859	14%	7,436	33%	206	10%
Low Flow Showerheads	1,859	14%	1,859	8%	110	5%
Pipe Insulation [b]	1,859	14%	5,577	25%	19	1%

[a] Kits with LEDs include 4 bulbs per kit.

[b] Measure quantity represents total footage of pipe insulation at 3 ft per kit.

9.1.2 Key Impact Results

The RAR Program implementers used a regression-based analysis to calculate the total PY2019 ex-post gross savings. The methodology and equations can be found in the Ameren Missouri TRM.[52] The evaluation team conducted a PY2019 participant survey, and sourced survey respondent reported values to update the following equation inputs: part use factor, installation rates, net-to-gross, kit units per home, occupants per home, and percentage of homes with electric water heaters. Upon review of the program participation database and included savings values, the evaluation team could not trace the ex-ante energy efficiency kit savings (especially peak savings) to their original savings inputs. The implementer provided several input scenarios to the evaluation team without clarifying which inputs they had used. The data accuracy issues directly correlate to the gross realization rates presented in Table 9-2 below.

Table 9-2 presents annual savings achieved in PY2019. As shown, the program achieved 53% of Ameren Missouri's net energy savings goal for RAR.

52 Ameren TRM – Appendix I, 2019-11-07.

Table 9-2. PY2019 Appliance Recycling Impacts Summary

	Ex Ante Gross	Realization Rate	Ex Post Gross	NTGR	Ex Post Net	Goal/Target Net	% of Goal/Target
First Year Savings							
Energy Savings (MWh)	2,028	102.3%	2,074	59.9%	1,224	2,358	53%
Demand Savings (MW)	0.32	89.7%	0.29	54.4%	0.16	0.34	46%
Last Year Demand Savings							
< 10 EUL (MW)	0.22	108.4%	0.23	44.0%	0.10	0.34	30%
10-14 EUL (MW)	0.08	28.8%	0.02	128.1%	0.03	0	NA
15+ EUL (MW)	0.03	106.4%	0.03	80.8%	0.03	0	NA

Overall, the RAR Program was the seventh-largest program in the PY2019 Residential portfolio, accounting for 1% of ex post net residential portfolio energy savings and 0.4% of ex post net Residential portfolio demand savings.

9.1.3 Key Process Findings

The evaluation team identified the following key process findings based on the PY2019 evaluation:

- The intent of the program is to remove old, functioning, but inefficient secondary appliances from the grid. Participant feedback indicates this does occur most of the time, with 74% of recycled refrigerators and 62% of recycled freezers categorized by participants as secondary units.
- Due to changes in efficiency standards, the program can claim more saving by recycling units manufactured prior to 2001. The program functions well at removing older appliances from the grid, with 85% of recycled units manufactured prior to 2001. Thirty-six percent of recycled units were manufactured prior to 1990, which indicates the program is removing a large percentage of units more than 30 years old.
- Program satisfaction is high, with 70% giving Ameren Missouri and 83% the Fridge and Freezer Recycling program the maximum “Very Satisfied” rank. A minority of respondents indicated lower satisfaction for the program and Ameren Missouri. The main drivers of lower satisfaction are issues with delays or rescheduling of the pickup of the appliance. Thirteen percent of Appliance Recycling respondents stated the wait time was too long for the appliance to be picked up, and 9% stated dissatisfaction with the amount of re-scheduling that occurred from the originally scheduled appliance pickup date.
- The evaluation team found opportunities to increase data completeness and consistency, both in the data collected by Recleim and data transfer to Franklin Energy.
- Ameren Missouri marketing materials are key to program awareness (72% first heard of the program from either Ameren printed collateral, website, advertisements, or an Ameren Missouri representative).
- Most recycled appliances are refrigerators (80%); refrigerators are less likely than freezers to be a spare or backup appliance (69% of refrigerators were backups, as opposed to 78% of freezers).

- Kit products overall demonstrate low rates of installation for all products. Lightbulbs have the highest installation rate, with 85% of respondents installing at least one lightbulb. Pipe insulation has the second highest installation rate at 41%. All other measures have installation rates of 24% or lower. Lack of time is the most cited reason for not installing the non-lighting measures. The main reason customers did not install lighting measures is the customers are waiting for existing bulbs to burn out first.
- The PY2019 evaluation results reveal very different process and impact results for kits that are distributed to appliance recycling participants compared to kits that are distributed via the education mechanism. We highlight these differences to underscore the importance that the delivery mechanisms have in these differences.

To meet the requirements of Missouri Code of State Regulations (CSR) for demand-side process evaluations, we provide responses to the five required process evaluation questions in Table 9-3.

Table 9-3. Summary of Responses to CSR Process Evaluation Requirements

CSR Required Process Evaluations Questions	Findings
What are the primary market imperfections that are common to the target market segment?	The primary market imperfection that the program addresses is residential customers' low impetus to remove old, inefficient refrigerators and freezers from the grid. Often customers will keep a spare refrigerator or freezer for secondary use or dispose of it in a way that it continues to be used as opposed to disposing of the appliance permanently.
Is the target market segment appropriately defined, or should it be further subdivided or merged with other market segments?	Yes. Opinion Dynamics conducted a residential baseline study in 2019 that found that 37% of residents have a secondary refrigerator, an additional 8% have a third refrigerator, and 39% report the presence of a stand-alone freezer.[53] This indicates ample opportunity to achieve savings by removing these additional appliances from the grid. Participant survey responses indicate 29% of recycled appliances were primary units, which, in the absence of the program, a customer might retain for secondary use. Regarding appliance age, baseline data indicates that there are very few existing appliances of vintages earlier than 1990 (1% of primary refrigerators, 10% of secondary refrigerators, and 12% of secondary freezers). Participant survey data indicate that 36% of recycled units are of vintages earlier than 1990. Thus, the program is successfully motivating the recycling of these units.
Does the mix of enduse measures included in the program appropriately reflect the diversity of enduse energy service needs and existing enduse technologies within the target market segment?	Yes. The program allows refrigerators or freezers to be recycled, along with window air conditioners and/or dehumidifiers at the same time. Two percent of recycled appliances were dehumidifiers and room air conditioners (4% total), demonstrating there is a market, albeit small, for these additional measures to be recycled. Customers did not mention requests for additional measures to be included in the program.
Are the communication channels and delivery mechanisms appropriate	Yes. Ameren Missouri primarily advertises this program through bill inserts and direct e-mail campaigns, and physical collateral is the primary mechanism responding participants report hearing about the program.

[53] Opinion Dynamics conducted a survey with 1,395 residential customers between July 31 and August 24, 2019 and in-home audits with a subsample of 120 baseline survey respondents between August 14 and September 25, 2019.

CSR Required Process Evaluations Questions	Findings
for the target market segment?	
What can be done to more effectively overcome the identified market imperfections and to increase the rate of customer acceptance and implementation for select enduses/measure groups included in the Program?	Ameren Missouri can annually revisit program assumptions regarding the percent of equipment in residential use that was manufactured prior to 1990, and percent of equipment recycled that is primary versus secondary. Based on the success of this program, the current incentive is satisfactory and results in participation. The time from scheduling to pick up is the primary reported participant concern, however, and Ameren Missouri could work with the program implementer to reduce the timeline between scheduling and pickup either via a more accurate and reliable interface where customers can schedule their own pickup, or providing greater quantity of available pickup times during the most popular pickup days.

9.1.4 Conclusions and Recommendations

Based on the results of this evaluation, the evaluation team offers the following conclusions and recommendations for the RAR Program moving forward:

- Conclusion #1: The factor driving for lower program satisfaction ratings is issues with scheduling the pickup of the appliance and any delays and rescheduling that may occur with the set pick up date and time.
  - Recommendation: Manage customer expectations about the program's timeline. Communicating to participants the average period between scheduling and pick up will help raise satisfaction as low satisfaction is generally tied to wait times exceeding expectations as opposed to exceeding any specific length of time. Once a customer schedules an appliance pickup time, reduce rescheduling to the absolute minimum to maintain high customer satisfaction.
- Conclusion #2: While the most frequently mentioned reason for not installing a kit measure is that the customer is planning to but hasn't had time yet, 3% of respondents mentioned either not understanding how to install the measure or indicated a lack of belief that the water-saving measures would save energy. These responses were not present in the education kits program. This suggests that additional savings with kits delivered outside of the education program may be achievable if more clear value propositions are employed in the kit marketing materials.
  - Recommendation: Include more information in the kits about the value proposition of the measures. Expanding on the kit instructions may help decrease the percentage of participants who do not understand how to install the measures. Include information on approximate time required to install. Clearly explaining how the measure works and projected energy savings may help decrease the number of respondents who believe installing the measures would not achieve savings.
- Conclusion #3: The RAR Program did not achieve program goals.
  - Kits account for 14% of RAR Program savings in PY2019, with an average kit measure installation rate of 31%. The evaluation team recommends that Ameren Missouri reevaluate how the Energy Efficiency Kits Program is included in RAR Program participation. Ameren Missouri

may want to revisit whether the inclusion of kit components is a worthwhile addition to this program, considering the low installation rate of kit measures.

Table 9-4. Installation rates

Kit Measure	Installation Rate
Bathroom Faucet Aerator	24%
Dirty Filter Alarm	9%
Kitchen Faucet Aerator	20%
LED 10W (Cumulative)	88%
Low Flow Shower Head	24%
Pipe Insulation Wrap	41%

- Conclusion #4: There are large differences between the ex-ante deemed savings and ex-post regression-based analysis savings for appliances.
  - The evaluation team recommends Franklin Energy and Ameren Missouri reconsider their method for calculating the ex-ante savings values for refrigerator and freezer recycling. We recommend using a regression-based calculation method from the Ameren TRM and using participant application input values over deemed values where available.
- Conclusion #5: The evaluation team could not recreate the ex-ante savings values stated in the tracking data. The implementers provided several deemed calculators to the evaluation team throughout the program year, but they did not clarify which values they used or their method of derivation.
  - The evaluation team recommends using one source document to calculate the ex-ante savings. This will enable the evaluation team and other stakeholders to recreate ex-ante savings estimates. Variable and algorithm consistency are necessary to achieve a high realization rate.
- Conclusion #6: The ex-ante savings values for Post-1990 refrigerator savings are 507 kWh less than Pre-1990 savings values, with no source provided validating the difference. The Ameren Missouri deemed table lists 520 kWh for post-1990 savings while the Ameren Missouri TRM[54] specifies a single kWh savings value of 1,028 kWh per unit recycled for both pre-1990 and post-1990.
  - The evaluation team recommends Ameren Missouri reconsider the process used to derive refrigerator ex-ante savings estimates. We recommend using the regression-based analysis from the Ameren Missouri TRM and using actual reported measure values from the program year's tracking data. This will produce more accurate energy and demand savings estimates and reduce uncertainties in the calculation of ex-post saving values.
- Conclusion #7: The program tracking data lacked the following inputs necessary for accurate savings calculation: 1) primary or secondary usage of appliances and 2) whether the appliance is located in a conditioned space.

[54] Ex ante applied Revision 2.0 (dated 12/21/2018) of the Ameren Missouri 2019-21 MEEIA Energy Efficiency Plan Appendix I – TRM: Residential Measures (referred to as the "Ameren Missouri TRM"). Ex post applied Revision 3.0 (released November 2019) of the Ameren Missouri TRM.

- Franklin Energy's assumption omits these factors, which results in an underestimation of savings (based on PY2019 participation survey results). We recommend the program implementer collect these variables upon appliance pickup and record them in the tracking database.

Table 9-5. Updated survey results for missing inputs.

Type	Average Primary Usage Survey Result	Average Unconditioned Space Survey Results
Refrigerator	26%	64%
Freezer	38%	67%

- Conclusion #8: The PY2019 evaluation results reveal very different process and impact results for kits that are distributed to appliance recycling participants compared to kits that are distributed via the education mechanism. We highlight these differences to underscore the importance that the delivery mechanisms have in these differences.
  - Thus, for future program years, we recommend considering the delivery mechanism when choosing NTG and impact calculation values to use: education kit values are not interchangeable with kit values of other delivery mechanisms.

9.2 Evaluation Methodology

The evaluation team performed both impact and process evaluation activities to assess the performance of the RAR Program in PY2019. In addition to the overarching research objectives outlined for the Residential portfolio, the evaluation team explored the following RAR specific objectives:

- Characterize program participation based on products recycled and distributed through the program by type and by distribution channel;
- Assess customer knowledge of energy-efficient products discounted through the program;
- Evaluate the effectiveness of program marketing materials in informing customers about the benefits of program-supported efficient products and their impact on customer purchases;
- Measure customer satisfaction, with program processes, discounted products, and motivations for participating; and
- Provide evaluation results that can be used to improve the design and implementation of the RAR Program.

Table 9-6 provides an overview of the HVAC Program evaluation activities. Following the table, we outline program-specific aspects of key evaluation methodologies.

Table 9-6. PY2019 Evaluation Activities for the Residential Appliance Recycling Program

Evaluation Activity	Description
Program Manager and Implementer Interviews	▪ Conducted interviews towards the end of PY2019 to understand program staff's perspective on program performance.
Program Material Review	▪ Reviewed available program materials to inform evaluation activities.
Program Theory/ Logic Model Review	▪ Reviewed implementer's program theory/logic model for understanding program activities and their expected outputs and outcomes, including expected impacts on the market.
Tracking System Review	▪ Reviewed implementer's tracking system to ensure that data required for the evaluation is being collected.
Participant Survey	▪ Conducted two waves of surveys with program participants to collect data to inform NTG (free ridership and participant spillover) and yield process-related insights.
Database Review	▪ Reviewed program database to check that program data are complete and that program-installed measures meet all program requirements.
Engineering Analysis	▪ Verified that ex ante savings use correct TRM values and algorithms. ▪ Developed overall and measure-level ex post savings using TRM values and algorithms, program tracking data, and any updated evaluation-estimated parameters.
Attribution / Net Impact Analysis	▪ Developed estimates of free ridership, participant spillover, and trade ally spillover. ▪ Applied portfolio-level non-participant spillover. ▪ Estimated PY2019 net impacts.

Participant Survey

The participant survey assessed how customers heard about the program, measured customer satisfaction with program processes, collected variables necessary for program-specific impact analysis (such as in-service rates), and inquired about suggestions for program improvement. The evaluation team fielded two online surveys via an e-mailed survey link to a census of participants. Half of all RAR participants received a link to the RAR survey that focused on the appliance recycling component of the program, and half received a link to the RAR kits survey, which focused on the Energy Efficiency Kits component. Separating the survey and population into two groups allowed for shorter survey lengths to reduce respondent fatigue and therefore increase the potential response rate and quality of responses.

Out of 1,862 PY2019 unique customers, 959 participants had valid e-mails. The RAR survey achieved a total of 352 completes for a response rate of 37%. The evaluation team administered the online surveys from October 25th, 2019 through January 20th, 2020. Response details are summarized in Table 9-7.

Table 9-7. Appliance Recycling Participant Survey Response Rate

Survey Cohort	Sample Population	Completes	Response Rate
Appliance	477	203	43%
Kits	482	149	31%
Total	**959**	**352**	**37%**

9.3 Evaluation Results

9.3.1 Process Results

Our process evaluation includes findings from our engineering review, as well as our participant survey.

Program Data Tracking and Management

Through the database and tracking system review, the evaluation team noted a large portion of missing required inputs from the program tracking database initially provided. After a series of evaluation team requests and updates from the implementation team, the final program database missing record rate improved to 1.5% of records from an initial rate of 47% (Table 9-8).

Table 9-8. Progress towards complete database

TRM Required Input	Percentage Missing From Initial Tracking Database	Percentage Missing From Final Tracking Database
Missing fields that were eventually populated		
Year Manufactured	33%	<1%
Size	13%	<1%
Configuration	35%	1%
Total	**47%**	**1.5%**
Missing fields that were never populated		
Primary Usage	100%	100%
Used in Unconditioned Space	100%	100%

Our evaluation of the data collection and tracking database found the following details:

- The appliance recycling contractor, Recleim, collects data onsite using a tablet. These data are automatically uploaded to the Recleim database. Reasons for missing inputs at this stage include incorrect data transcription of measure details, data not transferring correctly from Recleim to Franklin Energy, or lost data.
- The data transfer from Recleim to the program implementer Franklin Energy appears to be where most data gaps occurred. Once the evaluation team identified the missing inputs, Franklin Energy requested the missing data values from Recleim. Most of the missing data values were eventually provided by Recleim although there were still some missing values not populated.

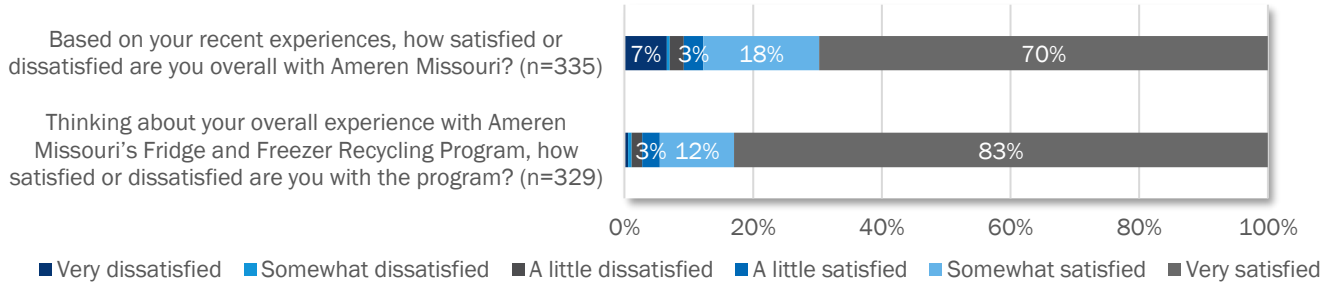
Program Satisfaction

The evaluation team assessed several metrics for participant satisfaction with Ameren Missouri overall and with the RAR Program. We assessed satisfaction on a 6-point scale.[55] Eighty-eight percent of respondents reported their satisfaction as a 5 or 6 (somewhat satisfied or very satisfied) with Ameren Missouri overall, and 95% of respondents reported these values with the Fridge and Freezer Recycling Program (Figure 9-1).

[55] 1-Very dissatisfied, 2-somewhat dissatisfied, 3-a little dissatisfied, 4-a little satisfied, 5-somewhat satisfied, 6-very satisfied

The main driver of lower satisfaction results for both the program and Ameren Missouri overall are delays (13% of respondents) or rescheduling (8% of respondents) of the pickup of the appliance.

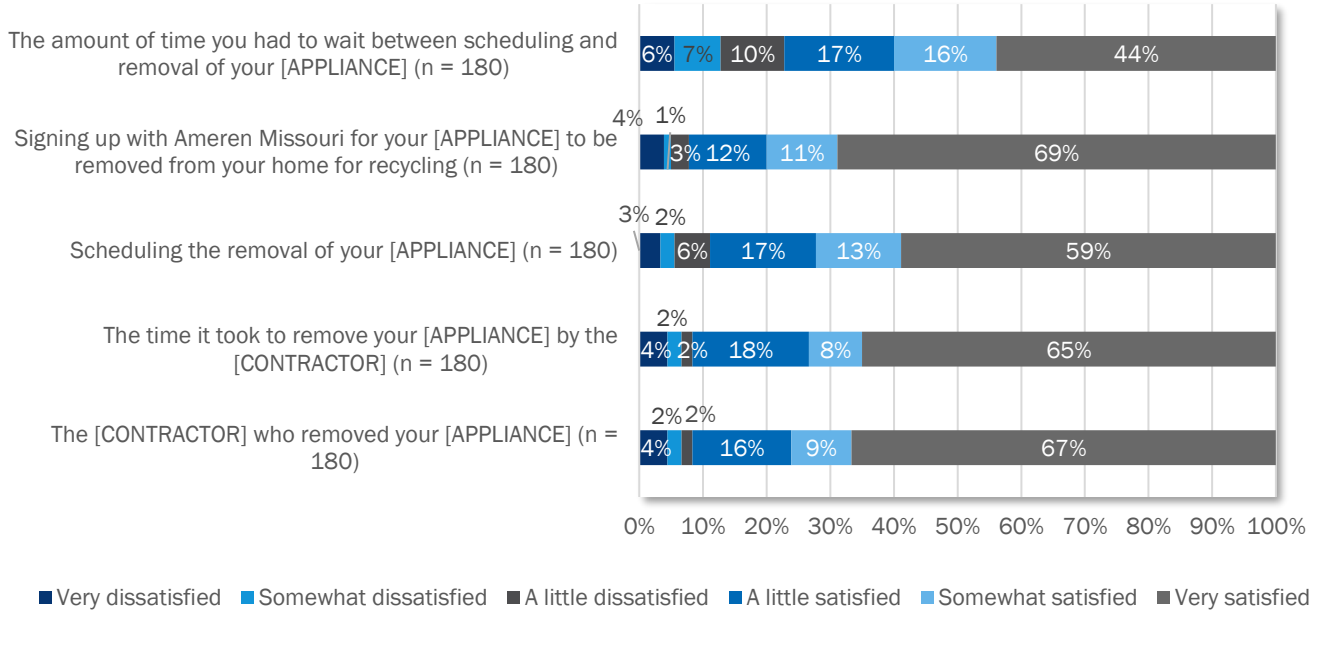
Figure 9-1. Satisfaction Responses



When asked how likely they would be to recommend Ameren Missouri's RAR Program to others (such as a friend, family member, and/or colleague) on a 1-5 scale,[56] the average response is a 4.5 (n=323). Fifty-four percent of respondents gave a "5" rating indicating they have already recommended the program to others.

Respondents rated their satisfaction with specific components of both the experience of recycling an appliance and of receiving the Energy Efficiency Kit. The highest-rated component of the RAR Program is the process of signing up, and the lowest-rated component is the period between scheduling and removal of the appliance (Figure 9-2). It is clear customers enjoy the benefit of Ameren Missouri assisting with the removal of their old appliance(s).

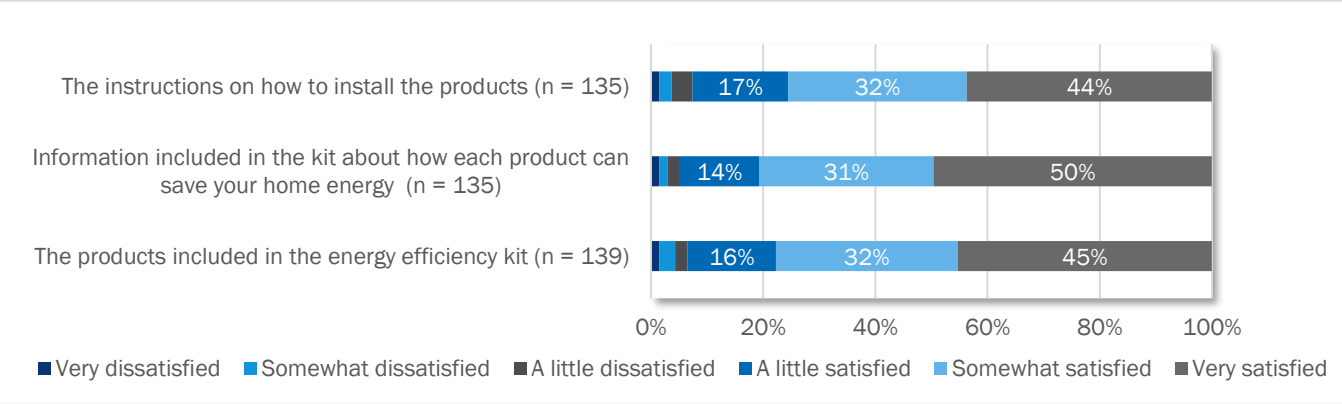
Figure 9-2. Satisfaction with the RAR Program Components



[56] 1=Not at all likely, 2=A little likely, 3= Somewhat likely, 4=Very likely, 5=Definite, I've already recommended it to others.

When asked about their satisfaction with the Energy Efficiency Kit, average results are highest for the products in the kit, and lowest for instructions on how to install the products. Open-ended comments indicate a small minority of customers (2% of respondents) felt the installation instructions were not sufficient, and others either did not appreciate the aesthetics of the kit items (7%) or felt that efficiency items were not necessary for them because they already conserve their usage (9%).

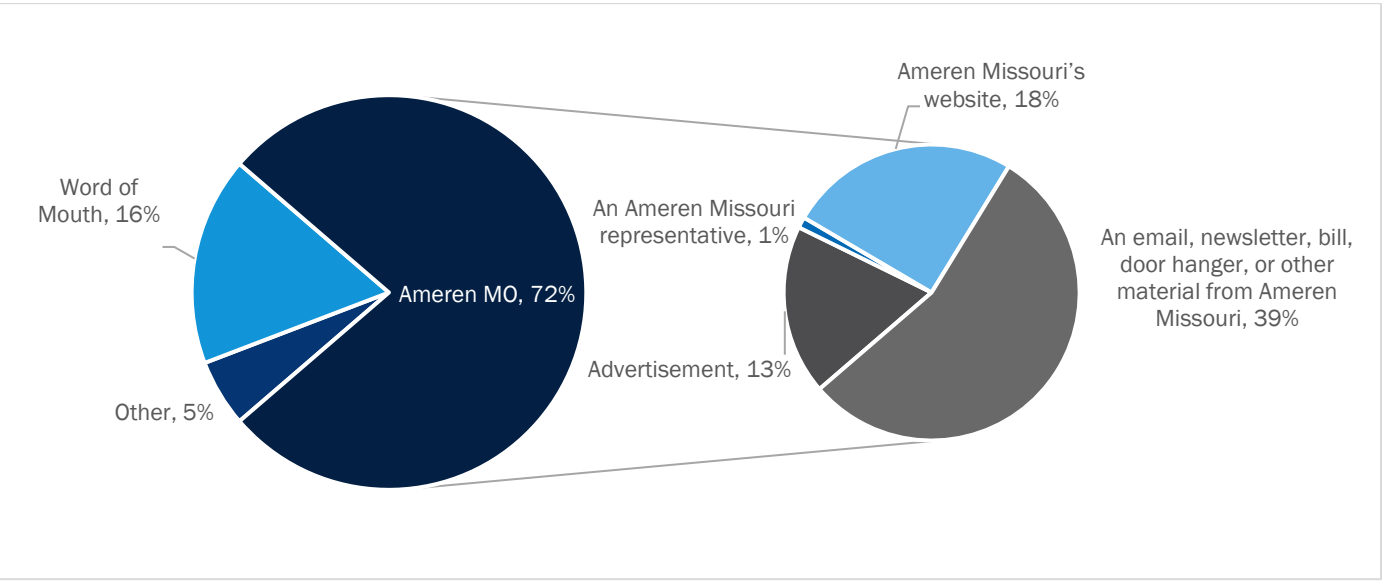
Figure 9-3. Energy Efficiency Kit Satisfaction



Participation Process

To determine customer knowledge of the program, we asked how they became aware of the program. The majority of customers became aware of the program directly from Ameren Missouri (72% of respondents, as shown in Figure 9-4). Physical collateral from Ameren Missouri such as bill inserts and letters are the primary source of awareness (39% of respondents), followed by the Ameren Missouri website (18% of respondents), and advertisement (primarily TV at 31% of those responding "advertisements," retail stores at 19%, website banners at 17%, and newspapers at 7%). This is consistent with Ameren Missouri's program marketing.

Figure 9-4. Participant Sources of Awareness of the RAR Program



The intent of the program is to remove old, inefficient secondary appliances from the grid. Participant feedback indicates that the program, in general, performs as intended, with 74% of recycled refrigerators categorized as secondary units, and 62% of recycled freezers claimed as secondary units. The program also functions well at removing older appliances from the grid, with 85% of recycled units manufactured prior to 2001. Thirty-six percent of recycled units were manufactured prior to 1990, indicating the program removes a large percentage of units more than 30 years old.[57] The appliances that were recycled by survey respondents had been used an average of ten months, with most (77%) having been used for the full 12 months of the preceding year. All appliances were able to turn on when they were recycled.

The Energy Efficiency Kit is gifted to customers upon appliance pickup.

Kit Product Installation Rates and Rationale

LED Installation

While 85% of parents reported installing at least one of their LED bulbs, 15% reported not installing any of the LED bulbs. When asked why the household did not install all the LED bulbs, the primary reason (noted by 84% of respondents that did not install all bulbs) is that the family is saving the bulbs for when others burn out. Six percent of respondents noted aesthetic reasons for not installing the bulbs, such as the bulbs' light level or color being undesirable. The remaining 10% of those that did not install all bulbs stated they intended to but have not made it a priority yet.

Similar to the method used to estimate the ISR for LEDs purchased through Ameren Missouri's online store (see Section 3.2), we estimated both the first year ISR and the cumulative ISR over a six year period. As we assume that participants install LEDs received through the RAR Program in subsequent years, we used the cumulative ISR to estimate gross savings for the program.

Table 9-9. UMP Calculated ISRs for LED Bulbs

First Year ISR	Cumulative ISR
0.66	0.88

Other Measure Installation

Customers reported installing other measures at a much lower rate than LEDs. Nine to forty-one percent of respondents reported installing the remaining kit measures. Once installed, removal rates are low, with less than 2% of respondents reporting having removed the item. For the respondents that have not installed the items, the primary mentioned rationale is they intended to but have not yet had time. The secondary reason varies by measure and is listed in Table 9-10.

[57] General population survey results indicate the following portion of refrigerators currently in use were manufactured prior to 2001: 11% of primary refrigerators, and 27% of secondary refrigerators. Since 36% of program recycled units were manufactured prior to 2001, the program is resulting in a larger portion of older units being recycled than those present in the general population.

Table 9-10. Summary of Non-lighting Kit Measure Installation

Measure/Enduse	Percent of Participants Reported Installed	Second [a] most commonly mentioned rationale for not installing (% of responding customers)
Bathroom Faucet Aerator	24%	I don't like the product (22%)
Dirty Filter Whistle	9%	Don't need it (5%)
Kitchen Faucet Aerator	20%	I don't like the product (24%)
Low Flow Showerhead	24%	I don't like this product (36%)
		Already have efficient one (15%)
Pipe Insulation Wrap	41%	Already insulated (7%)

[a] The primary reason for all measure types for not installing is "have not yet had time."

Comparison to the Energy Efficiency Kits Program - Education

The same Energy Efficiency Kit is provided to customers via the Energy Efficiency Kits Program, which is currently distributed along with educational curriculum via schools to 6th-grade students. Ameren Missouri is considering expanding the reach of the Energy Efficiency Kits Program by delivering kits via other avenues in addition to the school's delivery mechanism, such as through business outreach or for addressing residential customer service concerns. The PY2019 evaluation results reveal very different process and impact results for kits that are distributed to appliance recycling participants compared to kits that are distributed via the education mechanism. We highlight these differences to underscore the importance that the delivery mechanisms have in these differences. Thus, for future program years, we recommend considering the delivery mechanism when choosing NTG and impact calculation values to use: education kit values are not interchangeable with kit values of other delivery mechanisms.

Comparison 1: Installation Rates

From the installation rate comparison, the LED light bulbs are most popular for both the RAR kit and the Education kit (Table 9-11). However, the parents from the Education kit program are much more likely to install all four of the LED bulbs. The installation rates are also much higher for the non-lighting kit measures among education kit participants.

Table 9-11. Installation Rate Comparison Education Kits vs Appliance Recycling Kits

Measure/Enduse	Percent of Participants Reported Installed (RAR Kits)	Percent of Parents Reported Installed (Education Kits)
Bathroom Faucet Aerator [a]	24%	48%
Dirty Filter Alarm [a]	9%	44%
Kitchen Faucet Aerator	20%	40%
LED Light Bulb (at least one) [a]	85%	88%
LED Light Bulb (all 4)	45%	69%
Low Flow Showerhead*	24%	54%
Pipe Insulation Wrap*	41%	56%

[a] Difference in the populations responses is statistically significant

Comparison 2: Rationale for Not Installing

The rationale for not installing items may reflect the influence the education component of the program has on the parents reporting installations. For example, the education program's lower incidence of parents who reported that they are saving the bulbs for when the bulbs in use burn out (Table 9-12) could indicate a greater understanding that the earlier you replace an inefficient bulb with an LED, the more savings a residence will achieve. Education kit recipients are also much more likely to give a neutral reason for not installing an item, such as they intend to but haven't had time yet, already have the item, the item doesn't fit, or they do not understand how to install. RAR kit participants reported that they simply did not like the item.

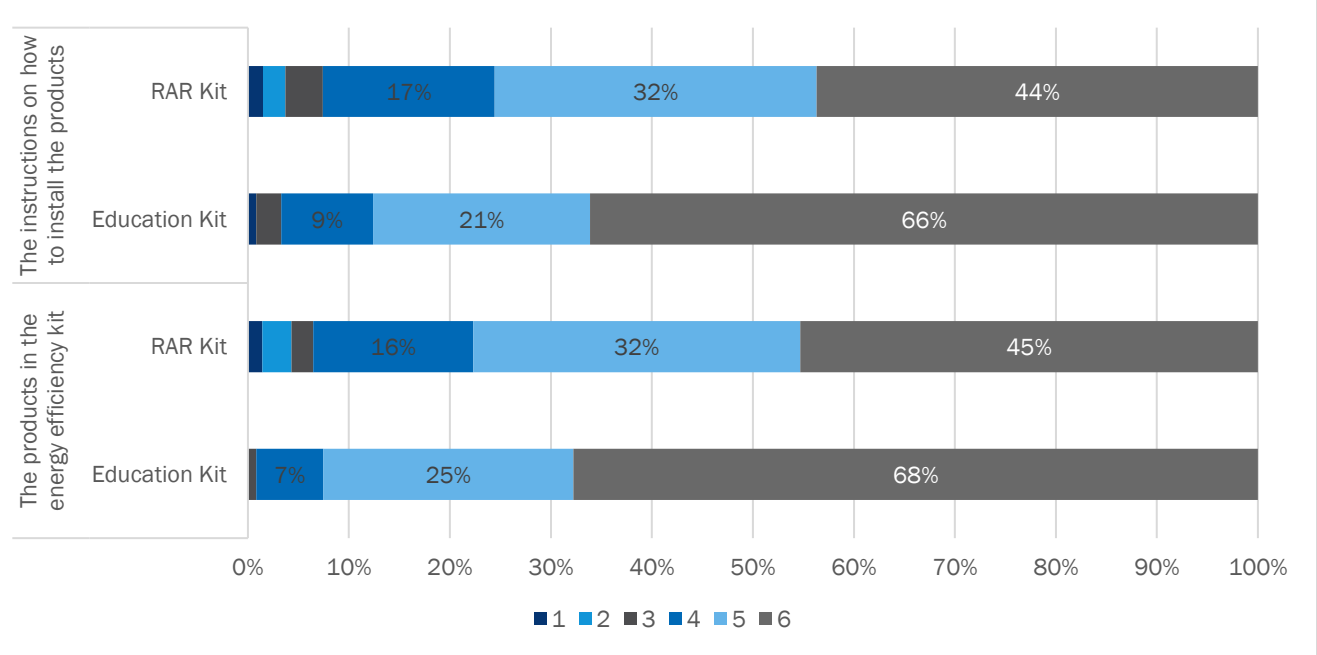
Table 9-12. Rationale Comparison Appliance Recycling Kits vs. Education Kits

Measure	Primary Reason		Secondary Reason	
	RAR Kits	Education Kits	RAR Kits	Education Kits
LED Light Bulbs	84% saving for when existing bulbs burn out	71% saving for when existing bulbs burn out	10% no time	18% no time
Hot Water Pipe Insulation	60% no time	67% no time	16% already have it	17% already have it
Showerhead	38% no time	65% no time	36% I don't like it	15% already have an efficient one
Bathroom Faucet Aerator	53% no time	54% no time	22% I don't like it	22% doesn't fit
Furnace Whistle	32% no time	56% no time	22% I don't like it	11% did not understand how to install
Kitchen Faucet Aerator	45% no time	47% no time	24% I don't like it	31% doesn't fit

Comparison 3: Satisfaction

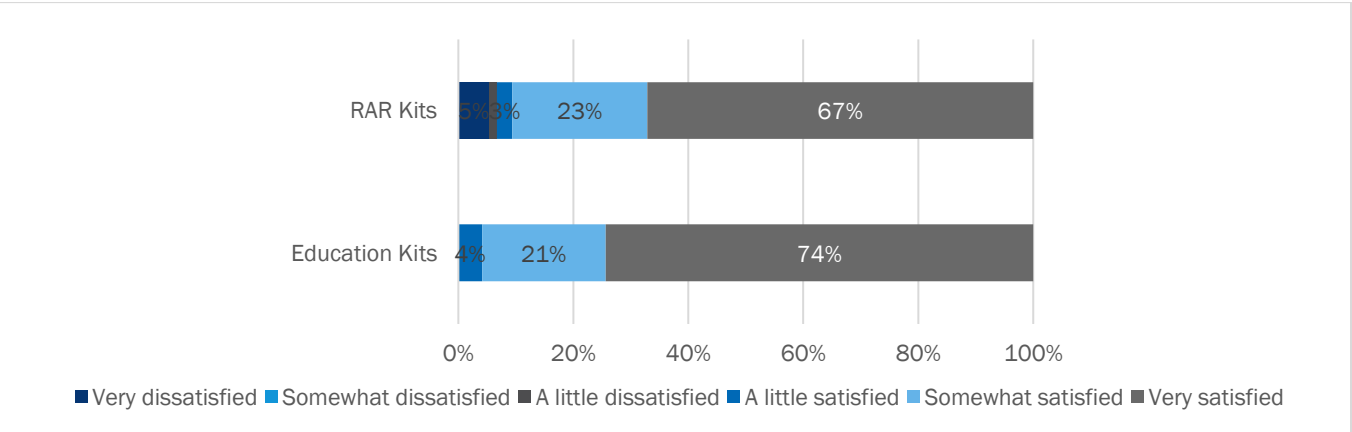
A substantially higher percentage of Education kit respondents reported a higher level of satisfaction with the kit items and installation instructions than the RAR kit respondents.

Figure 9-5. Satisfaction Results Comparison – Appliance Recycling Kit vs Education Kit



Education kits participants also report higher satisfaction with Ameren Missouri. While the RAR kit survey respondents were not asked about the appliance they recycled through the program, open-ended RAR kit responses indicate lower Ameren Missouri satisfaction scores are likely a result of delays in scheduling the appliance pickup and not related to the kit itself.

Figure 9-6. Satisfaction Results Comparison with Ameren Missouri – Appliance Recycling Kit vs. Education Kit



The installation rates, the rationale for not installing the items, and satisfaction results indicate the kit offerings perform very differently in the market when the kit is given to the customer with minimal information compared to the multi-pronged educational and informational avenues of the education kit program. Therefore, the evaluation team recommends considering the delivery mechanism when choosing NTG and impact calculation values to use: education kit values are not interchangeable with kit values of other delivery mechanisms. This recommendation may particularly apply to the Energy Efficiency Kits program should the program decide to offer kits to residential and business customers.

9.3.2 Gross Impact Results

Table 9-13 presents the RAR Program's annual savings achieved in PY2019. The PY2019 RAR Program achieved 2,074 MWh and 0.29 MW in ex post gross savings.

Table 9-13. PY2019 Appliance Recycling Gross Impact Summary

	Ex Ante	Realization Rate	Ex Post
First Year Savings			
Energy Savings (MWh)	2,028	102.3%	2,074
Demand Savings (MW)	0.32	89.7%	0.29
Last Year Demand Savings			
< 10 EUL (MW)	0.22	108.4%	0.23
10-14 EUL (MW)	0.08	28.8%	0.02
15+ EUL (MW)	0.03	106.4%	0.03

Table 9-14 presents the RAR Program's annual savings achieved in PY2019 by measure category. The PY2019 RAR Program comprises ten unique measures.

Table 9-14. PY2019 Appliance Recycling Annual First Year Gross Impacts

Measure/Enduse	Energy Savings			Demand Savings		
	Ex-Ante (MWh)	Realization Rate	Ex-Post (MWh)	Ex-Ante (MW)	Realization Rate	Ex-Post (MW)
Dehumidifier Recycling	7	100%	7	0.00	100%	0.00
Freezer Recycling (Pre-1990)	150	107%	160	0.03	82%	0.02
Freezer Recycling (post-1990)	191	67%	128	0.03	51%	0.02
Refrigerator Recycling (pre-1990)	539	102%	548	0.07	101%	0.07
Refrigerator Recycling (post-1990)	586	150%	877	0.08	150%	0.11
Room AC Recycling	12	100%	12	0.01	100%	0.01
Bathroom Faucet Aerator Kits	13	38%	5	0.00	38%	0.00
Dirty Filter Alarm Kits	119	24%	28	0.06	24%	0.01
Kitchen Faucet Aerator Kits	76	31%	24	0.01	31%	0.00
LED – 10W (Halogen Baseline) Kits	206	106%	219	0.03	106%	0.03
Low Flow Shower Head Kits	110	46%	51	0.01	46%	0.00
Pipe Insulation Kits	19	77%	14	0.00	77%	0.00
Total	**2,028**	**102%**	**2,074**	**0.32**	**90%**	**0.29**

Table 9-15. PY2019 Residential Appliance Recycling Annual Last Year Gross Demand Impacts

Measure/Enduse	Ex Ante Gross Savings (MW)[a]				Gross Realization Rate	Ex Post Gross Savings (MW)			
	<10	10-14	15+	Total		<10	10-14	15+	Total
Dehumidifier Recycling	0.00	0.00	0.00	0.00	100%	0.00	0.00	0.00	0.00
Freezer Recycling (Pre-1990)	0.03	0.00	0.00	0.03	82%	0.02	0.00	0.00	0.02
Freezer Recycling (post-1990)	0.03	0.00	0.00	0.03	51%	0.02	0.00	0.00	0.02
Refrigerator Recycling (pre-1990)	0.07	0.00	0.00	0.07	101%	0.07	0.00	0.00	0.07
Refrigerator Recycling (post-1990)	0.08	0.00	0.00	0.08	150%	0.11	0.00	0.00	0.11
Room AC Recycling	0.01	0.00	0.00	0.01	100%	0.01	0.00	0.00	0.01
Bathroom Faucet Aerator Kits	0.00	0.00	0.00	0.00	38%	0.00	0.00	0.00	0.00
Dirty Filter Alarm Kits	0.00	0.06	0.00	0.06	24%	0.00	0.01	0.00	0.01
Kitchen Faucet Aerator Kits	0.00	0.01	0.00	0.01	31%	0.00	0.00	0.00	0.00
LED – 10W (Halogen Baseline) Kits	0.00	0.00	0.03	0.03	106%	0.00	0.00	0.03	0.03
Low Flow Shower Head Kits	0.00	0.01	0.00	0.01	46%	0.00	0.00	0.00	0.00
Pipe Insulation Kits	0.00	0.00	0.00	0.00	77%	0.00	0.00	0.00	0.00
Total	**0.22**	**0.08**	**0.03**	**0.32**	**90%**	**0.23**	**0.02**	**0.03**	**0.29**

[a] Some values are too small to be shown in this table in megawatts, values do exist in kilowatts.

Table 9-16 below details the ex-ante savings, the gross realization rate, the ex-post savings, and an explanation for each discrepancy

Table 9-16. PY2019 Appliance Recycling Electric Energy Savings

Measure/Enduse	Ex-Ante Gross Savings (MWh)	Gross Realization Rate	Ex-Post Gross Savings (MWh)	Reason for Discrepancy (if RR is not 100%)
Dehumidifier Recycling	7	100%	7	NA
Freezer Recycling (Pre-1990)	150	107%	160	The ex-post savings calculations applied a regression-based analysis that used actual measure and survey characteristics instead of the Ameren TRM deemed values. The survey results provided the following updated variables: part use factor, primary usage, and unconditioned space.
Freezer Recycling (post-1990)	191	67%	128	See Freezer Recycled (Pre-1990) above
Refrigerator Recycling (pre-1990)	586	150%	877	The ex-post savings calculations applied a regression-based analysis that used actual measure and program-specific variables from the PY2019 participant survey results as a priority to the Ameren TRM deemed values. The survey results were used for the following updated variables: part use factor, primary usage, and unconditioned space. The Refrigeration Recycling ex-ante savings uses a pre-1990 and post-1990 deemed value. The Ameren TRM only supplies one deemed value that matches the pre-1990 value. The other post-1990 value does not contain any source references. Refrigerator Recycling makes up 70% of total RAR Program savings in PY2019. Therefore, the high realization rate of this one measure drove the program realization rate of 100%.
Refrigerator Recycling (post-1990)	539	102%	548	See Refrigerator Recycled (pre-1990) above
Room AC Recycling	12	100%	12	NA
Bathroom Faucet Aerator Kits	13	38%	5	The ex-post savings calculations used the participant survey results to update the following variables: percentage of homes with electric hot water heaters, members living in the household, and the installation rate. As stated with other kit measures, leakage is zero for this program. The leakage value from the education kits program is not applicable.
Dirty Filter Alarm Kits	119	24%	28	The ex-post calculation applied an updated Installation rate value of 66% from the participation survey which is lower than the value of 90% that was used in the ex-ante savings calculations.

Measure/Enduse	Ex-Ante Gross Savings (MWh)	Gross Realization Rate	Ex-Post Gross Savings (MWh)	Reason for Discrepancy (if RR is not 100%)
				The dirty filter alarm ex-ante calculations also used a leakage rate from the Energy Efficiency Kits Program. RAR Program Energy Efficiency Kit measures should not use a leakage rate because Ameren Missouri provides these kits directly to participants who have already been qualified as customers (to be able to participate in the RAR Program).
Kitchen Faucet Aerator Kits	76	31%	24	The ex-post savings calculations used the participant survey results to update the following variables: the percentage of homes with electric hot water heaters, members living in the household, and installation rate. The average difference in the ex-post versus the ex-ante values are 36%.
LED – 10W (Halogen Baseline) Kits	206	106%	219	The ex-post savings calculations used a leakage rate of 0%, while ex ante assumed a 92% leakage rate.
Low Flow Shower Head Kits	110	46%	51	The ex-post savings calculation used the participant survey results to update the following variables: percentage of homes with hot water heaters, members living in the household, showers taken per day, showerheads per home, and installation rate.
Pipe Insulation Kits	19	77%	14	The ex-post savings calculation used the participant survey results to update the following variables: the installation rate, and percentage of homes with electric water heaters.

- Upon review of the program participation database and included savings values, the evaluation team could not trace the ex-ante energy efficiency kit savings (especially peak savings) to their original savings inputs. The implementer provided several input scenarios to the evaluation team without clarifying which inputs they had used.
- Leakage is zero for the Kit program – the leakage value from the education kits program is not applicable.

9.3.3 Net-To-Gross Ratio Results

The evaluation team researched with 338 participants to develop NTGRs for PY2019. We developed the NTGRs using self-reported information from web-based surveys with program participants. We used participant survey responses to develop estimates of FR and PSO. Table 9-17 presents the results of our NTG analysis. Due to the low participation rate of room air conditioners and dehumidifiers, we have assigned the ex-post savings weighted average appliance value of the refrigerators and freezers.

Table 9-17. PY2019 Residential Appliance Recycling Measure-Level Net-to-Gross Ratio

Measure/Enduse	Measure-level Respondents	Free Ridership	Participant Spillover	NTGR
		(FR)	(PSO)	(1-FR+PSO)
Freezer	46	58.1%	4.4%	46.9%
Refrigerator	143	62.6%	4.4%	42.3%
Room A/C and Dehumidifiers (Ex-Post savings weighted appliance value)	-	61.3%	4.4%	43.6%
Bathroom Faucet Aerators	149	21.6%	1.2%	79.6%
Dirty Filter Alarm	149	15.7%	1.2%	85.5%
Kitchen Faucet Aerators	149	21.4%	1.2%	79.8%
Low Flow Showerheads	149	28.0%	1.2%	73.2%
Pipe Insulation (Hot Water)	149	34.1%	1.2%	67.1%
Overall Program	**338**	**56.5%**	**3.8%**	**47.7%**

Based on results from the participant survey, PSO was present for 14 survey respondents. Our engineering analysis of SO measures for these participants yielded total spillover savings of 13 MWh and 0.004 MW for the participant sample. These savings are presented in Table 9-18.

Table 9-18. Residential Appliance Recycling Participant Spillover Measures and Savings

Spillover Measure	Appliance Quantity (participants)	Kits Quantity (participants)	Total Quantity (participants)	Appliance Savings (kWh)	Kits Savings (kWh)	Total RAR Program Savings (kWh)
Advanced Power Strips	1	-	1	59	-	59
EE Clothes Washer	2	1	3	198	99	297
EE Cooling and Heating Equipment	3	1	4	1,841	614	2,455
EE Dehumidifier	1	-	1	204	-	204
EE Refrigerator or Freezer	4	2	6	233	116	349
EE Water Heater	2	-	2	3,139	-	3,139
Faucet aerators	3	-	3	87	-	87
Installed EE Cooling Equipment	1	-	1	232	-	232
Low-flow Showerheads	6	-	6	488	-	488
Programmable or Smart Thermostat (Central Air Conditioner)	3	1	4	560	187	747
Programmable or Smart Thermostat (Heat Pump)	3	1	4	1,843	614	2,457
Upgraded Insulation	2	-	2	515	-	515
Water Heater Tank Insulation	1	-	1	103	-	103
Window and Door Weather-stripping	3	2	5	906	604	1,510
Total	**35**	**8**	**43**	**10,409**	**2,234**	**12,643**

The evaluation team calculated two separate spillover values, one for each survey cohort (the appliance specific survey and the kits specific survey).

Appliance specific spillover: dividing the estimated total SO in our appliance cohort sample (10,409 kWh) by total program ex post gross savings of the overall appliance cohort participant sample (235,610 kWh) yields a SO rate of 4.42% (Equation 9-1).

Equation 9-1. PY2019 Appliance Recycling Appliance Cohort Participant Spillover Rate

$$PSO\ \%_{Energy} = \frac{Total\ participant\ sample\ SO\ (kWh)}{Total\ participant\ sample\ savings\ (\mathrm{kWh})} = \frac{10{,}409\ kWh}{235{,}610\ \mathrm{kWh}} = 4.42\%$$

Similarly for RAR kits specific spillover: dividing the estimated total SO in our kits cohort sample (2,234 kWh) by total program ex post gross savings of the overall kits cohort participant sample (193,993 kWh) yields a SO rate of 1.15%. The two spillover rates are averaged with ex-post gross savings of the total appliance and kits participant sample to yield the program level spillover rate of 3.80%.

Net Impacts

The evaluation team applied the PY2019 NTGRs to determine net impacts for the PY2019 Appliance Recycling Program (Table 9-19).

Table 9-19. PY2019 Residential Appliance Annual First Year Net Impacts

Measure/Enduse	Energy Savings			Demand Savings		
	Ex-Post Gross Savings (MWh)	NTGR	Ex-Post Net Savings (MWh)	Ex-Post Gross Savings (MW)	NTGR	Ex-Post Net (MW)
Dehumidifier Recycling	7	43%	3	0.00	43%	0.00
Freezer Recycling (Pre-1990)	160	46%	74	0.02	46%	0.01
Freezer Recycling (post-1990)	128	46%	59	0.02	46%	0.01
Refrigerator Recycling (pre-1990)	548	42%	230	0.07	42%	0.03
Refrigerator Recycling (post-1990)	877	42%	368	0.11	42%	0.05
Room AC Recycling	12	43%	5	0.01	43%	0.00
Bathroom Faucet Aerator	5	80%	4	0.00	80%	0.00
Dirty Air Filter Alarm	28	85%	24	0.01	85%	0.01
Kitchen Faucet Aerator	24	80%	19	0.00	80%	0.00
LED – 10W (Halogen Baseline)	219	60%	132	0.03	60%	0.02
Low Flow Showerhead	51	73%	37	0.00	73%	0.00
Pipe Insulation	14	67%	10	0.00	67%	0.00
Nonparticipant Spillover			277			0.02
Total	**2,074**	**60%**	**1,242**	**0.29**	**54%**	**0.16**

Table 9-20. PY2019 Residential Appliance Recycling Last Year Net Demand Impacts

Measure/Enduse	Ex Post Gross Savings (MW)				NTGR	Ex Post Net Savings (MW)			
	<10	10-14	15+	Total		<10	10-14	15+	Total
Dehumidifier Recycling	0.00	0.00	0.00	0.00	43%	0.00	0.00	0.00	0.00
Freezer Recycling (Pre-1990)	0.02	0.00	0.00	0.02	46%	0.01	0.00	0.00	0.01
Freezer Recycling (post-1990)	0.02	0.00	0.00	0.02	46%	0.01	0.00	0.00	0.01
Refrigerator Recycling (pre-1990)	0.07	0.00	0.00	0.07	42%	0.03	0.00	0.00	0.03
Refrigerator Recycling (post-1990)	0.11	0.00	0.00	0.11	42%	0.05	0.00	0.00	0.05
Room AC Recycling	0.01	0.00	0.00	0.01	43%	0.00	0.00	0.00	0.00
Bathroom Faucet Aerator	0.00	0.00	0.00	0.00	80%	0.00	0.00	0.00	0.00
Dirty Air Filter Alarm	0.00	0.01	0.00	0.01	85%	0.00	0.01	0.00	0.01
Kitchen Faucet Aerator	0.00	0.00	0.00	0.00	80%	0.00	0.00	0.00	0.00
LED – 10W (Halogen Baseline)	0.00	0.00	0.03	0.03	60%	0.00	0.00	0.02	0.02
Low Flow Showerhead	0.00	0.00	0.00	0.00	73%	0.00	0.00	0.00	0.00
Pipe Insulation	0.00	0.00	0.00	0.00	67%	0.00	0.00	0.00	0.00
Nonparticipant Spillover						0.00	0.01	0.01	0.02
Total	**0.23**	**0.02**	**0.03**	**0.29**	**54%**	**0.10**	**0.03**	**0.03**	**0.16**

10. Single Family Low-Income (SF LI)

This section summarizes the PY2019 evaluation methodology and results for the Residential Single Family Low-Income (SF LI) program. Additional details on the methodology, including data collection instruments and sampling plans, are presented in Appendix A.

10.1 Evaluation Summary

Ameren Missouri launched the Residential Single Family Low-Income Program in PY2019. The program is known to customers as the CommunitySavers Program and is designed to provide whole-home energy efficiency upgrades that result in long-term energy savings and bill reduction opportunities to low-income Ameren Missouri customers living in single family properties, including mobile homes and duplexes. The program leverages three participation channels: (1) the single family neighborhoods channel; (2) the mobile home park channel; and (3) the Low-Income Efficiency Housing Grant channel. Each channel is designed to reach low-income customers in different ways that collectively overcome barriers to efficiency among this segment; all work to achieve the objective of providing energy saving measures to income qualified customers. As presented in the Participation Summary, the single family neighborhoods channel generated the most savings (39%) in PY2019, followed by the mobile home park channel (36%) and the Low-Income Efficiency Housing Grant (24%).

The single family and mobile homes channels leverage separate but similar implementation strategies. Both channels are administered by Franklin Energy and implemented by Resource Innovations. Ameren Missouri identifies high need communities to serve through the program based on factors such as average community income, the suitability of housing stock, historic energy usage, and the share of accounts which have received Ameren Missouri energy assistance. Communities are defined at the census tract level, and all residents in the target community are eligible to participate. Once a community is selected, Franklin Energy and Resource Innovations coordinate to launch a "community-blitz" style outreach campaign, which includes direct mailings, door-to-door canvassing, and local kick-off events at popular community venues. Interested customers sign up for a home energy assessment, during which a home energy advisor conducts a walkthrough of the home, performs direct installation of energy-saving measures at no cost to the participant, and identifies opportunities for additional home energy upgrades like insulation, air sealing, refrigerator replacements, or heating and cooling system replacements. Following the assessment, the customer receives information on the measures that were installed, opportunities for additional no-cost upgrades through the Single Family Low-Income Program, and educational materials on ways to further reduce energy use (including general tips to save energy and cross-promotions to other Ameren Missouri programs). Resource Innovations arranges for a local contractor to conduct these home energy assessments and coordinate any follow-up installations.[58]

In PY2019, Ameren Missouri served four communities through the Single Family Low-Income Program, including two single family communities and two mobile home communities (Table 10-1).

[58] In PY2019, Resource Innovations worked with two contractors: Anton's Air Conditioning and Heating and Vantage Air. Both contractors used internal crews to install HVAC follow-up measures and subcontracted insulation and air sealing upgrades.

Table 10-1. PY2019 Single Family and Mobile Home Low-Income Communities Served

Community [a]	Channel	Number of Participants	Installation Dates
Desloge	Single Family	128	June-October
St. Louis	Single Family	251	September-December
Cape Girardeau	Mobile Home	100	November-December
Hayti	Mobile Home	8	December
Total		**487**	**June-December**

[a] Throughout this report we refer to Desloge as "Community #1", St. Louis as "Community #2", and Cape Girardeau and Hayti as the "mobile home communities."

Franklin Energy administers and implements the Low-Income Efficiency Housing Grant channel as a distinct offering that expands on a lighting distribution program from previous MEEIA portfolios. The channel is designed to reach additional low-income customers and directly provide them with energy efficiency measures through community-based organizations. Eligible organizations must serve Ameren Missouri residential electric customers who reside in single family homes, receive electric assistance, and have an annual family income at or below 80% of Area Median Income (AMI). Organizations can participate in one or both of the following capacities:

- **Measure distribution**: Organizations receive measures at no cost and distribute them to customers who visit the organization. Eligible measures include LED bulbs and energy efficiency kits.[59] Organizations are required to verify recipients' eligibility before distributing measures.
- **Measure installation**: Organizations arrange for the installation of energy-saving measures in the homes of qualified customers. Organizations can install LED bulbs, energy efficiency kits, smart thermostats, and room air conditioners at no out-of-pocket expense. Larger energy-saving measures including refrigerators, central air conditioners, fan blower motors, heat pump water heaters, air-source heat pumps, and ductless air source heat pumps are also eligible for installation, but organizations must procure the equipment through traditional means and apply for a reimbursement after the installation.[60]

Interested organizations must apply through Franklin Energy and provide information on the amount and types of measures they are interested in and how they plan to deliver them. In PY2019, participating organizations mostly consisted of non-profits in the St. Louis area, including a community development organization, community center, a community action agency, and two energy assistance and advocacy charities (Table 10-2). Most organizations distributed measures, while the action agency and two charities installed measures.

[59] Energy efficiency kits include 4 LED bulbs, a dirty filter alarm, faucet aerators, hot water pipe insulation, and a low flow showerhead.

[60] Organizations can pair the housing grant reimbursement with incentives from the HVAC and Efficient Products programs. In these cases, Ameren Missouri does not claim the savings through the Single Family Low-Income program and instead claims them under the applicable other program.

Table 10-2. Participating Organizations in the Low-Income Efficiency Housing Grant Channel

Organization	Form of Participation	Measures
Ameren Missouri [a]	Distribution	LED bulbs, energy efficiency kits
Beyond Housing	Distribution	LED bulbs
Thomas Dunn Learning Center	Distribution	LED bulbs, energy efficiency kits
Community Action Agency of St. Louis County	Installation	Smart thermostats
Cool Down St. Louis	Distribution and Installation	LED bulbs,[b] room ACs
Energycare Inc.	Installation	Room ACs

[a] According to the implementer, Ameren Missouri also distributed measures directly to organizations throughout the year as-requested. Tracking data do not indicate which organizations Ameren Missouri provided these measures to.

[b] Tracking data do not indicate whether these LEDs were distributed vs. directly installed.

In its first year, Ameren Missouri and the implementers worked to refine the Singe Family Low-Income Program design and implementation as they gained experience with on-the-ground market conditions, housing stock, and refined program tracking procedures. Noteworthy changes throughout PY2019 included:

- **Change to mobile homes implementer**: At program launch, Resource Innovations was contracted to implement the single family neighborhoods channel. However, when the anticipated mobile homes implementer was unable to fulfill their role, Franklin Energy also awarded this channel to Resource Innovations.
- **Community selection for single family and mobile home channels**: Resource Innovations selected Community #1 while Ameren Missouri took on community selection thereafter. Many communities are interested in the services provided through the Single Family Low-Income Program and the goal is to focus on communities with the highest need. Ameren Missouri has robust internal customer analytics and, therefore, has a unique tool to identify the highest-need communities. Resource Innovations remains a partner in the selection process and scouts the communities to ensure the housing stock is suitable for the program design.
- **Addition of gas co-delivery for single family and mobile home channels:** Ameren Missouri began delivering dual-fuel measures with two gas utilities midyear, including Ameren Missouri Gas and Spire Gas. To co-deliver measures, Ameren Missouri retained full responsibility for upfront funding and implementation, with the gas utilities providing a reimbursement for their share of the measures. Ameren Missouri added co-delivery in the transition from Community #1 to Community #2. Co-delivered program measures included furnace clean and checks, domestic hot water measures, and dual fuel measures (i.e., thermostats, insulation, etc.). For co-delivered measures that achieve both electricity and gas savings, Ameren Missouri program earns credit for the electric savings and the appropriate gas utility earned credit for the gas savings.
- Refinements to measure replacement criteria for single family and mobile home channels: During home energy assessments in Community #1, implementers found that none of the homes qualified for a central air conditioner (CAC) replacement and just 1% qualified for a refrigerator replacement. To better reflect baseline conditions, the replacement criteria for refrigerators and CACs were adjusted in the transition from Community #1 to Community #2.
  - Ameren Missouri initially planned to replace refrigerators manufactured before 1994. Finding that few refrigerators were that old, they loosened the requirement to allow replacements of refrigerators manufactured before 2001.

- Ameren Missouri initially planned to replace CACs that had a Seasonal Energy Efficiency Ratio (SEER) of 8 SEER or lower. This criterion was modified to a 10 SEER or lower once implementers identified research suggesting that most 10 SEER systems are at an age where their operating efficiency meets replacement criteria. This adjustment also impacted the installation of ASHPs because to replace electric heating and CAC cooling with an air-source heat pump (ASHP), the CAC is required to meet replacement criteria.

10.1.1 Participation Summary

The single family and mobile home park channels drove program savings in PY2019 (39% and 36% of program savings, respectively). Through these two channels, the implementation team treated 378 single family premises and 109 mobile homes, resulting in an average savings of 22% per site. Notably, the St. Louis community accounted for 52% of total participation in these channels but resulted in just 20% of the savings, while the Cape Girardeau mobile home community accounted for 21% of total participation and 46% of savings (see Table 10-4).

The Low-Income Efficiency Housing Grant channel accounted for the remaining 24% of program savings. Participating organizations in the Grant channel installed or distributed nearly 24,000 measures, which accounted for 75% of the total measures provided to customers through the Single Family Low-Income Program.

Table 10-3 presents participation in the Single Family Low-Income Program during PY2019 by channel.

Table 10-3. PY2019 Single Family Low-Income Program Participation Summary

Channel	Participants		Measures [a]		Ex Ante Savings	
	Number	%	Number	%	MWh	%
Single Family	378	78%	6,039	19%	893	39%
Mobile Homes	109	22%	1,957	6%	828	36%
Low-Income Efficiency Housing Grant	NA	NA	23,871	75%	551	24%
Total	**487**	**100%**	**31,867**	**100%**	**2,272**	**100%**

[a] This quantity includes co-delivered measures that provide electric savings but for which the program implementer did not track ex ante savings.

Table 10-4 presents participation in the Single Family Low-Income Program's single family neighborhoods and mobile home channels during PY2019 by community.

Table 10-4. PY2019 Single Family Low-Income Program Participation by Community

Community	Participants		Measures [a]		Ex Ante Savings	
	Number	%	Number	%	MWh	%
Desloge [b]	128	26%	2,416	31%	549	32%
St. Louis	251	52%	3,452	44%	345	20%
Cape Girardeau	100	21%	1,795	23%	799	46%
Hayti	8	2%	133	2%	29	2%
Total	**487**	**100%**	**7,796**	**100%**	**1,721**	**100%**

[a] This quantity includes co-delivered measures that provide electric savings but for which the program implementer did not track ex ante savings.

[b] One of the participants in Desloge was a mobile home resident.

Table 10-5 presents PY2019 participation in the Low-Income Efficiency Housing Grant by the organization.

Table 10-5. PY2019 Low-Income Efficiency Housing Grant Participation by Organization

Organization	Measures		Ex Ante Savings	
	Number	%	MWh	%
Ameren Missouri	12,812	54%	294	53%
Beyond Housing	6,464	27%	146	26%
Thomas Dunn Learning Center	316	1%	8	1%
Cool Down St. Louis	4,236	18%	96	17%
Community Action Agency of St. Louis County	30	<1%	7	1%
Energycare Inc.	13	<1%	1	<1%
Total	**23,871**	**100%**	**551**	**100%**

10.1.2 Key Impact Results

Table 10-6 presents the annual savings achieved in PY2019. As shown, the program (including all distribution channels) achieved 24% of Ameren Missouri's net energy savings goal and 30% of the net demand savings goal.

Table 10-6. PY2019 Single Family Low Income Program Impact Summary

	Ex Ante Gross	Realization Rate	Ex Post Gross	NTGR	Ex Post Net	Goal/Target Net	% of Goal/Target
First Year Savings							
Energy Savings (MWh)	2,272	98%	2,222	100%	2,222	8,556	26%
Demand Savings (MW)	0.57	100%	0.58	100%	0.58	1.83	31%
Last Year Demand Savings							
< 10 EUL (MW)	0.33	48%	0.16	100%	0.16	0.34	47%
10-14 EUL (MW)	0.09	113%	0.10	100%	0.10	0.06	169%
15+ EUL (MW)	0.15	96%	0.14	100%	0.14	1.39	10%

To encourage the pursuit of deeper savings per property and provide a holistic assessment of the program's impact, the SF LI Program has a goal to achieve an average 10% percent energy savings per property among the single family and mobile homes properties. Table 11-3 summarizes the key inputs to calculating the average percent site savings according to 2019-21 MEEIA Energy Efficiency Plan guidance.[61] We calculated average percent energy savings per property as total ex post energy savings divided by the total billed energy consumption at participating properties. Ex post savings—which are based on engineering approaches using the Ameren Missouri TRM—equate to 22% of the recorded baseline energy use.

Table 10-7. PY2019 Single Family Low-Income Program Average Percent Energy Savings Per Property

Metric	Value
Ex post gross energy savings (kWh) [A]	1,690,780
Total billed pre-participation energy consumption (kWh) [B]	7,771,628
Average percent energy savings per property [A/B]	22%

Overall, the SF LI Program was the largest program in the PY2019 low-income portfolio, accounting for 50% of ex post net low-income portfolio energy savings and 57% of ex post net low-income portfolio demand savings.

10.1.3 Key Process Findings

Key process findings from the PY2019 Single Family Low Income program include:

- Overall, participants are pleased with the Single Family Low-Income Program: 88% of survey respondents reported they were very satisfied with Ameren Missouri, and 83% were very satisfied with the program. Additionally, at least 88% of respondents were very satisfied with each of the steps in the enrollment and scheduling process, and at least 71% were very satisfied with each component of the home energy assessment.
- The evaluation team calculated high in-service rates (ISRs) for LEDs (100%), faucet aerators (89%), low flow showerheads (94%), and advanced power strips (95%) (Table 10-10). Additionally, we confirmed that home energy advisors are installing these measures during the home energy assessment and conducting the necessary customer training.

Overall, the program is well-designed to overcome most of the primary market imperfections in the single family low-income market. To meet the requirements of Missouri Code of State Regulations (CSR) for demand-side process evaluations, we provide responses to the five required process evaluation questions in Table 10-8.

Table 10-8. Summary of Responses to CSR Process Evaluation Requirements

CSR Required Process Evaluations Questions	Findings
What are the primary market imperfections that are common to the target market segment?	Low-income households face multiple barriers to investing in energy efficiency either through Ameren Missouri programs or outside of them. Market imperfections include: ▪ the high upfront cost of energy-efficient products relative to household capital and available credit, even when taking into account traditional utility program incentives,

[61] 2019-21 MEEIA Energy Efficiency Plan, p. 53.

CSR Required Process Evaluations Questions	Findings
	▪ lack of access to traditional forms of information about energy efficiency programs, ▪ housing stock that may need health and safety improvements, which can preclude efficiency upgrades unless these issues are addressed first, and ▪ split incentives between property owners and renters, for those who rent their home.
Is the target market segment appropriately defined, or should it be further subdivided or merged with other market segments?	Ameren Missouri has defined the target customer market as occupants of single family housing who live in areas where most residents have an annual income at or below 80% if AMI. This criterion is aligned with low-income program eligibility criteria in other states and should not be merged with any other income-based market segments. Additionally, the program's community-driven channels each target a specific housing stock subsegment (single family and mobile homes). This helps to target community and measure selection, as well as audits and measure installation assumptions, but the program and implementer should consider that: ▪ The program is set up to serve one type of housing at a time. Still, implementation experience shows many neighborhoods have mixed housing stock (including single family, small multifamily, and mobile homes). Notably, Ameren Missouri is formally pursuing a change in program eligibility requirements through the 11-step stakeholder process, asking to serve not only detached homes and duplexes but also attached dwellings of 4 or fewer units. Ultimately, this could help the program serve a larger share of homes per neighborhood, but also calls for a need to clarify when to serve small multifamily (i.e., 3- and 4-unit dwellings) through the Multifamily low-income vs Single Family low-income programs. ▪ Additionally, 23% of Ameren Missouri's single family low income households rent their home compared to just 5% of non low income single family residents. In PY2019 implementers found it took more effort to enroll rental properties due to the extra step of gaining landlord approval after already spending time encouraging the tenant's interest. Single family rental properties should remain in the target segment due to the split-incentive market barrier, but it would be worth examining US Census data on the share of renters in proposed PY2020 neighborhoods to appropriately define budgets and timeframes by neighborhood. ▪ In some towns, mobile homes are clustered together in private parks or neighborhoods, while in others they are mixed in with other types of housing. Implementers found the private parks easier to serve given that park owners or managers are a built-in community champion. Mobile home-specific outreach makes the most sense for private parks.
Does the mix of enduse measures included in the program appropriately reflect the diversity of enduse energy service needs and existing enduse technologies within the target market segment?	Opinion Dynamics' recent baseline study of residential Ameren Missouri customers shows that low-income households tend to have lower-efficiency products in their home than their non low-income counterparts, including efficient lighting. These results are consistent with findings from around the United States. The program's mix of enduse measures appropriately reflects these needs. The program offers measures that cover major single family and mobile home energy saving needs, including building envelope, HVAC and thermostats, refrigeration, lighting, domestic hot water, and plug load. Additionally, the program cross-promotes opportunities for additional savings through the Ameren Missouri HVAC program. That said, implementation experience has already identified and made changes to measure eligibility criteria that need refinement to best reflect the housing stock among the target

CSR Required Process Evaluations Questions	Findings
	market, including mobile home insulation, refrigerator efficiency, and air conditioning efficiency.
Are the communication channels and delivery mechanisms appropriate for the target market segment?	The communication and delivery channels are appropriate to the target market segment. Staff used a variety of community-centric approaches to promote the program, including through community groups and mobile home park owners; conducting direct outreach to residents through neighborhood canvassing; holding meet-and-greet events with community leaders in popular community gathering places like restaurants; and working with Ameren Missouri to identify community non-profits serving low-income areas who could distribute efficient products to their constituents. These approaches are appropriate for the target market segment because they work around traditional time, geographic, and other barriers to learning about energy efficiency and the availability of utility-sponsored programs. That said, the level of personalized effort and outreach central to neighborhoods approaches necessarily slows the program's progress towards serving large numbers of homes per year. Because PY2019 was the inaugural launch year, we recommend reviewing how well these channels and mechanisms worked at-scale in PY2020. For the Housing Grant channel, the program is targeting the right kind of organizations who are prepared to distribute and install energy efficiency measures outside of a neighborhood "blitz" approach. However, according to the implementer, this channel tended to focus on urban areas in PY2019, as Ameren Missouri identified several of the partners through their existing connections, and the program did not have a specific budget spending goal—together suggesting that the program has the resources to serve additional untapped areas of potential need and savings. To fully serve the target market through this program, the program should focus on organization recruitment in 2020 with the goals of expanding the number of actively participating organizations, enrolling organizations specifically prepared to complete eligible direct installation (such as more Community Action Agencies), and enrolling organizations serving rural communities.
What can be done to more effectively overcome the identified market imperfections and to increase the rate of customer acceptance and implementation for select enduses/measure groups included in the Program?	PY2020 participants are satisfied with their program experience and received a variety of measures in their homes. As noted above, the program may want to consider additional methods to achieving more savings per community by overcoming split incentives in single family rental housing (to serve more homes) and should continue to validate the match between measure eligibility criteria by carefully observing on-the-ground housing stock (to provide more savings per home). With one year of implementation complete, it is early in this program's lifecycle and the program should focus on executing strategies to refine the existing delivery model. At this stage, some of the delivery challenges appear to reflect the process of launching a new program more so than problems with the program's design and ability to overcome barriers or promote customer acceptance. For example, implementers have discussed working with Ameren Missouri upfront to define all of the communities to be served each year, at the beginning of the year—reducing midyear transition time between communities and enabling greater delivery efficiency. Once the logistics are streamlined, the program may be able to step back to reassess what components are truly working well vs. which may need revision.

10.1.4 Conclusions and Recommendations

Based on the results of this evaluation, the evaluation team offers the following conclusions and recommendations for the Single Family Low-Income Program moving forward:

- Conclusion #1: Community housing stock and heating fuel mix drive the savings opportunities per community. Community #1 was a rural community with a high incidence of electric heating, and Community #2 was more urban and had a high incidence of natural gas heating. As a result, 16% of homes in Community #1 received an ASHP compared to just 1% of homes in Community #2. Similarly, the prevalence of flat roofs in Community #2 resulted in far lower rates of ceiling insulation compared to Community #1. This reflects the inherent challenge of balancing income and housing stock when selecting communities for treatment.
  - Recommendation: Ameren Missouri should determine which communities will be served before the start of the program year. This will allow the implementation team to develop more accurate measure mix and savings projections by community and for the program year in total.
- Conclusion #2: As common to many low-income energy efficiency programs, trust and awareness are two primary barriers to participation in this program's neighborhoods channels. According to implementers, potential participants sometimes hesitated to enroll, thinking the program was "too good to be true." That said, the implementation team effectively tailored their outreach strategy to each community's unique needs. In Community #2, the implementation team leveraged trusted community messengers and targeted outbound calling to boost interest in the program when the planned methods did not generate anticipated levels of interest. And, implementers attribute their success in enrolling nearly all residents to two factors: the mobile home park owner joined the door-to-door canvassing, and all residents were homeowners. It is important that the implementation team continue to tailor their outreach strategy to each community in future program years.
  - Recommendation #1: Continue to refine the standard set of outreach methods, while allowing contingency time and budget to adapt strategies on-the-fly for each neighborhood. Understanding relationships about what worked, at what cost, in which situations, and why, will allow the implementation team to deploy the most cost-effective outreach strategy.
  - Recommendation #2: To the extent that there are additional well-defined mobile home parks[62] with energy-saving potential, Ameren Missouri should continue to target these types of communities as opposed to neighborhoods that have mobile homes. Well-defined parks usually have a key staff person who can serve as a trusted messenger to aid in community-based outreach.
- Conclusion #3: The Low-Income Efficiency Housing Grant channel is a critical driver of energy savings generated through the Single Family Low-Income Program. It is important that the implementation team tracks, to the extent possible, detailed information on the measures delivered through this channel including who received them (name, address, etc.). By the end of PY2019, the implementer had developed tracking forms for all participating organizations to complete, but the tracking data provided for evaluation did not include installation-specific information such as customer name, household characteristics, or whether those measures were delivered in conjunction with another

[62] A mobile home "park" has an owner to which residents pay a fee, much like a condo association. A mobile home "community" is a collection of mobile home parks in a community with no formal linkage between the homes.

Ameren Missouri program. Additionally, although the implementer reported providing kits to several police departments, low-income apartment buildings, and a church, none of these organizations appeared in the tracking data.

- Recommendation #1: All data collected by the implementation team should be integrated into the program tracking database in PY2020, including customer-specific data on measure installations. All distributions and direct installations should also be tracked by organization.
- Recommendation #2: Develop educational collateral to pair with the distribution of LED lighting and energy efficiency kits. Specifically, the collateral should instruct customers to install the measures immediately, as opposed to waiting until existing equipment fails. Additionally, materials should provide guidance on which lighting fixtures to install LED bulbs to maximize energy savings.

10.2 Evaluation Methodology

As described in Section 2, the evaluation team performed both impact and process evaluation activities to assess the performance of the Single Family Low-Income Program in PY2019. In addition to the overarching research objectives outlined for the Low-Income portfolio, the evaluation team explored the following Single Family Low-Income specific objectives:

- Characterize program participation concerning the number and characteristics of participants and installed measures;
- Assess how well the educational information and energy savings opportunities are understood by customers;
- Measure customer satisfaction with program processes and implementers, and motivations for participating;
- Identify opportunities for improvement in participant recruitment and customer experience; and

Table 10-9 provides an overview of the Single Family Low-Income evaluation activities. Following the table, we outline program-specific aspects of key evaluation methodologies.

Table 10-9. PY2019 Evaluation Activities for the Single Family Low-Income Program

Evaluation Activity	Description
Program Manager and Implementer Interviews	▪ Conducted interviews (1) before program launch to inform evaluation planning and (2) towards the end of PY2019 to understand program staff's perspective on program performance.
Program Material Review	▪ Reviewed available program materials to inform evaluation activities.
Program Theory/ Logic Model Review	▪ Reviewed implementer's program theory/logic model to understand program activities and their expected outputs and outcomes, including expected impacts on the market.
Tracking System Review	▪ Reviewed implementer's tracking system to ensure that data required for the evaluation was being collected and supported evaluation efforts.
Participant Survey	▪ Surveyed single family and mobile homes program participants to collect data to inform in-service rates for direct install measures and yield process-related insights.
Engineering Analysis	▪ Reviewed program database to check that program data were complete and that program-installed measures met all program requirements. ▪ Verified that ex ante savings use correct TRM values and algorithms. ▪ Developed ex post savings using TRM values and algorithms, program tracking data, and updated evaluation-estimated parameters like in-service rates.

Participant Survey

The evaluation team fielded a web survey with 41 participants in the PY2019 Single Family Low-Income Program. We conducted a census attempt of all single family and mobile homes channel participants who had participated before November 14th, 2019, and had a valid e-mail address (62% of participants), yielding a 35% response rate. Each participant was e-mailed an invitation and three reminders to complete the survey. Note that we present the results of this survey as a characterization of the entire participant population and assume that participants for whom the program tracked a valid e-mail address serve as a random subset of the population.

We designed the participant survey to support both the impact and process evaluations. The key impact objective was to inform updates to in-service rates for LED lighting, faucet aerators, and showerheads by verifying the installation and persistence of these measures. The process objectives included assessing the effectiveness of program processes by asking participants to describe their experiences with each and measuring participant satisfaction with the program and installed measures.

10.3 Evaluation Results

10.3.1 Process Results: Single Family and Mobile Homes Channels

We present findings related to the single family and mobile homes channels in the following sections.

Program Design and Launch

As mentioned in section 10.1, the Single Family Low-Income Program launched in PY2019. Program implementation was postponed for multiple reasons, including delays finalizing the program design and

Ameren Missouri's deliberations regarding community selection. The resource-intensive nature of the "community-blitz" outreach strategy resulted in an additional lag period between program launch and enrollment of the first participants. As a result, the first home energy assessment was not completed until June 11th, effectively limiting the implementation team to half a program year. With this in mind, the program accomplished a great deal in its first year. The program team met all performance goals while selecting communities for treatment in real-time. The program team also effectively built on lessons learned as they pivoted from one community to the next. Many of these lessons learned resulted in formal adjustments to program design and will be incorporated into future program planning. Notably, community selection will be finalized at the beginning of PY2020 which should allow the implementation team to seamlessly transition between communities.

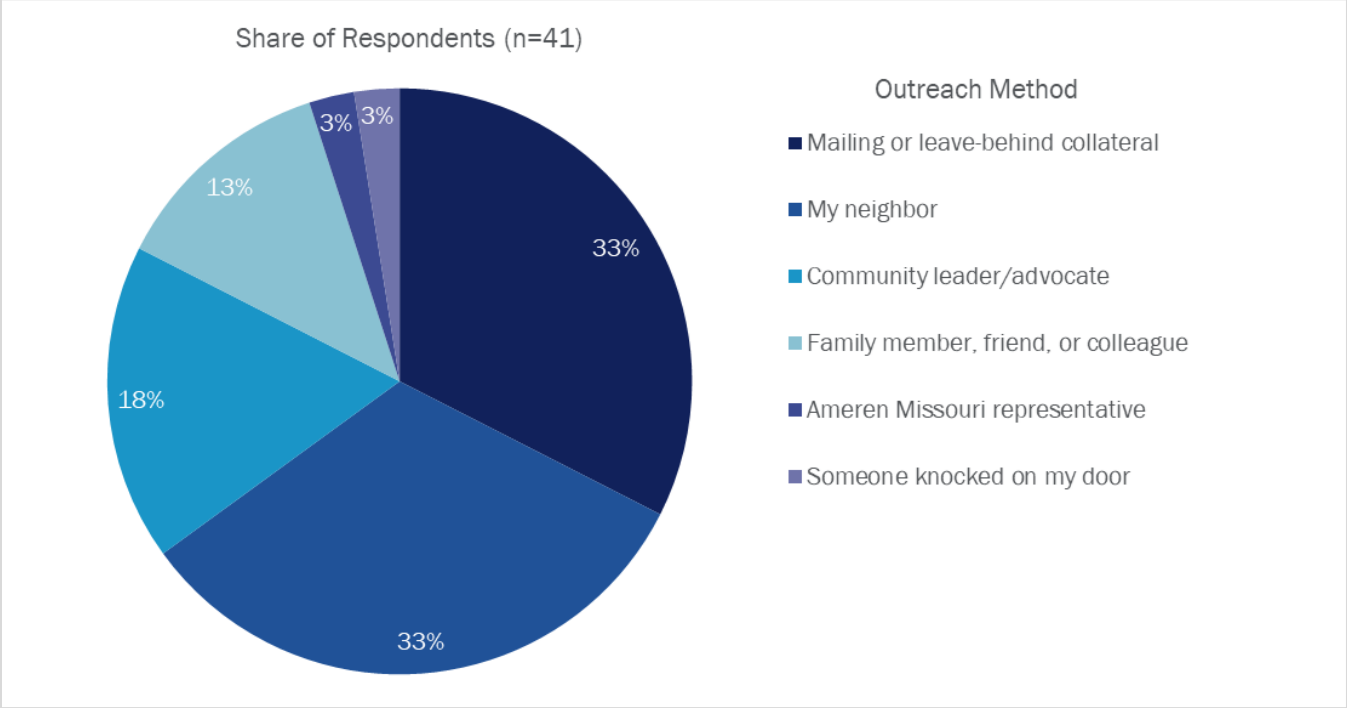
Marketing and Outreach

The Single Family Low-Income Program utilizes a "community-blitz" style outreach campaign. Outreach activities include direct mailings, door-to-door canvassing, and community kick-off events. Franklin Energy produces all program collateral, and Resource Innovations distributes it. Resource Innovations also engages with trusted community leaders to develop local advocates for the program. In the single family channel, these program advocates primarily consisted of CBOs including the Urban League, Salvation Army, and St. Vincent DePaul. For the mobile homes channel, the owner of one of the mobile home parks was a critical partner in encouraging participation in that community.

Word of mouth is the primary driver of program awareness (Figure 10-1). Nearly half the survey respondents first heard about the program from a neighbor (33%), family member, friend, or colleague (13%). Direct mailings and leave-behind collateral from community canvassing (33%) were the next most common source. Notably, the program emphasized different outreach strategies for different communities. Community #1 was a small, rural community. Once the program was established, word of mouth drove program participation. Community #2 was more urban, and, according to the implementation team, the traditional forms of outreach were not as successful. Consequently, the implementation team focused on engaging the community through events at local schools and restaurants. They also deployed outbound calling to customers who historically participated in assistance programs and therefore were more familiar with programs similar to the Single Family Low-Income Program.

The effectiveness of these community events and outbound calling may be underrepresented in our analysis. As mentioned in section 10.2 (see Participant Survey), the participant survey was distributed to customers who participated in the program prior to November 14th. The treatment period for Community #2 ran from the end of September through the end of December. It is likely many of the participants reached through these alternative outreach methods were not included in our sample. Franklin Energy reported these efforts were successful and are considering emphasizing these outreach tactics in future program years.

Figure 10-1. How Participants First Heard About the Single Family Low-Income Program



The design of the Single Family Low-Income Program results in unique marketing and outreach challenges. The program team must balance their use of in-person and personalized outreach efforts against limited budgets and a confined treatment area. Resource Innovations noted that launching each community is resource-intensive and is like launching a new "mini-program" each time they enter a community. Using geographically targeted messaging delivered one community at a time means the implementation team has to overcome the same awareness barriers in each new community. However, program staff must be intentional with their outreach to avoid community spillover. Reaching customers outside the treatment area can lead to customer dissatisfaction if they are told they are ineligible to participate. This limits the outreach methods available to the implementation team.

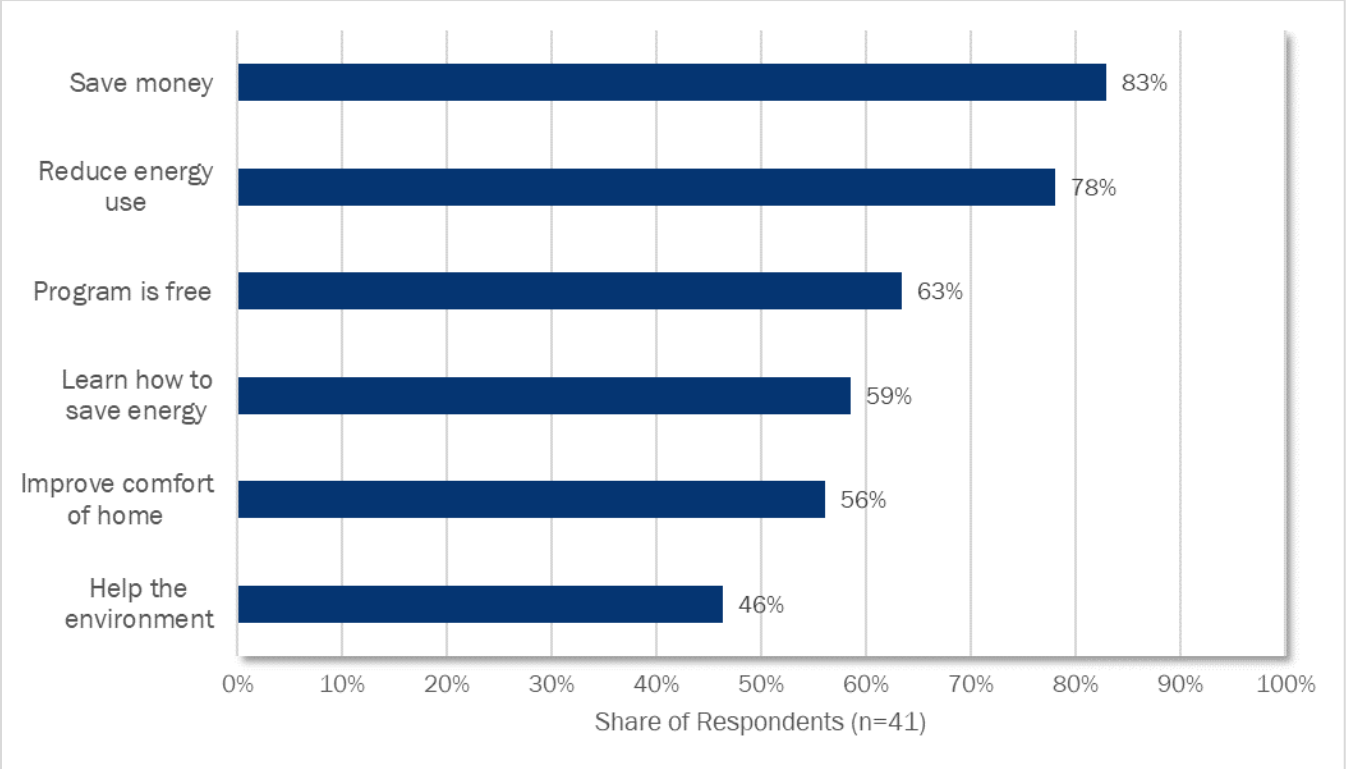
Additionally, the implementation team must be careful not to over-extend the program. The program is required to treat all interested customers in the treatment area. Generating too much interest introduces the risk of exceeding program budgets. As a result, in PY2019, the program team proceeded cautiously with outreach as they did not know what the return on each outreach method would be. Moving forward, there may be opportunities to streamline the use of resources while maintaining a targeted outreach approach. As Figure 10-1 above presents, just 3% of participants heard about the program through door-to-door canvassing which is one of the most time-intensive methods used in PY2019. The program team may be able to reduce outreach spending while maintaining engagement and participation rates by focusing on the strategies that participants most often recalled, like direct mailings, outbound calling, and engagement with community leaders.

Participant Motivations

Respondents offered a range of reasons why they decided to participate in the program (Figure 10-2). The three most common were to save money (83%), reduce energy use (78%), and because it was free to

participate (63%). These three benefits are at the forefront of program messaging, indicating program collateral is effectively communicating the program's value proposition to customers.

Figure 10-2. Participant Motivations to Sign Up for the Program



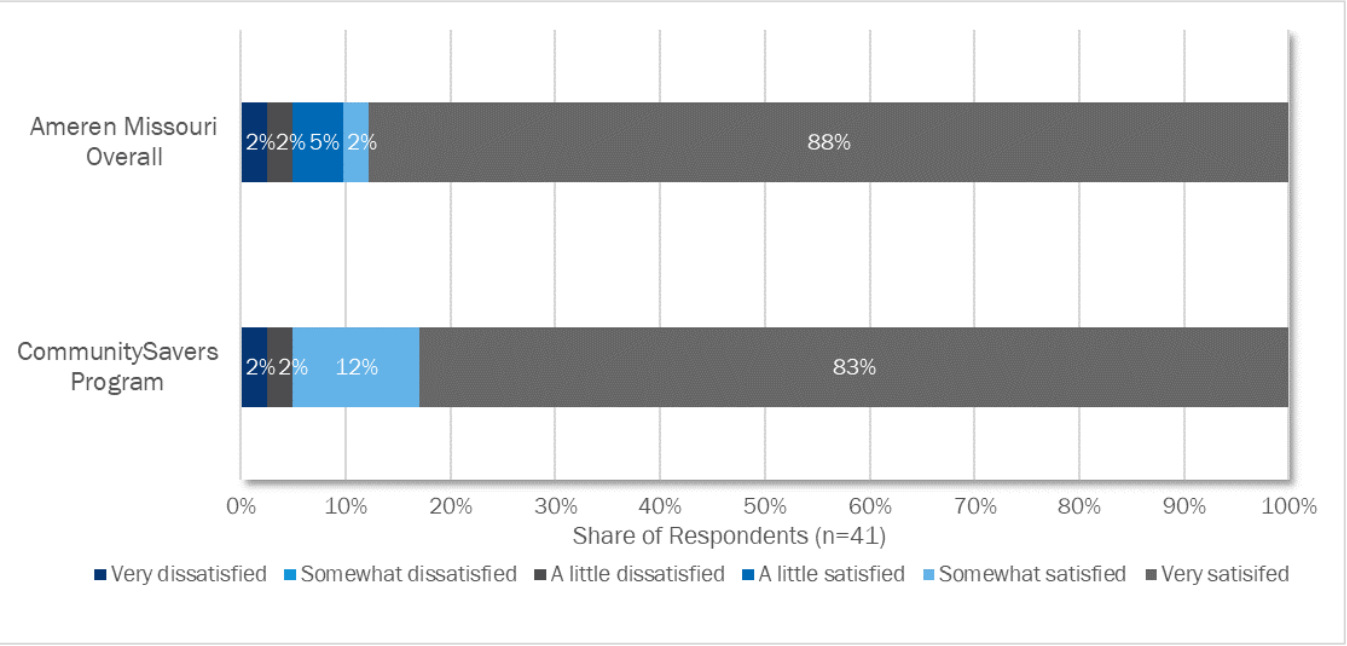
Note: Participants were asked to select all the factors that motivated them to participate in the program. Thus, percentages sum to more than 100%.

Program Delivery

Overall Satisfaction

Overall, participants are very satisfied with Ameren Missouri and the Single Family Low-Income Program. Figure 10-3 shows that most respondents reported they were somewhat or very satisfied with Ameren Missouri and the program.

Figure 10-3. Participant Satisfaction with Ameren Missouri and the Single Family Low-Income Program



We also asked respondents how their participation in the program impacted their perception of Ameren Missouri. Eighty-three percent of respondents said they felt more favorable toward Ameren Missouri, 15% felt the same, and 2% felt less favorable after participating. Additionally, we asked respondents about their likelihood to recommend the program to a neighbor, friend, or family member. More than half the respondents (54%) reported they had already recommended the program, and another 39% said they were very likely to recommend the program in the future. The remaining respondents reported they were a little likely (5%) or not at all likely (2%) to recommend the program.

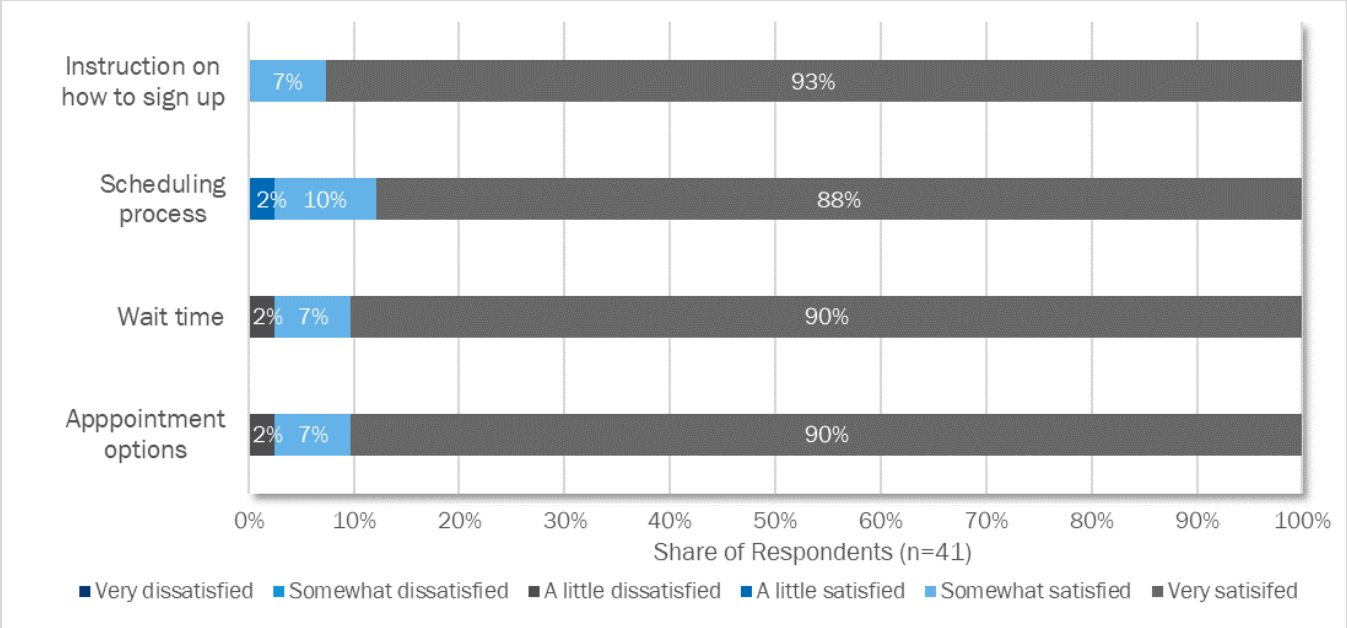
Whole-home upgrades can provide a range of participant benefits, from energy savings to non-energy benefits like improved comfort and safety within the home. We asked respondents about the benefits they had experienced since participating in the program. Many respondents noted improvements to the comfort or safety of their home (73%), while less than half (48%) the respondents had noticed savings on their energy bill. Notably, we surveyed participants within several months of their upgrades. Although changes in comfort are relatively easy to perceive shortly after participating, it may take longer for customers to notice bill savings. Specifically, most respondents had not experienced a full cooling season at the time of our survey and were just beginning their first post-upgrade heating season.

Program Enrollment

The primary pathway for participants to enroll in the program is by calling the Franklin Customer Care Center. Customers can call the Customer Care Center to ask questions, express their interest in the program, confirm their eligibility, and schedule their home energy assessment. Ameren Missouri refers to this enrollment process as a "one-call" resolution, because customers can schedule their assessment in their first interaction with program staff. Customers can also enroll in the program at community events or when canvassers come to their door. In general, participants are pleased with the ease of the enrollment process. Nearly all respondents felt the participation process was very easy (83%) or somewhat easy (15%); the

remaining 2% felt the participation process was somewhat difficult. Additionally, Figure 10-4 shows that approximately 90% of respondents were very satisfied with each component of the enrollment process.

Figure 10-4. Participant Satisfaction with the Enrollment and Scheduling Process



According to Franklin Energy, it was a challenge to effectively enroll rental properties in the PY2019 program because of difficulties convincing landlords to allow their tenants to enroll in the program. Notably, 23% of Ameren Missouri's single family low income households rent their home compared to just 5% of non low income single family residents.[63] Tenants can sign up for the home energy assessment and direct-install measures but need the landlord's authorization for any follow-up installations. Franklin Energy noted that oftentimes the landlords of single family properties have other jobs (vs. managing rental properties full-time), so reaching them and communicating the benefits of participating can be difficult, particularly when the tenant is responsible for paying the energy bills. This "split incentive" challenge is a barrier for all energy efficiency programs that target rental properties. Program staff noted that developing collateral specifically targeting these barriers will be critical in future program years:

> "Again, you basically have to get over the initial hump of disbelief on the part of a participant in this program, and you have to do the exact same thing all over again when you interact with a landlord...we have to do a...better job of communicating to them why this benefits them and why this is something that that helps them out, even though they don't pay the bills."
>
> -Program Manager

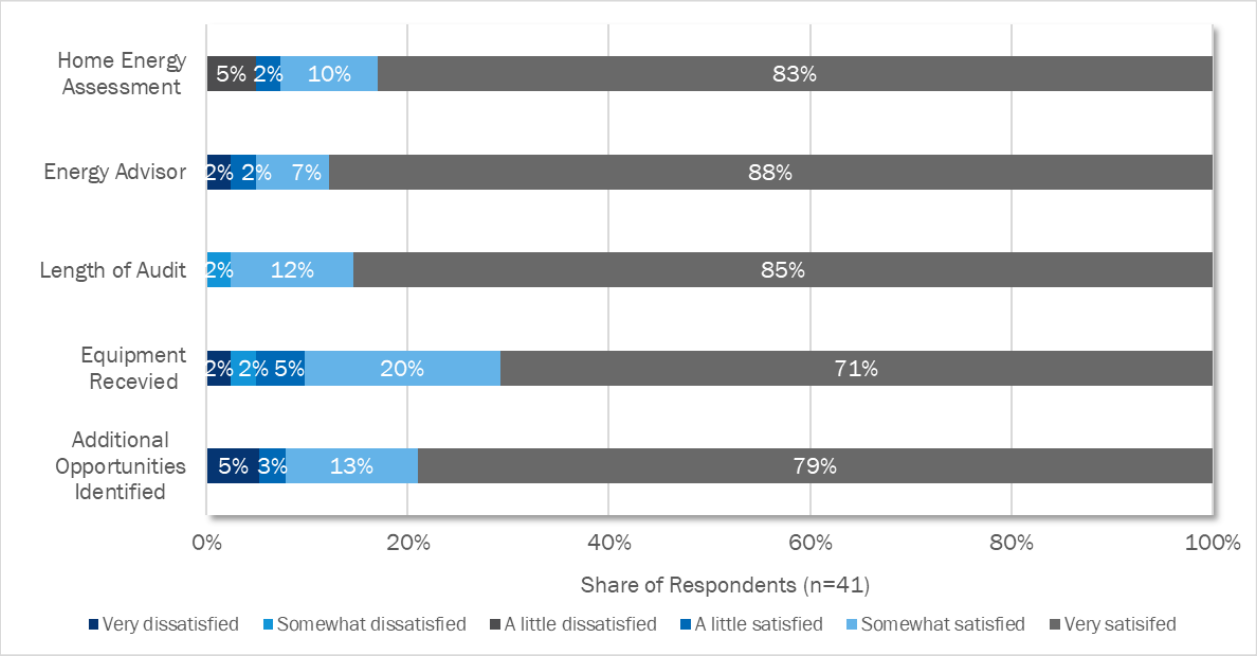
[63] Results are drawn from a survey of 4,804 Ameren Missouri residential customers conducted between January 13 and 27, 2020. Appendix A on non-participant spillover contains additional information on survey methods.

Home Energy Assessment

During the enrollment process, customers schedule an appointment for a home energy advisor to visit their home and conduct the initial home energy assessment. These home energy advisors are representatives from Resource Innovations' implementation partner. In PY2019, Anton's Air Conditioning and Heating was the single family partner, and Vantage Air was the mobile homes partner. During the assessments, the energy advisor performs an interior and exterior inspection of the property to identify upgrade opportunities, performs direct installation of energy-saving measures, and identifies health and safety concerns. They also document any conditions that may prevent the home from being treated, such as obstruction to attic or basement access.

Overall, participants are pleased with the home energy assessment process. Most respondents are somewhat or very satisfied with each component of the assessment from the advisor who completed the work to the measures that they installed or recommended (Figure 10-5). Few participants (2% to 5% by component) were dissatisfied with their home energy assessment experience.

Figure 10-5. Participant Satisfaction with Home Energy Assessment



Participants most commonly received LED lighting (95%), along with advanced power strips (35%), low flow showerheads (28%), and faucet aerators (27%). Other eligible measures installed during the home energy assessment include duct sealing (5%), duct insulation (<1%), and pipe insulation (2%). We surveyed participants about their experience with the most common measures, and the feedback was largely positive. Most participants verified receipt of the measures recorded in the tracking data and reported that they are still using most of them (i.e., a high persistence rate; Table 10-10). The respondents also confirmed that the energy advisors installed these measures at the time of the assessment, per the program design.

Table 10-10. Verification and Persistence Rates for Common Direct-Installation Measures

Measure (n=respondents)	Verification Rate [a]	Persistence Rate [b]	In-Service Rate [c]
LED lighting (n=39)	100%	100%	100%
Advanced power strip (n=20)	100%	95%	95%
Low flow showerhead (n=15)	100%	97%	94%
Faucet aerator (n=16)	91%	100%	89%

[a] The verification rate is the share of measures reported in the program tracking data that customers verified were installed.

[b] The persistence rate is the share of the verified measures that were still installed at the time of the survey.

[c] The in-service rate is a quantity-weighted average. The verification and persistence rates are intermediate calculations and are not quantity weighted.

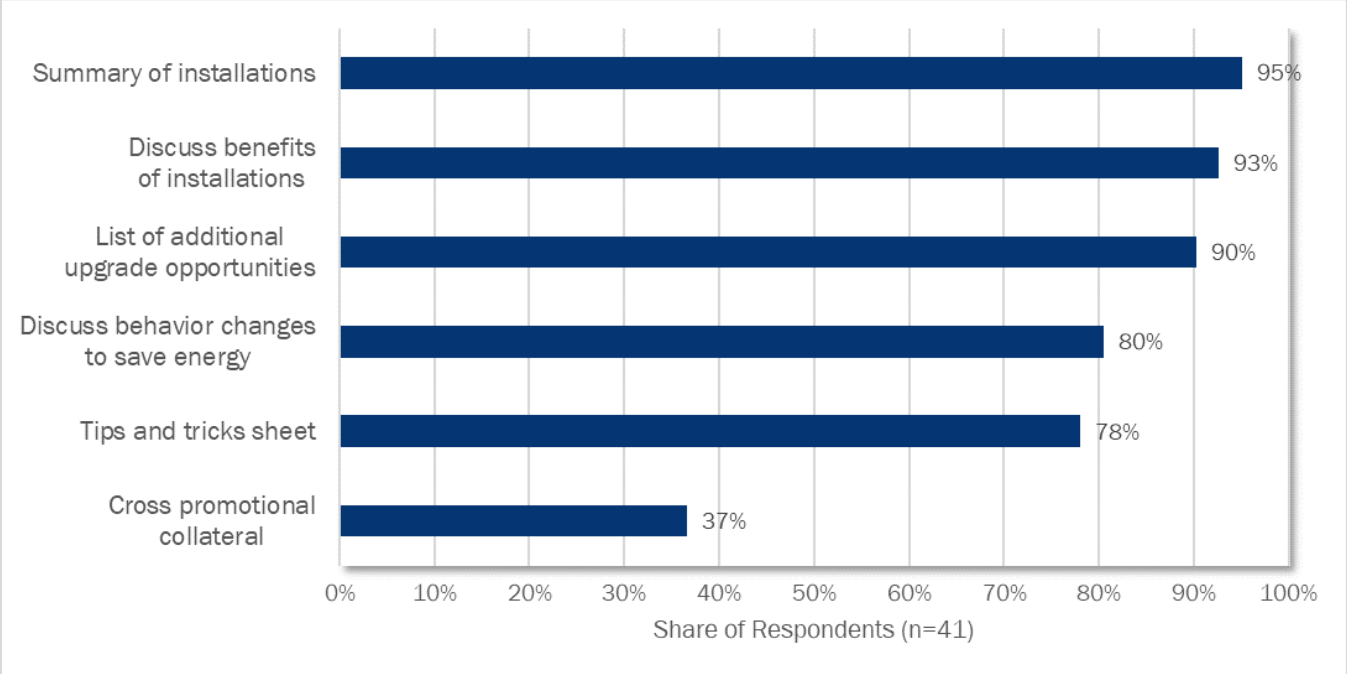
Lastly, we asked respondents about their satisfaction with the LED bulbs, low flow showerheads, and faucet aerators:

- 90% of respondents were very satisfied with the LEDs bulbs, and the remaining 10% were somewhat satisfied.
- 79% of respondents were very satisfied with the showerheads, and the remaining 21% were somewhat satisfied.
- 77% of respondents were very satisfied with the faucet aerators, 12% were somewhat satisfied, and 12% were a little satisfied.

Customer Education

After the home energy assessment, the energy advisor sits down with the customer to educate them about the measures installed, their benefits, and any additional program measures they are eligible to receive. They also provide participants with materials on "tips and tricks" to reduce energy use through behavioral changes and information on additional Ameren Missouri programs they may be eligible to participate in. As Figure 10-6 displays, most survey respondents recalled discussing these topics with the energy advisor. Just 37% of participants recalled receiving the cross-promotional materials about other Ameren Missouri programs; however, program staff added these flyers to the program later in the year, and earlier participants would not have received them. Notably, 90% of participants who recalled receiving educational collateral felt the materials were helpful and easy to understand, and 87% said the collateral improved their understanding of where energy improvements could be made to their home.

Figure 10-6. Share of Participants that Recall Customer Education Components of the Program



The energy advisors also provide any necessary training on how to use the installed equipment. For advanced power strips, they discuss the functionality of the strips and instruct the customer on how to use it to maximize energy savings. We confirmed with respondents that this training is occurring: 90% of respondents who received an advanced power strip recalled the energy advisor discussing the functions of the power strip and how to properly use the device. This education is seemingly effective as 80% of advanced power strip recipients reported using their advanced power strip to automatically shut off power to devices not in use. The energy advisors also provide training on how to use smart thermostats. They install the thermostat app on the customer's phone and show them how to navigate the app and adjust the thermostat. If the customer is interested, the advisor will also assist in programming a schedule for the thermostat. In PY2019, most smart thermostats were installed during follow up visits due to time constraints during the assessment. In these cases, the installation technician conducted customer training.

Ultimately, the home energy assessment is increasing participant knowledge about energy efficiency. We asked respondents to compare their energy efficiency knowledge after the home energy assessment according to their understanding prior to the assessment, on a scale of 1 to 6 where 1="no more knowledgeable" and 6=" significantly more knowledgeable." Respondents reported an average score of 4, indicating most felt they became more knowledgeable as a result of the home energy assessment. Specifically, 25% felt significantly more knowledgeable. Just 8% felt they were no more knowledgeable. Nearly all the respondents (95%) said they had shared this information with friends, family members, or neighbors.

Follow-up Installations

As noted above, energy advisors schedule a time to install any follow-up larger equipment that the participant qualifies for. In PY2019, 75% of participants received follow-up installations. The most commonly

delivered follow-up measures included dirty filter alarms (49%), smart thermostats (31%), air conditioner tune-ups (20%), and ASHPs (15%) (Table 10-11).

Table 10-11. Incidence of Follow-up Energy Saving Installations

Measure [a]	Number of Participants	Percent of Participants (n=487)
Smart thermostat [b]	266	55%
Dirty filter alarm	239	49%
Tune-ups	119	24%
Air-source heat pump	74	15%
Air sealing	70	14%
Central air conditioner	69	14%
Refrigerator	66	14%
Ceiling insulation	61	13%
Thermostat setback	52	11%
ECM auto fan	50	10%
Room air-conditioner	19	4%
Floor insulation	2	<1%

[a] Table reflects all measures with claimed electric savings. We omitted gas saving measures co-delivered with gas utilities.

[b] Smart thermostats were originally intended to be installed during the home energy assessment. However, for the single family channel they often were installed during follow up visits due to time constraints. For the mobile homes channel, smart thermostats were most often installed during the home energy assessment. For the purposes of this analysis, we categorized all smart thermostat as follow up installations. 12% overall were installed during the home energy assessment.

In general, the incidence of follow-up measures differed from what program staff originally anticipated. Specifically, Franklin Energy and Resource Innovations noted that by the end of the year, they had encountered more opportunities for equipment replacements than expected. In comparison, they had fewer opportunities for insulation and air sealing than expected. As mentioned in Section 3.1, the implementation team initially found that the planned refrigerator and CAC eligibility criteria were too strict for the housing stock in the selected communities, and had to make revisions as they pivoted from the Community #1 to subsequent communities to provide these measures. As Table 10-12 shows, these modifications led to increasing CAC and refrigerator replacements as the program progressed.

Table 10-12. Share of Sites that Received Various Program Measures

Measure	Desloge Participants (n=128)		St. Louis Participants (n=251)		Mobile Home Participants (n=109)	
	Number	%	Number	%	Number	%
CAC	0	0%	60	24%	9	8%
Refrigerator	1	1%	35	14%	30	28%
Air sealing	55	43%	15	6%	0	0%
Insulation	46	36%	15	6%	2	2%

The implementation team also encountered barriers with the criteria for insulation and air sealing improvements. For the single family channel, the prevalence of flat roofs in Community #2 prevented many homes from qualifying for ceiling insulation (Table 10-12, above). Flat roofs provide limited opportunities to

add insulation and require a more labor-intensive process. The limited savings potential and added expense make it difficult to justify the additional insulation. For air sealing, the program requires a 30% reduction in infiltration. Still, program staff noted that a 30% reduction is difficult to achieve given the budget they can allocate toward air sealing, particularly if the air sealing is not paired with insulation. Except for Community #1, few participants received air sealing. And finally, for mobile homes, the program supports floor insulation where there is no existing insulation. According to Resource Innovations, nearly all mobile homes served in PY2019 had some degree of existing floor insulation. Ultimately, they were able to insulate two of the 109 mobile homes served, and could not provide air sealing in any of them.

10.3.2 Process Results: Housing Grant Channel

The PY2019 Low-Income Efficiency Housing Grant channel had limited activity focused late in 2019, and also did not develop its official tracking system until late in the year. Because of this, we focused our process evaluation on understanding program design (through program staff interviews) and review of tracking-data.

The Low-Income Efficiency Housing Grant channel got off to a slow start in PY2019. Implementers attributed this to a mix of factors, including staff turnover within both the implementation and Ameren Missouri teams. To some extent, the amount of effort spent launching the single- and mobile home channels also diverted staff away from launching this one. Accordingly, implementers spent most of their PY2019 grant channel effort developing the program's overall design, process, collateral, and tracking systems. For PY2019, and unlike the single- and mobile home channels, the grant channel did not have specific savings or participation targets. However, they were generally instructed to spend as much of the available budget to provide savings as they could.

As a result, implementers and Ameren Missouri primarily delivered this channel on an "as-requested" basis. The implementation team did not conduct any outreach to organizations, and all PY0219 participating organizations came through Ameren Missouri referrals. Consequently, most of the Housing Grant channel distributions and installations occurred from September through December, and 82% of the measures were delivered during this period. As of late December 2019, implementers estimated that they had spent approximately 20% of the program's budget for energy-efficient measures, and planned to roll unspent funds to PY2020.

In future program years, the implementation team will actively recruit organizations for participation. The team envisions targeting local governments and other charitable organizations like food banks. The team will also draw on Ameren Missouri's existing community connections. Moreover, the implementation team expects to set goals, budget, and spending and savings goals with Ameren Missouri.

10.3.3 Gross Impact Results

Measure-Level In-Service Rates

In-service rates (ISRs) indicate the percentage of program measures that are installed or in use and vary based on measure type and distribution approach. For example, HVAC equipment is likely to be installed and in use, while an LED bulb may remain on a participant's shelf rather than in use. For Direct Install distribution methods, ISRs are typically 100% or close to 100% because a qualified program contractor directly installed the measure at the participant location.

Conversely, a "giveaway" distribution approach--such as those used in the Grants channel—will tend to have a lower ISRs because the participant may not install the collected item for various reasons. The evaluation

team leveraged single family and mobile home participant survey responses to calculate ISRs for LEDs (100%), advanced power strips (95%), showerheads (94%), and aerators (89%) that were installed through the single family and mobile homes channels. For LED, aerator, and showerhead measures distributed through the Grants channel "giveaway" methods, we applied the ISRs used for similar measures distributed through the RAR Program (see Chapter 9). All other ISRs were taken from the TRM; note that the TRM algorithms for some measures do not include an ISR term and thus implicitly deem the ISR at 100%. We present all ISRs used for the PY2019 evaluation as part of our Detailed Impact Analysis Methodology for the Single Family Low-Income program (Appendix A). We applied the ISR values to each measure in the ex-post analysis to calculate the PY2019 gross savings (Table 10-13).

Table 10-14 shows total program ex ante and ex post impacts for first year energy and demand savings and last year demand savings by EUL class. Table 10-13. PY2019 Single Family Low-Income Gross Impact Summary

	Ex Ante	Realization Rate	Ex Post
First Year Savings			
Energy Savings (MWh)	2,272	98%	2,222
Demand Savings (MW)	0.57	100%	0.58
Last Year Demand Savings [a]			
< 10 EUL (MW)	0.33	48%	0.16
10-14 EUL (MW)	0.09	113%	0.10
15+ EUL (MW)	0.15	96%	0.14

[a] Ex ante MW savings for each EUL bin are based on reported MW savings by measure and typically represent first year demand savings; the ex post demand values for each EUL bin are based on the evaluation of savings achieve in the last year of the measure's life.

Table 10-15 shows the ex ante, ex post, and gross realization rates for first year electric energy and demand savings for each measure category. Although the realization rates range from a low of 40% (for duct sealing) up to 155% (for room air conditioners), most measure categories contribute a small percentage of overall program savings and do not significantly impact the overall program realization rate. Air Source Heat Pumps (39%) and Lighting (30%) contribute almost 70% of program ex ante savings and have gross realization rates of 98.6% and 93.9%, respectively.

Table 10-14. PY2019 Single Family Low-Income Annual First Year Gross Impacts

Measure Category/Enduse	Energy Savings			Demand Savings		
	Ex Ante (MWh)	Realization Rate	Ex Post (MWh)	Ex Ante (MW)	Realization Rate	Ex Post (MW)
Air Sealing	31	86.0%	27	0.014	86.0%	0.012
Advanced Power Strip	29	92.9%	27	0.003	92.9%	0.003
Air Source Heat Pumps	877	98.6%	865	0.126	97.6%	0.123
Central Air Conditioner	131	100.0%	131	0.124	100.0%	0.124
Ceiling Insulation	58	111.2%	64	0.027	111.2%	0.030
Duct Insulation	4	75.5%	3	0.002	75.5%	0.002
Duct Sealing	5	40.2%	2	0.002	40.2%	0.001
ECM Auto Fan	16	116.3%	18	0.007	116.3%	0.009
Floor Insulation	5	130.0%	7	0.002	130.0%	0.003
Dirty Filter Alarm	43	77.2%	33	0.020	77.2%	0.015
Lighting	681	93.9%	640	0.102	93.9%	0.095
Aerator	20	112.8%	23	0.002	112.8%	0.002
Showerhead	56	101.0%	56	0.005	101.0%	0.005
Pipe Insulation	1	120.7%	2	0.000	120.7%	0.000
Learning Thermostat	144	118.7%	171	0.033	163.0%	0.053
Room Air Conditioner	4	154.7%	6	0.004	154.7%	0.006
Refrigerator	37	100.0%	37	0.005	100.0%	0.005
Setback Thermostat	37	66.1%	25	0.027	66.6%	0.018
Tune up	90	93.6%	84	0.068	100.0%	0.068
Total	**2,272**	**97.8%**	**2,222**	**0.575**	**100.2%**	**0.575**

Table 10-15 presents the total PY2019 last-year ex ante and ex post electric demand savings and realization rates by measure by EUL class.

Table 10-15. PY2019 Single Family Low-Income Annual Last Year Gross Demand Impacts

Measure Category/Enduse	Ex Ante (MW)			Realization Rate	Ex Post (MW)		
	<10	10-14	15+		<10	10-14	15+
Air Sealing	0.00	0.00	0.01	86.0%	0.00	0.00	0.01
Advanced Power Strip	0.00	0.00	0.00	92.9%	0.00	0.00	0.00
Air Source Heat Pumps	0.13	0.00	0.00	34.1%	0.04	0.00	0.00
Central Air Conditioner	0.12	0.00	0.00	26.8%	0.03	0.00	0.00
Ceiling Insulation	0.00	0.00	0.03	111.2%	0.00	0.00	0.03
Duct Insulation	0.00	0.00	0.00	75.5%	0.00	0.00	0.00
Duct Sealing	0.00	0.00	0.00	40.2%	0.00	0.00	0.00
ECM Auto Fan	0.01	0.00	0.00	116.3%	0.00	0.00	0.00
Floor Insulation	0.00	0.00	0.00	130.0%	0.00	0.00	0.00
Dirty Filter Alarm	0.00	0.02	0.00	77.2%	0.00	0.02	0.00
Lighting	0.00	0.00	0.10	93.9%	0.00	0.00	0.10
Aerator	0.00	0.00	0.00	112.8%	0.00	0.00	0.00
Showerhead	0.00	0.00	0.00	101.0%	0.00	0.01	0.00
Pipe Insulation	0.00	0.00	0.00	120.7%	0.00	0.00	0.00
Learning Thermostat	0.00	0.03	0.00	163.0%	0.00	0.05	0.00
Room Air Conditioner	0.00	0.00	0.00	154.7%	0.01	0.00	0.00
Refrigerator	0.00	0.00	0.00	100.0%	0.00	0.00	0.00
Setback Thermostat	0.00	0.03	0.00	66.6%	0.00	0.02	0.00
Tune up	0.07	0.00	0.00	100.0%	0.07	0.00	0.00
Total	**0.33**	**0.09**	**0.15**	70.3%	**0.16**	**0.10**	**0.14**

The gross realization rates of 97.8% for electric energy savings and 100.2% for demand savings indicate the evaluated (ex post) gross savings achieved by the program are very similar to the program's tracked ex ante savings.

Discrepancies between ex ante saving and ex post savings stem from multiple sources, including: new methods and/or parameter values included in updated TRM versions, use the actual equipment and measure data in the ex post calculations instead of deemed or default values, and the use of new evaluation results from participant surveys. Because the tracking database does not include all algorithms and parameters used to calculate ex ante savings, the evaluation team could not always recreate the ex ante savings calculation and identify all differences between ex ante and ex post.

The following list highlights the largest contributors to differences between ex ante and ex post savings:

- *Lighting*: The gross realization rate for Lighting was 94% for both energy and demand savings.
  - The reduced savings for lighting was caused primarily by the ex post application of the kit-based ISRs (88%) from the PY 2019 Customer Survey for the RAR Program for lighting measures

distributed through the Grants channel. We applied this ISR for lighting measures distributed through the Grants channels due to similarities in the distribution models.

- *Learning Thermostat: The gross realization rate for advanced learning thermostats was 119%.*
  - Updates to the following parameters in the TRM Appendix F changed the values from those used in the ex ante analysis, which appears to be the December 2018 version: Heating_electric_kWh, Heating_Gas_therm, Heating Reduction %, Delta Therms, $EFLH_{cool,}$ and SEER,
  - The ex ante claims understated electric heating season savings by attributing the savings for a "Gas Heated / Central AC" measure to three "ASHP Heating/Cooling" installations.
  - Ex post analysis included cooling electricity savings for multiple Learning Thermostat installation in gas heated homes with electric air conditioning systems for which the ex ante tracking database included no savings.
- *Setback Thermostats: The gross realization rate for programmable setback thermostats was 66%.*
  - Updates to the following parameters in the TRM Appendix F December 2019 version changed the values from those used in the ex ante analysis, which appears to be the December 2018 version: heating and cooling capacities, $EFLH_{cool}$, $EFLH_{heat,}$ and $SBdegrees_{cool}$ and $SBdegrees_{heat.}$ The differences in EFLH and SBdegrees between the two versions for both heating and cooling appear to have the biggest impact on the realization rate for this measure.
- *Air Source Heat Pump*: The gross realization rate for new air source heat pumps was 99%.
  - Changes in the Cooling Capacity, Heating Capacity, $HPSF_{base}$, $HSPF_{proposed}$, parameters between the December 2018 Appendix F (assumed version used in the ex ante analysis) and the updated TRM Appendix F November 2019 version (used in the ex post analysis) slightly decreased the savings values.
- *Dirty Filter Alarm*: The gross realization rate for dirty filter alarms was 77%.
  - Updates to effective full load cooling and heating hours in the Appendix F tables changed the values used in the ex ante analysis, resulting in reduced savings.

10.3.4 Net Impact Results

Because the SF LI Program falls under the umbrella of low-income programs, we applied a default NTGR of 1.0, assuming that both free ridership and spillover are zero. As such, net impacts for the SF LI Program are equal to the gross impacts presented in the section above.

11. Multifamily Low-Income (MF LI)

This section presents the PY2019 evaluation summary, methodology, and results for the MFLI Program. Additional details on the methodology are presented in Appendix A.

11.1 Evaluation Summary

Ameren Missouri has been offering energy efficiency programs for multifamily low-income properties since 2015.[64] In PY2019, Ameren Missouri launched a revised program called the Multifamily Low-Income (MFLI) Program, designed to offer a one-stop-shop approach to assist owners and operators of multifamily low-income properties to overcome barriers to completing comprehensive retrofits. Franklin Energy administers the program. The program serves multifamily properties that have three or more tenant units, receive electric service from Ameren Missouri, and which meet one of several income eligibility criteria.[65] The program is designed to target multifamily property managers in this segment and to encourage them to complete a comprehensive package of upgrades and retrofits, moving them beyond direct install measures to deeper savings.

The program's implementer, ICAST, delivers the one-stop-shop approach using concierge-style engagement in which ICAST staff work with property decisionmakers throughout the participation process to provide extra support and resources. Planned customer touchpoints included outreach and marketing, a Level 1 Energy Assessment to identify savings opportunities at each property, discussing measure recommendations with property manager needs and interests, assistance completing the program application and connecting the property staff to complementary financing options, measure installation, rebate processing, and verification. ICAST and its local program allies install all measures. In PY2019, the program continued to offer direct-install measures at no cost and, to further address economic barriers among the low-income segment, offered increased incentives on whole-building and common area measures compared to market rate programs.

These program processes and criteria are designed to support the program's stated objectives[66] of (1) helping multifamily low-income property managers understand their buildings' energy usage amounts, (2) continuing to achieve immediate energy savings through no-cost direct install measures, and (3) moving beyond initial measures to investments in standard and/or custom measures for common areas, building shell, and whole-building systems in order to benefit from deeper energy savings and bill reductions. The MFLI Program was expected to achieve 900 MWh of electric savings in PY2019.

In PY2019, the MFLI Program completed AC Tune-Ups (AC Tune-up), lighting upgrades (EXT Lighting BUS, Lighting BUS, Lighting RES), advanced thermostats (HeatCool), bathroom faucet aerators, kitchen faucet aerators and showerheads (Water Heating Res), Ductless AC units (Ductless AC), and ceiling insulation

[64] Previously known as the CommunitySavers Program.
[65] Income eligibility criteria include: participation in a federal, state, or local subsidized housing program; proof of resident income at or below 80% of AMI or 200% of the Federal Poverty Level such as through rent rolls or being on the wait list for U.S. Department of Energy's Weatherization Assistance Program waitlist; or location within one of Ameren Missouri's pre-identified low-income U.S. Census tracts. Properties are served at the whole-building level, and those in which at least 50% of the tenants meet these eligibility criteria can still qualify for the program.
[66] Ameren Missouri 2019-2021 MEEIA Energy Efficiency Plan.

(Insulation). Marketing activities included pre-launch informational events, printed, and e-mailed outreach materials, and in-person meetings with potential customers.

PY2019 evaluation activities for the MFLI Program included reviewing program materials and the program tracking database, an impact evaluation, and interviews with program manager and implementation staff. Due to program delays compared to expectations, the evaluation team postponed property staff interviews to PY2020.

11.1.1 Participation Summary

In PY2019, the program superseded savings projection expectations with 1,280 projects submitted ushering 3,067 energy-efficient measures into the multifamily low-income housing market.

Table 11-1 presents participation in the MFLI during PY2019.

Table 11-1. PY2019 Multifamily Low-Income Program Participation Summary

End-Use	Unique Participants		Projects		Measures		Ex Ante Savings	
	Number	%	Number	%	Number	%	MWh	%
AC TuneUp	687	82.9%	687	83.5%	694	22.6%	64.3	4.7%
Ductless AC	125	15.1%	125	15.2%	125	4.1%	923.6	67.6%
EXT Lighting BUS	2	0.2%	2	0.2%	99	3.2%	62.9	4.6%
HeatCool	99	11.9%	99	12.0%	99	3.2%	54.6	4.0%
Insulation	4	0.5%	4	0.5%	4	0.1%	1.9	0.1%
Lighting BUS	11	1.3%	11	1.3%	308	10.0%	117.4	8.6%
Lighting Res	174	21.0%	169	20.5%	1316	42.9%	30.8	2.3%
Water Heating Res	188	22.7%	183	22.2%	422	13.8%	110.8	8.1%

11.1.2 Key Impact Results

The program used a custom based calculation approach, which relies on collecting savings input values during the removal and installation process. After conducting an engineering analysis on the program database, the evaluation team could not recalculate ex ante program savings or verify all input values due to program data lacking critical calculation parameters and references. The implementation and data management concerns are the primary drivers of the Realization Rates presented in Table 11-2 below.

Table 11-2 presents annual savings achieved in PY2019. As shown, the program achieved 117% of Ameren Missouri's net first year energy savings goal, but fell short compared to first and last year demand savings goals and targets.

Table 11-2. PY2019 Multifamily Low-Income Program Impact Summary

	Ex Ante Gross	Realization Rate	Ex Post Gross	NTGR	Ex Post Net	Goal/Target Net	% of Goal/Target
First Year Savings							
Energy Savings (MWh)	1,366	77.1%	1,053	100%	1,053	900	117%
Demand Savings (MW)	0.26	85.1%	0.22	100%	0.22	0.40	54%
Last Year Demand Savings							
< 10 EUL (MW)	0.07	83.8%	0.06	100%	0.06	0.00	NA
10-14 EUL (MW)	0.019	173.4%	0.03	100%	0.03	0.00	NA
15+ EUL (MW)	0.063	198.2%	0.12	100%	0.12	0.40	31%

To encourage the pursuit of deeper savings per property and provide a holistic assessment of the program's impact, the MFLI Program has a goal to achieve an average 10% percent energy savings per property. Table 10-7 summarizes the key inputs to calculating the average percent site savings according to 2019-21 MEEIA Energy Efficiency Plan guidance.[67] We calculated average percent energy savings per property as total ex post energy savings divided by the total billed energy consumption at participating properties. Ex post savings—which are based on engineering approaches using the Ameren Missouri TRM—equate to 17% of the recorded baseline energy use.

Table 11-3. PY2019 Multifamily Low-Income Program Average Percent Energy Savings Per Property

Metric	Value
Ex post gross energy savings (kWh) [A]	1,053,457
Total billed pre-participation energy consumption (kWh) [B]	6,204,307
Average percent energy savings per property [A/B]	17%

Overall, the MFLI Program was the third-largest program in the PY2019 low-income portfolio, accounting for 24% of ex post net low-income portfolio energy savings and 22% of ex post net low-income portfolio demand savings.

11.1.3 Key Process Findings

Key process findings from the PY2019 Multifamily Low-Income program include:

- The Community Savers program was revamped in 2019 and launched as the Multifamily Low-Income Program with a new implementation staff. Franklin Energy, the program administrator, and ICAST, the program implementer, did not have communication protocols, savings algorithm alignment, and cohesive implementation systems between each other. This led to delays in approvals, which further delayed the launch until August 2019.
- The evaluation team found that the lack of standardized data tracking systems between ICAST and Franklin Energy caused challenges and errors in data handling. The evaluation team acknowledges that the implementers plan to switch from a secure FTP site to an API based data transfer system and align on data storage and assumptions of multifamily units.

[67] 2019-21 MEEIA Energy Efficiency Plan, p. 53.

- Despite implementation delays, customer recruitment is meeting or exceeding projections.

To meet the requirements of Missouri Code of State Regulations (CSR) for demand-side process evaluations, we provide responses to the five required process evaluation questions in Table 11-4.

Table 11-4. Summary of Responses to CSR Process Evaluation Requirements

CSR Required Process Evaluations Questions	Findings
What are the primary market imperfections that are common to the target market segment?	Market imperfections specific to the multifamily sector include 1) the split incentive [a] for in-unit measures between property owners, managers, and residents, 2) awareness of the potential for saving money and energy through energy efficiency upgrades, 3) costs associated with energy efficiency upgrades, 4) knowledgeable staff available to install energy-efficient upgrades, and 5) the time investment to plan, budget and implement energy efficiency upgrades.
Is the target market segment appropriately defined, or should it be further subdivided or merged with other market segments?	Yes, the target market is appropriately defined as a building including three or more units with Ameren Missouri electric service. This program addresses multifamily property needs, both common area and in-unit upgrades.
Does the mix of end-use measures included in the program appropriately reflect the diversity of end-use energy service needs and existing end-use technologies within the target market segment?	Yes, the program offers measures that cover all major multifamily common area and in-unit enduse needs: lighting, space cooling and heating, insulation, and water heating. The tracking data indicated that only 1% of participating customers installed both tenant and common area upgrades at their property. This indicates that there may be an opportunity for educating customer to take advantage of the "one-stop-shop" program offered.
Are the communication channels and delivery mechanisms appropriate for the target market segment?	For this initial program year launch, the primary communication channel used was one-on-one contact between customers and implementation staff. The program does have a more varied marketing and communication plan they intend to employ in future program years, which includes conferences, promotional, and networking events.
What can be done to more effectively overcome the identified market imperfections and to increase the rate of customer acceptance and implementation for select enduses/measure groups included in the Program?	Ameren Missouri can consider promoting Green Leases [b] Green Leases are contracts between landlords and tenant(s) that negotiate the mutual benefit of installing energy-efficient or green measures in shared buildings. For shared buildings, owners are burdened with green upgrade costs, while tenants benefit from lower operating costs. Without green leases, there is little incentive for owners to make green upgrades. Green leases are designed to allow both parties financial benefits and incentives, and multifamily building types are ideal buildings. The rate of customer acceptance and implementation is currently above expectations, as the program met goals despite implementation delays.

[a] The split incentive occurs when the tenant pays the cost of the electricity use, but the owner is responsible for choices that affect building and equipment efficiency.

[b] http://cbei.psu.edu/split-incentives-and-green-leases/

11.1.4 Conclusions and Recommendations

Based on the results of this evaluation, the evaluation team offers key conclusions and recommendations for the MFLI Program moving forward. For a more detailed explanation, please see the Gross Impact Results section.

- Conclusion #1: The misalignment between the program implementer, Franklin Energy, and program administrator, ICAST, caused delays in processing customer rebates, engineering savings calculations, and evaluation activities.
  - Recommendation: The evaluation team acknowledges the plans to switch from FTP site to an API based data transfer system to align data storage and assumptions of multifamily units.
  - Recommendation: Ameren Missouri, ICAST, and Franklin Energy set and document clear protocols for data gathering procedures, data quality assurance, and savings algorithm and savings projection alignment, prior to onboarding new customers.
  - Recommendation: Ameren Missouri, ICAST and Franklin Energy develop communication systems and quality control procedures to ensure critical program guidelines and changes are well-documented and communicated to stakeholders. These systems and procedures can include but are not limited to projected savings and costs, measure savings and assumptions, tracking database sources and inputs, rebate amounts, technical reference manuals, program timelines, and potential delay areas.
- Conclusion #2: Ex ante savings for the following measures did not have critical calculation parameters, including baseline values, and did not provide documentation for measures with input values. The provided tracking data did not include information to distinguish whether a district value was an error or a custom input; therefore, ex-post calculations used TRM savings assumptions and baselines to calculate savings, when tracking data provided was not complete.
    - "BUS" (business) lighting measures, i.e., those installed in communal or exterior locations, are consistently and significantly higher than ex post savings.
    - Residential interior lighting measures (e.g., LED – 10W (Halogen baseline), Directional LED) and common area lighting
    - Kitchen, Bathroom and Showerhead Aerators
  - Recommendations #2: The tracking data should provide all fields necessary to recalculate ex-ante savings. The evaluation team recommends that program implementers capture all calculation and custom inputs, including GPM baseline inputs for kitchen, bathroom, and showerhead aerators that follow the TRM Appendix I. The evaluation ream also recommends that residential lighting, interior lighting, common area, and exterior lightings calculations should use an appropriate annual hours for each lamp type as verified in TRM Appendix I or Appendix H.
- Conclusion #3: The program data tracking and management systems differ between ICAST and Franklin Energy leading to errors, processing delays, and a static data transfer process.
  - Recommendations #3: Develop a dynamic system to better manage data across stakeholders, reducing errors and delays. The evaluation team understands this is underway through Salesforce-based tracking system.

- Follow through with the plan to align savings calculations assumptions by moving all parties from FTP site to an API based data transfer system to align data storage. The evaluation team believes this efficient information transfer and streamlined approval process will minimize data discrepancies in the future.
- ICAST should accurately record and store data after each project is completed and share program data with Franklin Energy at regular and timely intervals to avoid delays in claiming savings and payment of customer rebates.

11.2 Evaluation Methodology

The evaluation team performed both impact and process evaluation activities to assess the performance of the MFLI Program in PY2019. In addition to the overarching research objectives outlined for the Residential portfolio, the evaluation team explored the following MFLI Program-specific objectives:

- Characterize program participation with respect to the number and characteristics of participants and installed measures;
- Measure customer satisfaction, with program processes and implementers, and motivations for participating;
- Identify opportunities for improvement in participant recruitment and customer experience; and
- Provide evaluation results that can be used to improve the design and implementation of the Multifamily Low-Income Program.
- Estimate the first-year ex-post gross average percent energy (kWh) savings per participating property; and

Due to lower than expected program participation in PY2019, the evaluation team rescheduled the customer satisfaction, customer characterization and property manager interviews activities to PY2020. Table 11-5 provides an overview of the MFLI Program evaluation activities.

Table 11-5. PY2019 Evaluation Activities for the Multifamily Low-Income Program

Evaluation Activity	Description
Program Manager and Implementer Interviews	▪ Conducted interviews towards the end of PY2019 to understand program staff's perspective on program performance.
Program Material Review	▪ Reviewed all program materials to inform evaluation activities.
Program Theory/ Logic Model Review	▪ Reviewed implementer's program theory/logic model to understand program activities and their expected outputs and outcomes, including expected impacts on the market.
Tracking System Review	▪ Reviewed implementer's tracking system to ensure that data required for the evaluation is being collected.
Program Benchmarking*	▪ Compare Ameren Missouri's implementation of a one-stop shop program delivery method to similar programs in other jurisdictions.
Database Review	▪ Review program database to check that program data are complete. ▪ Verified reasonableness of EUL assumptions for lighting measures.
Engineering Analysis	▪ Verified that ex ante savings use correct TRM values and algorithms. ▪ Developed ex post savings using TRM algorithms, deemed savings assumptions, and evaluation-estimated parameters.
NTGR/Net Impact Analysis	▪ Estimated PY2019 net impacts.

* The program benchmarking task was started in PY2019, but given delays in implementation, results will be provided as a standalone memo in PY2020.

11.3 Evaluation Results

11.3.1 Process Results

In this section, the evaluation team presents the findings, recommendations, and suggestions for future evaluation activities based on the evaluation activities in 11.2. For ease of reference, we have summarized the evaluation results into the following categories:

- Implementation
- Program Data Tracking and Management
- Goal Projections, Customer Pipeline, and Customer Experience
- Marketing

Implementation

Ameren Missouri originally intended the program to launch in March 2019, but due to implementation delays between the implementer and administrator, the program launched in August 2019. Additionally, program implementation was delated due to misalignments between Franklin Energy and ICAST involving data savings, data storage, and protocols.

Regarding savings data, the program ICAST chose a custom savings approach, which relies on custom inputs, rather than a prescriptive approach for the program. The benefit of a custom approach is the

opportunity for deep savings; however, the approach requires custom inputs in order to verify savings. Franklin Energy expressed concern with this custom approach during the first year of the evaluation. Furthermore, the evaluation team found that the year-end database did not include sufficient custom inputs in order to recalculate savings, as detailed in this section.

ICAST and Franklin Energy were misaligned on savings calculations for several weeks, which impacted both customers and the evaluation team. ICAST reported the savings misalignments between them and Franklin, was the cause for program launch delays and customer frustration due to delayed approvals and rebates. The evaluation team's activities were also delayed for several months, preventing the completion of some intended program activities.

The program started recruiting customers before developing protocols and quality control procedures for documenting baseline and efficient measures (processes for savings calculations and corresponding technical resource manual guidance documents). With trade allies and other parties involved, developing well-documented materials before implementation is a best practice to remove data errors and capture complete and accurate field information.

Implementation recommendations include aligning savings algorithms and necessary inputs for ICAST and Franklin Energy prior to onboarding new customers. Additional details are provided in the Data Management section. Ameren Missouri, ICAST, and Franklin Energy should also develop and communicate program protocols and procedures, including documentation expectations, rebate timelines, and customer-facing materials to all program representatives and trade allies. Finally, Ameren Missouri, ICAST, and Franklin Energy should develop communication systems and quality control procedures to ensure critical program guidelines and changes are well-documented and communicated to stakeholders. These systems and procedures can include but are not limited to projected savings and costs, measure savings and assumptions, rebate amounts, technical reference manuals, program timelines, and potential delay areas.

Program Data Tracking and Management

Our initial research found that data storage and tracking systems differ between ICAST and Franklin Energy. ICAST provided sampled data that calculated multifamily units and common areas as one site or property in a spreadsheet. In contrast, Franklin Energy compiled data across multiple properties at the measure level. At the time of the ICAST interview, data was not able to be stored and shared between ICAST and Franklin Energy, causing delays in processing data and project completion. This data transfer process from implementer to administrator was static.

Data management recommendations include that Franklin Energy complete the development of their integrated data tracking system, Energy Manager As part of this process, ICAST and Franklin should follow through with the plan to align savings calculations assumptions by moving all parties from FTP site to an API based data transfer system to align data storage. The evaluation team believes this efficient information transfer and streamlined approval process will minimize data discrepancies in the future. Finally, ICAST should accurately record and store data after each project is completed and share program data with Franklin Energy at regular and timely intervals to avoid delays in claiming savings and payment of customer rebates.

Goal Projections, Customer Pipeline, and Customer Experience

For PY2019, goal projections, reported by the project manager, were met or exceeded, indicating customer recruitment, even in the midst of delays. The evaluated savings determine if the ex ante savings estimations were reasonable projections. The program manager strives to meet several goals that define program success. The program achieved its projected savings goals in 2019, by achieving 98% of rebate goals, 122% of projected savings goals, and 239% of 10-14 year kW projected savings targets. The program goals and status at the end of 2019 are shown in Table 11-6.

Table 11-6. PY2019 Multifamily Low-Income Program Annual Savings

Category	Projection Goal	2019 Year-End Projection Status	% of Projected Goal Achieved
Rebates	$871,972.00	$857,706.96	98%
Total project Savings (kWh)	1,543,049.00	1,883,279.00	122%
Project Demand (kW) Goal	308.00	735.45	239%

Interviews with ICAST and Franklin revealed opportunities to improve customer experience through clear communication, managing project expectations, implementation process requirements, and project timelines. During evaluation interviews, the implementer reported that, although customers were overall happy with the program, they were eager to start the projects which were delayed due to unexpected implementation challenges.

Customer Experience and Pipeline Recommendations include continuing to recruit to secure a robust customer pipeline for the program's future success.

Marketing

According to the marketing plan provided, Ameren Missouri planned a series of marketing activities including the development and distribution of promotional materials, one-on-one outreach to potential participants, and participation in industry conferences and events. However, according to Franklin and ICAST, program staff did not ultimately participate in industry conferences and trade ally trainings, given delays in approval, Table 11-7 shows the marketing plan for PY2019.

Table 11-7. PY2019 Multifamily Low-Income Marketing Activities

Planned Marketing Events and Materials	Description
Owner Manager E-mail	Pre-launch events describing the new program, offered once a month post-launch.
Trade Allies/Referral E-mail	
Program brochure, pre-launch education fryers, presentation and handouts	Education information on the new program launch. Used at pre-launch events, and in-person meetings and events.
Direct Marketing	One-on-one meetings with potential customers.

Removing barriers for program staff to attend marketing activities should increase awareness and set up the program for continued success. For PY2019, the most effective strategy to increase program uptake was one-on-one meetings, according to Ameren, ICAST, and Franklin.

One marketing recommendation is for Ameren to work with ICAST and Franklin to plan, forecast, and participate in marketing activities in line with achieving annual program goals and reduce potential customer barriers. As this program continues to reach customers and mature, Ameren, ICAST, and Franklin Energy should think strategically about when and how to engage in marketing activities to yield the desired impact.

11.3.2 Gross Impact Results

Table 11-8 presents MFLI Program annual savings achieved in PY2019. The PY2019 MFLI Program achieved 1,017 MWh and 0.21 MW in first year ex post gross savings.

Table 11-8. PY2019 Multifamily Low-Income Gross Impact Summary

	Ex Ante Gross	Gross Realization Rate	Ex Post Gross
First Year Savings			
Energy Savings (MWh)	1,366	77.1%	1,053
Demand Savings (MW)	0.26	85.1%	0.22
Last Year Demand Savings			
< 10 EUL (MW)	0.07	83.8%	0.06
10-14 EUL (MW)	0.02	173.4%	0.03
15+ EUL (MW)	0.06	198.2%	0.12

The evaluation team completed analysis on the following program measures: AC Tune-Ups (AC TuneUp), lighting upgrades (EXT Lighting BUS, Lighting BUS, Lighting RES), advanced thermostats (Heat Cool), bathroom faucet aerators, kitchen faucet aerators, and showerheads (Water Heating Res), Ductless AC units (Ductless AC), and ceiling insulation (Insulation). The remainder of this section summarizes the evaluation team's ex-post analysis, which includes detailed assumptions for each omitted or unsourced parameter value found in the tracking data. All calculation methodology, parameters, and assumptions are detailed in this section and sourced in Appendix A.

Table 11-9. PY2019 Multifamily Low-Income Annual First Year Gross Impacts

End-Use	Energy Savings			Demand Savings		
	Ex Ante (MWh)	Realization Rate	Ex Post (MWh)	Ex Ante (MW)	Realization Rate	Ex Post (MW)
AC TuneUp	64	98.1%	63	0.06	98.1%	0.06
Ductless AC	924	71.8%	664	0.15	73.1%	0.11
EXT Lighting BUS	63	63.8%	40	0.00	63.8%	0.00
HeatCool	55	156.5%	86	0.01	262.9%	0.02
Insulation	2	252.4%	5	0.00	220.4%	0.00
Lighting BUS	117	79.4%	93	0.02	81.8%	0.02
Lighting Res	31	77.8%	24	0.01	77.8%	0.00
Water Heating Res	111	71.6%	79	0.01	65.1%	0.01
Total	**1,366**	**77.1%**	**1,053**	**0.26**	**85.1%**	**0.22**

Table 11-10. PY2019 Multifamily Low-Income Annual Last Year Gross Demand Impacts

End-Use	Ex Ante (MW)			Realization Rate	Ex Post (MW)		
	<10	10-14	15+		<10	10-14	15+
AC TuneUp	0.06	0.00	0.00	98.1%	0.06	0.00	0.00
Ductless AC	0.00	0.00	0.05	230.5%	0.00	0.00	0.11
EXT Lighting BUS	0.00	0.00	0.00	63.8%	0.00	0.00	0.00
HeatCool	0.00	0.01	0.00	262.9%	0.00	0.02	0.00
Insulation	0.00	0.00	0.00	220.4%	0.00	0.00	0.00
Lighting BUS	0.01	0.00	0.01	81.8%	0.00	0.01	0.01
Lighting Res	0.00	0.00	0.00	77.8%	0.00	0.00	0.00
Water Heating Res	0.00	0.01	0.00	65.1%	0.00	0.01	0.00
Total	**0.07**	**0.02**	**0.06**	**141.9%**	**0.06**	**0.03**	**0.12**

Table 11-11 details the ex ante savings, the gross realization rate, the ex-post savings, and an explanation for each discrepancy. The measure description column details how the energy efficient measure is documented in the tracking database. There are items with BUS following their name, indicating a business measure or typically installed in a commercial space.

The evaluation team may update realization rates in the table below to reflect any newly provided information or assumptions.

Table 11-11. PY2019 Multifamily Low-Income Program Electric Energy Savings by Measure Description

Measure Description	Ex Ante Unit Gross Savings (kWh)	Gross Realization Rate	Ex Post Unit Gross Savings (kWh)	Reason for Discrepancy (If RR is not 100%)
AC Tune-up / Refrigerant charge-Multifamily Low-Income-V2	93	98%	91	Unclear. Ex post savings use SEER_test in 11.9, SEER_test out of 12.5664. The RR discrepancy may be due to a rounding error when calculating SEER_test out (which is 5.6% higher than SEER_test in).
Ceiling Insulation-Multifamily Low-Income	464	252%	1,170	Unclear. Ex post savings used custom values, when provided, and TRM Appendix I (see 'Savings Inputs' tab).
Common Areas Business Custom Measure Ext Lighting BUS	371	71%	264	Unclear. Ex post savings use 2876 annual hours of use (TRM Appendix H - Midrise Apartment Building). Ex ante savings likely use higher hours of use.
Common Areas Business Custom Measure HVAC BUS	541	0%	0	Ex ante savings do not provide sufficient inputs (wattages) or measure description to calculate ex post savings. No information was provided about this measure; therefore, no savings were estimated.
Directional LED-MFIE	401	34%	136	Unclear. Ex post savings use 728 annual hours of use (TRM Appendix I). Ex ante savings likely use higher hours of use.

Measure Description	Ex Ante Unit Gross Savings (kWh)	Gross Realization Rate	Ex Post Unit Gross Savings (kWh)	Reason for Discrepancy (If RR is not 100%)
Ductless AC-Multifamily Low-Income	7389	72%	5,308	There were multiple rows without inputs. Assumed defaults include: SEER_baseline = 8, SEER efficient = 18, HSPF = 3.41, CoolingCapacity = 24000 BTU/hr.
Exit Sign-MFIE	394	105%	414	Ex post savings use 8,760 annual hours of use (TRM Appendix H - Mid-rise apartment). It is unclear which exact parameters led to this discrepancy as we did not have detailed ex ante assumptions from the implementation team.
Kitchen Aerator-MFIE	116	73%	85	Ex post savings use Household value of 1.66, L_base and L_low of 4.5, FPH of 1.18, SupplyTemp of 60.83 (TRM Appendix I). Ex ante savings, per deemed savings table, use Household value of 2.07, L_base and L_low of 3.7, FPH of 1, SupplyTemp of 61.3.
Learning Thermostat MIFE	552	157%	864	Unclear. The ex post and ex ante unit savings are the same in the MFMR program. The evaluation team recommends that the MFLI program use the same savings calculation as the MFMR program.
LED - 10W (CFL baseline) LIDI-Multifamily Low-Income	36	8%	3	There were sparse inputs in the tracking data, no baseline wattage values were provided and only a few efficient wattages were provided. The evaluation team used the following defaults: WattsBase = 13.4, WattsEE = 7.
LED - 10W (Halogen baseline) LIDI-Multifamily Low-Income-V2	25	79%	20	Unclear. Ex post savings use 728 annual hours of use (TRM Appendix I). Ex ante savings likely use higher hours of use.
LED Fixture-MFIE	635	64%	405	Unclear. Ex post savings use 728 annual hours of use (TRM Appendix I). Ex ante savings likely use higher hours of use.
Low Flow Bathroom Faucet Aerator MFLI DI-Multifamily Low-Income-V2	96	46%	44	Unclear. Ex post savings use custom GPMs from preliminary data (2.2 gpm baseline, 0.5 gpm efficient). No GPM baseline values were provided in final tracking data. Deemed savings table unit savings (33.5 kWh), do not match ex ante unit savings.
Low Flow Showerhead MFLI DI-Multifamily Low-Income-V2	470	75%	354	Unclear. Ex post savings use custom GPMs from preliminary data (2.5 gpm baseline, 1.25 gpm efficient). No GPM baseline values were provided in final tracking data. Deemed savings table unit savings (204.7 kWh) do not match ex ante unit savings.

Measure Description	Ex Ante Unit Gross Savings (kWh)	Gross Realization Rate	Ex Post Unit Gross Savings (kWh)	Reason for Discrepancy (If RR is not 100%)
Omnidirectional LED-MFIE	190	58%	110	Unclear. Ex post savings use 728 annual hours of use (TRM Appendix I). Ex ante savings likely use higher hours of use.
TLED-MFIE	368	70%	257	Unclear. Ex post savings use 728 annual hours of use (TRM Appendix I). Ex ante savings likely use higher hours of use.

11.3.3 Net Impact Results

Because the MFLI Program falls under the umbrella of low-income programs, we applied a default NTGR of 1.0, assuming that both free ridership and spillover are zero. As such, net impacts for the MFLI Program are equal to the gross impacts presented in the section above.

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