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Ameren Missouri Program Year 2021 Annual EM&V Report

Volume 4: Demand Response Portfolio Report

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Opinion Dynamics

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1. Glossary of Terms Acronyms and Abbreviations

This section contains definitions of the key terms used throughout this report.

Bring your own thermostat (BYOT) – Program enrollment channel that engages customers with existing and already installed devices.

Capacity – Amount of electric load available for reduction.

Cumulative DR Capability – A metric based upon the resource capability used to determine earnings opportunity award for DR programs to provide incentives for peak demand savings as well as retention of the DR capability over the implementation period.

Device – Smart thermostat in the context of the Residential DR Program.

Dispatch platform – A software solution comprised of a set of algorithms designed to modify smart thermostat setpoints to achieve load reductions.

Emergency event – A dispatch of participants in the program as issued by MISO to manage system emergencies.

Energy optimization – Proprietary algorithms that optimize thermostat setpoints to achieve HVAC system runtime.

Event day – Twenty-four hours during which an event, either test or peak shaving, is dispatched.

Load curtailment – Reduction of electricity usage for a period of time.

Marketplace – Program enrollment channel that engages customers who purchase qualifying devices through Ameren Missouri Online Marketplace program.

Missouri Energy Efficiency Investment Act (MEEIA) goal – Three-year savings target approved by the Missouri Public Service Commission for a given program.

NERC holidays – Holidays set forth by the North American Reliability Corporation (NERC) and includes the days on which the following holidays are observed: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day.

Nominated capacity – Event hour demand reduction goal set for each participating account by the Program Aggregator.

Non-event day – Twenty-four hours during which no event, either test or peak shaving is dispatched.

Peak demand – The highest electrical demand during any one-hour interval during a designated period of time.

Peak shaving event – A dispatch of participants in the program to reduce Ameren Missouri's distribution system peak demand.

Resource capability – Event performance under typical weather conditions reflecting total demand under control by the programs at program year-end and available to be called under conditions consistent with Ameren Missouri's peak forecasting weather assumptions.

Test event – A dispatch of participants in the program to test the performance of the DR Program.

Systemwide event – A dispatch of participants in a program wherein all participants receive an event signal.

2. Executive Summary

This volume of the PY2021 Annual Report presents evaluation results for the Ameren Missouri PY2021 portfolio of demand response (DR) programs, as described in Ameren Missouri's 2019–21 Missouri Energy Efficiency Investment Act (MEEIA) Energy Efficiency Plan. The DR portfolio consists of two programs—Residential DR Program (also referred to as Peak Time Savings Program) and Business DR Program—which Ameren Missouri launched in 2019 and are now in their third year of operation. In this document, the evaluation team provides portfolio-level results for PY2021 as well as detailed findings for each program.

This evaluation summarizes key lessons learned regarding data capture, program participation, and program impacts. Evaluation activities in PY2021 focused on the assessment of program impacts, including measuring event season demand reductions, energy savings on event and non-event days, as well as resource capability. Process-related research activities in PY2021 were limited to a review of program materials, analysis of participation and device telemetry data, interviews with program staff and implementation contractors, and limited analysis of the event season participant survey data collected by Uplight in the winter of 2021.

This volume is organized as follows:

- Sections 2.1–2.4 present key evaluation findings and recommendations for the DR portfolio.
- Section 3 presents the overarching evaluation objectives and an overview of the PY2021 evaluation activities and methodologies for the DR programs.
- Sections 4 and 5 present evaluation results and detailed methods for the Residential and Business DR programs, respectively.

2.1 Portfolio Summary

The Residential DR Program is designed to control cooling load with the help of smart thermostats to achieve peak demand savings and energy savings. Eligible customers include Ameren Missouri electric customers with central air conditioning systems, including heat pumps and a program-qualifying smart thermostat. Qualifying smart thermostats in PY2021 included ecobee®, Nest®, and Emerson™ devices.[1] Customers either bring their own thermostats (also known as the BYOT channel) or purchase and install qualifying devices through the Ameren Missouri Online Marketplace (also known as the Marketplace channel). Franklin Energy administers the program, and Uplight delivers the program. While the program was originally designed as an integrated program aiming to deliver energy savings using optimization strategies alongside demand reductions, the program's pursuit of energy optimization savings in PY2021 was limited to just Emerson devices.

The Business DR Program is designed to reduce load during periods of peak demand. Enel X is the program aggregator, responsible for recruiting and enrolling customers, developing customized load reduction nominations and load curtailment strategies, dispatching demand response events, and maintaining customer relationships with participating businesses. Eligible business customers can participate in DR events through a variety of strategies, including direct load control and manual response. Each enrolled facility receives a customized load curtailment strategy, focusing on a variety of energy loads such as lighting, HVAC, chillers, motors, and processing equipment.

[1] All product or company names that are mentioned in this document are tradenames, trademarks or registered trademarks of their respective owners.

Error! Reference source not found. provides a summary of the DR portfolio program designs.

Figure 1. Summary of DR Portfolio of Programs

Program	Residential DR Program	Business DR Program
Eligible Customers	Residential electric customers with individual central air conditioning systems	Business customers
Program Interventions	DR events	DR events via custom load curtailment strategies
Eligible measures	Nest, ecobee and Emerson smart thermostats	Measure agnostic
Number of 2021 Events	4 test events (varying duration) 1 one-hour system reliability event	3 one-hour test events 1 one-hour system reliability event
Participation Incentive	$50 sign up; $25 participation	Custom incentive
Program Implementers	Franklin Energy, Uplight	Enel X

Note: For the Business DR program, one of the test events was dispatched in December 2021.

Table 1 shows the DR portfolio MEEIA III demand reduction and energy savings goals for the three-year cycle, which are 114.79 MW in demand savings and 5,412 MWh in energy savings. The Business DR Program is expected to contribute to 65% of the portfolio's demand savings goal, while the Residential DR Program is expected to deliver 72% of the portfolio's energy savings goal.[2]

Table 1. Incremental and Cumulative MEEIA Goals

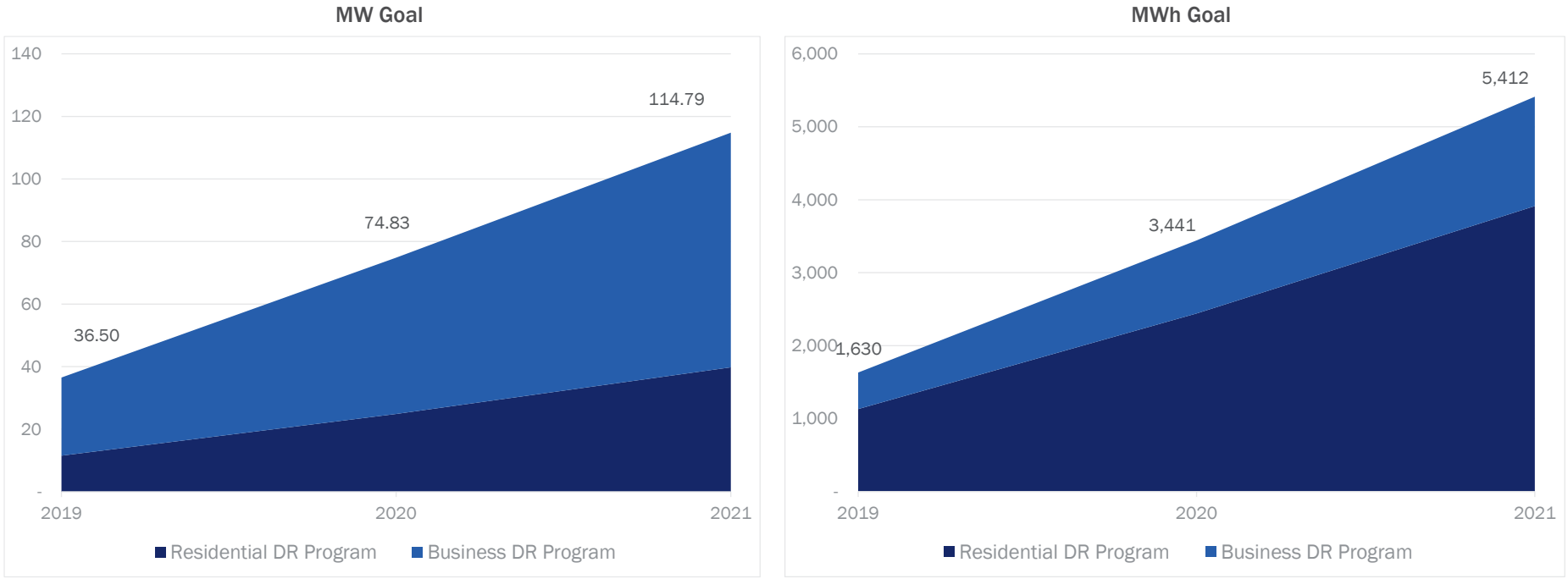
Program Year	Residential DR Program		Business DR Program		DR Portfolio	
	Incremental Goal	Cumulative Goal	Incremental Goal	Cumulative Goal	Incremental Goal	Cumulative Goal
Participation Goal (Customers)						
PY2019	6,533	6,533	50	50	6,583	6,583
PY2020	7,905	14,438	50	100	7,955	14,538
PY2021	9,206	23,644	50	150	9,256	23,794
Total	**23,644**	**23,644**	**150**	**150**	**23,794**	**23,794**
Demand Savings Goal (MW)						
PY2019	11.50	11.50	25.00	25.00	36.50	36.50
PY2020	13.33	24.83	25.00	50.00	38.33	74.83
PY2021	14.96	39.79	25.00	75.00	39.96	114.79
Total	**39.79**	**39.79**	**75.00**	**75.00**	**114.79**	**114.79**
Energy Savings Goal (MWh)						
PY2019	1,130	1,130	500	500	1,630	1,630
PY2020	1,311	2,441	500	1,000	1,811	3,441

[2] 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.

Program Year	Residential DR Program		Business DR Program		DR Portfolio	
	Incremental Goal	Cumulative Goal	Incremental Goal	Cumulative Goal	Incremental Goal	Cumulative Goal
PY2021	1,471	3,912	500	1,500	1,971	5,412
Total	**3,912**	**3,912**	**1,500**	**1,500**	**5,412**	**5,412**

Figure 2 summarizes cumulative DR portfolio goals. Throughout the remainder of this report, we assess the programs' performance against MEEIA cumulative PY2021 goals.

Figure 2. Summary of Cumulative DR Portfolio Goals for the Planning Cycle



2.2 Portfolio Impact Results

At the end of the PY2021 event season, the demand response portfolio achieved 111.31 MW in average load reduction as well as 1,131.23 MWH in energy savings (Table 2). A limited number of events were dispatched across both the Residential and Business DR programs over the course of the season. Notably, evaluation limitations for the Residential DR Program resulted in likely under-estimates of demand and energy savings for two high-temperature events, thus likely driving down the total impacts reported in the table below and elsewhere in this report.

Table 2. PY2021 Event Season Performance Summary

Program	Participants [A]	Event Season MW Performance	Event Season MWH Performance [B]
Residential DR Program	31,684	33.38	229.34
Business DR Program	601	77.94	901.89
Total DR Portfolio	**32,285**	**111.31**	**1,131.23**

[A] Participant count for the Residential DR program represents the average number of participants among whom events were dispatched. In some cases, participant counts are adjusted to reflect impact modeling decisions.
[B] Energy savings for the Business DR program only include event season events.

To compare the DR portfolio demand savings performance against the MEEIA III MW goals, the evaluation team calculated weather-normalized resource capability estimates. Resource capability reflects total demand under control by the programs at program year-end and available to be called under conditions consistent with Ameren Missouri's peak forecasting weather assumptions. Figure 3 summarizes portfolio performance toward MEEIA III cumulative goals. As shown in the figure, the portfolio exceeded the demand goal of 114.79 MW by 18.68 MW for a total of 133.47 MW, achieving 116% of the goal, but fell considerably short of the energy savings goal, achieving 1,137.90 MWH of the 5,412 MWH (21%).[3]

Figure 3. DR Portfolio Performance Against MEEIA III Cumulative Goals

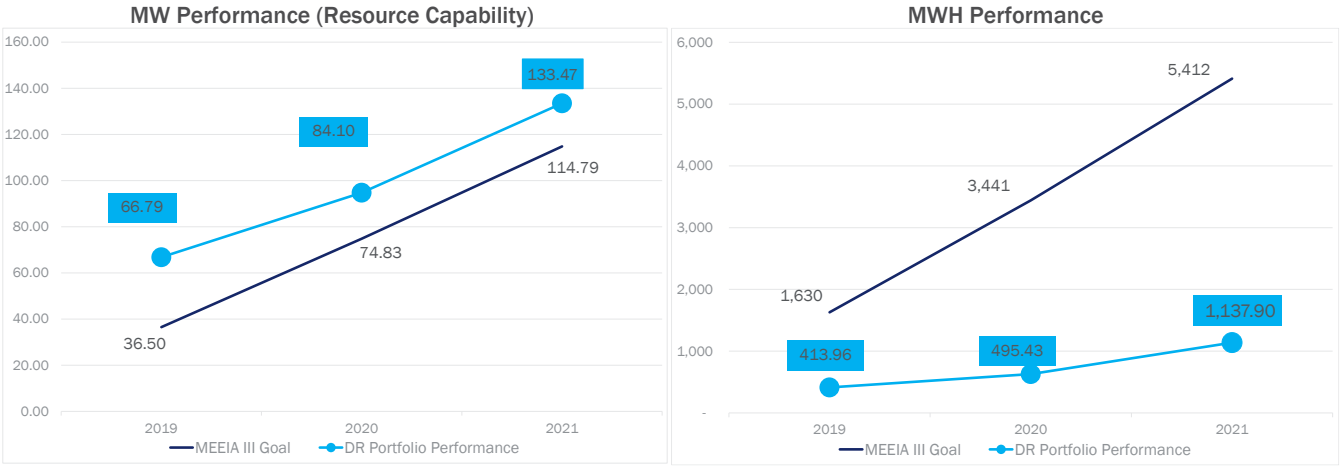


Table 3 provides a detailed summary of each program's performance against MEEIA III goals, including participation goals. As shown in the table, both programs exceeded goals in terms of customer enrollment. As of the end of PY2021, the Residential DR Program achieved 157% of its enrollment goal, while the Business DR program achieved 424% of the enrollment goal. From a resource capability perspective, both Residential and Business DR programs had a strong performance, achieving 113% and 118% of their respective goals. Combined,

[3] Energy savings for the Business DR program includes savings from the December test event in addition to the event season events.

the two programs exceeded the MEEIA III goal by 16%. Similar to the event season impacts, resource capability impacts likely suffer from under-estimation of savings for two high-temperature event days.

Both programs underperformed against their energy savings goals (6% and 61% for the Residential and Business DR programs, respectively). Energy savings for the Residential DR Program include event day impacts during the event season as well as energy savings achieved through optimization of Emerson devices on non-event days. Energy savings for the Business DR Program include savings achieved during the December test event, in addition to the savings achieved during the three events called during the event season.

Table 3. DR Portfolio Performance Against MEEIA III

Program	Cumulative 2021 MEEIA III Goal	PY2021 Performance	Goal Achieved (%)
Participation as of the End of PY2021 (Participants)			
Residential DR Program	23,644	37,129	157%
Business DR Program	150	636	424%
Total DR Portfolio	**23,794**	**37,765**	**159%**
Resource Capability (MW)			
Residential DR Program	39.79	45.10	113%
Business DR Program	75.00	88.37	118%
Total DR Portfolio	**114.79**	**133.47**	**116%**
Energy Savings (MWH)			
Residential DR Program	3,912.00	229.34	6%
Business DR Program [A]	1,500.00	908.56	61%
Total DR Portfolio	**5,412.00**	**1,137.90**	**21%**

[A] Includes energy savings achieved during the December test event.

In addition to the event season performance and resource capability performance, we also calculated cumulative DR capability (Table 4). Cumulative DR capability is calculated to support the earnings opportunity metric for Ameren Missouri's DR programs. For the Residential DR Program, the cumulative DR capability mirrors the resource capability. For the Business DR Program, however, per the MEEIA III Plan,[4] the cumulative DR capability is based on the performance of only tested participants, as opposed to all participants enrolled in the program at year-end.[5] In PY2021, all Business DR participating customers were tested as part of either summer events or the winter test event. Therefore, cumulative DR capability is equal to the resource capability.

Table 4. DR Portfolio Summary of Cumulative DR Capability Estimated Impacts by Program

Program	Target (MW)	PY2021 Performance (MW)	% of Target Achieved
Residential DR Program	39.79	45.10	113%
Business DR Program	75.00	88.37	118%
Total DR Portfolio	**114.79**	**133.47**	**116%**

[4] Ameren Missouri. "Ameren Missouri 2019–21 MEEIA Energy Efficiency Plan." https://efis.psc.mo.gov/mpsc/commoncomponents/viewdocument.asp?DocId=936195031

[5] Including event season DR or test events as well as winter test events.

2.3 Portfolio Process Findings and Recommendations

In PY2021, the third year of operation for Ameren Missouri's demand response portfolio, Ameren Missouri continued to work with an array of implementation partners across both programs, including Enel X, Franklin Energy, and Uplight. Ameren Missouri offered a Residential DR Program that balanced smart thermostats, market channels, and intervention strategies, as well as a Business DR Program designed to bid into the Midcontinent Independent System Operator, Inc. (MISO) market.

The DR portfolio overachieved in terms of customer enrollment, suggesting an interest in the market for these programs as well as strong implementer performance in recruiting customers. While the Business DR Program ran smoothly with little changing in the way of program implementation and event dispatch, the Residential DR Program encountered several unexpected challenges with event dispatch and timely Emerson optimization as well as challenges with telemetry data.

Looking forward, Ameren Missouri should continue to focus on continued engagement of enrolled participants as well as targeted enrollment of future participants to balance performance against portfolio goals. More specifically, key considerations include ensuring continued persistence in delivery of load impacts, mitigation of event overrides, as well as ensuring consistency in commercial load impacts for participants through continuous education and feedback.

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

2.3.1 Residential DR Program

- **Conclusion 1:** The Residential DR program succeeded in enrolling significantly more customers than planned. Program demand planning assumptions per device remained considerably higher than what the program delivered in PY2021, both in terms of actual as well as weather-normalized demand savings. Moving forward, the program will either need to continue enrolling more participants than planned or achieve greater per-device impacts to meet demand impact goals. Enrollment of additional devices to achieve goals will likely carry higher cost for the program. The change in the timing of the enrollment bonus payments through the Marketplace channel has a risk of slowing new customer engagement with the program further.
  - **Recommendation 1:** Program staff should continue to balance participant enrollment targets with consideration of both resource capability and event season demand impacts to optimize the program's performance against the demand goal.
- **Conclusion 2:** The Residential DR Program fell short of the MEEIA III energy savings goals and likely faces considerable shortfalls in the future. The shortfall in energy savings in PY2021 was primarily due to ecobee and Nest opening their optimization platforms to all device owners, which limited the program's ability to harvest additional savings via optimization driven interventions. Given these developments, energy savings goals are likely unattainable moving forward and need revision.
  - **Recommendation 2:** Should increasing energy savings become a priority for the program, program staff could consider tailored messaging for Emersons and ecobees aimed at and encouraging more participants to enroll in Seasonal Savings and eco+, respectively. For eco+ specifically, program staff could further tailor messaging to encourage selection of more aggressive optimization algorithms. Should the program pursue the latter set of recommendations, discussion of the appropriate evaluation approach to capture program attributable changes in energy consumption should occur prior to messaging launch to ensure the evaluability of these interventions.

- **Conclusion 3:** Event impacts decline hour-after-hour, sometimes considerably, indicating likely presence of override behaviors.[6] The data provided to the evaluation team could not support mining and analysis of override behaviors and their impact on event performance. Participant research insights as well as hourly impact results suggest, however, that override behaviors are tied to participant demographic characteristics and the associated presence at home during events, as well as to aggressiveness of setpoint adjustments prior to and during DR events. Participant satisfaction and override behaviors are related as well.
  - **Recommendation 3:** Program staff should seek to better understand and assess the impact of override behaviors on participant satisfaction and performance. Further, to ensure sustained performance, program staff should consider deploying additional messaging and engagement activity to minimize overrides, especially in case of multi-hour event dispatches.
- **Conclusion 4:** Poor proxy day matching performed in support of the quasi-experimental approach to the evaluation likely resulted in an underestimate of impacts for the two hottest events of the PY2021 event season. In our explorations, the underestimates can have a meaningful impact on both event season and resource capability savings. The evaluation team has available data to explore and deploy a superior approach to estimating demand and energy impacts, namely experimental design data, but was prevented from leveraging it due to timeline and budgetary constraints associated with the poor quality of the data received from the implementation contractor.
  - **Recommendation 4:** The evaluation team recommends that moving forward, Ameren Missouri and program staff revisit the data tracking processes and data pipelines in conjunction with the evaluation team to ensure sufficiently detailed and consistently tracked data across core input fields. This will ensure more rigorous, accurate, and cost-effective evaluation efforts. Furthermore, as AMI data penetration in Ameren Missouri's service territory increases, impact evaluation should be shifted to leverage actual load data. To that end, the evaluation team is planning to use PY2022 as the year to explore using AMI data for impact evaluation purposes.

2.3.2 Business DR Program

- **Conclusion 1:** The Business DR Program exceeded its MEEIA III participation and demand savings goals and is well-positioned for continued success. The Business DR Program fell short of its MEEIA III energy savings goal. The key driver behind the shortfall is a dispatch of a limited number of events and short event duration in PY2021. With a limited pool of eligible commercial and industrial customers available for targeting, new customer engagement is likely to be more resource intensive and will need to include continued outreach attempts. Future participants are also likely to offer lower capacity reduction potential as compared to the current participant mix. As a result, a selective and targeted approach to new customer engagement will be important in balancing customer engagement costs with resource benefits and program goals. To that end, leveraging insight on existing participant performance will allow for a more refined targeting of new customers.
  - **Recommendation 1:** Program staff should balance participant enrollment with the size of their nominations and uncertainty surrounding their performance. Program staff should leverage existing insight from the program's performance over the last three years to inform new customer targeting. Notably, Enel X is already planning to incorporate available information into their targeting strategy.

[6] It is also likely that system cycling contributes to savings degradation over time.

- **Conclusion 2:** Lack of interval data among commercial and industrial customers limits program staff's ability to effectively target customers with high peak load as well as to accurately gauge new enrollees' performance potential. That results in sometimes significant departures between customer performance in the events and their nominations.
  - **Recommendation 2:** Program staff should continuously revisit and revise participant capacity nominations in light of event performance data to ensure better alignment between performance and nominations. That can help better gauge anticipated program performance against goals and ramp new customer recruitment or existing customer engagement.
- **Conclusion 3:** Program staff deployed a multi-faceted process for existing customer outreach to ensure participant readiness for the event season and to deepen engagement. However, delays with the provision of interval data to calculate performance limited Enel X's opportunity to engage participants soon after the completion of the events to educate participants about their achievements, discuss reasons for performance, educate, and identify opportunities to both deepen impacts among strong performers as well as identify opportunities to remedy and increase impacts among underperforming participants. To that end, Enel X is planning to deploy additional metering infrastructure to increase the speed of access to performance information among a larger number of participants.
  - **Recommendation 3:** Program staff should continue to collaborate with Ameren Missouri on ways to accelerate interval data provision to support additional opportunities for customer engagement and education in an effort to sustain and deepen impacts.
- **Conclusion 4:** Supply chain shortages, growing demand for goods, and labor constraints following the first year of the COVID-19 pandemic required participating customers to adapt their operations thus limiting their flexibility and their potential for deeper load reductions during the events, per Enel X feedback. Rising inflation and continued supply side and labor shortages may continue in PY2022, presenting a risk to performance expectations.
  - **Recommendation 4:** Program staff should consider proactively engaging customers in advance of the event season to explore the anticipated strain on their operations that external market forces may present and work with customers to either adapt their load curtailment plans seeking more opportunities or adjust their nominations in order to better understand the needed ramp up in new customer recruitment.

2.4 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 both Demand Response programs, using all five cost-effectiveness tests recommended by the California Standard Practice Manual and used in prior evaluations:[7]

- **Total Resource Cost (TRC) Test:** Perspective of all utility customers (participants and non-participants) in the utility service territory

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

- **Utility Cost Test (UCT):** Perspective of utility, government agency, or third-party program implementer
- **Ratepayer Impact Measure (RIM) Test:** Impact of efficiency measure on non-participating ratepayers overall
- **Participant Cost Test (PCT):** Perspective of the customers installing the measures
- **Societal Cost Test (SCT):** Perspective of all utility customers (participants and nonparticipants) in the utility service territory[8]

Table 5 summarizes the cost-effectiveness results for both DR programs. Both programs screen cost-effective under the TRC test, and the UCT. The Residential DR Program is cost-effective under the RIM test, while the Business DR Program is not. The PCT is not applicable to DR programs because there is no cost to the participants.

Table 5. Summary of Demand Response Cost-Effectiveness Results

Program	TRC	UCT	RIM	PCT
Residential Demand Response [A]	1.62	1.62	1.91	n/a
Business Demand Response [A]	1.00	1.00	0.96	n/a

[A] Includes the lifetime costs and benefits of Demand Response programs over a 10-year effective useful life.

For portfolio-level cost-effectiveness testing, the Residential DR Program and the Business DR Program are included in the Residential Portfolio and the Business Portfolio, respectively. Portfolio-level results are presented in Volume 1.

[8] 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.

3. Evaluation Approach

This section presents the evaluation approach for the Ameren Missouri PY2021 Residential DR Program and Business DR Program. The evaluation team assessed each program separately. The activities and results of each program-level evaluation are presented individually in subsequent sections of this volume. The following subsections discuss the research objectives common to the two program evaluations and present an overview of the evaluation approach and the activities conducted to address the research objectives.

3.1 Research Objectives

The DR portfolio evaluation was designed to address numerous process and impact objectives. An additional objective is also included focused on responding to the five key research questions stipulated in 20 CSR 4240.22(8).[9] The research objectives addressed by the PY2021 DR portfolio evaluations are described in greater detail below.

3.1.1 Process Objectives

Process-related activities were limited in PY2021 and focused on targeted mining of telemetry and participation data streams supported by a limited analysis of the end-of-season participant survey efforts completed by Uplight in the winter of 2021-early 2022 to address the following key process evaluation objectives:

- Understand participant composition and its changes over time
- Assess participant enrollment and de-enrollment behaviors
- Understand participant experiences
- Identify opportunities for improvement
- Provide evaluation results that can be used to improve the design and implementation of the Program

3.1.2 Impact Objectives

Across the DR portfolio, we estimated ex post demand response event load reduction and energy savings. We also estimated non-event energy savings stemming from optimization of Emerson devices. In addition, we calculated the anticipated resource capability for the following year. There are four primary research objectives for this effort:

- Estimate ex post DR event demand impacts
- Estimate resource capability impacts
- Estimate DR event energy savings
- For the Residential DR program specifically, estimate non-event energy savings for Emerson devices

[9] The Missouri Code of State Regulations (20 CSR 4240.22(8), formerly 4 CSR 240-22.070(8)) requires that demand-side programs, operating as part of a utility's preferred resource plan, are subject to ongoing process and impact evaluations that meet certain criteria, including the process evaluation questions presented in this section.

3.1.3 Cost-Effectiveness Objectives

Cost-effectiveness objectives include the following:

- Assess the cost-effectiveness of each DR program and the DR portfolio as a whole using industry-standard cost-effectiveness tests.
- Ensure alignment of cost-effectiveness testing assumptions and parameters with the PY2021 DR evaluation results, Ameren Missouri's TRM Revisions 2.0, and industry best practices.
- Provide total program benefits, costs, net benefits, and cost-effectiveness testing results.

3.1.4 CSR Mandated Research Objectives (4 CSR 240-22.070(8))

CSR-mandated research objectives include providing responses to the following requirements:

- 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 enduse measures included in the program appropriately reflect the diversity of enduse energy service needs and existing enduse 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 enduses/measure groups included in the Program?

3.2 Evaluation Activities and Methodologies

The combination of research activities used to examine each program varied, largely dictated by the data available, as well as an analytical approach to estimating impacts for each program. Table 6 shows the research activities included in each of the evaluations. Details for each program are included in each program-specific section, where relevant.

Table 6. Research Activities by Program

Research Activity	Residential DR Program	Business DR Program
Program Manager and Implementer Interviews	✓	✓
Program Material Review	✓	✓
Tracking System Review	✓	✓
Participant and Market Actor Research		
Participant Survey	✓ A	-
Participant In-Depth Interviews	-	-
Market Partner Survey	-	-
Trade Ally/Service Provider In-Depth Interviews	-	-
Participating Developer & Designer Interviews	-	-
Gross Impact Analysis		

Research Activity	Residential DR Program	Business DR Program
Database Review	✓	✓
Ex Post Event DR Impacts	✓	✓
Ex Post Event Energy Impacts	✓	✓
Resource Capability Assessment	✓	✓
Energy Optimization Impacts	✓[B]	-
Attribution/Net Impact Analysis		
Free Ridership	-	-
Participant Spillover	-	-
Market Partner Spillover	-	-

[A] Limited to select analysis of the end-of-season participant survey data. The survey was designed, programmed, and administered by Uplight in the winter of 2021-early 2022.
[B] Only completed for Emerson devices as only those devices received program-driven optimization interventions.

3.2.1 Program Manager and Implementer Interviews

To support evaluation planning, we gathered feedback from program implementation staff over the course of PY2021. We explored details of the design and planned implementation for each program; ongoing changes in design, marketing, targeting, and event dispatch occurring over the course of the year; and program staff's feedback on programs' performance and evaluation priorities.

The evaluation team conducted focused interviews with program and implementation staff at the end of PY2021 with the focus on overall assessment of the PY2021 processes and plans for programmatic changes in PY2022.

3.2.2 Program Material Review

We conducted a comprehensive review of all available program materials, including program-tracking data, implementation strategies, and load curtailment plans. This review served to familiarize the evaluation team with details of program design and implementation.

3.2.3 Tracking System Review

In the spring of 2021, the evaluation team revisited program-tracking, telemetry, and interval data systems and provision processes across Ameren Missouri, Franklin Energy, Uplight, Nest, ecobee, Emerson, as well as Enel X. The goals of this review were to (1) capitalize upon lessons learned throughout the PY2020 evaluation, (2) ensure the data extracts and frequency of data provision aligned with evaluation goals and timelines, and (3) ensure the data extracts contained the necessary data to complete our evaluation accurately.

3.2.4 Participant Survey

The evaluation team leveraged participant survey data collected by Uplight at the close of the event season to support focused process analysis. Uplight completed a web survey with program participants active in the program during the PY2021 event season. Uplight administered the survey between December 13, 2021, and January 9, 2022, and received 1,705 responses. We cleaned the data to remove partial respondents as well as respondents who did not recall participating in the program, leaving a total of 1,341 completed survey respondents.

3.2.5 Gross Impact Analysis

We performed the following key gross impact analyses for the PY2021 Ameren Missouri DR programs:

- Reviewed the program-tracking database to check that the databases contained all needed information to estimate program impacts
- Characterized program participation with respect to event participation, and other relevant characteristics
- Estimated the first year ex post event day gross energy (kWh) and demand (kW) savings
- Estimated non–event day energy optimization impacts of the Residential DR program for Emerson devices
- Determined resource capability for all participants enrolled throughout PY2021

Attribution/Net Impact Analysis

Per industry standard practices, we assume a net-to-gross ratio of 1.0 for impacts from DR events (i.e., there is no free ridership or spillover). Our estimate of non–event day energy impacts incorporates Uplight's randomized controlled trial, producing net energy impacts adjusted for free ridership and participant spillover.

CSR-Mandated Research Objectives

We address the CSR-mandated research objectives in each program-specific chapter. These questions were answered by leveraging participant research, database review, impact analyses, and baseline research.

4. Residential Demand Response Program

This chapter summarizes the PY2021 evaluation methodology and results for the Residential DR Program.

4.1 Evaluation Summary

4.1.1 Program Description

The Residential DR Program, designed to control cooling load with the help of smart thermostats to achieve peak demand savings and energy savings, was in its third year in PY2021. Eligible customers included Ameren Missouri electric customers with central air conditioning systems who either had or were ready to purchase an eligible smart thermostat and enroll in the program.[10] Qualifying smart thermostats in PY2021 included ecobee, Nest, and Emerson devices. Customers could either enroll their existing devices (BYOT channel) or purchase, install, and enroll qualifying devices through the Ameren Missouri Online Marketplace (Marketplace channel) in the DR Program.[11] Customers could enroll multiple devices in the program and received a $50 sign-up bonus for enrolling their device(s) in the program and $25 for each year they remained in the program, provided their active participation in events. The program was administered by Franklin Energy, responsible for customer acquisition and marketing, and delivered by Uplight. Uplight was responsible for event dispatch, overall program delivery and event-related customer communications. Franklin Energy is the overall residential portfolio implementation contractor and was responsible for coordinating the overall management and data systems for the residential portfolio. The focus of the program in PY2021 was on delivering demand impacts. Depending on device manufacturers, event dispatch platforms varied and as a result, so did participant notifications, precooling strategies, and event hour thermostat adjustment algorithms.

Program delivery in PY2021 included a randomized control trial (RCT) design, wherein, for each event, devices were randomly assigned into treatment and control groups. Treatment group devices received event notifications and event signals, while control group devices did not. Control group sizes varied by manufacturer. The exception to this was a system reliability event, during which all devices received an event signal.

Program marketing and enrollment included a variety of outreach strategies, including direct mail and e-mail communications from Ameren Missouri or notifications on customer devices or device apps from Ameren Missouri and device manufacturers, as well as advertising on Ameren Missouri's website.

Program participation processes varied by the device manufacturer and channel, but generally included an eligibility check based on HVAC equipment, verification of customer account information, confirmation that enrolled customers were active Ameren Missouri electric customers, and customer review and acceptance of terms and conditions. Nest and ecobee conducted equipment verification and initial enrollment prior to handing data to Uplight for final verification and enrollment, whereas Uplight conducted all verification and enrollment for Emerson devices. Uplight sent successful enrollments to Franklin Energy daily for official records and incentive payments.

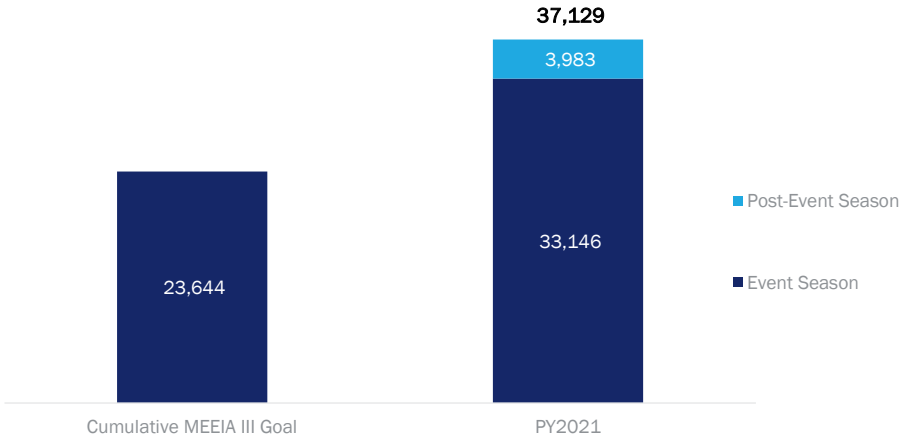
4.1.2 Participation Summary

Figure 4 presents participation in the Residential DR Program during PY2021 and compares participation against the MEEIA III participation goal. As can be seen in the figure, there were 37,129 active customers as of the end of the year, with 33,146 being enrolled before the end of the PY2021 event season and an additional 3,983

[10] Including customers with heat pumps
[11] Devices could be self-installed or professionally installed.

customers enrolled between October and December 2021. Active participation of 37,129 customers represents 157% of the MEEIA III cumulative participation goal. Notably, PY2021 marked the first year of Franklin Energy performing incentive chargebacks of customers who did not complete program enrollment. Based on Franklin feedback, nearly 7,000 were charged back the enrollment bonused paid to them. Chargebacks occurred either via on-bill pay-pack or credit or debit card chargeback activity. Charged back customers are not included in participant counts presented throughout this report.

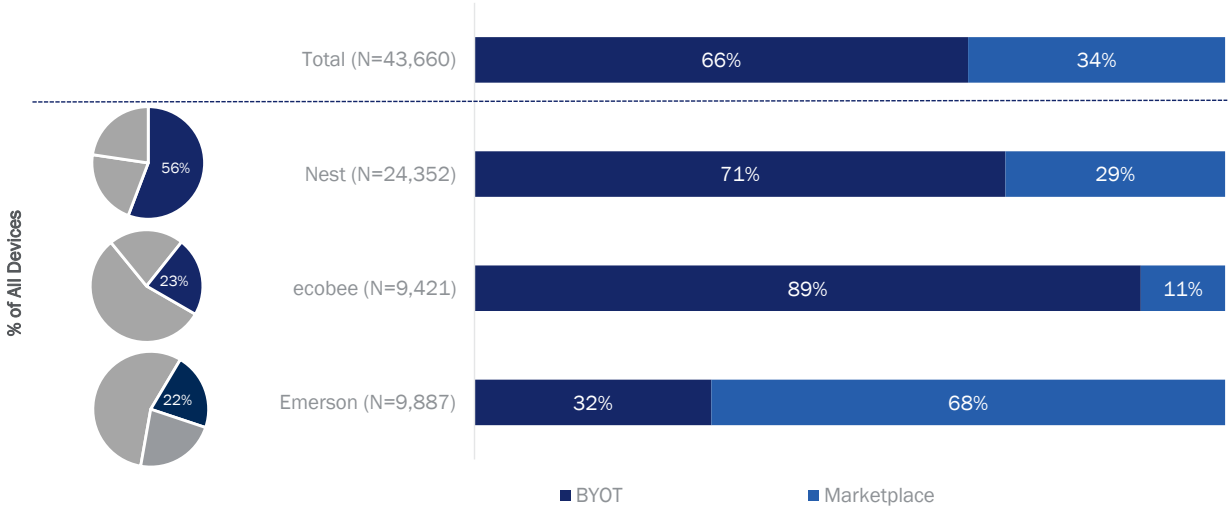
Figure 4. Residential DR Program: PY2021 Program Participation Summary (Customers)



Active participants had 43,660 devices enrolled and active in the program as of the end of PY2021, an average of 1.2 devices per household. Participating devices in PY2021 represented a mix of manufacturers and enrollment channels. More specifically, over half of participating devices (56%) were Nest devices, over a fifth (23%) were ecobees, and the remaining fifth (22%) were Emerson devices. Overall, two-thirds of all participating devices (66%) active in the program at the end of PY2021 enrolled in the program via the BYOT channel, while the remainder entered the program via the Marketplace channel. Nest and ecobee devices were predominantly enrolled via the BYOT channel (71% and 89% respectively). Conversely, over two-thirds of Emerson devices (68%) entered the DR program via Ameren Missouri's Marketplace channel (

Figure 5). This volume of enrollment via the Marketplace was driven primarily by an ongoing marketplace promotion offering Emerson devices to customers at no cost, as well as a Nest promotion for a free thermostat that ran between August and December in PY2021.

Figure 5. Residential DR Program: Device Distribution by Manufacturer and Enrollment Channel



4.1.3 Program Implementation Summary

Over the course of the event season, Ameren Missouri successfully dispatched a total of five demand response events, one of which was a system reliability or peak load shaving event. In addition, two events were scheduled to be dispatched but ultimately failed to dispatch successfully due to technical reasons. Figure 6 documents successfully dispatched event days and times alongside average temperature during the event dispatch hours.

Figure 6. Residential DR Program: Event Days with Average Maximum Temperatures and Event Hours

Table 7 details platforms that Uplight relied on to dispatch events in PY2021. Specifically, Uplight relied on the Rush Hour Rewards (RHR) platform to dispatch events among Nest devices, eco+ platform for ecobee devices, and the Orchestrated Energy (OE) platform for Emerson devices. Each of the platforms features its own precooling strategies as well as event hour temperature setbacks.

Table 7. Residential DR Program: Event Dispatch Platforms

Device Manufacturer	Dispatch Platform Name	Platform Type	Events Deployed
Nest	Rush Hour Rewards (RHR)	Vendor DR platform	All events
ecobee	eco+	Vendor DR platform	All events
Emerson	Orchestrated Energy (OE)	Uplight DR platform	All events

The Residential DR Program was originally designed as an integrated demand response and energy efficiency program aimed at not only achieving demand reductions but also harvesting energy savings on non-event days. To that end, Uplight started using its OE platform to run optimization of the ecobee devices at the beginning of the summer season (May 2019). Nest launched energy optimization using its Seasonal Savings platform in early August 2019. Uplight did not run optimization on Emerson devices during the PY2019 event season. In PY2020, ecobee made their energy optimization platform, eco+, broadly available to device owners, which eliminated Uplight's ability to offer its OE platform for ecobee devices as part of the program. In the summer of 2020, Nest made its Seasonal Savings platform available to a broad customer base, as opposed to just utility program participants. In light of these changes, Uplight could not deploy program-driven energy optimization algorithms on either Nest or ecobee devices. Uplight did not dispatch OE on Emerson devices in PY2020. In PY2021, Uplight ran OE optimization algorithms on Emerson devices only, starting in mid-July 2021.

4.1.4 Key Impact Results

At the end of the event season, the Residential DR Program achieved 33.38 MW in average demand savings and 229.34 MWh in energy savings (Table 8). Event day energy savings were negative meaning that energy consumption over the course of the event day increased due to DR event dispatch.

Table 8. Residential DR Program: Summary of Event Season Performance

Metric	Result
Participant Count	31,684
Event Day Demand Impact (MW)	33.38
Event Day Energy Impact (MWH)	-243.87
Non-Event Day Energy Impact (MWH)	473.21

In addition, the program's resource capability estimate is 45.10 MW, which represents 113% of the PY2021 MEEIA III goal (Table 9).

Table 9. Residential DR Program: Comparison of Resource Capability Impacts to Goal

Metric	Result
Resource Capability (MW)	45.10
PY2021 MEEIA III Goal (MW)	39.79
Percent of PY2021 Goal	113%

We also showed the PY2021 cumulative DR capability in Table 10. For the Residential DR Program for PY2021, cumulative DR capability is equivalent to the resource capability.

Table 10. Residential DR Program: Cumulative DR Capability

Metric	Result
Cumulative DR Capability (MW)	45.10
PY2021 Target (MW)	39.79
Percent of PY2021 Target	113%

Figure 7 summarizes the performance of the Residential DR program. As presented in the figure, Nest devices comprised over half of all participating devices as of the end of PY2021. Demand impacts were highest for Emerson devices and lowest for ecobees. Event day energy savings were negative across all device manufacturers.

Figure 7. Residential DR Program: Summary of Program Impacts

		Nest	ecobee	Emerson	Total
Event Season Demand Impacts	Number of Events	5	5	5	5
	Average Number of Participating Devices*	18,015	7,078	7,258	32,351
	Per Device kW Impact	1.00	0.84	1.27	1.02
	Total MW Impact	17.98	6.06	9.34	33.38
	% of Cooling Load Reduced	56%	50%	66%	57%
Weather Normalized Resource Capability Estimate	Average Number of Participating Devices*	19,860	9,421	9,887	39,168
	Per Device kW Impact	1.15	0.93	1.37	1.15
	Total MW Impact	22.78	8.77	13.55	45.10
	% of Cooling Load Reduced	73%	61%	78%	72%
Event Day Energy Savings	Average Number of Participating Devices*	18,015	7,078	7,258	32,351
	Per Device kWh Impact	-8.05	-7.04	-9.30	-8.11
	Total MWh Impact	-153.27	-16.27	-74.33	-243.87
	% of Baseline Energy Usage Reduced	6%	2%	7%	6%
Non-Event Day Energy Savings	Average Number of Participating Device Days**	N/A	N/A	327,151	327,151
	Per Device Day kWh Impact	N/A	N/A	1.45	1.45
	Total MWh Impact	N/A	N/A	473.21	473.21
	% of Baseline Energy Usage Reduced	N/A	N/A	7%	7%

4.2 Key Process Findings

Throughout PY2021, the Residential DR Program continued to successfully engage eligible Ameren Missouri residential customers to deliver load reductions. Key highlights for PY2021 include the following:

- Program-eligible devices consisted of three major thermostat manufacturers (Nest, ecobee, and Emerson) and spanned a variety of devices. Device mix across device manufacturers remained balanced; however, Nest devices continued to account for the majority of devices. Moving forward, program implementation contractors are looking to further expand program presence by engaging additional device manufacturers and exploring other control technologies.
- Program implementation contractors continued to rely on two key channels—the BYOT and Marketplace—for program enrollment, with the Marketplace channel gaining traction over the course of PY2021 in part due to promotional activity.
- Program marketing and messaging was effective in reaching and engaging customers, evidenced by higher than planned program enrollment. As of the end of PY2021, the Residential DR Program had a total of 43,660 enrolled and active devices across 37,129 customers, which averaged to 1.2 participating devices per customer. This level of participant enrollment represents 157% of the MEEIA III goal.
- The enrollment bonus was a key motivator for program enrollment based on participant feedback. Moving forward, enrollment bonuses will be delayed for devices purchased via the Marketplace

channel,[12] presenting a potential enrollment and engagement challenge for the program. With less than half of the devices sold through the Marketplace channel enrolling in the Residential DR program in PY2021, the change in the timing of the enrollment bonus payments will likely result in a declining program enrollment rate.

- Since program launch in PY2019, a total of 13% of program participants de-enrolled from the program, with de-enrollment rates being considerably higher among BYOT participants as compared to Marketplace participants.
- Participant satisfaction with their program experience is generally high. High levels of program satisfaction translate into positive perceptions of Ameren Missouri. Participant satisfaction and temperature overrides are related, suggesting that comfort during event hours is one of the key drivers of satisfaction. To that end, more aggressive event dispatch and optimization algorithms for Emerson devices likely contributed to lower Emerson participant satisfaction and much higher incidence of overrides.
- Event impacts reduce, sometimes considerably, over the course of the second and third event hours, with much of the reduction likely attributable to customer override behaviors.[13] Lack of detailed data on participant override behaviors limits additional insight related to the impact of event dispatch specifics on override behaviors and participant performance in longer-lasting events.

The evaluation team encountered several data-driven challenges in conducting the evaluation as initially planned. They include the following:

- Inconsistencies and gaps in device status tracking and device participation assignment, along with telemetry data imperfections, prevented the evaluation team from using the RCT design in our evaluation and resulted in the need to shift to an alternative evaluation methodology that leverages proxy day to construct counterfactual baseline.[14] Due to poor proxy day matches for two high temperature events, this alternative approach resulted in downward biased estimates of those event days. Resource capability estimates as a result also likely suffer from the underestimation bias.
- The evaluation team's ability to compare impacts year-over-year was limited due to data limitations encountered each year. These limitations required us to shift to an approach that estimates average treatment effect on the treated (ATT) in PY2020, rather than developing impact estimates consistent with the intent-to-treat (ITT) approach deployed in the PY2019 evaluation. In PY2021, data limitations required further modifications to the approach with ecobee and Emerson impacts being aligned with the ITT approach and Nest impacts being only partially aligned with the ITT approach.
- The evaluation team was unable to map Nest devices to the participant data in PY2021 due to ongoing Nest telemetry data anonymization practices. Consistent with past years, Nest did not provide a way to match participant to telemetry data, necessitating continued adjustments to the planned approach to estimate energy and demand impacts. While the evaluation team was able to estimate demand and energy impacts using assumptions and extrapolations, these changes in approach reduced the rigor of the evaluated results and our ability to provide more granular results or insight into customer behavior and engagement with the program to inform future planning.

[12] Enrolled and qualified customers will remain eligible for an enrollment bonus at a later time following device purchase.
[13] It is also likely that system cycling contributes to savings degradation over time.
[14] Event dispatch in PY2021 across all manufacturers was designed as an experiment, wherein for each event a random subset of devices was assigned to the control group, with one exception—a single systemwide event designed to be dispatched across all devices enrolled and active at the time of the event. For all except the systemwide event, the event dispatch design called for the treatment group to receive an event signal while the control group did not, thus forming a baseline to determine program impacts.

Missouri Code of State Regulations (CSR) requires that demand-side programs, operating as part of a utility's preferred resource plan, are subject to ongoing process and impact evaluations that meet certain criteria. Table 11 summarizes responses to the CSR process evaluation requirements for the Residential DR Program.

Table 11. Residential DR Program: 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?	Smart thermostat penetration in the Ameren Missouri service territory was relatively low in PY2019, with smart thermostats comprising only 8% of all thermostats. It is likely that most, if not all, of the devices enrolled in the program in PY2021 were newly purchased devices as the program marketed to and enrolled all interested existing smart thermostat owners as part of the PY2019 outreach. Program participation goals for PY2022 will require continued strong sales of smart thermostats and strong engagement to sustain future enrollment goals. Broadband internet access, which is presently at 85% in Ameren Missouri service territory, limits the number of homes that can participate in the program. Based on research conducted in PY2019, customers have a variety of concerns about participating in the central air conditioning (CAC) DR solution, including concerns about allowing the utility to control customer's thermostats, potential negative impact on comfort, data security, and knowledge of the participation process. While none of these concerns emerged as extreme barriers, comfort was the one about which customers reported the most worry.
Is the target market segment appropriately defined, or should it be further subdivided or merged with other market segments?	All residential customers with central air conditioning (CAC) systems (including heat pumps) and a program-supported smart thermostat are eligible to participate. Given the nature of the program design, which relies on smart thermostats to deliver demand impacts during DR events, the target market is appropriately defined, and further market segmentation is not necessary.
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?	Program-eligible devices cover the most prominent device manufacturers—Nest, ecobee, and Emerson. Inclusion of devices from other manufacturers, however, could help increase the program's reach. It is our understanding that Uplight and Franklin Energy are working on introducing those devices as part of the program in PY2022.
Are the communication channels and delivery mechanisms appropriate for the target market segment?	E-mail outreach along with outreach via devices and device apps are cost-effective and targeted given program design and the target market segment. The "virtual" aspect of program enrollment and event dispatch ensured program operations remained uninterrupted during the second year of the COVID-19 pandemic.
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?	Aligning acquisition channels and introducing new device manufacturers into the program could help capture more customers as well as different customers; thus ensuring achievement of participation goals in future years and serving a broad spectrum of Ameren Missouri customer segments. Monitoring de-enrollment trends and reasons can help anticipate additional enrollment needs, as well as craft program engagement to minimize participant attrition. Working to ensure sustained performance over multi-hour events by better understanding override behaviors and tailoring messaging and engagement

CSR Required Process Evaluations Questions	Findings
	strategies to minimize those behaviors, thus increasing the depth of demand impacts, will be important to continued effectiveness of the program.

4.2.1 Conclusions and Recommendations

The evaluation team offers the following conclusions and recommendations for the Residential DR Program:

- **Conclusion 1:** The Residential DR program succeeded in enrolling significantly more customers than planned. Program demand planning assumptions per device remained considerably higher than what the program delivered in PY2021, both in terms of actual as well as weather-normalized demand savings. Moving forward, the program will either need to continue enrolling more participants than planned or achieve greater per-device impacts to meet demand impact goals. Enrollment of additional devices to achieve goals will likely carry higher cost for the program. Removal of enrollment bonuses through the Marketplace channel has a risk of slowing new customer engagement with the program further.
  - **Recommendation 1:** Program staff should continue to balance participant enrollment targets with consideration of both resource capability and event season demand impacts to optimize the program's performance against the demand goal.
- **Conclusion 2:** The Residential DR Program fell short of the MEEIA III energy savings goals and likely faces considerable shortfalls in the future. The shortfall in energy savings in PY2021 was primarily due to ecobee and Nest opening their optimization platforms to all device owners, which limited the program's ability to harvest additional savings via optimization driven interventions. Given these developments, energy savings goals are likely unattainable moving forward and need revision.
  - **Recommendation 2:** Should increasing energy savings become a priority for the program, program staff could consider tailored messaging for Emersons and ecobees aimed at and encouraging more participants to enroll in Seasonal Savings and eco+, respectively. For eco+ specifically, program staff could further tailor messaging to encourage selection of more aggressive optimization algorithms. Should the program pursue the latter set of recommendations, discussion of the appropriate evaluation approach to capture program attributable changes in energy consumption should occur prior to messaging launch to ensure the evaluability of these interventions.
- **Conclusion 3:** Event impacts decline hour-after-hour, sometimes considerably, indicating likely presence of override behaviors.[15] The data provided to the evaluation team could not support mining and analysis of override behaviors and their impact on event performance. Participant research insights as well as hourly impact results suggest, however, that override behaviors are tied to participant demographic characteristics and the associated presence at home during events, as well as to aggressiveness of setpoint adjustments prior to and during DR events. Participant satisfaction and override behaviors are related as well.
  - **Recommendation 3:** Program staff should seek to better understand and assess the impact of override behaviors on participant satisfaction and performance. Further, to ensure sustained performance, program staff should consider deploying additional messaging and engagement activity to minimize overrides, especially in case of multi-hour event dispatches.

[15] It is also likely that system cycling contributes to savings degradation over time.

- **Conclusion 4:** Poor proxy day matching performed in support of the quasi-experimental approach to the evaluation likely resulted in an underestimate of impacts for the two hottest events of the PY2021 event season. In our explorations, the underestimates can have a meaningful impact on both event season and resource capability savings. The evaluation team has available data to explore and deploy a superior approach to estimating demand and energy impacts, namely experimental design data, but was prevented from leveraging it due to timeline and budgetary constraints associated with the poor quality of the data received from the implementation contractor.
  - **Recommendation 4:** The evaluation team recommends that moving forward, Ameren Missouri and program staff revisit the data tracking processes and data pipelines in conjunction with the evaluation team to ensure sufficiently detailed and consistently tracked data across core input fields. This will ensure more rigorous, accurate, and cost-effective evaluation efforts. Furthermore, as AMI data penetration in Ameren Missouri's service territory increases, impact evaluation should be shifted to leverage actual load data. To that end, the evaluation team is planning to use PY2022 as the year to explore using AMI data for impact evaluation purposes.

4.3 Evaluation Methodology

The evaluation team performed both impact and process evaluation activities to assess the performance of the Residential DR Program in PY2021. The evaluation team explored the following research objectives:

- Characterize program participation concerning the devices selected, event participation, and other relevant characteristics;
- Estimate the first-year ex-post gross energy (kWh) and demand (kW) savings;
- Determine weather-normalized DR capability for all participants enrolled throughout PY2020; and
- Provide evaluation results that can be used to improve the design and implementation of the program.

Table 12 provides an overview of the program evaluation activities. Following the table, we provide a detailed description of our approach to the impact analysis. The Appendix volume submitted alongside this report contains details related to the participant survey data as well as additional methodological detail.

Table 12. Residential DR Program: PY2021 Evaluation Activities for the Demand Response Program

Evaluation Activity	Description
Program Manager and Implementer Interviews	▪ Gathered feedback to understand program staff's perspective on program performance. Feedback was gathered on a continuous basis as part of periodic check-in meetings over the course of the program year.
Program Material Review	▪ Reviewed available program materials to inform evaluation activities.
Tracking System Review	▪ Reviewed implementer's tracking system to ensure that data required for the evaluation was being collected.
Impact Analysis	▪ Conducted event regression modeling to estimate hourly and average event kW, and kWh impacts. ▪ Assessed average event kW impacts under normalized weather conditions for all participants enrolled in PY2021.
Participant Survey Analysis	▪ Analyzed season-end participant survey data gathered by Uplight. Leveraged responses from 1,341 survey participants to support focused process exploration.

4.3.1 Impact Analysis

Factors Driving Impact Evaluation Design

Ameren Missouri is in the process of deploying Advanced Metering Infrastructure across its service territory with robust coverage expected at the end of PY2022. In the absence of AMI data to support the impact analysis, the evaluation team is dependent on device telemetry data to estimate program load impacts. Telemetry data has historically featured a number of limitations and imperfections. The following are the most notable:

- Nest anonymizes device serial numbers limiting the evaluation team's ability to 1) verify device eligibility against program-tracking data and 2) attach additional data points from external sources to remedy data gaps and explore and resolve imperfections.
- Historically, Uplight has not been tracking device assignment into treatment and control groups for each event as part of the telemetry data. Data fields available in the telemetry data did not provide a clear picture of treatment or control group customers. While Uplight made those assignments available as an additional dataset, for Nest devices, integrating that data with the telemetry data was impossible due to device anonymization, thus limiting the evaluation team's ability to leverage experimental design for evaluation purposes.

Additional telemetry data imperfections include shifts in timestamps and missing and erroneously collated data. Finally, telemetry data extracts were made available to the evaluation team late in the program year limiting the team's ability to conduct adequate quality control and remedy data imperfections ahead of time.

At the outset of PY2021, based on learnings and experiences with data limitations and imperfections from the PY2020 evaluation, the evaluation team engaged in a series of conversations with Uplight and Ameren Missouri in an effort to position the PY2021 evaluation for success. More specifically, the following were the topics surrounding desired improvements to the telemetry data to ensure rigorous impact evaluation process:

- Integrating experimental assignments as part of the telemetry data
- Conducting data verification and validation steps prior to supplying data extracts to the evaluation team
- Obtaining interim data partway through the program year in an effort to troubleshoot any issues early

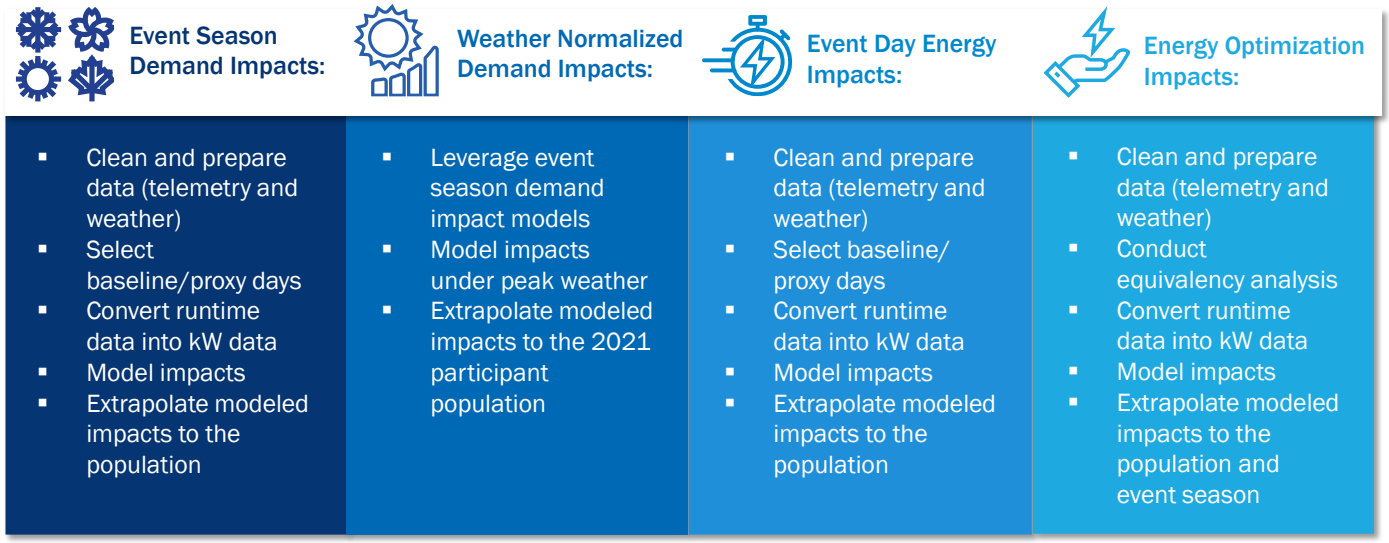
Despite the discussions and efforts, telemetry data supplied to the evaluation team contained similar imperfections and gaps to prior years, necessitating additional discussions and explorations. Some of the data imperfections were remedied while others were not. Notably, the telemetry data did not contain information on treatment and control group assignments, limiting our ability to leverage experimental design for Nest devices. In light of the resources and time needed to support data explorations and corrections, the evaluation team, in concert with Ameren Missouri and following a discussion with the Independent Auditor decided to pursue a quasi experimental design leveraging a proxy day methodology for all device manufacturers, as opposed to our preferred approach of employing the most rigorous method for each device manufacturer, based on available data, which would have allowed us to employ a RCT design for Emerson and ecobee devices.[16] As a result, our impact methodology to estimate event impacts as well as resource capabilities leverages a proxy day design for all device manufacturers, which is consistent with the approach used in PY2019 and PY2020. Our approach for developing impacts from Emerson device optimization on non-event days leverages experimental design.

[16] While this decision is in conflict with the Independent Auditor recommendations from the PY2021 report, it was necessary in order to meet evaluation reporting timelines and avoid negative budgetary implications.

Summary of Impact Analysis Approach

Impact analysis for the program consisted of several components, namely event season demand impacts, weather-normalized resource capability impacts, event day energy impacts, and non-event energy impacts. Figure 8 provides an overview of the data cleaning and preparation steps associated with each impact analysis component. Following the figure, we detail data sources that the evaluation team leveraged to complete each analysis as well as summarize our approach.

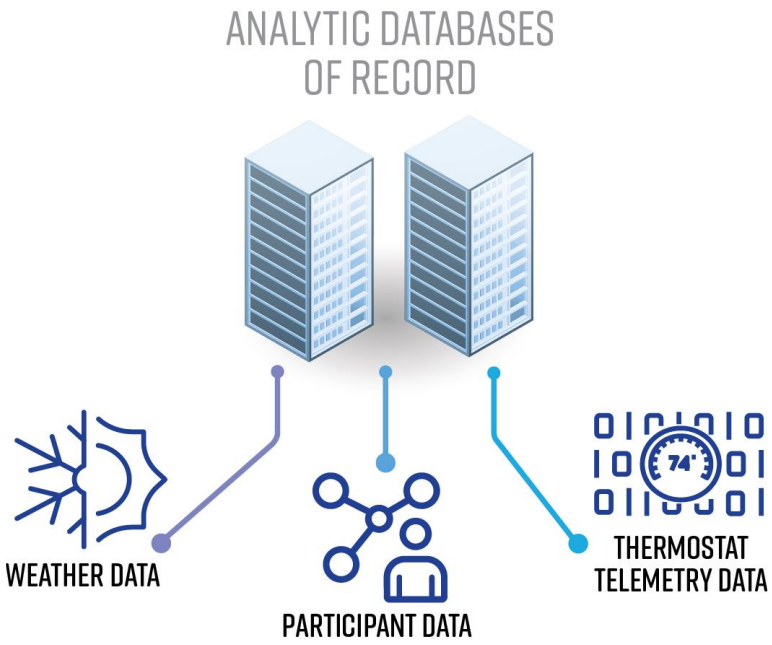
Figure 8. Residential DR Program: Gross Impact Analysis Overview



Data Cleaning and Preparation

We used data from several sources in support of the gross impact analysis, namely participation, weather, and device telemetry data. We processed data from each source separately before integrating them in analytic databases to support the impact analysis and modeling efforts. Figure 9 provides a visual representation of the various data sources that supported the gross impact analysis. Following the graphic, we provide detail on each source.

Figure 9. Residential DR Program: Overview of Data Sources



Weather Data

To ensure consistency with Ameren Missouri's weather used for planning purposes, we used weather data from St. Louis Lambert airport weather for this analysis. We gathered weather data from the National Oceanic and Atmospheric Administration's National Climatic Data Center, which houses the Integrated Surface Database of hourly weather measurements from thousands of locations across the country. We downloaded the hourly weather data from that station for 2021. As part of the data preparation, we calculated cooling degree hours with an outdoor base temperature of 75° Fahrenheit for use in the model. We chose 75° Fahrenheit as the base temperature because 75° Fahrenheit is approximately the point at which participants start using their CAC during summer afternoons.

Participant Data

We relied on participant data extracts provided by Franklin Energy. The Franklin Energy file served as the file of record. As part of the file, we received device enrollment and de-enrollment records for three program years. Each record contained associated customer information, enrollment dates, de-enrollment dates (where applicable), device manufacturer information, and device enrollment channel, among other data fields. As part of the data cleaning process, we reconciled participant counts, reviewed and eliminated duplicate records, and addressed gaps, missing, and unreasonable values, where possible and feasible. We also conducted a careful review of accounts associated with participating devices and ensured that all participating devices were associated with Ameren Missouri electric accounts. Finally, we verified the accuracy of the date of customer enrollment in the program. This date was essential for determining participant counts for the impact analysis.

Device Telemetry Data

We received ecobee, Emerson, and Nest telemetry data from Uplight. The data included hourly runtime with associated setpoints and indoor temperatures. Additionally, the data contained device identifiers and detail on day type (demand-response, learning, inoperative, etc.). Device identifies for Nests were anonymized and could not be linked to the device information in the participant dataset. Emerson and ecobee device identifiers, on the

other hand, were not anonymized and could be linked to external data sources such as participant. Similar to the participant data cleaning process, we scrutinized the data for duplicate records, missing records, and outlier records. Detailed data cleaning steps are included in the Appendix Volume accompanying this report.

Event Season Demand Impacts

The event season DR impact analysis resulted in event period demand impacts for devices in place and operational during the PY2021 event season. Below, we outline analytical activities that were a part of the analysis.

Select Baseline Days

As a result of the data challenges described above, we relied on a quasi-experimental design to evaluate program impacts for all device manufacturers. To develop matches, we used Euclidean distance matching to select best matching non-event days that were similar in weather profile for each event day. This method pairs event and non-event day hours by choosing pairs with the smallest overall distance between hourly weather profiles. Figure 10 through Figure 14 show the weather profiles for each event day and the selected proxy non-event days. As can be seen in the figures, through the matching efforts, we were able to find reasonably similar proxy days for the June 11, June 14, and July 14 event days. Proxy day matching did not result in good matches for the June 18 and August 25 event days, which are both days with the highest temperature, with June 18 being a system reliability event. Our ability to find better matches is limited by the observed weather during the event season, i.e., no proxy days with similarly hot temperatures are available. Imperfect proxy day matches are likely to have implications on the modeling rigor and results. We dedicated a significant amount of time and effort to exploring the implications of the available proxy days for the two events on the impact results.

Figure 10. Residential DR Program: Average Hourly Temperatures on Event Days and Matched Non-Event Days – June 11, 2021 Event Day

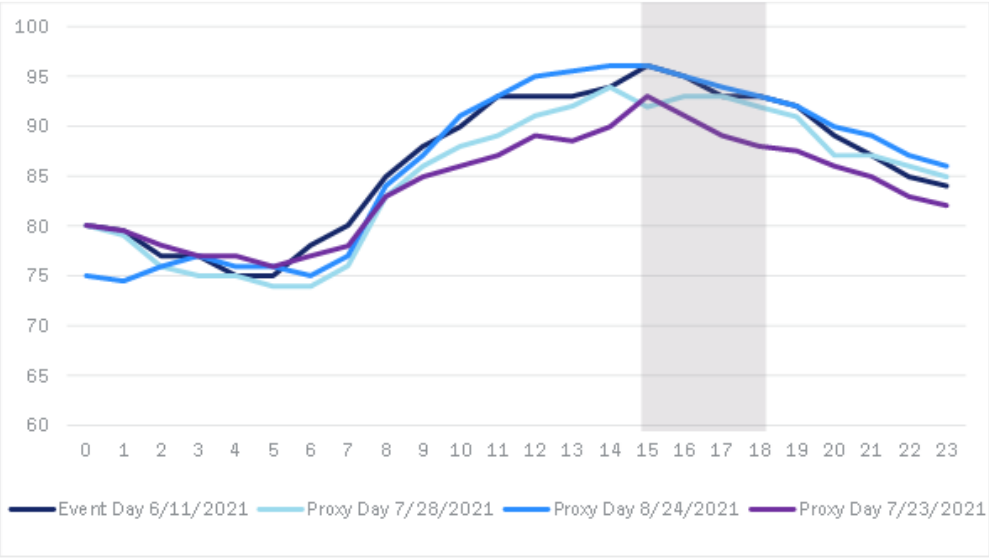


Figure 11. Residential DR Program: Average Hourly Temperatures on Event Days and Matched Non-Event Days – June 14, 2021 Event Day

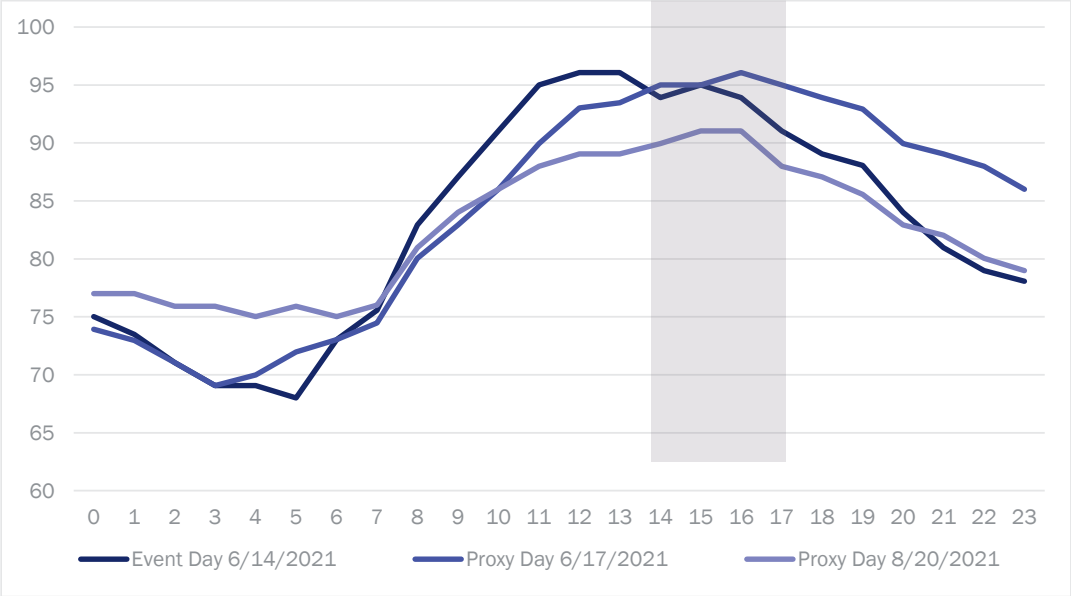


Figure 12. Residential DR Program: Average Hourly Temperatures on Event Days and Matched Non-Event Days – June 18, 2021 Event Day

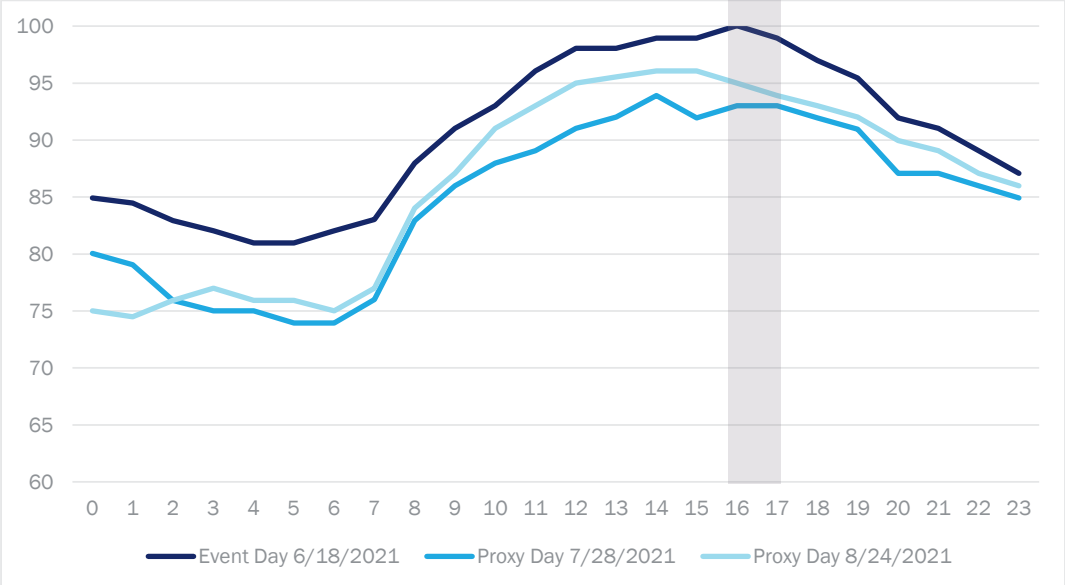
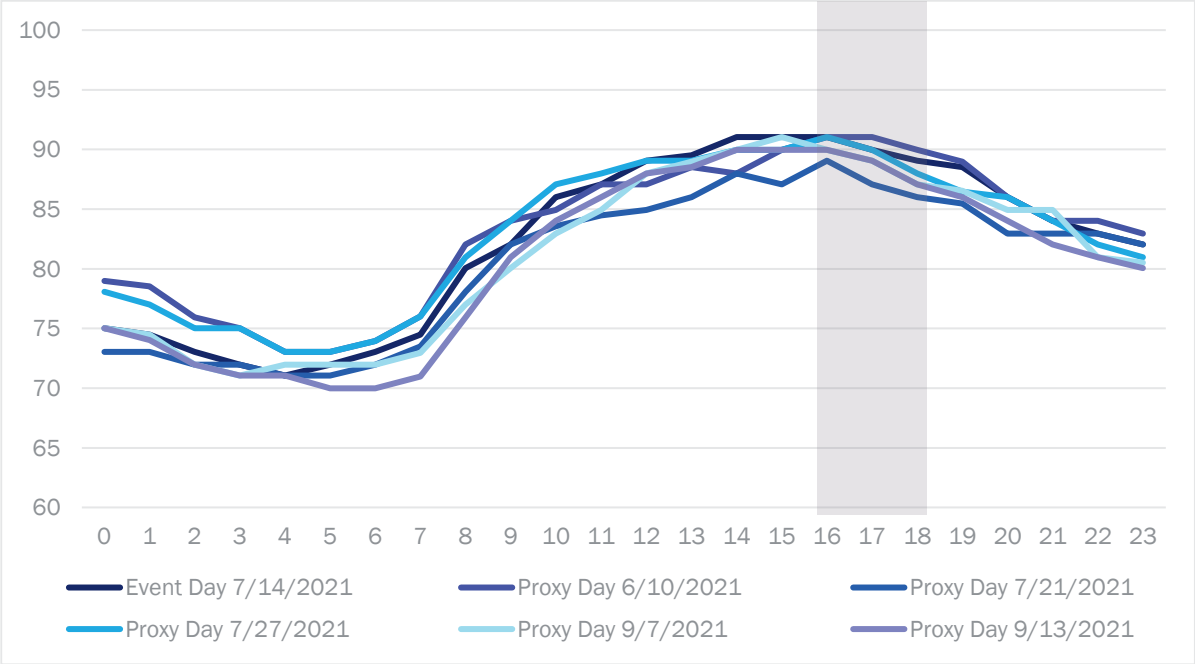
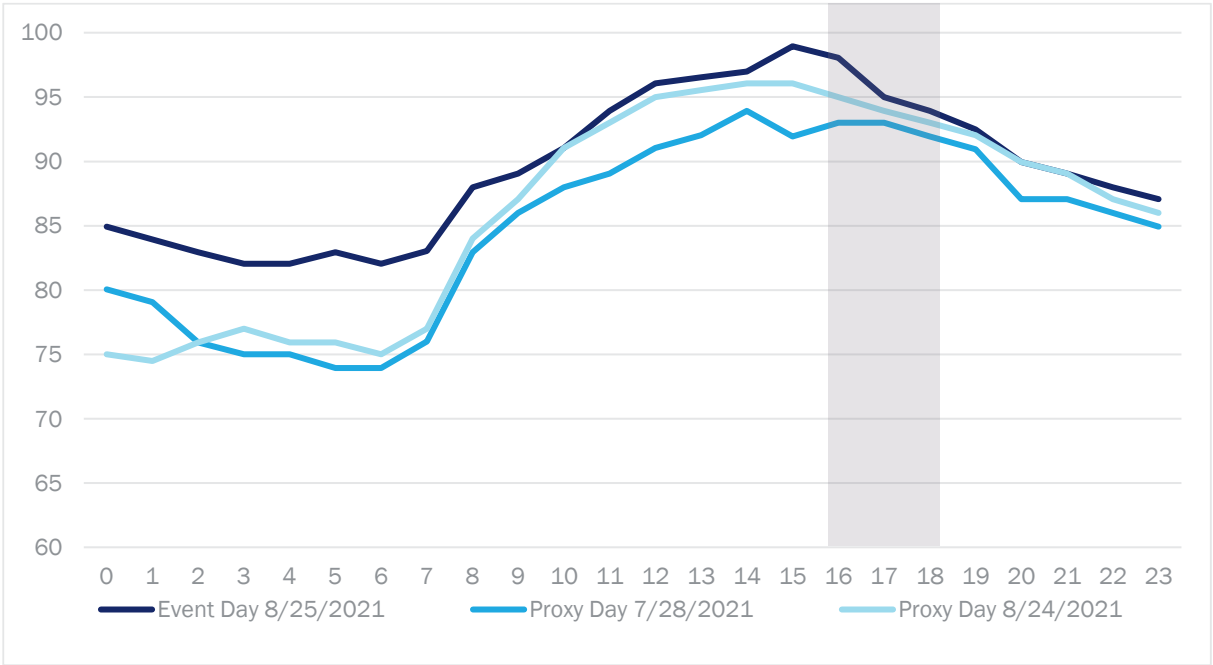


Figure 13. Residential DR Program: Average Hourly Temperatures on Event Days and Matched Non-Event Days – July 14, 2021 Event Day



Note: Due to telemetry data quality issue, September 7, 2021 and September 13, 2021 were excluded from the modeling efforts for ecobee devices.

Figure 14. Residential DR Program: Average Hourly Temperatures on Event Days and Matched Non-Event Days – August 25, 2021 Event Day



Convert Runtime to kW

Because telemetry data contains runtime information, as opposed to cooling load, it is necessary to convert runtime data to cooling load. We relied on the HVAC capacity measurements collected as part of the 2019 baseline study to develop an estimate of the connected load. The Appendix volume submitted alongside this report contains further detail on the approach used to develop the connected load assumption. The resulting per-device connected load is 3.07 kW. We converted runtime to cooling load prior to modeling.

Model Impacts

Depending on the device manufacturer, our modeling efforts included different subpopulations of devices available for treatment. More specifically:

- For Nest devices, data limitations prevented us from being able to discern control devices from a portion of devices available for treatment but not treated. As such, we excluded those devices from the analysis. As a result, our model included treatment and treated devices as well as most but not all devices available for treatment but not treated. We made adjustments for this on the back end by adjusting population of devices to extrapolate savings to.
- For ecobee and Emerson devices, we included devices marked as treatment in our analysis. As such, our impacts reflect intent to treat or ITT.

Notably, for Emerson devices program driven device optimization was running throughout the event season. In order to avoid biasing savings estimates downward, we limited proxy day data to just devices assigned to the control group on those days, as those devices were withheld from treatment and therefore would not have experienced load shape modification through optimization activity.

We used a linear fixed-effects regression modeling approach for the demand response impact analysis. The model estimates the hourly kW demand impacts on a per-device level. Event impacts are the mean difference between the modeled (predicted) baseline kW and the modeled (predicted) event kW over the event period. The fixed-effects modeling approach allows us to control for the time-invariant device-level factors affecting demand (i.e., factors that do not change over the study period, such as square footage of home) without measuring those factors explicitly in the models.

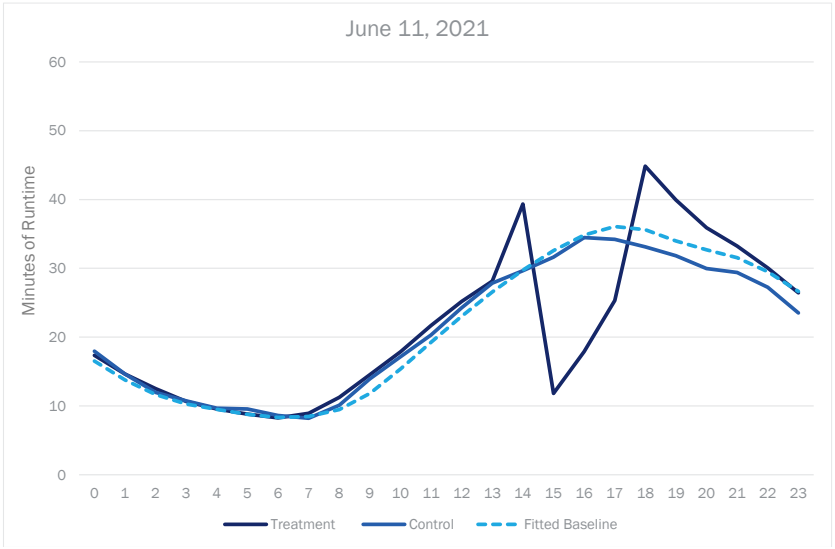
As is standard practice for impact analysis, we tested several different model specifications before selecting the best model. The Appendix volume submitted alongside this report contains the final model specification, and model fit output

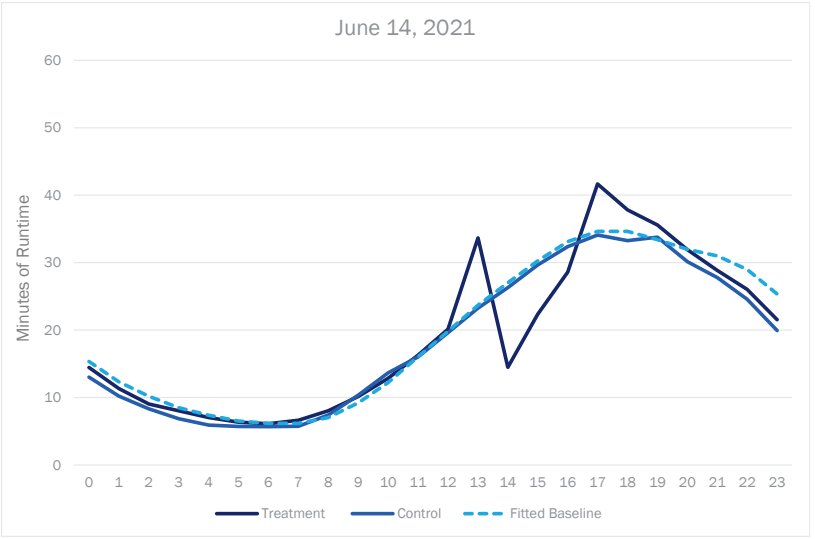
We ran separate models for each event and manufacturer. Our final models resulted in comparable fit to prior years as well as to other evaluations leveraging similar approach. For Emersons and ecobees, while we were unable to leverage the RCT design in our evaluation, we were able to leverage control group runtime profiles when performing additional validation of the modeling outputs. To that end, we compared fitted baseline runtime curves from the final models to the runtime curves for devices retained as control on event days for Emerson and ecobee devices.[17] The resulting analysis confirmed our concern related to poorly matching proxy days. As can be seen in the figures below, fitted baselines on June 18 and August 25 event days likely underestimate the actual runtime that would have been occurring in the absence of the DR event dispatch. As such, demand impacts from those days are likely underestimates of what actually occurred as a result of the event dispatch. The evaluation team carefully considered the available options related to incorporating the results from those two event days into aggregate event season and resource capability impacts, including performing sensitivity analysis and exploring

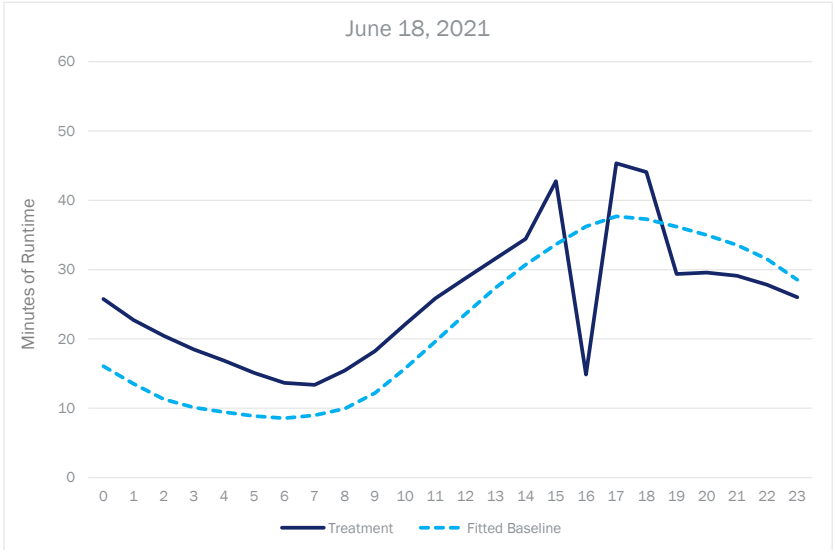
[17] Due to the data limitations described above, we are unable to identify Nest control devices.

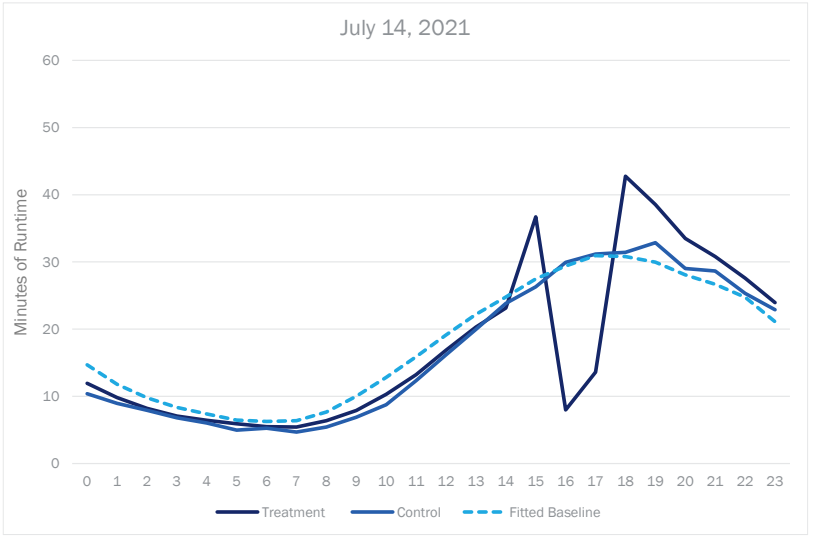
alternative pathways such as performing manual adjustments and including additional interaction terms in the models. We were unable to remedy the modeling imperfections caused by the poor proxy day matching outcomes absent additional time and resources to allow rerunning models leveraging the control group design for ecobees and Emersons. We estimate that impacts for the two events are underestimated by as much as 20%, which is significant.

Figure 15. Residential DR Program: Fitted, Actual, and Control Runtime Shapes – ecobees









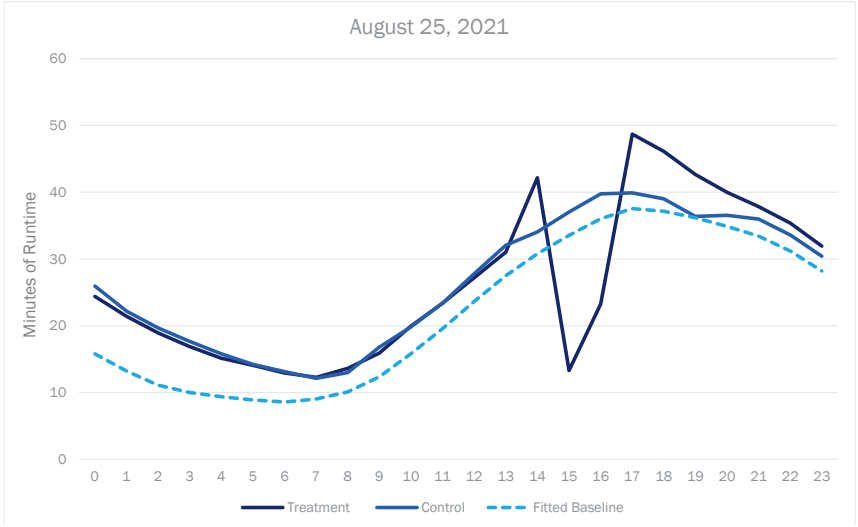
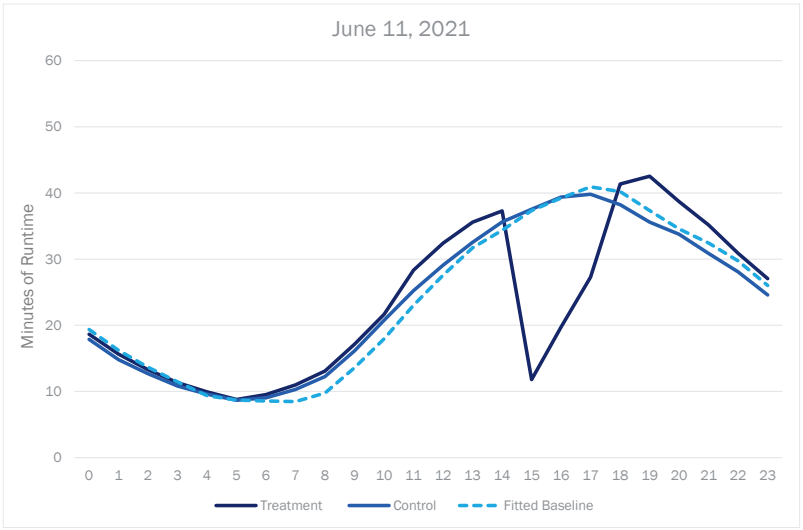
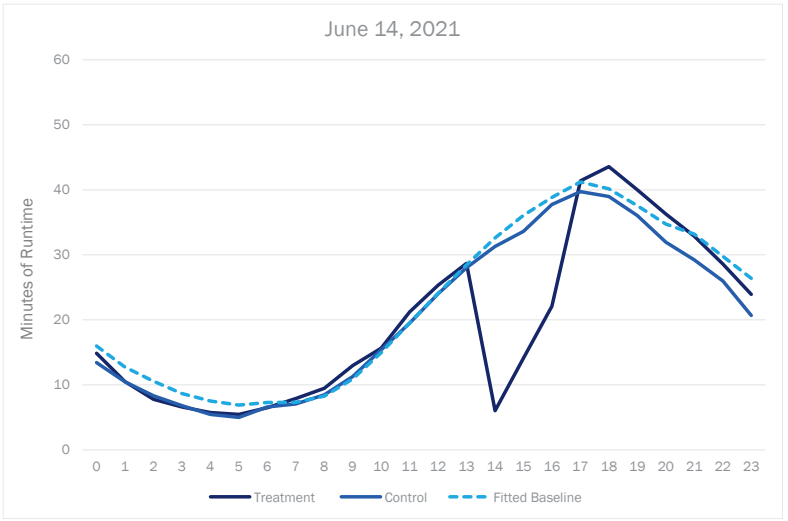
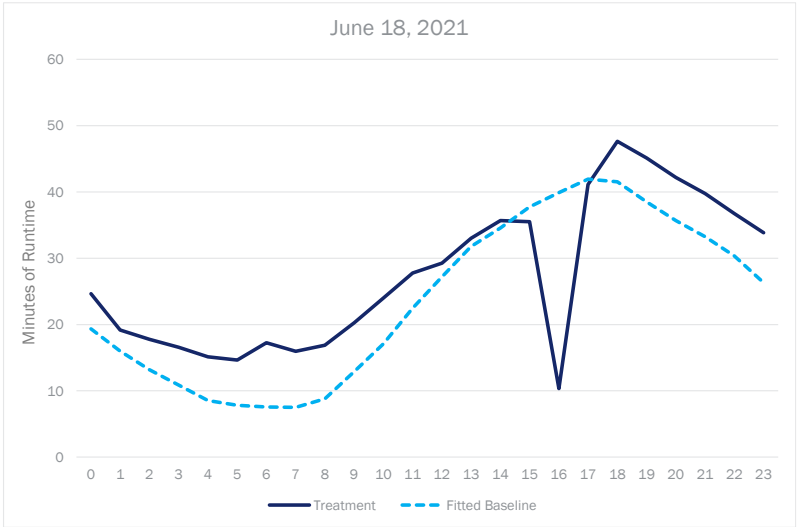
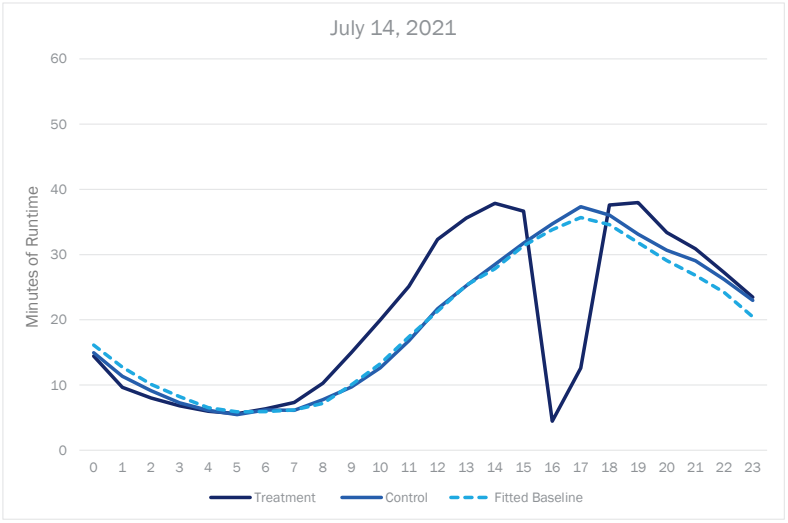

August 25, 2021
Minutes of Runtime
60
50
40
30
20
10
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Treatment
Control
Fitted Baseline

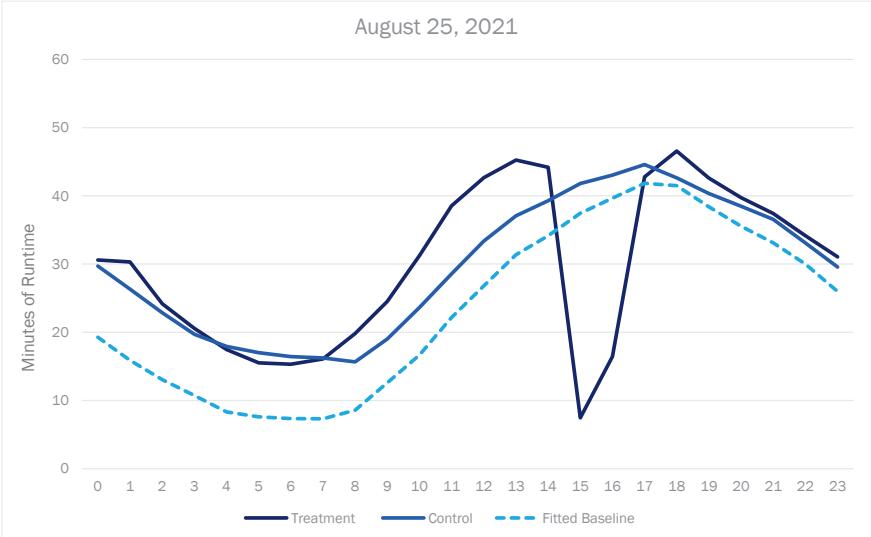
Figure 16. Residential DR Program: Fitted, Actual, and Control Runtime Shapes – Emersons










August 25, 2021
Minutes of Runtime
60
50
40
30
20
10
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Treatment
Control
Fitted Baseline

Extrapolate Modeled Impacts to Population

We calculated total impacts for each event by multiplying the per-device modeled impacts by the number of enrolled devices for that event scaled to reflect the modeled population. We relied on the participant datafile of record and scaled the participant counts using the following assumptions:

- For Nest devices, we calculated percent of devices that were assigned as Learning in the MV_DAY_TYPE variable in the telemetry data and adjusted the participant count downward to reflect the population of modeled devices. The Learning category contains devices assigned as control as well as devices that were available for dispatch but not engaged in the event dispatch.
- For Emersons and ecobees, we calculated percent of devices assigned as control for each event day and adjusted the participant count downward to reflect the population of modeled devices.

Total event-season demand impacts as the weighted average of impacts across events were calculated by thermostat manufacturer, weighting by the number of treated devices in each event.

Weather-Normalized Resource Capability

An estimate of weather-normalized resource capability reflects estimated demand impacts from devices enrolled as of the end of PY2021 under peak weather conditions.

Model Impacts Under Peak Weather Normals

To determine weather-normalized resource capability, we trained a separate set of models utilizing a similar model specification used for event season demand impacts. Similar to the event season models, we included the following devices in our modeling efforts.

- For Nest devices, data limitations prevented us from being able to discern control devices from a portion of devices available for treatment but not treated. As such, we excluded those devices from the analysis. As a result, our model included treatment and treated devices as well as most but not all devices available for treatment but not treated.
- For ecobee and Emerson devices, we included devices marked as treatment in our analysis. As such, our impacts reflect intent to treat or ITT.

We fit a series of fixed-effects models for each device manufacturer, pooling all event season data to create a single model for each device manufacturer. We trained the models on 2021 weather data and evaluated them at a peak temperature of 99°F as specified in the Ameren Missouri TRM. To account for differing event dispatch windows, our models included flexible hour terms defined as the number of hours relative to the start of an event.

We fit these models using the hourly cooling load data separately for each device manufacturer. Upon fitting these models, we estimated the predicted event impact for an average event duration observed during the PY2021 event season. The predicted event impact is the predicted baseline demand minus the predicted event demand for each of the three hours.

Given the limitations of the proxy day design for high temperature event days, we tested specifying resource capability models excluding as well as including the two event days with poor proxy day matches. Modeling only low temperature events has the risk of biasing the model outputs because the model is extrapolating beyond the temperatures present in the modeled data, whereas including event days with biased baselines increases the risk the models will not be able to establish an accurate relationship between increase in temperature and increase load impacts well.

The results show virtually no difference in load impacts. We decided to use data from all event as part of the resource capability modeling.

The Appendix volume submitted alongside this report contains the final model specification, model fit output, and RMSE values for the selected model specification.

Extrapolate Modeled Impacts to Population

We calculated total weather-normalized resource capability by multiplying the weather-normalized per-device impacts for each manufacturer by the number of devices enrolled in the program as of the end of PY2021. We used participant data extracts to derive the total number of enrolled devices. For Nests, we adjusted the final participant count downward by the estimated percent of available for dispatch but not dispatched devices consistent with the device inclusion in the modeling efforts.

Cumulative DR Capability

Cumulative DR capability is a performance metric used to establish Ameren Missouri's earnings opportunity award. The evaluation team calculated the cumulative DR capability consistently with the approach specified in the MEEIA III Plan. Per the plan, cumulative DR capability calculations mirror those for weather-normalized resource capability.

Event Day Energy Impacts

In addition to estimating demand impacts for each event during the event hours, we also estimated energy savings achieved during event days. To estimate event day energy savings, we used a similar methodology as the event season demand impacts except we compared the predicted baseline load to the predicted event day load for all hours of the event day. Therefore, the event day load reduction is estimated as the difference between the predicted baseline and event day load for an average device based on the regression model outlined in the Event Season Demand Impacts section above. To calculate program-level energy savings, we multiplied the predicted impacts for each event by the number of devices who participated in those events and then summed impacts across events. The Event Season Demand Impacts section above provides additional detail regarding data cleaning and preparation, selected baseline days, converted runtime to load, modeled impacts to estimate event day energy impacts, and extrapolated modeled savings to participating devices.

Non-Event Day Energy Impacts

Energy Optimization Impacts

In addition to DR events, Uplight deployed Orchestrated Energy algorithms on Emerson devices over the course of the summer. The algorithms adjusted thermostat temperature setpoints over the course of the day in an effort to harvest additional energy savings. Uplight launched the optimization interventions on July 12, 2021, and ran them until July 18, 2021. leveraging more aggressive optimization strategies. At that point, treatment was discontinued and restarted on August 3, 2021, using a less aggressive set of algorithms. After that treatment ran until the end of the season (September 30, 2021). Non-event energy optimization design for Emerson devices structured as a simple crossover design, wherein Uplight randomly assigns 20% of Emerson devices into a control group. Assignments are performed in two day blocks. For devices that are assigned in the control group for a given two-day block, no optimization is performed until the end of the two day block at which point, new randomization assignments into treatment and control group take place. As part of our analysis, we modeled savings using a linear fixed effects regression model as well as calculated savings as the simple difference between the mean runtime on non-treatment days minus mean run time on treatment days.

Clean and Prepare Data

To support this analysis, we leveraged the same runtime data that we used for the event season demand impact analysis. As part of the data cleaning process, we identified and removed devices that were not a part of the experimental design as well as devices without experimental assignments. We also removed devices that were assigned to just control or just treatment categories and not both over the course of the summer. Appendix A contains detailed tables with device drops.

Conduct Equivalency Analysis

Before running the models, we performed an equivalency analysis to ensure that treatment and control days were equivalent in terms of weather. This check ensures the fidelity of the experimental design. The analysis confirmed equivalency. Appendix A contains detailed results from the equivalency analysis.

Convert Runtime Impacts to kWh Impacts

We used the connected load assumption of 3.07 per-device to convert the total runtime reduction to kWh savings.

Model Impacts

We relied on the control days to establish the counterfactual, i.e., the baseline run time that participants likely would have used in the absence of the optimization intervention.

We specified a linear fixed effects model. In addition, we also calculated energy savings by taking a simple difference between mean consumption on control days and mean consumption on treatment days. Our analysis resulted in energy savings per treatment day. Modeled impacts were only slightly lower than actual difference between treatment and control days.

Table 13. Residential DR Program: Modeled and Actual Optimization Impact Comparisons

Impact Source	Daily Impact (kWh)	Impact as a % of Baseline Daily Consumption
Modeled	1.4	7.4%
Actual	1.7	8.1%

Extrapolate Modeled Impacts to Population and Event Season

To extrapolate results to the eligible population, we calculated the total number of treatment devices for each of the treatment days in the season. We then multiplied modeled per-day treatment energy saving impacts by the total number treatment participant days in order to arrive at the event season non-event energy savings.

4.4 Evaluation Results

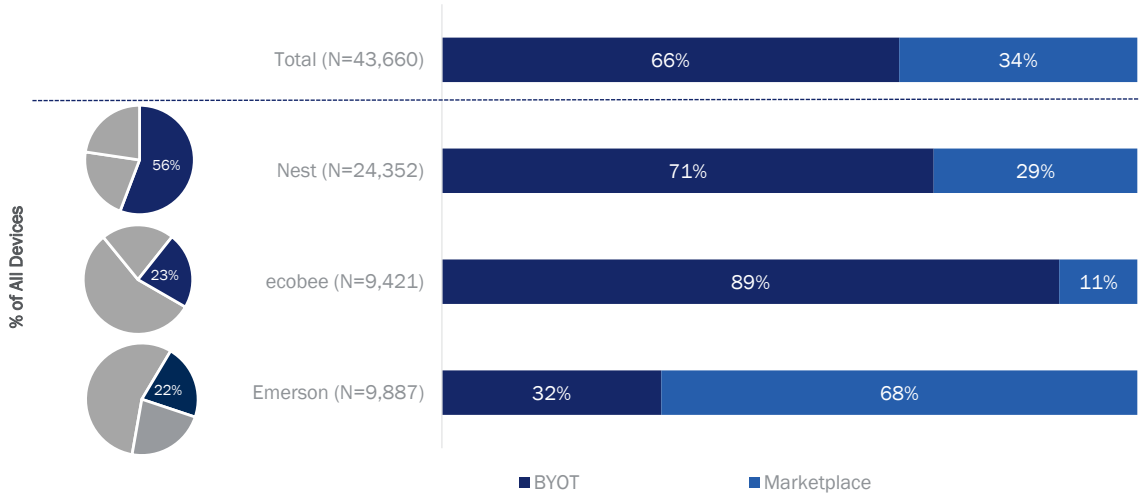
This section presents a detailed process and impact evaluation results for the Residential DR Program.

4.4.1 Process Results

PY2021 Participation Summary

At the end of PY2021, a total of 43,660 devices across 37,129 customers were actively enrolled in the program. On average, a participating home had 1.2 devices. Most (85%) of participants had only one device, and a very small number of participants (N=20) had between six and 11 devices associated with their accounts. Nests accounted for over half (56%) of all devices active in the program as of the end of PY2021, followed by ecobees and Emersons at 23% and 22%, respectively. A third of devices (34%) entered the program via the Marketplace channel. Only 11% of ecobees entered the program through the Marketplace channel. In contrast, 68% of Emersons were purchased and entered the program through that channel.

Figure 17. Residential DR Program: Year-End PY2021 Device Distribution by Manufacturer and Channel

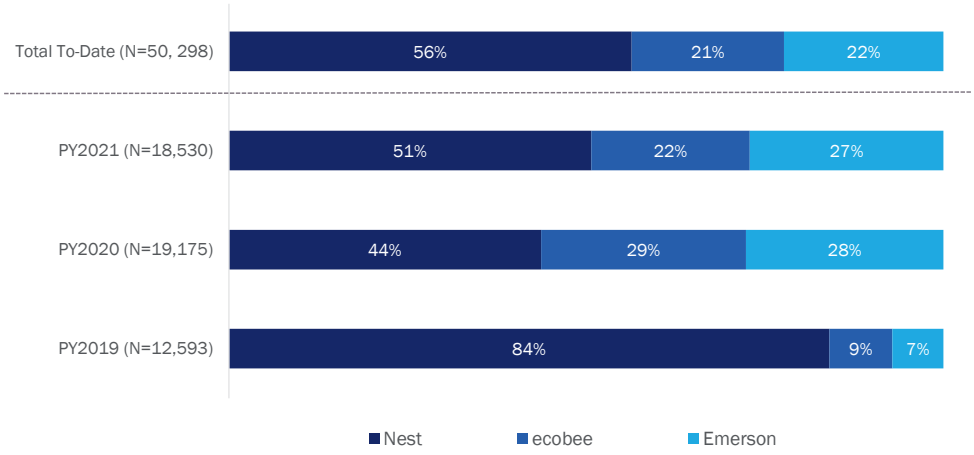


Note that device counts only includes devices active in the program as of the end of PY2021.

PY2019-PY2021 Enrollment Trends

Participating device mix changed in PY2021 as compared to the previous years in terms of manufacturer mix and enrollment channel (Figure 18). Overall, Nest devices continued to represent the majority of participating devices (56%), followed by ecobee and Emerson devices, accounting for 21% and 22% of all devices enrolled in PY2021, respectively. PY2021 device mix on the most part mimicked that of PY2020, with Nests increasing in presence.

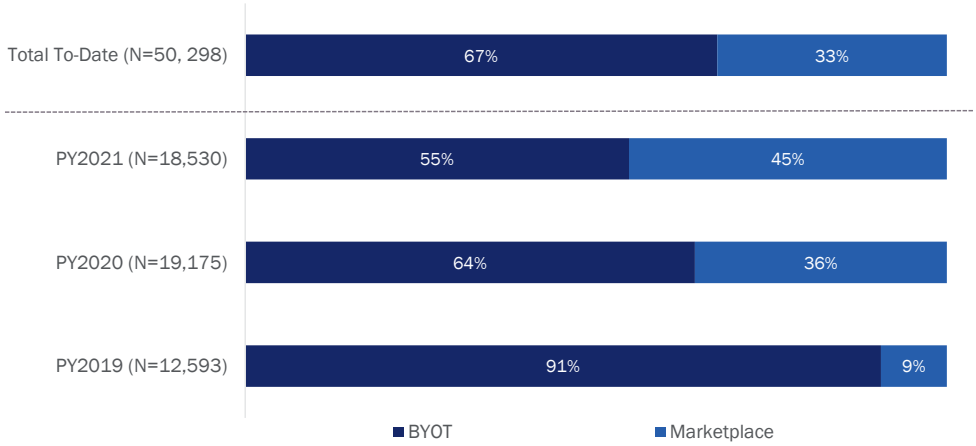
Figure 18. Residential DR Program: Device Enrollment Trends by Manufacturer



Note that device counts include devices that de-enrolled from the program over the course of three years and are not reflective of the active device counts as of the end of the program years.

A third of all devices enrolled in the program over the course of three years entered the program via the Marketplace channel. The share of devices entering the program via the Marketplace channel was at a three-year high in PY2021 with 45% of all devices enrolling in program that year doing so via Ameren Missouri's Marketplace (Figure 19). This is not surprising, as there was a variety of promotions running over the course of PY2021 driving Marketplace thermostat sales, including a year-long promotion of Emerson devices, and multiple promotions of Nests and ecobees over the course of PY2021.

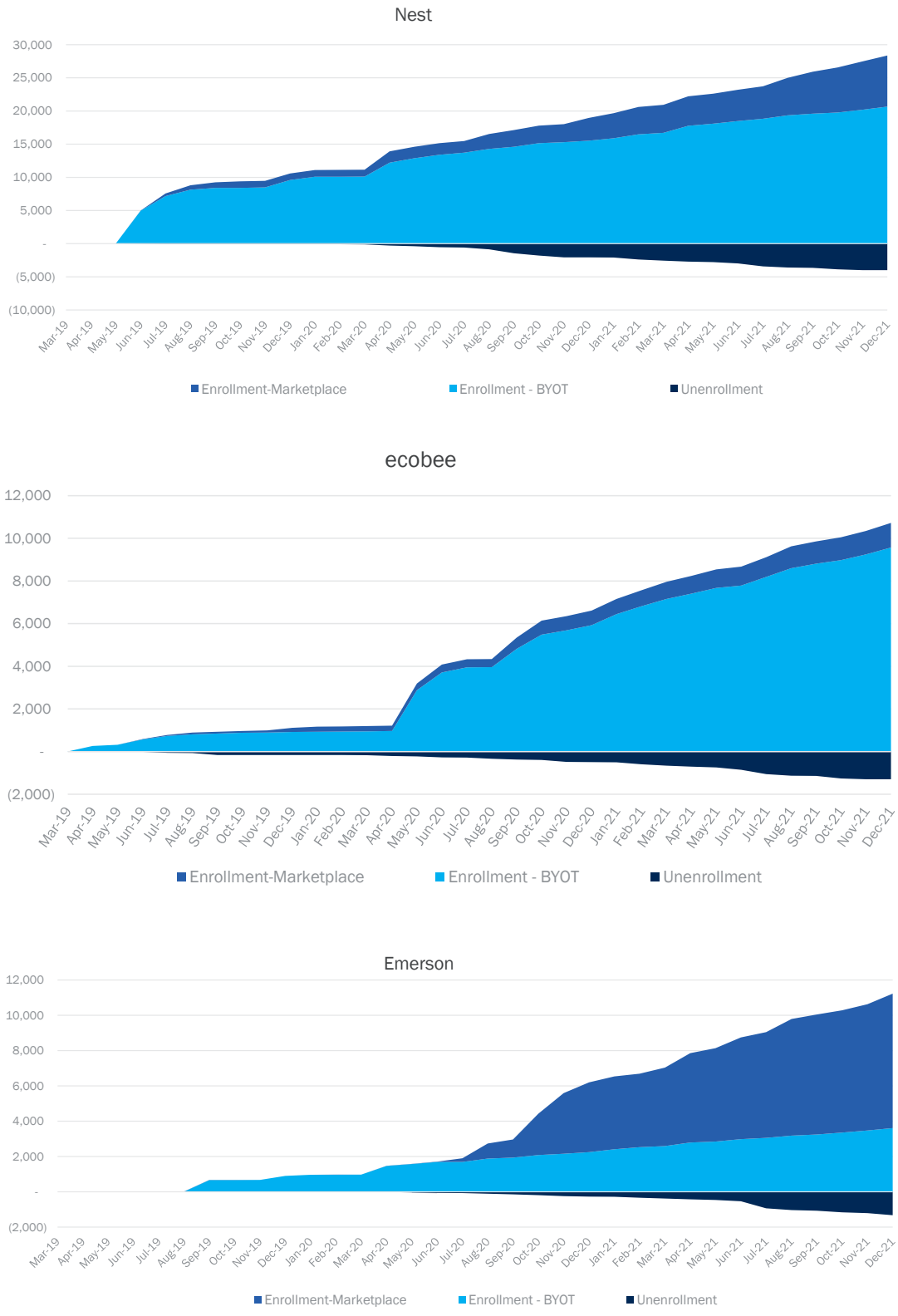
Figure 19. Residential DR Program: Device Enrollment Trends by Channel



Note that device counts include devices that de-enrolled from the program over the course of three years and are not reflective of the active device counts as of the end of the program years.

Figure 20 summarizes cumulative device enrollment and de-enrollment trends by device manufacturer over the course of three program years. Enrollment trends are categorized by channel, and de-enrollment trends are overlaid on top of enrollment trends for each device. Enrollment trends for Nest devices show steady gains over time with a slight increase prior to the PY2020 event season. The Marketplace channel trends show a steady increase in prominence for Nest devices, while de-enrollments increase at the end of the season. Ecobee device enrollment experienced a significant spike prior to the start of the PY2020 event season, with small but steady gains in Marketplace enrollments. Enrollment of Emerson devices via the Marketplace channel continued to increase over the course of PY2021.

Figure 20. Residential DR Program: Device Enrollment Over Time by Device Manufacturer



Notably, while device incentives did not change between PY2019 and PY2021, enrollment of devices into the DR program via the Marketplace channel continued to increase. Table 14 shows DR program enrollment rate among Marketplace devices. The enrollment rate is calculated by dividing the total number of devices enrolled in the DR program via the Marketplace channel by the total number of devices incented by Ameren Missouri via the Marketplace channel. As can be seen in the table, DR enrollment rate more than doubled from 17% in PY2019 to 41% in PY2020. The enrolment rater further increased from 43% to 46% between PY2020 and PY2021. However, enrollment rate between PY2020 and PY2021 varied by device, with Nests experiencing an increase in enrollment and ecobees experiencing a considerable decrease. While it is unclear what the drivers of the varying DR program enrollment are, maintaining high levels of DR program enrollment through appealing messaging and marketing will help capitalize on the Marketplace-driven device purchases in order to reach PY2022 DR Program participation goals.

Table 14. Residential DR Program: Program Enrollment Rate of Marketplace Devices

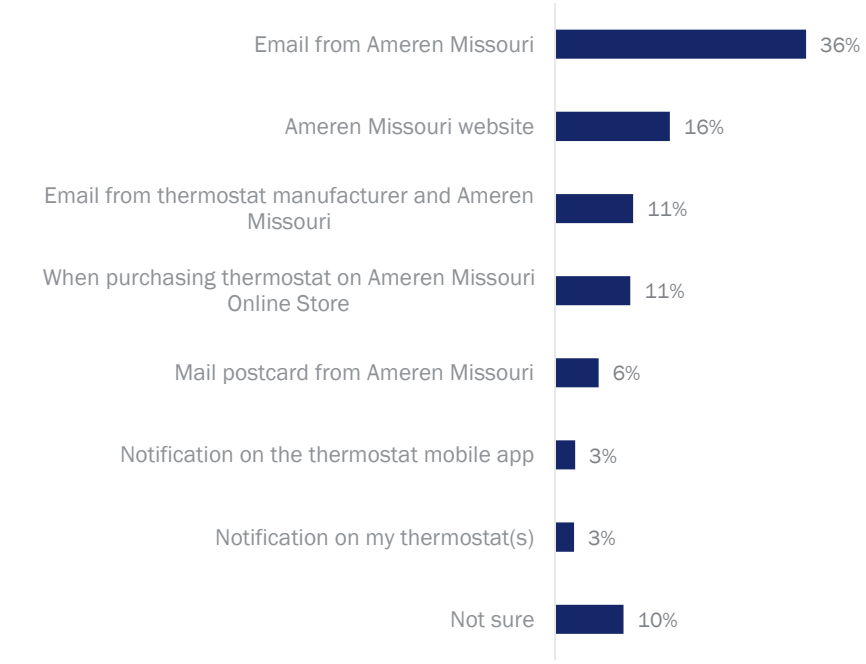
Device Manufacturer	PY2019 Marketplace DR Enrollment Rate	PY2020 Marketplace DR Enrollment Rate	PY2021 Marketplace DR Enrollment Rate
Nest	20%	31%	47%
ecobee	47%	71%	44%
Emerson	0%	54%	44%
Total	**18%**	**43%**	**46%**

Participant Program Experiences

Sources of Program Awareness

Ameren Missouri and its implementers relied on a variety of tactics to engage customers in the program, including e-mail communications through Ameren Missouri and device manufacturers, application push notifications, and direct mail. DR program information was visible and accessible through Ameren Missouri website as well throughout 2021. The evaluation team leveraged participant survey data collected by Uplight to glean additional insight into sources of program awareness as well as other topics. We leveraged responses from 1,341 survey respondents to support analysis in this and other sections of this report. Participant survey results are consistent with the key outreach and engagement tactics with primary source of program awareness as reported by the survey participants being e-mails from Ameren Missouri or thermostat manufacturers, and Ameren Missouri website. Interestingly, 11% of program participants reported first learning about the program when purchasing their thermostat on the Ameren Missouri Marketplace. Continued program presence and marketing through the Marketplace channel will likely be an important pathway to engaging customers.

Figure 21. Residential DR Program: Sources of Program Awareness



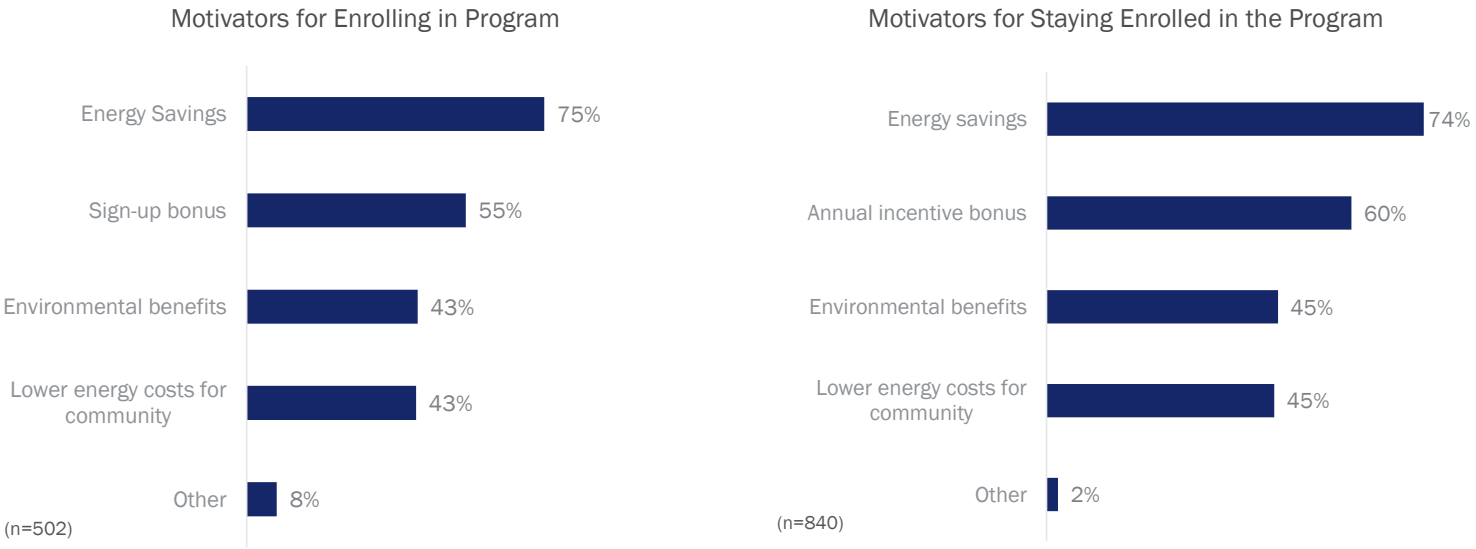
(n=1,340)

Note that responses of less than 2% are not shown in the figure

Motivators to Program Enrollment

As part of the participant survey, Uplight explored key motivators for both enrolling in the program as well as staying enrolled in the program. Participants cited energy savings as the key motivator for both enrolling in the program as well as staying enrolled, followed by incentives (Figure 22). In PY2022, Marketplace incentives associated with the DR program enrollment are scheduled to go away. Given the importance of incentive in customer program engagement, the absence of enrollment bonuses at the time of purchase will likely have a negative impact on participant enrollment.

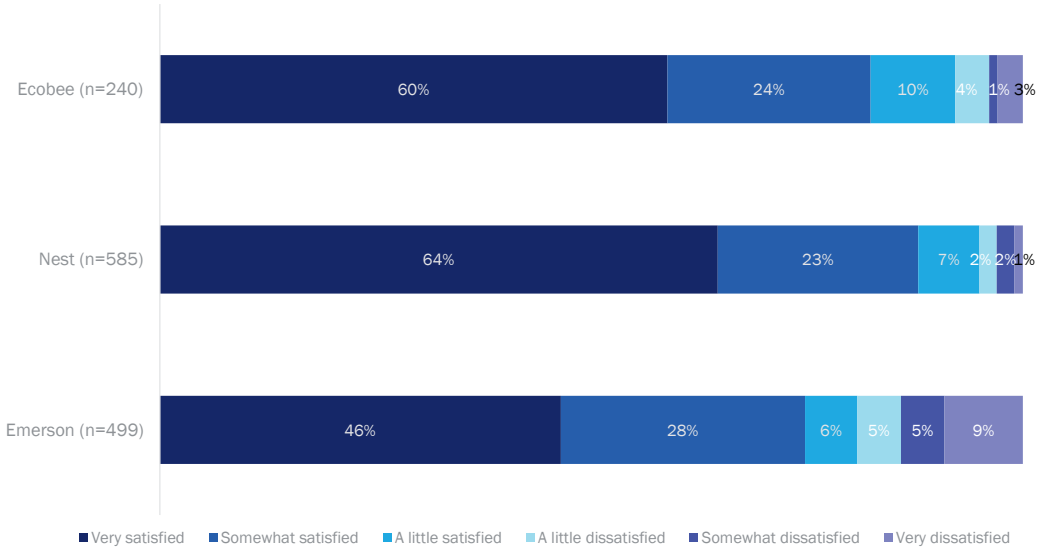
Figure 22. Residential DR Program: Motivators for Program Enrollment and Staying Enrolled



Satisfaction with Overall Program Experience

Figure 23 shows participant satisfaction with their overall program experience. As can be seen in the figure, participant satisfaction levels are high. However, Emerson participants are more likely to be dissatisfied with their experiences than Nest or ecobee participants. Not surprisingly, high participant satisfaction is directly related to positive perceptions about Ameren Missouri. Sixty two and 61% of Nest and ecobee participants respectively reported that their program experiences made them feel more favorable toward Ameren Missouri, while only 51% of Emerson participants said the same.

Figure 23. Residential DR Program: Satisfaction with Overall Program Experiences



Participant satisfaction is also associated with participant presence at home during the events as well as with participant override behaviors. Figure 24 shows participant satisfaction broken down by temperature overrides.

Participants not overriding their thermostat setpoints are more likely to be satisfied with their program experiences. This suggests that participant satisfaction with the program is related to participant comfort level during the events.

Figure 24. Residential DR Program: Participant Satisfaction and Temperature Overrides During the Events

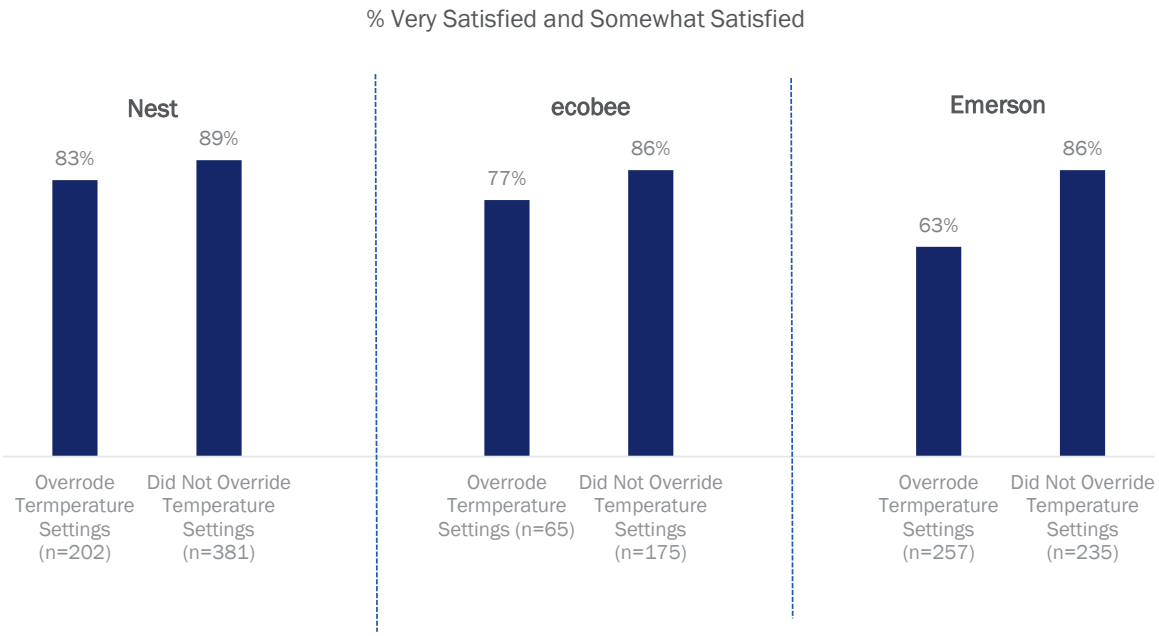
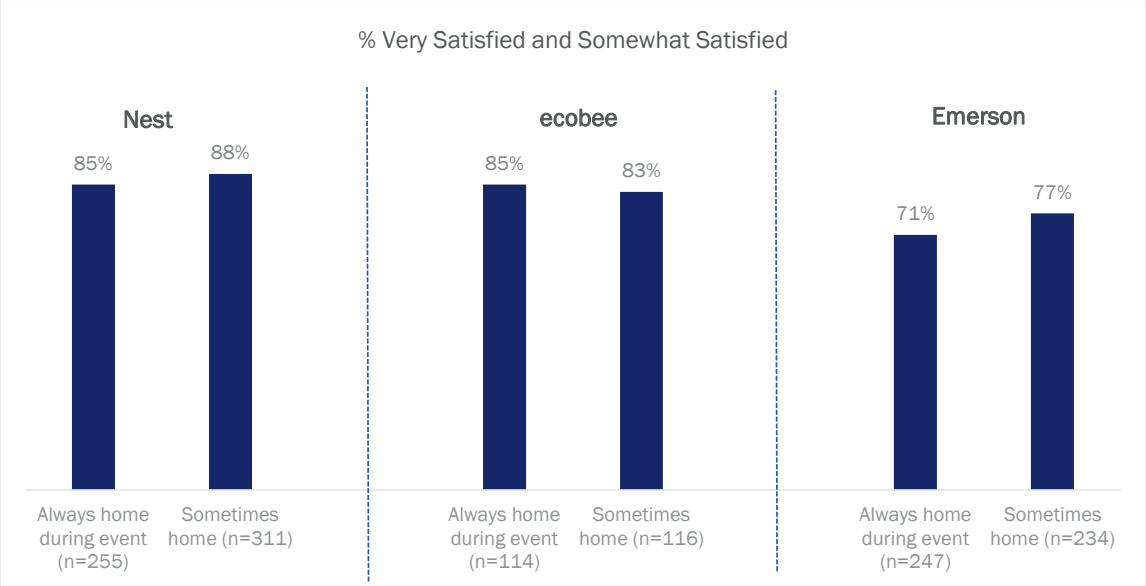


Figure 26 shows participant satisfaction broken down by presence at home during the events. As can be seen in the table, there is little difference in satisfaction among Nest and ecobee participants based on whether they were at home during the events. On the other hand, Emerson participants who were always home during the events were less satisfied with their program experiences. This points to aggressive event dispatch conditions for Emersons affecting participant comfort and therefore their satisfaction. Continued satisfaction of participants is an important ingredient to high levels of participant retention in the program as well as participant performance during events. Monitoring and engaging with customers to improve on satisfaction while balancing event dispatch strategies will be important to continued engagement of existing customers with the program.

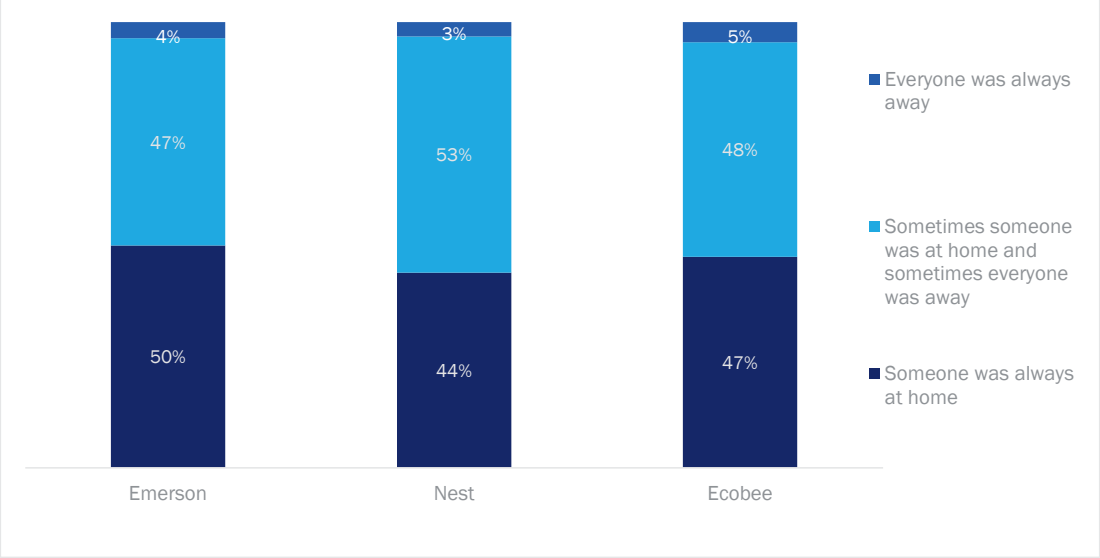
Figure 25. Residential DR Program: Participant Satisfaction and Presence at Home During the Events



Event Participation

Most respondents recalled participating in at least one event over the course of the PY2021 event season (84% Emerson, 90% Nest and 90% ecobees). Participants were rarely at home during all of the events, and were frequently away from their homes for at least some events. Understanding of when participants are at home and tailoring event dispatch algorithms to more aggressive settings when participants are away can help retain high levels of participant satisfaction while improving the depth of load curtailment impacts achieved through the program. Such adjustments, however, will likely require added complexity related to dispatch algorithms. One way to ascertain customer presence is by leveraging data available for device manufacturers via sensors and other means that is already widely used to adjust temperature setpoints and customer preferences for when they are not home. Another alternative could include embedding an inquiry at the time of the event notification to see whether customers intend to be at home and whether they might be open to a more aggressive setpoint adjustment.

Figure 26. Residential DR Program: Participant Presence at Home During the Events

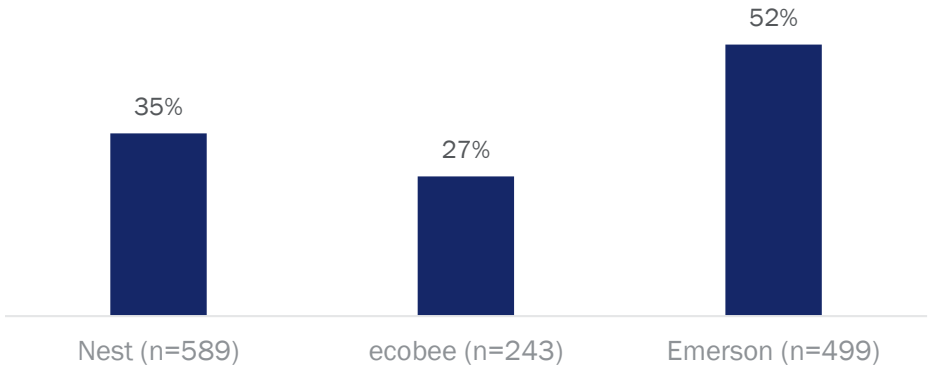


Override Behaviors

Telemetry data did not contain information on participant-driven temperature overrides and our ability to detect override behaviors by analyzing average hourly setpoints is limited. However, participant survey results combined with analysis of hourly demand impacts affords an interesting insight into participant override behaviors and their relation to as well as impact on the depth of savings achieved during DR events.

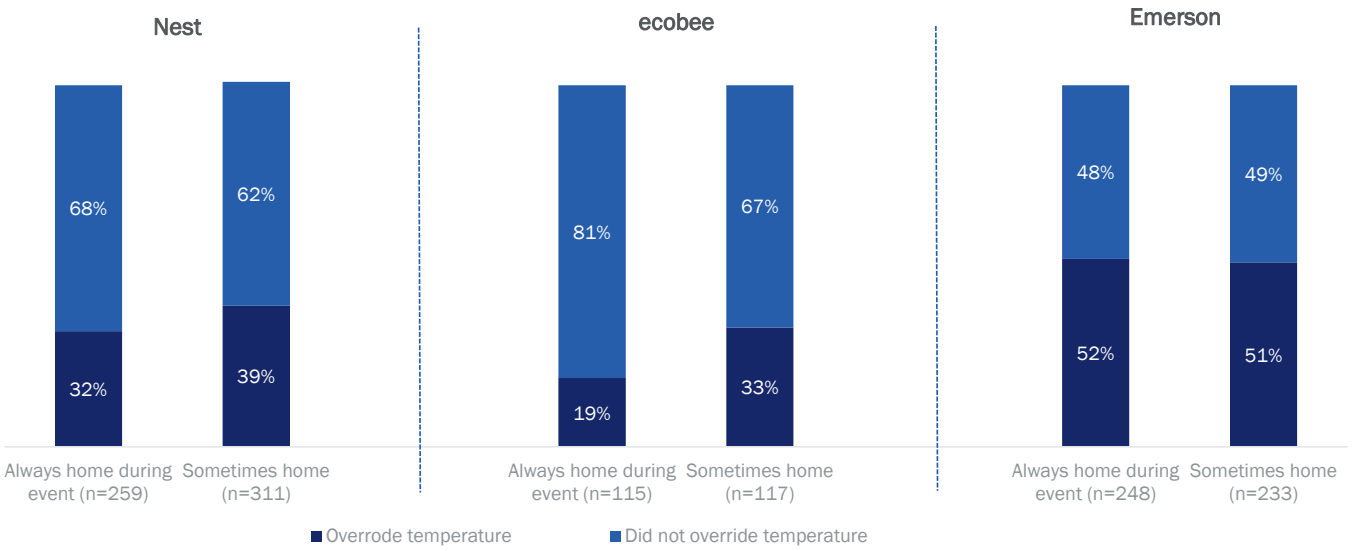
Overall, over a third of participants (37%) reported overriding temperature settings on their thermostats over the course of the event(s). Override behaviors varied considerably by device manufacturer, with ecobee participants being least likely to override and Emerson participants being the most likely to override. Customers cite being uncomfortable or having engagements, including family and friends at home, as key reasons for override behaviors, based on the survey results. Some participants (10%) overrode thermostat setting during events due to health reasons. Interestingly, 9% of participants reported overriding temperature settings because they were too cold. This finding suggests a need to monitor precooling algorithms to minimize overrides due to aggressive precooling strategies.

Figure 27. Residential DR Program: Percent of Participants Reporting Overriding Temperature Settings on Their Devices During DR Events



Temperature overrides vary by whether participants were at home during the events. As can be seen in the figure below, Nest and ecobee participants who reported being always home during the events were also less likely to report overriding than participants who reported being sometimes home during the events. This finding suggests that there may be drivers behind overrides other than discomfort, such as demographic. Unfortunately, demographic data on survey participants was not collected as part of the survey effort. Emerson participants override at the same frequency regardless of their presence at home.

Figure 28. Residential DR Program: Participant Override Behaviors by Presence at Home During Events and Device Manufacturer



Override behaviors are likely to have an impact on average event performance. Table 15 contains average hourly demand impacts for the two events from the PY2021 event season that were three hours in duration (June 11 and June 14 events). Looking at the demand impact trends over the course of the three hours shows decrease of between 21% and 25% in load impacts from the first to the second hour of the event. Load impacts decrease even further in hour three, representing between 46% and 58% of the first hour impacts depending on device manufacturer. This analysis suggests that event override activity may be present leading to decreased impacts over the course of a multiple hour event. Interestingly, however, load impacts for Emerson devices do not reduce hour over hour to the same extent as for Nest and ecobee devices, which appears inconsistent with the above participant self-reported much higher levels of overrides. This could be due to Emerson precooling strategies that involve pre-cooling starting in the early hours of the morning to build cooling mass and prepare the building shell to "ride through" the event with lesser impact on the HVAC runtime.

Table 15. Residential DR Program: Change in Hourly Event Impacts

Device Manufacturer	Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 2/Hour 1 % Difference	Hour 3/Hour 1 % Difference
Nest	1.23	0.96	0.61	78%	50%
ecobee	0.85	0.64	0.39	75%	46%
Emerson	1.33	1.06	0.78	79%	58%

Program De-Enrollment and Chargeback

A total of 13% of participants de-enrolled from the Program since its launch in PY2019 (Table 16). Nest participants are slightly more likely than other participants to de-enroll. Furthermore, BYOT participants are more likely to de-enroll across all device manufacturers, as compared to the Marketplace participants.

Table 16. Residential DR Program: Customer De-Enrollment Trends

Device Manufacturer	De-Enrollment Rate											
	PY2019			PY2020			PY2021			Cumulative as of the End of PY2021		
	BYOT	Market-place	Total	BYOT	Market-place	Total	BYOT	Market-place	Total	BYOT	Market-place	Total
Nest	1%	0%	1%	7%	4%	6%	4%	2%	3%	17%	7%	14%
ecobee	17%	1%	14%	4%	4%	4%	6%	4%	5%	13%	8%	12%
Emerson	0%	0%	0%	5%	2%	3%	5%	4%	4%	13%	11%	12%
Total	**2%**	**0%**	**2%**	**6%**	**3%**	**5%**	**5%**	**3%**	**4%**	**15%**	**9%**	**13%**

Note: Includes customer enrolled and de-enrolled within the program year. Does not include customers who enrolled during the program year and de-enrolled during the following program year.

Notably, PY2021 marked the first year of Franklin Energy performing incentive chargebacks of customers who did not complete program enrollment. Based on Franklin feedback, nearly 7,000 were charged back the enrollment bonused paid to them. Chargebacks occurred either via on-bill pay-pack or credit or debit card chargeback activity.

4.4.2 Impact Results

This section details demand and energy impact results from the Residential DR Program. We first discuss event season demand impacts, followed by impacts for resource capability purposes. We then detail event and non-event day energy impact results.

Event Season Demand Impacts

The Residential DR Program achieved 33.38 MW in average event season demand impacts across all treated devices. Table 17 provides event season demand impacts by event and device manufacturer. Event day demand impacts represent average impacts across all event hours. The Appendix volume submitted alongside this report contains detailed tables with hourly demand impacts by event and device manufacturer.

Per device demand impacts range from 0.43 to 1.51 kW and are generally higher on hotter days. Notably, evaluation limitations for the Residential DR program (described in detail in the methodology section of this report) resulted in likely under-estimates of demand and energy savings for two high-temperature events, thus likely driving down the total impacts reported in the table below and elsewhere in this report.

Table 17. Residential DR Program: Demand Impacts by Event and Manufacturer

Event	Manufacturer	Total Number of Enrolled Devices	Total Number of Devices Participating in Event	Aggregate (MW)		Per Device (kW)		% Load Impact
				Baseline Load	Load Impact	Baseline Load	Load Impact	
June 11, 2021	Nest*	20,069	17,509	31.68	15.53	1.81	0.89	49%
	ecobee	7,906	6,740	11.90	5.57	1.77	0.83	47%

Event	Manufacturer	Total Number of Enrolled Devices	Total Number of Devices Participating in Event	Aggregate (MW)		Per Device (kW)		% Load Impact
				Baseline Load	Load Impact	Baseline Load	Load Impact	
	Emerson	8,002	6,878	13.78	6.88	2.00	1.00	50%
	Total	**35,977**	**31,127**	**57.36**	**27.98**	**1.84**	**0.90**	**49%**
June 14, 2021	Nest*	20,124	17,584	28.69	17.30	1.63	0.98	60%
	ecobee	7,905	6,767	10.43	2.89	1.54	0.43	28%
	Emerson	8,040	6,930	12.70	7.71	1.83	1.11	61%
	Total	**36,069**	**31,281**	**51.83**	**27.89**	**1.66**	**0.89**	**54%**
June 18, 2021	Nest*	20,092	18,541	34.92	20.44	1.88	1.10	59%
	ecobee	7,852	7,852	14.55	8.58	1.85	1.09	59%
	Emerson	8,072	8,072	16.48	12.21	2.04	1.51	74%
	Total	**36,016**	**34,465**	**65.95**	**41.23**	**1.91**	**1.20**	**63%**
July 14, 2021	Nest*	20,179	17,693	28.55	18.46	1.61	1.04	65%
	ecobee	7,924	6,777	10.46	6.72	1.54	0.99	64%
	Emerson	7,996	6,870	12.21	9.22	1.78	1.34	75%
	Total	**36,099**	**31,339**	**51.22**	**34.60**	**1.63**	**1.10**	**68%**
August 25, 2021	Nest*	21,253	18,748	35.00	18.01	1.87	0.96	51%
	ecobee	8,420	7,255	12.91	6.13	1.78	0.85	47%
	Emerson	8,671	7,540	14.87	10.11	1.97	1.34	68%
	Total	**38,344**	**33,543**	**62.79**	**34.45**	**1.87**	**1.03**	**55%**

Note that total number of devices participating in an event exclude devices assigned as control for that event.

* Total number of Nest devices participating in an event excludes devices available for event dispatch among which the event was not dispatched and that were classified in the same category as control devices.

Table 18 provides a summary of average demand impacts by device manufacturers for the event season. Across the PY2021 season events,[18] the program achieved 1.02 kW in per-device demand impact. The average per event demand impact for the PY2021 event season is 33.38 MW. Emerson devices achieved higher per-device demand impacts than ecobee and Nest devices on average (1.27 kW vs. 0.84 and 1.00 kW). Across all manufacturers, per-device impacts were considerably lower than the planned value (2.01 kW).[19]

Table 18. Residential DR Program: Average Event Season Demand Impacts by Manufacturer

Manufacturer	Average Number of Enrolled Devices	Average Number of Devices Participating in Event	Aggregate (MW)		Per Device (kW)		% Load Impact	Average Event Temp. (F)
			Baseline Load	Load Impact	Baseline Load	Load Impact		
Nest*	20,343	18,015	31.84	17.98	1.76	1.00	56%	96
ecobee	8,001	7,078	12.14	6.06	1.70	0.84	50%	96
Emerson	8,156	7,258	14.10	9.34	1.93	1.27	66%	96

[18] Note that we excluded the September 8 event for ecobee devices due to data quality concerns.
[19] This value is based on MEEIA III PY2020 enrollment goal of 14,438 participants and 24.83 MW in demand savings and an assumption of 1.17 devices per participant. The most recent version of the Ameren MO TRM deems the demand savings at 1.53 kW per thermostat.

Manufacturer	Average Number of Enrolled Devices	Average Number of Devices Participating in Event	Aggregate (MW)		Per Device (kW)		% Load Impact	Average Event Temp. (F)
			Baseline Load	Load Impact	Baseline Load	Load Impact		
All	36,501	32,351	58.08	33.38	1.79	1.02	57%	96

Note that total number of devices participating in an event exclude devices assigned as control for that event.

* Total number of Nest devices participating in an event excludes devices available for event dispatch among which the event was not dispatched and that were classified in the same category as control devices.

The Appendix volume submitted alongside this report contains detailed plots and tables of per-device demand impacts by device manufacturer and event.

Resource Capability Estimates

Resource capability estimates reflect weather-normalized demand impacts applied to the population of devices enrolled as of the end of PY2021 that are anticipated to participate in events. Table 19 details resource capability impacts by device as well as cumulatively across all devices. Similar to the event season impacts, resource capability impacts likely suffer from underestimation of savings for two high-temperature event days.

Anticipated demand impacts are 45.10 MW. Average per-device impacts under TRM-defined peak weather conditions are estimated at 1.15 kW and are higher for Emerson and Nest devices (1.37 and 1.15 kW, respectively) than for ecobee devices (0.93 kW). The average demand impact is considerably lower than the per-device planned value of 2.01 kW,[20] indicating that even under peak weather conditions the program will likely fall short of the goal.

Table 19. Residential DR Program: Resource Capability Impacts

Manufacturer	Total Number of Devices Enrolled	Total Number of Devices Anticipated to Participate in Events	Aggregate (MW)		Per Device (kW)		% Load Impact
			Baseline Load	Load Impact	Baseline Load	Load Impact	
Nest*	21,352	19,860	31.38	22.78	1.58	1.15	73%
ecobee	9,421	9,421	14.28	8.77	1.52	0.93	61%
Emerson	9,887	9,887	17.29	13.55	1.75	1.37	78%
All	**40,660**	**39,168**	**62.95**	**45.10**	**1.61**	**1.15**	**72%**

* Total number of Nest devices participating in an event excludes devices available for event dispatch among which the event was not dispatched and that were classified in the same category as control devices.

Table 20 compares the resource capability impacts to the PY2021 MEEIA III goals. Weather-normalized demand impacts of 45.10 represents 113% of the cumulative PY2021 goal.

Table 20. Comparison of Resource Capability Impacts to Goal

Metric	Result
Resource capability load impact (MW)	45.10
Cumulative PY2021 MEEIA III goal (MW)	39.79

[20] This value is based on MEEIA III PY2020 enrollment goal of 14,438 participants and 24.83 MW in demand savings and an assumption of 1.17 devices per participant. The most recent version of the Ameren MO TRM deems the demand savings at 1.53 kW per thermostat.

Metric	Result
Percent of PY2021 goal	113%

Cumulative DR Capability

Cumulative DR capability for the Residential DR program mirrors resource capability and is presented in Table 21. Cumulative DR capability represents a performance metric for the earnings opportunity award for the DR programs.

Table 21. Residential DR Program: Comparison of Cumulative DR Capability to Target

Metric	Result
Cumulative DR capability (MW)	45.10
PY2021 target (MW)	39.79
Percent of PY2021 target	113%

Summary of Energy Impacts

Energy impacts in PY2021 included event day impacts as well as non-event impacts resulting from the optimization activity performed on Emerson devices. Table 22 summarizes energy savings achieved during event days as well as energy savings achieved through the optimization of Emerson devices. As can be seen in the table, the total energy savings achieved during the PY2021 event season are 229.34 MWh which is 6% of the MEEIA III goal. Event day energy savings were negative. Similar to the event season impacts, event day energy savings impacts likely suffer from underestimation of savings for two high-temperature event days.

Table 22. Residential DR Program: Energy Savings Summary

Metric	Result
Event season energy savings (MWh)	229.34
Event day energy savings (MWh)	*-243.87*
Energy savings from the optimization component (MWh)	*473.21*
PY2021 MEEIA III goal (MWh)	3,912.00
Percent of goal	6%

Event Day Energy Impacts

In addition to demand reductions, demand response events resulted in moderate energy savings during event days. Achieving energy savings as a result of the demand response events is not the primary goal of the Demand Response programs.

Table 23 details event day per-device and total energy savings by manufacturer. Energy savings presented in the table reflect cumulative reductions in energy over the 24-hour period, as compared to baseline days, across all four test events.[21] Energy savings range from -7.63 kWh to 3.38 kWh per treated device, depending on event and manufacturer. Negative energy savings are common for DR programs and are often a result of precooling in advance of the event or snapback following the event leading to higher energy consumption than any reductions

[21] Energy savings for ecobee devices for Event 4 (September 8, 2020) were imputed based on the average per-device savings across all other event performance for ecobees.

achieved during event hours. Notably energy savings are deepest for the two events with poor proxy day matches. These negative savings are likely overestimated and are likely less negative than the models showed.

Table 23. Residential DR Program: Event Day Energy Savings by Event and Device Manufacturer

Event	Manufacturer	Total Number of Enrolled Devices	Total Number of Devices Participating in Event	Aggregate (MWh)		Per Device (kWh)		% Savings	Average Event Day Temp. (F)
				Baseline Usage	Energy Savings	Baseline Usage	Energy Savings		
June 11, 2021	Nest*	20,069	17,509	498.71	3.24	28.48	0.18	1%	86
	ecobee	7,906	6,740	177.94	0.64	26.40	0.10	0%	
	Emerson	8,002	6,878	201.19	4.70	29.25	0.68	2%	
	Total	**35,977**	**31,127**	**877.84**	**8.58**	**28.20**	**0.28**	**1%**	
June 14, 2021	Nest*	20,124	17,584	467.48	37.40	26.59	2.13	8%	83
	ecobee	7,905	6,767	163.08	4.21	24.10	0.62	3%	
	Emerson	8,040	6,930	189.19	23.44	27.30	3.38	12%	
	Total	**36,069**	**31,281**	**819.75**	**65.05**	**26.21**	**2.08**	**8%**	
June 18, 2021	Nest*	20,092	18,541	516.90	-118.29	27.88	-6.38	-23%	91
	ecobee	7,852	7,852	185.54	7.40	27.41	-3.89	-14%	
	Emerson	8,072	8,072	235.75	-36.99-	29.21	-4.58	-16%	
	Total	**36,016**	**34,465**	**938.20**	**-147.88**	**28.08**	**-5.39**	**-19%**	
July 14, 2021	Nest*	20,179	17,693	418.07	16.68	23.63	0.94	4%	82
	ecobee	7,924	6,777	150.07	6.59	22.14	0.97	4%	
	Emerson	7,996	6,870	162.36	-7.97	23.63	-1.16	-5%	
	Total	**36,099**	**31,339**	**730.50**	**15.30**	**23.31**	**0.49**	**2%**	
August 25, 2021	Nest*	21,253	18,748	555.12	-92.29	29.61	-4.92	-17%	89
	ecobee	8,420	7,255	198.17	-35.12	27.31	-4.84	-18%	
	Emerson	8,671	7,540	218.07	-57.52	28.92	-7.63	-26%	
	Total	**38,344**	**33,543**	**971.36**	**-184.93**	**28.96**	**-5.51**	**-19%**	

* Total number of Nest devices participating in an event excludes devices available for event dispatch among which the event was not dispatched and that were classified in the same category as control devices.

Table 24 summarizes event day energy savings by device manufacturer across all events. As can be seen in the table, event day energy savings averaged -8.11kWh per-device and represented 6% increase of the total baseline usage. Across the five demand response events dispatched in PY2021, the Residential DR Program increased energy consumption by 243.87MWh.

Table 24. Residential DR Program: Event Day Energy Savings by Device Manufacturer

Manufacturer	Average Number of Enrolled Devices	Average Number of Devices Participating in Event	Aggregate (MWh)		Per Device (kWh)		% Savings
			Baseline Usage	Energy Savings	Baseline Usage	Energy Savings	
Nest*	20,343	18,015	2,456.29	-153.27	136.19	-8.05	-6%
ecobee	8,001	7,078	874.80	-16.27	127.37	-7.04	-2%
Emerson	8,156	7,258	1,006.56	-74.33	138.31	-9.30	-7%
All	**36,501**	**32,351**	**4,337.64**	**-243.87**	**134.73**	**-8.11**	**-6%**

* Total number of Nest devices participating in an event excludes devices available for event dispatch among which the event was not dispatched and that were classified in the same category as control devices.

Impacts from Device Optimization

Notably, optimization of Emersons ran for only part of the season. The savings would have been higher had Emerson devices been optimized for the entire duration of the event season.

Table 25 summarizes energy savings from the device optimization component. Through running optimization algorithms on participating Emerson devices over the course of the event season, the program achieved 1.45 kWh in per-device per day savings and 473.21 MWh in total energy savings across all treated days and devices. The average savings rate is 7%. Notably, optimization of Emersons ran for only part of the season. The savings would have been higher had Emerson devices been optimized for the entire duration of the event season.

Table 25. Residential DR Program: Device Optimization Energy Savings Summary

Manufacturer	Number of Device Days	Aggregate (MWh)		Per Device Per Day (kWh)		% Savings
		Baseline Usage	Energy Savings	Baseline Usage	Energy Savings	
Emerson	327,151	6,431.92	473.21	19.66	1.45	7%

5. Business Demand Response Program

This section summarizes the PY2021 evaluation methodology and results for Ameren Missouri's Business Demand Response (DR) Program.

5.1 Evaluation Summary

5.1.1 Program Description

The Business Demand Response Program was in its third year of deployment in PY2021. The program was designed to reduce load during periods of peak demand. Enel X acted as the program aggregator in PY2021, responsible for recruiting and enrolling customers, developing load reduction nominations, developing customized load curtailment strategies, dispatching demand response events, and maintaining customer relationships with participating businesses. Enel X engaged customers to participate in DR events through a variety of efforts, including direct load control, manual response, and behind-the-meter generation. Notably, there are no defined measures for this program as each participant is unique and may utilize a variety of mechanisms to reduce load during an event. Furthermore, the program is voluntary, and participants may choose not to participate in the events. In PY2021, as in the previous years, leveraging behind-the-meter generation to support load reductions was not permitted.

Each enrolled facility received a customized load curtailment strategy, focusing on a variety of energy loads such as lighting, HVAC, chillers, motors, and processing equipment. Participants received a custom capacity-based payment (based on the average MW performance across all events in a given program year), and an energy payment (based on each MWh of performance during events) developed and negotiated by Enel X. Participants were not subject to performance penalties.

Demand response events were called during the summer event season lasting from May 1 through September 30, 2021. Enel X also called an additional test event in December in order to test the capability of the customers enrolled in the program after the completion of the summer season and prior to the end of the program year. Enel X could call up to five peak shaving events and up to two test events.[22] Both event types could last for up to four hours in duration. No more than two events could be called consecutively.

Figure 29 provides a visual overview of the event notification process that Enel X followed in PY2021 to prepare customers for events and communicate event start and end dates. As can be seen in the figure, a week before a DR event is likely to be called, Enel X sent participants an e-mail with advance notice for a likely event day. Participants also received a reminder notification a few days before the event day. On the day of the event, Enel X issued a formal event notification several hours in advance with a start and end time of the event, as well as a link in an e-mail to confirm receipt. Non-responsive participants may have received a second alert. After the event ended, Enel X sent a final e-mail confirming the end of the DR event dispatch.

[22] Emergency demand response events were not planned for the 2021 event season.

Figure 29. Business DR Program: Event Notification Flow

The program does not have customer eligibility requirements—everyone who is interested in participating and has not opted out of MEEIA Programs can do so. However, Enel X historically focused its outreach on larger customers to ensure sufficient DR opportunities. Once a customer agrees to participate, Enel X installs its metering equipment to collect interval electric usage data. In cases where enrolled customers do not have interval metering equipment, Ameren Missouri upgrades those customers' meters to capture energy consumption at 15-minute intervals.

Incentives to participants are based on their average performance during the events. Participants are not subject to penalties for non-performance or under-performance.

Ameren Missouri registered Business DR program as a Load Modifying Resource in the Midcontinent Independent System Operator (MISO) market in PY2020.

5.1.2 Participation Summary

Based on the MEEIA III filing, the program cumulative goal for PY2021 was 75 MW of capacity reduction. In PY2022, Ameren Missouri will raise its MEEIA III goal to 100 MW of capacity reduction. Enel X enrolled 601 customers by the end of the PY2021 event season with a total nominated capacity of 115.06 MW, which represents 153% of the PY2021 MEEIA III goal of 75MW.[23]

Table 26. Business DR Program: Goals and Participation Summary

Metric	Cumulative MEEIA III Goal	Enrollment	% of Goal
End of the PY2021 Event Season Enrollment Summary			
Accounts	150	601	401%
Enrolled Nominated capacity (MW) as of PY2021 Year-End	75	115.06	153%

In PY2021, Ameren Missouri used the program for peak shaving purposes. To assess participant performance, Enel X called one one-hour peak shaving event and two one-hour test events during the event season. Following the completion of the event season, Enel X dispatched one one-hour test event to ascertain nominated capacity values for customers enrolled in the program after the end of the 2021 event season. Figure 30 below provides details for each test event.

[23] Customers are defined as unique accounts.

Figure 30. Business DR Program: Overview of PY2021 Events

Note: Number of customer accounts and nominated capacity represents those among whom the event was called.

PY2021 participants spanned a range of business types, including education, mining, retail, and agriculture.

5.1.3 Key Impact Results

Table 27 summarizes program impacts. The Business DR Program achieved 77.94 MW in average demand savings during the PY2021 event season.

Resource capability represents the sum of average event performance across all accounts enrolled in the program as of the end of PY2021 and is an estimate of what the program can expect to have available toward the PY2021 goal. Notably, resource capability includes customers who were enrolled in the program after the completion of the event season but before the end of the program year and whose performance was tested during the December test events. The Business DR Program is estimated to achieve 88.37 MW in event impacts through accounts enrolled in the program as of the end of PY2021. This represents 118% of PY2021 cumulative MEEIA III MW goal.

Cumulative DR capability represents demand impacts from tested accounts, either during the PY2021 event season or during the December test event. The main difference between resource capability and cumulative DR capability is that resource capability can include accounts that were enrolled during a program year but not tested, while cumulative DR only includes tested accounts. In PY2021, all accounts enrolled in the program participated in a test event, therefore resource capability and cumulative DR capability values are the same.

Achieving energy savings during demand response events was not the primary goal of the Business DR Program. Nonetheless, participants decreased consumption by a total of 908.56 MWh across the four test events

dispatched over the course of PY2021. The energy savings fell short of the target of 1,500 MWh and represent 61% of the MEEIA III cumulative energy savings goal.

Table 27. Business DR Program: Event Season Demand Savings

Metric	Goal	Achieved	% of Goal Achieved
Event Season Demand Impacts (MW)	--	77.94	--
Resource Capability (MW)	75.00	88.37	118%
Demand Capability (MW)	75	88.37	118%
Energy Savings (MW)	1,500.00	908.56	61%

5.1.4 Key Process Findings

In PY2021, the Business DR program continued effective customer engagement and event dispatch. Key participation highlights include the following:

- The program has engaged a variety of segments, including manufacturing, mining, consumer services, and transportation. Different segments varied in their contributions to the program in terms of nominated capacity and performance, with education and manufacturing segments delivering the largest portion of program impacts and real estate and construction, healthcare, and agriculture and mining segments offering deeper per-participant load reductions compared to all other segments.
- While the program is well positioned for continued success from the perspective of customer enrollment to-date, future efforts to engage additional customers will have challenges. Per Enel X's feedback, the biggest challenge to-date to engaging new customers has been large commercial and industrial customers opting out of energy efficiency programs and therefore being ineligible for program participation. Enel X acknowledges that the remaining customer base is not large and offers lower per-customer load curtailment potential and will likely take a considerable amount of effort, including continued outreach attempts, to engage with the program.
- Not all customers are performing consistently or in a way that is aligned with their nominations, and customers who offered relatively consistent performance event-to-event, performed below average against their nominations. Revisiting and re-engaging existing customers by offering additional insight, education, motivation, and advice will become important, especially in light of increasing challenges with new customer engagement.
- Program de-enrollment reached 5% at the end of PY2021. The key driver of de-enrollment is participants enrolling but not completing the onboarding process and exiting the program without an opportunity to participate in any events.
- Program operations ran smoothly with no issues reported by Enel X. PY2022 will mark the first year of the program being available for up to ten MISO emergency events and an additional five test events.

Missouri CSR requires that demand-side programs, operating as part of a utility's preferred resource plan, are subject to ongoing process and impact evaluations that meet certain criteria. Table 28 summarizes responses to the CSR process evaluation requirements.

Table 28. Business DR Program: 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?	Ameren Missouri customers generally lack experience with demand response programs and therefore are less used to the load reduction strategies and not as skilled at estimating their load reduction potential during peak periods in the summer. As the program enters its fourth year, some program participants are gaining more experience. Lack of interval data in Ameren Missouri service territory limits visibility into customer hourly load profile to ensure more effective targeting and more accurate goal setting.
Is the target market segment appropriately defined, or should it be further subdivided or merged with other market segments?	Targeting medium and large facilities with a customized DR offering is appropriate due to the heterogeneity of facility types, operations, and appropriate load reduction strategies. The program has been focused on customers with the highest load reduction opportunities during the peak summer period, which is consistent with the program goals of shaving peak load.
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 program's approach to load reduction is customized to each facility, which is appropriate given unique energy demands of medium and large customers and the resulting load shaving opportunities.
Are the communication channels and delivery mechanisms appropriate for the target market segment?	Program implementer feedback indicates no program delivery issues.
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?	Enel X is actively working on developing processes for expediting participant payment. Enel X is also exploring strategies for streamlined and cost-effective enrollment of customers with smaller nominations to ensure cost-effective recruitment and engagement of customers. Enel X is actively working to explore ways to achieve more performance among already enrolled participants. Enel X plans to deploy additional metering to ensure timely communication of event performance with a larger share of participating customers.

5.1.5 Conclusions and Recommendations

The evaluation team offers the following conclusions and recommendations for the Business DR Program:

- **Conclusion 1:** The Business DR Program exceeded its MEEIA III participation and demand savings goals and is well-positioned for continued success. The Business DR Program fell short of its MEEIA III energy savings goal. The key driver behind the shortfall is a dispatch of a limited number of events and short event duration in PY2021. With a limited pool of eligible commercial and industrial customers available for targeting, new customer engagement is likely to be more resource intensive and will need to include continued outreach attempts. Future participants are also likely to offer lower capacity reduction potential as compared to the current participant mix. As a result, a selective and targeted approach to new customer engagement will be important in balancing customer engagement costs with resource benefits and program goals. To that end, leveraging insight on existing participant performance will allow for a more refined targeting of new customers.
  - **Recommendation 1:** Program staff should balance participant enrollment with the size of their nominations and uncertainty surrounding their performance. Program staff should leverage

existing insight from the program's performance over the last three years to inform new customer targeting. Notably, Enel X is already planning to incorporate available information into their targeting strategy.

- **Conclusion 2:** Lack of interval data among commercial and industrial customers limits program staff's ability to effectively target customers with high peak load as well as to accurately gauge new enrollees' performance potential. That results in sometimes significant departures between customer performance in the events and their nominations.
  - **Recommendation 2:** Program staff should continuously revisit and revise participant capacity nominations in light of event performance data to ensure better alignment between performance and nominations. That can help better gauge anticipated program performance against goals and ramp new customer recruitment or existing customer engagement.
- **Conclusion 3:** Program staff deployed a multi-faceted process for existing customer outreach to ensure participant readiness for the event season and to deepen engagement. However, delays with the provision of interval data to calculate performance limited Enel X's opportunity to engage participants soon after the completion of the events to educate participants about their achievements, discuss reasons for performance, educate, and identify opportunities to both deepen impacts among strong performers as well as identify opportunities to remedy and increase impacts among underperforming participants. To that end, Enel X is planning to deploy additional metering infrastructure to increase the speed of access to performance information among a larger number of participants.
  - **Recommendation 3:** Program staff should continue to collaborate with Ameren Missouri on ways to accelerate interval data provision to support additional opportunities for customer engagement and education in an effort to sustain and deepen impacts.
- **Conclusion 4:** Supply chain shortages, growing demand for goods, and labor constraints following the first year of the COVID-19 pandemic required participating customers to adapt their operations thus limiting their flexibility and their potential for deeper load reductions during the events, per Enel X feedback. Rising inflation and continued supply side and labor shortages may continue in PY2022, presenting a risk to performance expectations.
  - **Recommendation 4:** Program staff should consider proactively engaging customers in advance of the event season to explore the anticipated strain on their operations that external market forces may present and work with customers to either adapt their load curtailment plans seeking more opportunities or adjust their nominations in order to better understand the needed ramp up in new customer recruitment.

5.2 Evaluation Methodology

This section summarizes the key objectives and methods for the PY2021 Business DR Program evaluation. The key evaluation objectives included:

- Ascertain changes to program delivery, customer enrollment, load reduction strategies, and nominated capacities;
- Understand and describe participant mix in terms of size, business segment, and other available characteristics;
- Identify program successes and challenges; and
- Provide evaluation results that can be used to improve the design and implementation of the program.

Table 29 provides an overview of the Business DR Program evaluation activities. Following the table, we outline program-specific aspects of key evaluation methodologies.

Table 29. Business DR Program: PY2021 Evaluation Activities for the Business DR Program

Evaluation Activity	Description
Program Manager and Implementer Interviews	▪ Gathered feedback to understand program staff's perspective on program performance. Feedback was gathered on a continuous basis as part of periodic check-in meetings over the course of the program year.
Program Material Review	▪ Reviewed available program materials to inform evaluation activities.
Gross Impact Analysis	▪ Used aggregator's established baseline method to estimate hourly and average event kW and kWh savings impacts. ▪ Calculated average demand savings across all peak shaving events throughout the summer event season. ▪ Calculated demand savings including participants enrolled in the program as of the end of PY2021. ▪ Support bidding of DR program impacts as a load modifying resource into MISO market.

5.2.1 Program Manager and Aggregator Interviews

Throughout PY2021, the evaluation team, Enel X, and Ameren Missouri staff met monthly to discuss ongoing administration of the program, any changes or anticipated challenges to program delivery and goal achievement, and to help finalize results after demand response events. In addition to these monthly conversations, the evaluation team conducted a formal interview with Enel X staff at the end of 2021 to debrief on PY2021 experiences and understand any programmatic changes going into PY2022.

5.2.2 Impact Analysis

As part of the gross impact analysis, the evaluation team estimated event-day demand and energy impacts, as well as resource capability. The three analyses are described below. Per industry-standard practices, we assume a net-to-gross ratio of 100% for impacts from DR events, i.e., there is no free ridership or spillover.

Event Day Demand Impacts Estimation

For each event season test event, as well as for the December test event, we estimated demand impacts by comparing actual interval meter readings during the event to the customer's baseline to calculate demand savings per event. We leveraged the contractually agreed upon performance calculation approach between Enel X and Ameren Missouri.

We calculated event day demand impacts by taking the difference between baseline and actual demand during the event hour (Equation 1). We calculated event-specific performance independently for each account among whom the events were called. We calculated total event season performance by summing average performance across the two test events for each account.[24]

Equation 1. Business DR Program: Event Day Demand Impact Calculation

$$Event\ Day\ Demand\ Impact\ (kW) = Final\ Baseline\ (Event\ Hour) - Actual\ Demand\ (Event\ Hour)$$

[24] For accounts with only one event dispatched (total of 11 accounts), we used that event's performance.

Baseline calculation leverages a "high 4 of 5" approach with symmetrical adjustment. The following steps were used in the calculation of the baseline.

Step 1: Calculate Provisional Baseline

We calculated the provisional baseline as the average demand during the event hour for the highest four of the last five most-recent non-holiday, non-event, weekdays before the event day. NERC holidays were excluded from the calculation of the provisional baseline.

Step 2: Calculate Baseline Adjustment

The baseline adjustment is symmetrical and is calculated as the average difference in demand on an hourly interval basis between the actual metered demand on an event day and the provisional baseline demand during a baseline adjustment window. The baseline adjustment window is defined as the two-hour period immediately preceding the start of the hour in which dispatch instructions were sent to participants. Baseline adjustment is capped at 75% of the provisional baseline.[25] In other words, in cases where an account's baseline adjustment amounts to 75% or more of its provisional baseline, the adjustment is not applied.

Step 3: Calculate Final Baseline

We calculated the final baseline by subtracting baseline adjustment from the provisional baseline for each hourly interval for all 24 hours (Equation 2).

Equation 2. Business DR Program: Final Baseline Calculation

$$Final\ Baseline = Provisional\ Baseline + Baseline\ Adjustment$$

Missing Data

Not every participating account in PY2021 had interval data available to calculate demand impacts using the above-described approach. Furthermore, some accounts did not have full interval data necessary to calculate demand impacts. To mitigate data gaps, the evaluation team used the following approach to calculating demand impacts:

- For accounts where bill grade interval data was not available, the evaluation team relied on the KYZ collected by Enel X.
- For accounts with interval data available for four, as opposed to five, baseline days, we included all four days in the baseline calculation.
- For accounts with no interval data for one event but data present for the other event, the evaluation team imputed the other event's performance for the event with missing data.
- For accounts with no interval data for any of the events, the evaluation team imputed performance using a weighted average per-account performance across all participating accounts with valid interval data.

The evaluation team imputed demand savings for 27 accounts or 4% out of 637 accounts participating in any of the events. Of those 27 accounts, 15 did not have any interval data for any of the events. Most of the accounts had less than 75kW in nominated capacity. Overall, accounts without any interval data accounted for less than 2% of PY2021 nominations and less than 2% of total resource capability demand impacts. Missing data can result

[25] This represents a modification to the baseline adjustment calculation instituted in PY2020.

for a variety of reasons, including non-operational meter equipment or interval metering equipment not deployed in advance of the DR event, among others. In order to further ensure that the above-described imputations were reasonable, the evaluation team worked with Enel X to obtain data on participant confirmation of event participation and validate that all accounts with missing data actively confirmed their intent to participate in the event(s).[26]

Event Day Energy Impact Estimation

The evaluation team calculated event day energy savings by comparing total daily energy consumption during each event day to the total average daily energy consumption during the baseline days. Consistent with the event day demand impact approach, we used a "high 4 of 5" approach to defining baseline period, wherein we averaged total daily energy consumption for four days with the highest consumption of the last five most-recent non-holiday, non-event, weekdays prior to the event day. NERC holidays were excluded from the calculation of the baseline. Equation 3 details the event day energy impact calculation. We calculated event day energy impacts for each account and for each event. We summed energy impacts across accounts and events to arrive at the total event season event day energy impacts.

Equation 3. Business DR Program: Event Day Energy Savings Calculation

$$Event\ Day\ Energy\ Impact\ (kWh) = Average\ Daily\ Baseline\ Consumption\ (kWh) - Daily\ Event\ Day\ Consumption\ (kWh)$$

Missing Data

Similar to demand savings, not every participating account in PY2021 had interval data available to calculate energy savings. We used the same imputation processes as for demand savings to calculate energy savings. Additionally, in cases where baseline load for accounts was missing, it was imputed using average baseload values across all participating accounts with valid interval data.

The evaluation team imputed energy for the same number of accounts as in the case of the demand savings imputations. Energy saving imputations resulted in 15,099 kWh in energy savings and represented less than 2% of total energy savings achieved for the year.

Resource Capability Estimation

Annual resource capability is the sum of the demand response impacts each facility can provide, as demonstrated during the events called that year. Resource capability is calculated by adding the evaluated impacts or average evaluated impacts across events (if a facility participated in multiple events) from each participating facility during the year under consideration. If a customer enrolls during the program year but is not able to participate in a test event, they can also be included in resource capability using an applied demand response impact value.[27]

To check for weather sensitivity, the evaluation team pulled data from Lambert Airport Weather Station and examined it in a correlation matrix against the summer usage values of all the customers enrolled in the program.

[26] As part of the event notification communications Enel X requests that participants confirm their intent to participate in the upcoming event. Participants may choose to reply back confirming their participation, declining participation, or they may choose not to respond. All of the 27 accounts with missing interval data actively confirmed their intent to participate in the respective events per the Enel X records shared with us.

[27] The applied demand response impact value is the nominated capacity adjusted by the event season performance rate across accounts that participated in the event season.

Our analysis found that usage was not correlated with heating and cooling degree days. Therefore, we did not weather normalize event season impacts when estimating resource capability.

Cumulative DR Capability

Cumulative DR capability is a performance metric used to establish Ameren Missouri's earnings opportunity award. The evaluation team calculated the cumulative DR capability consistently with the approach specified in the MEEIA III Plan. Cumulative DR capability included demand impacts only from participants tested either during the event season events or during the December test events. More specifically:

- For accounts that participated in the PY2021 event season, we used average event season performance to estimate cumulative DR capability.
- For accounts whose performance was tested during the December test events, we used the results of the test event to estimate cumulative DR capability. No account participated in both December test events, so averaging performance was not necessary.

Data Sources and Data Cleaning

The evaluation team relied on three core sources of data when developing program impacts:

- Interval data: The evaluation team leveraged revenue quality 15-minute interval data supplied by Ameren Missouri for all enrolled customers.
- Enel X KYZ data: In cases where interval data was missing, the evaluation team worked with Enel X to obtain interval data collected by Enel X through KYZ pulse outputs at participating facilities.
- Participation data: The evaluation team obtained participation data from Enel X. The participation data extract included all customers enrolled in the program as of the end of 2020. For each customer, Enel X recorded customer account numbers, customer name and facility address, customer business segment information, load reduction nomination, and load reduction strategy.

The evaluation team ingested the data from the two sources mentioned above, merged the data, and carefully processed the data to prepare it for analysis. The core data cleaning steps included:

- Exploration of duplicate records including duplicate accounts and interval periods;
- Consolidation of multiple meters per account;
- Exploring and correcting data irregularities including missing interval periods, missing accounts, periods with zero usage, low usage, or unreasonably high usage; and
- Updating participating customer business segments based on the review of participant business names and locations.

We did not drop any records as a result of the data cleaning steps.

Attribution/Net Impact Analysis

Per industry-standard practices, we assume a net-to-gross ratio of 1.0 for impacts from DR events, i.e., there is no free ridership or spillover.

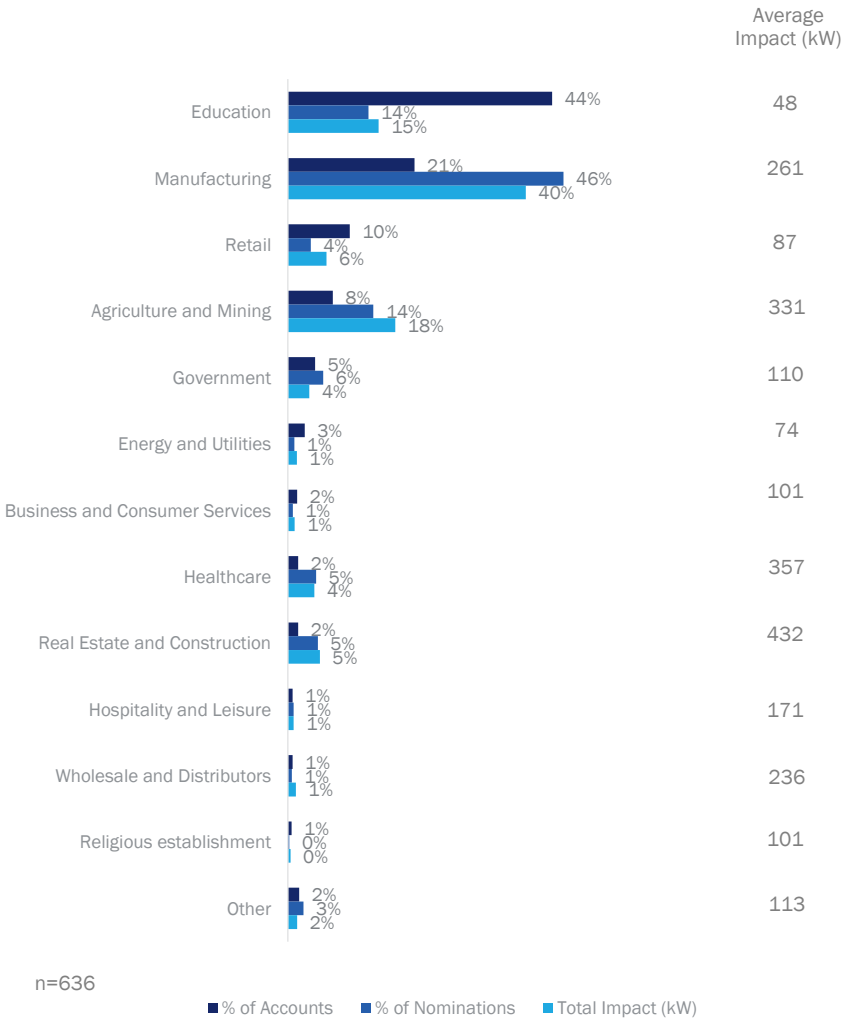
5.3 Evaluation Results

5.3.1 Process Results

PY2021 Participant Composition and Performance

As of the end of PY2021 a total of 636 accounts across 551 unique facilities and 205 businesses were enrolled in the program with a nominated capacity of 131.1 MW. Enrolled customers spanned a range of business segments, including manufacturing, mining, consumer services, and transportation. Figure 31 shows distribution of PY2021 program participants by segment both in terms of count of accounts as well as nominations and kW performance. The figure also contains average per account kW performance achieved by each segment as a result of participating in PY2021 events. As can be seen in the figure, the vast majority of customers in PY2021 were education and manufacturing facilities. These segments were also key contributors to the program impacts from the volumetric perspective. On a per-account basis, however, real estate and construction, healthcare, and agriculture and mining segments offered deeper load reductions compared to all other segments.

Figure 31. Business DR Program: PY2021 Customer Distribution by Segment

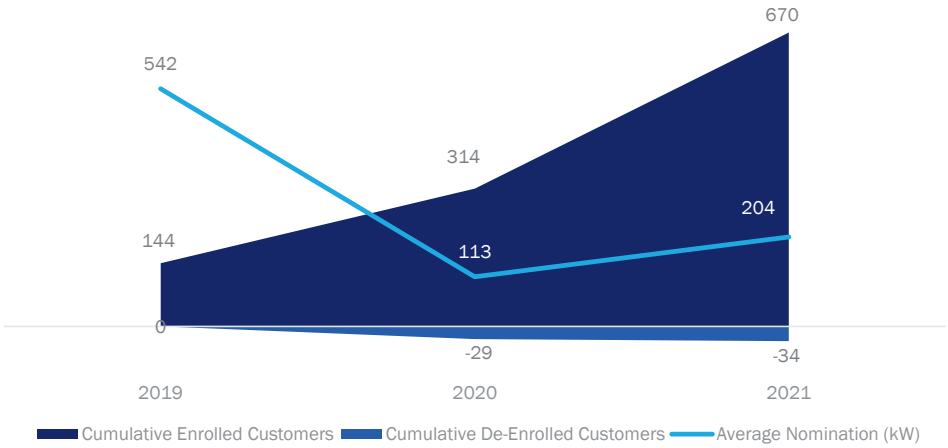


Note that business segments may not always be accurate.

Program Enrollment Trends Over Three Years

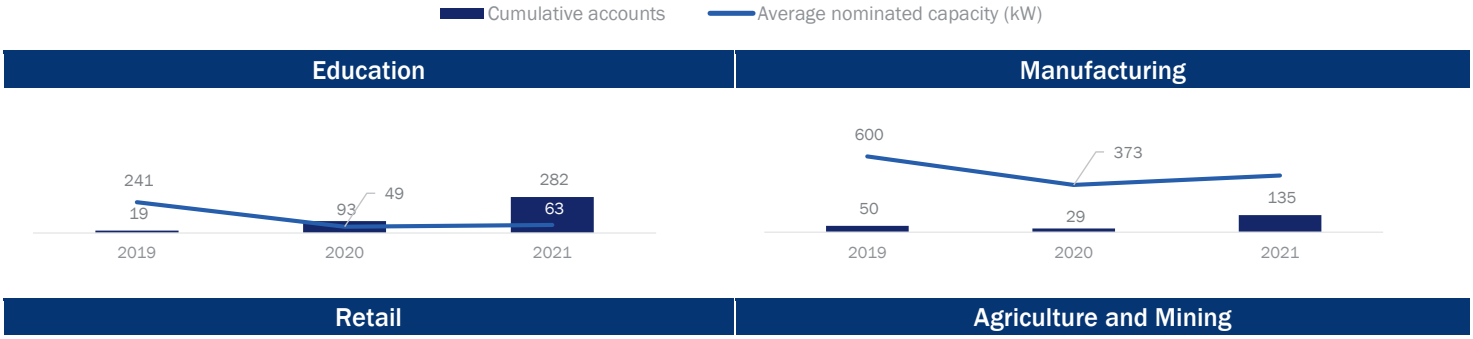
Since program inception in PY2019, a total of 670 customers were enrolled in the program by Enel X, with 34 de-enrolling by the end of PY2021. Figure 32 shows customer enrollment and de-enrollment trends overlayed with average per-customer nomination reflective of customers enrolled in a given program year. As can be seen in the figure, customer nominations changed over time, with PY2019 nominations being the highest of the three program years and PY2021 nominations being the lowest. This trend is not surprising and is consistent with Enel X targeting strategies focused on largest accounts followed by outreach and marketing to smaller customers. Overall, Enel X views customer enrollment in the program relative to Ameren Missouri's customer population size and system size.

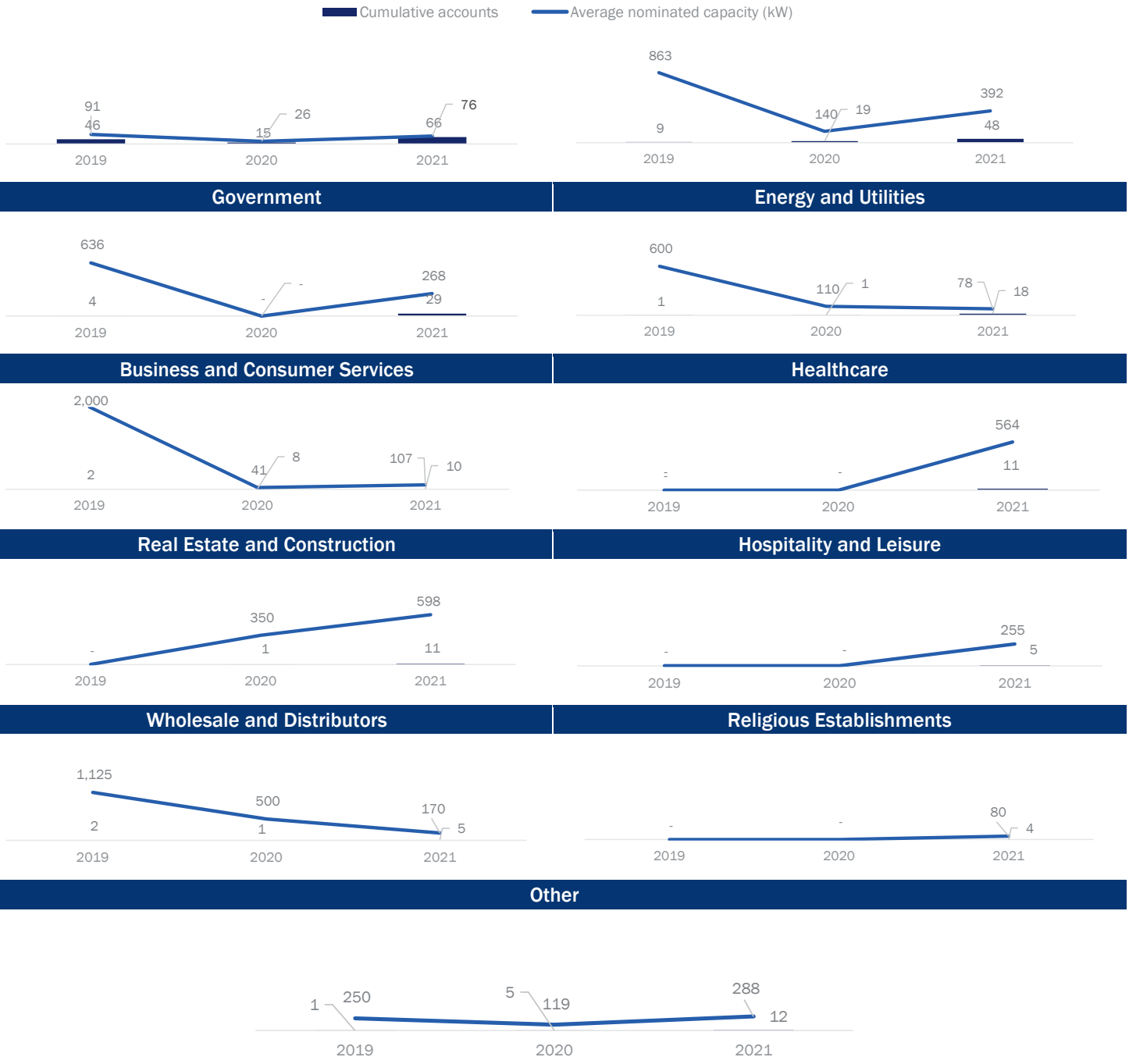
Figure 32. Business DR Program: PY2019-PY2021 Customer Enrollment



Over the course of three years, Enel X enrolled a broad swath of commercial and industrial customers, considerably diversifying participant composition. Customer engagement by sector varied over the years. Figure 33 below shows customer enrollment trends of the three program years, including both customer counts as well as average per-customer nomination capacity. As can be seen in the graphs, customer enrollment by segment was highly variable, with the manufacturing segment experiencing most notable growth in terms of the number of customers. Healthcare, real estate and construction, and hospitality and leisure also experienced considerable growth and presence as part of the program portfolio.

Figure 33. Business DR Program: PY2019-PY2021 Customer Enrollment Trends by Segment





Customer Engagement

Enel X's process for new customer engagement is multi-step and involves a range of touchpoints to inform customer of the program, learn about business operations, as well as work with the potential customer to identify load curtailment opportunities and onboard them into the program. Enel X is targeting all Ameren Missouri's commercial and industrial customers with over 100 kW in peak demand who are opted into energy efficiency.

According to Enel X, the biggest challenge to-date to engaging new customers has been large commercial and industrial customers opting out of energy efficiency programs and therefore being ineligible for the program benefits. Enel X acknowledges that the remaining customer base is not large and offers lower per-customer load curtailment potential and will likely take a considerable amount of effort, including continued outreach attempts, to engage with the program. The key reason for that is that for smaller commercial and industrial customers, the program does not offer a significant financial benefit given their peak load and therefore load reduction capacity.

In an effort to cost-effectively engage smaller commercial and industrial customers, Enel X piloted a "Tech touch DR" - a solution aimed at customers with interval meters to streamline and automate enrollment of those customers into the program. According to Enel X, the pilot yielded limited success and will not be pursued in PY2022 as part of the new customer engagement.

Future customer engagement efforts will be informed by performance successes seen among specific customer segments. Additionally, Enel X is exploring engaging customers with permitted backup generators.

Outreach to existing customers consists of both scheduled and unscheduled engagements. Scheduled engagements include season readiness outreach as part of which Enel X reaches out to customers, checks and updates customer contact information for event dispatch purposes, works to adjust their load curtailment plans and nominations as necessary, and testing notification communications to prepare for a smooth event dispatch process. Unscheduled engagement include outreach related to customer performance during the event season, as well as deeper engagement with underperforming customers to understand reasons for performance and make the necessary adjustments as well as outreach to well performing participants to explore opportunities for an even deeper performance and subsequent increase in nominations and potential incentive payments.

Business Operations

The effects of the COVID-19 pandemic were felt throughout PY2021 with business customer adjusting to the new demands of the market. More specifically, based on the feedback from Enel X, Ameren Missouri Business DR program participants, just like business customers elsewhere across the country, had to adapt their operations to the supply side strains, growing demand, and labor constraints. Those factors were limiting to achieving deeper load reductions during events, per the Enel X. Program participants were reluctant or even unable to disrupt their operations to curtail load as part of the program participation process.

Furthermore, according to Enel X feedback, participating customers entered the program with varying understanding and comfort level around developing curtailment plans and performing against them during event dispatch hours. Enel X's efforts over the last year have been focused on building participant competency around effective load curtailment, especially as this relates to local and smaller in size commercial and industrial customers, who lack experience and expertise with DR programs.

Program De-Enrollment

A total of 34 accounts de-enrolled from the program, which represents 5% of all accounts enrolled in the program, between PY2019 and PY2021. De-enrolled accounts span a range of segments, including manufacturing, education, business and consumer services, and media and entertainment. Most customers who de-enrolled from the program did so soon after enrollment inquiry frequently prior to their nominations being developed or finalized. Reasons for remaining account de-enrollment include cost to curtailment being too high, sites shutting down, and inability to enroll or participate due to onsite construction.

Program Implementation and Participant Experiences

PY2021 marked the dispatch of the first ever system reliability event as part of the program. The event dispatch, just like dispatches of all other events during the program season, went smoothly with no issues related to communications related to the dispatch, event notifications and customer acknowledgement of the upcoming event dispatch. While Enel X acknowledges that the event performance did not quite meet the expectations as compared to customer nominations, event delivery was executed well.

One of the challenges that Enel X faced with delivering the program is the challenge with obtaining customer load data and sharing the performance results with participating customers shortly after DR events. According to Enel X, historically it has been taking upward of two months following event dispatch to share event performance with the participating customers. Such delays limit customer visibility into their performance as well as impede Enel X's ability to work with customers on analyzing performance and identifying opportunities for improvement. To mitigate that, Enel X is planning to meter a larger percentage of the program portfolio, however this effort is still bound to leave a portion of participating customers unmetered and thus lagging in terms of receiving performance insights.

Not all Ameren Missouri commercial and industrial customers have interval meters. When working with customers to develop load curtailment nominations, Enel X is limited by lack of information on customer peak load ta in order to rightsize nominations. As Ameren Missouri rolls out AMI data across its service territory, Enel X should be able to leverage interval data to not only develop more accurate nominations but also to better identify and target customer for program engagement. In the meantime, Enel X is planning to work with existing participating customers, leveraging the data gathered over the most recent event season to update load curtailment nominations thus better aligning performance expectations with goals.

Moving forward in PY2022, per the MISO load modifying resource requirements, the Business DR program will be available for up to ten emergency events, which will need to be reflected in customer contracts and associated communications ensuring that program participants are aware and available for a larger number of load curtailment events. Other than that, Enel X does not plan to pursue any additional program design or implementation modifications in PY2022.

5.3.2 Event Season Demand Savings

The Business DR Program achieved 77.94 MW in total demand savings during the PY2021 event season. The load reduction of 77.94 MW represents 68% of the total nominated capacity from customers, among whom the events were called (Table 30). The evaluation team calculated event performance matches Enel X's calculations of event performance.

Table 30. Business DR Program: Event Performance Summary, Demand Savings

Event	Event Date	Time	Participating Accounts	Total Nominated Capacity (MW)	Event Season Performance (MW)	Share of Nominated Capacity Achieved	Average Per Account Performance (kW)
1	June 18, 2021	4-5 pm CST	453	92.14	62.26	68%	137.45
2	August 16, 2021	3-4 pm CST	544	106.31	74.30	70%	136.59
3	September 7, 2021	3-4 pm CST	56	8.70	3.01	35%	53.81
Overall Event Season Result				**115.06**	**77.94**	**68%**	**129.68**

Note: Accounts among which the event was called.

Not all participants delivered consistent or desired performance. More specifically, 13% of all accounts delivered negative impacts, meaning that their load during event hours increased. Two thirds (67%) delivered positive load reductions during events. The remaining participants delivered mixed load reductions consisting of sometimes negative and sometimes positive load reductions.

A total of 435 customers participated in two events over the course of the PY2021 event season. We explored consistency of those customers' performance across the two events. Of those, only 116 customers (27%) performed consistently.[28] Consistently performing customers also performed well below average event season performance rate collectively averaging at 59% performance rate. Stability of performance event-to-event alongside with alignment of performance with nominated capacity are key to the program being able to anticipate and adapt to ensure continued success.

Table 31 summarizes event season performance by industry. As can be seen in the table, real estate and construction, followed by agriculture and mining, manufacturing, and wholesale and distributors industries yielded the best performance per participating account. Education and energy utility industries delivered the lowest load reduction impacts. Wholesale and distributors, religious establishments, and retail participants delivered impacts above their nominated capacity, suggesting that participants in these segments are capable of better and deeper performance than initially anticipated, whereas participants in the government, healthcare, and manufacturing industries performed well below their nominations, suggesting that further explorations of reasons for underperformance and adjustment of nominations might be warranted.

Table 31. Business DR Program: Event Performance by Segment

Industry	Number of Participating Accounts as of the End of the Event Season	Average per Account Nomination (kW)	6/16/2021 Per Account Average Performance (kW)	8/18/2021 Per Account Average Performance (kW)	9/28/2021 Per Account Average Performance (kW)	Event Season Per Account Average Performance (kW)	Event Season Average Performance Rate (%)
Real Estate and Construction	9	689	610	325	634	523	76%
Agriculture and Mining	38	381	257	313	408	285	75%
Manufacturing	129	430	319	252	131	262	61%
Wholesale and Distributors	5	170	98	374	--	236	139%
Hospitality and Leisure	5	255	60	171		171	67%
Healthcare	4	281	251	137		147	52%
Government	29	268	77	145	-20	110	41%
Business and Consumer Services	10	107	56	107	--	101	95%
Religious establishment	4	80	--	101	--	101	126%
Retail	66	76	80	93	--	87	114%
Energy and Utilities	18	78	163	223	-1	74	95%
Education	272	61	45	53	-9	48	78%

[28] Consistent performance is defined as performance rates between the two events being less than 20 percentage points from one another.

Industry	Number of Participating Accounts as of the End of the Event Season	Average per Account Nomination (kW)	6/16/2021 Per Account Average Performance (kW)	8/18/2021 Per Account Average Performance (kW)	9/28/2021 Per Account Average Performance (kW)	Event Season Per Account Average Performance (kW)	Event Season Average Performance Rate (%)
Other	12	288	151	76		113	39%
Total	**601**	**191**	**137**	**137**	**54**	**130**	**68%**

Enel X's focus in the coming years will be on working with existing customers to find ways to improve their program performance, while pursuing engagement of new customers.

5.3.3 Energy Savings

Achieving energy savings during demand response events was not the primary goal of the Business DR Program. As a result of the three test events during the event season and an additional test event dispatched in December, participants decreased consumption by a total of 908.56 MWh. The energy savings fell short of the target of 1,500 MWh and represent 61% of the MEEIA III goal (Table 32).

Table 32. Business DR Program: Energy Savings Comparison to MEEIA III Goal

Event	MEEIA III Goal (MWh)	Event Season Energy Savings (MWh)	Percent of Goal
Event 1 (June 18, 2021)		107.21	
Event 2 (August 16, 2021)		805.00	
Event 3 (September 7, 2021)		-10.32	
Event 4 (December 7, 2021)		6.67	
Total	**1,500.00**	**908.56**	**61%**

The average per account energy savings was 1.43 MWh. Savings varied by event, but on average represented 8% of the baseline load (Table 33).

Table 33. Business DR Program: Performance Summary, Energy Savings

Event	Date	Time	Participating Accounts	Total Energy Savings (MWh)	Average Per Account Energy Savings (MWh)	Savings as Percent of Baseline Load
1	June 18, 2021	4-5 pm CST	453	107.21	0.24	2%
2	August 16, 2021	3-4 pm CST	544	805.00	1.48	15%
3	September 7, 2021	3-4 am CST	56	-10.32	-0.18	-3%
4	December 7, 2021	3-4 pm CST	35	6.67	0.19	1%
			Overall Result	**908.56**	**1.43**	**8%**

5.3.4 Resource Capability Estimate

Table 34 presents resource capability estimates. These estimates reflect what Ameren Missouri can expect to achieve during a typical weather year and reflects available capacity from all accounts enrolled in the PY2021 event season.

For accounts participating in the event season, resource capability represents a sum of their average event performance during the season. For accounts untested during the event season (e.g., had not enrolled until after the summer event season), resource capability represents their nominated capacity adjusted by the event season performance rate across accounts that participated in the event season. For PY2021, there were no accounts enrolled by the end of the year that were untested. We did not weather normalize resource capability given that we tested weather sensitivity of the participating accounts and generally found little to no correlation of load to weather. Total estimated resource capability is 88.37 MW, representing 77% of the adjusted nominated capacity of the accounts enrolled as of the end of PY2021.

Table 34. Business DR Program: PY2021 Resource Capability Estimate

Metric	Result
Total accounts enrolled as of the end of 2021	636
Nominated capacity (MW)	131.09
PY2021 resource capability estimate (MW)	88.37
PY2021 per-account resource capability estimate (kW)	138.95

Looking ahead to PY2022, the Business DR Program resource capability of 88.37 MW represents 88% of the cumulative PY2022 goal of 100 MW (Table 35). With this enrollment to-date, Enel X is well-positioned to meet the PY2022 demand response target provided sustained performance in PY2022 and successful efforts to enroll additional customers in the program.

Table 35. Business DR Program: Comparison of Resource Capability to Goal

Metric	Result
2021 resource capability estimate (MW)	88.37
PY2022 goal (MW)	100.00
Percent of PY2021 goal	88%

5.3.5 Cumulative DR Capability Estimate

Table 36 presents the PY2021 cumulative DR capability. The value in the table represents demand impacts from tested accounts,[29] either during the PY202! event season or during the December test events. Cumulative DR capability represents a performance metric for the earnings opportunity award for the DR programs. The programs cumulative DR capability is 88.37 MW and represents 118% of the target.

Table 36. Business DR Program: Comparison of Cumulative DR Capability to Target

Metric	Result
PY2021 cumulative DR capability (MW)	88.37

[29] A "tested account" is one that has participated in a demand response event, either during the event season or in one of the additional test events called outside of the event season.

Metric	Result
PY2021 target	75.00
Percent of PY2021 target	118%

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