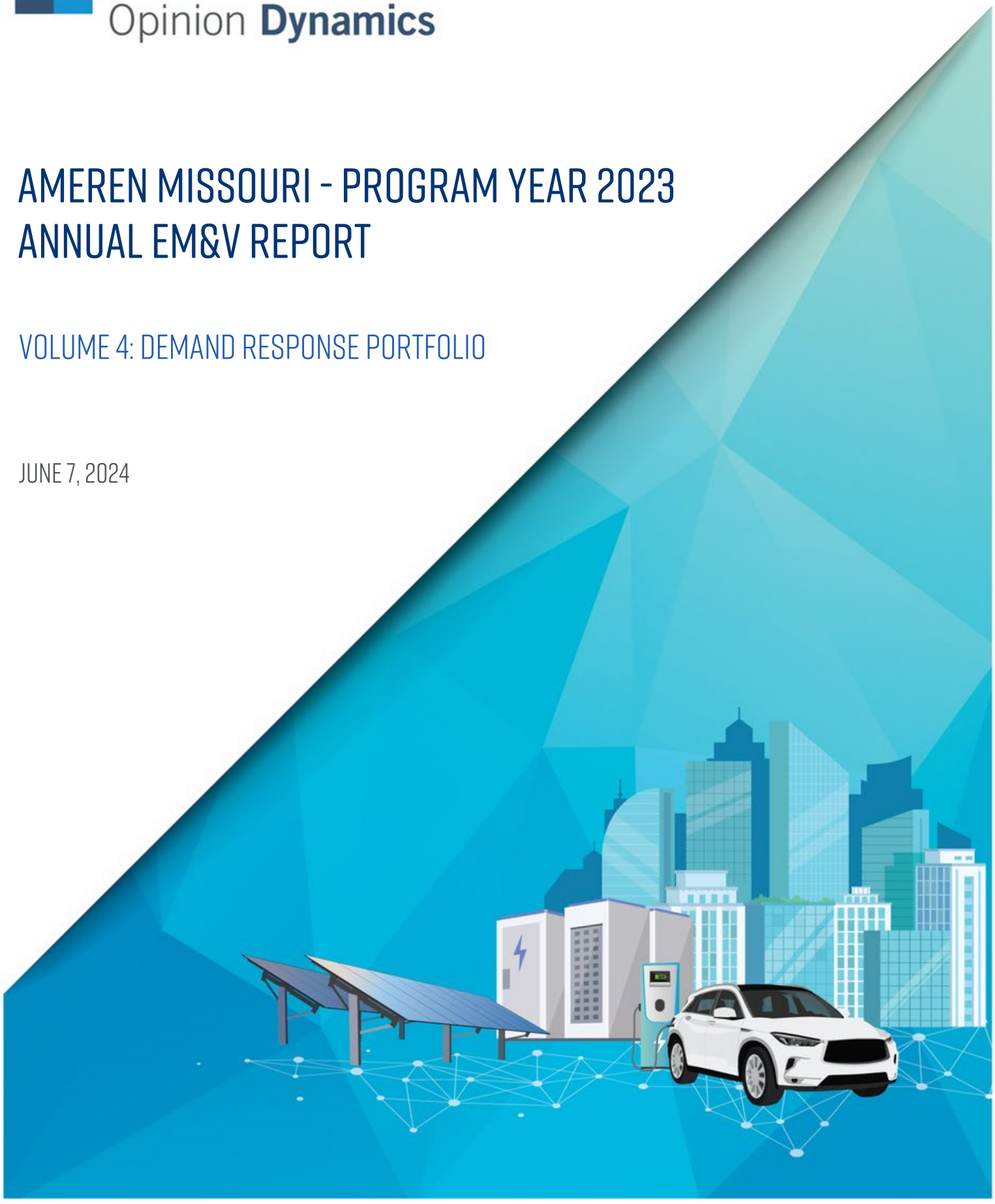
Opinion Dynamics

AMEREN MISSOURI - PROGRAM YEAR 2023 ANNUAL EM&V REPORT

VOLUME 4: DEMAND RESPONSE PORTFOLIO

JUNE 7, 2024



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I. 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 resource capability, also used to assess retention of 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 – The former Residential DR Program enrollment channel that engaged customers who purchased qualifying devices through the Online Store channel of Ameren Missouri's Residential Efficient Products (REP) Program. The Marketplace channel was discontinued in PY2022.

MISO - Midcontinent Independent System Operator, Inc

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

NERC holidays – Holidays observed by the North American Reliability Corporation (NERC). They include 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 PY2023 Annual Report presents evaluation results for the Ameren Missouri PY2023 portfolio of demand response (DR) programs, as described in Ameren Missouri's 2019–21 Missouri Energy Efficiency Investment Act (MEEIA) Energy Efficiency Plan, the subsequent *Unanimous Stipulation and Agreement Regarding the Implementation of Certain MEEIA Programs Through Plan Year 2022* (Stipulation PY2022), and the nonunanimous Stipulation and Agreement Regarding the Implementation of Certain MEEIA Programs Through Plan Year 2023 ("Stipulation PY2023"). The DR portfolio consists of two programs: the Residential DR Program (also referred to as the Peak Time Savings Program) and the Business DR Program. Launched by Ameren Missouri in 2019, these programs are now in their fifth year of operation. In this document, the evaluation team provides portfolio-level results for PY2023 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 PY2023 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 PY2023 were limited to a review of program materials, analysis of participation data, and interviews with program staff and implementation contractors.

This volume is organized as follows:

- The remainder of this chapter presents key evaluation findings and recommendations for the DR portfolio.
- Chapter 3 presents the overarching evaluation objectives and an overview of the PY2023 evaluation activities and methodologies for the DR programs.
- Chapters 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 PY2023 included ecobee®, Nest®, and Sensi® devices; Honeywell® devices were also added near the end of PY2023.[1,2] Customers either bring their own thermostats (also known as the BYOT channel) or can receive their thermostats through direct installation. Historically, customers were also able to purchase and install qualifying devices directly through the Ameren Missouri Online Marketplace. Eligible devices are still available on the marketplace; however, there was no direct channel into the DR program in PY2023. 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 PY2023 was limited to Sensi devices.

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

[2] Sensi was a former Emerson brand that was purchased by Copeland.

The Business DR Program is designed to reduce load during periods of peak demand. Enel X, the program aggregator, is responsible for recruiting and enrolling customers, developing customized load reduction nominations and load curtailment strategies, dispatching DR events, and maintaining customer relationships with participating businesses.[3] 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.

Figure 1 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, Sensi and Honeywell* smart thermostats	Measure agnostic
Number of 2023 Events	6 test events (varying duration) 3 load shaving events (varying duration) 1 four-hour staggered test event	4 events (varying duration)
Participation Incentive	$50 sign up; $25 participation	Custom incentive
Program Implementers	Franklin Energy, Uplight	Enel X

Note: One of the Business DR Program test events was dispatched in December 2023.
*Honeywell was added in October 2023. No Honeywell devices were dispatched in 2023.

Table 1 shows the DR portfolio MEEIA III demand reduction and energy savings targets for the Business DR, Residential DR, and overall DR portfolio. In PY2023, the cumulative targets for demand reduction and energy savings of the Business DR program and energy savings of the Residential DR program remained unchanged. The demand savings cumulative target for the Residential DR program experienced smaller incremental growth than in previous years. The overall targets are 166.5 MW in demand savings and 8,547 MWh in energy savings. The Business DR Program is expected to contribute to 60% of the portfolio's demand savings target, while the Residential DR Program is expected to deliver 76% of the portfolio's energy savings target.[4]

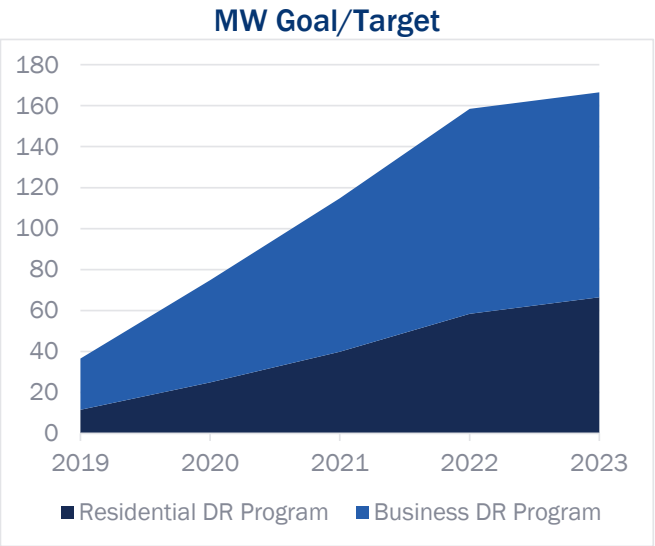
[3] In PY2023, Enel X continued their channel partnership with Enersponse as part of their contract with Ameren Missouri to support recruitment of small- and medium-sized customers into the program.
[4] Stipulation PY2023 sets annual first year energy and demand savings goals/targets. In addition, Ameren Missouri developed impact metrics that are used to determine performance bonuses.

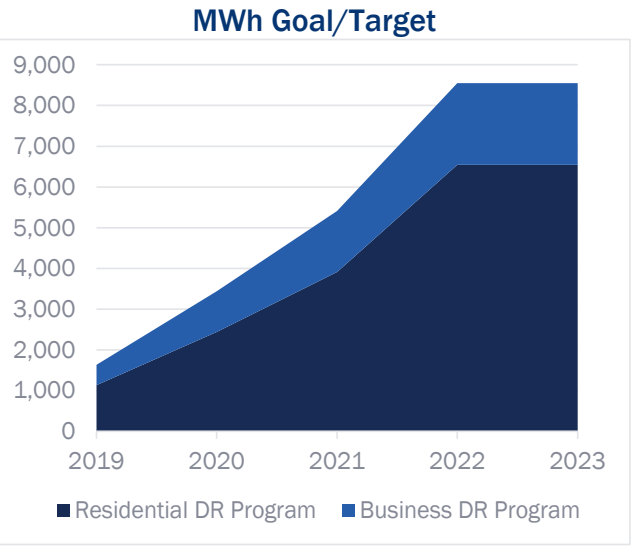
Table 1. Incremental and Cumulative MEEIA Goals/Targets

Program Year	Residential DR Program		Business DR Program		DR Portfolio	
	Incremental Goal/Target	Cumulative Goal/Target	Incremental Goal/Target	Cumulative Goal/Target	Incremental Goal/Target	Cumulative Goal/Target
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
PY2022	18.62	58.41	25.00	100.00	43.62	158.41
PY2023	8.09	66.50	0.00	100.00	8.09	166.50
Total	**66.50**	**66.50**	**100.00**	**100.00**	**166.50**	**166.50**
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
PY2021	1,471	3,912	500	1,500	1,971	5,412
PY2022	2,635	6,547	500	2,000	3,135	8,547
PY2023	0	6,547	0	2,000	0	8,547
Total	**6,547**	**6,547**	**2,000**	**2,000**	**8,547**	**8,547**

Figure 2 summarizes cumulative DR portfolio targets. Throughout the remainder of this report, we assess the programs' performance against MEEIA cumulative PY2023 targets.

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





2.2 PORTFOLIO IMPACT RESULTS

At the end of the PY2023 event season, the demand response portfolio achieved 103.40 MW in average load reduction as well as 1,626.21 MWh in energy savings (Table 2).

Table 2. PY2023 Event Season Performance Summary

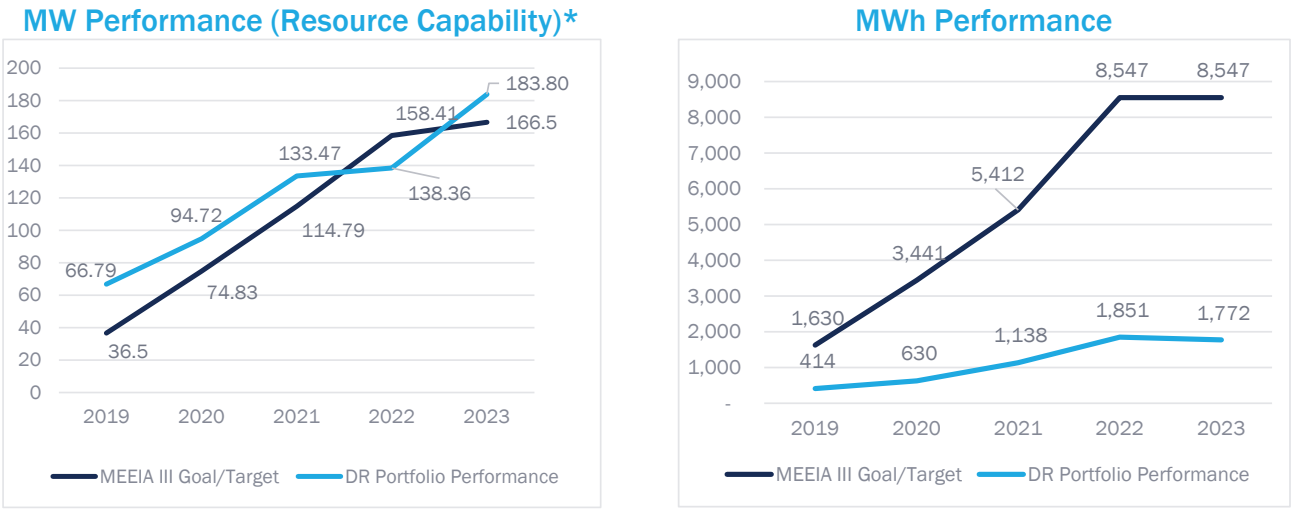
Program	Participants	Event Season MW Performance	Event Season MWh Performance
Residential DR Program	43,340	39.53	843.65
Business DR Program	1,025	63.87	782.56
Total DR Portfolio	**44,365**	**103.40**	**1,626.21**

Note: The participant count for the Residential DR Program represents the average number of participants among whom events were dispatched. Energy and Demand savings for the Business DR Program only include event season events.

To compare the DR portfolio demand savings performance against MEEIA III MW targets, 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 targets. The portfolio achieved a total of 183.80 MW (or 110% of target), exceeding the demand goal of 166.5 MW by 17.30 MW, but falling considerably short of the energy savings goal, achieving 1,769 MWh (or 21%) of the 8,547 MWh target.[5] Notably, the MEEIA III target for the Residential DR Program relied on the expectation that device optimization through the program would be performed across all participating devices. However, following the release of the energy optimization algorithms by Nest and ecobee across all of their devices, program-driven optimization was no longer possible. Consequently, MEEIA targets are not feasible for the program to achieve.

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

Figure 3. DR Portfolio Performance Against MEEIA III Cumulative Goals/Targets



*Includes a very small number (~35) of accounts that unenrolled prior to the end of the year.

Table 3 provides a detailed summary of each program's performance against MEEIA III targets. The Residential DR Program did not meet its resource capability targets, achieving 79% of its target; however, the Business DR Program exceeded its resource capability target, achieving 131% of its target. Combined, the two programs exceeded the PY2023 target by 10%.

Both programs underperformed against their energy savings targets (13% for the Residential Program and 46% for the Business Program). Energy savings for the Residential DR Program include event day impacts during the event season as well as energy savings achieved through optimization of Sensi 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 Goals/Targets

Program Year	Cumulative 2023 MEEIA III Goal/Target	PY2023 Performance	Goal/Target Achieved (%)
Resource Capability (MW)			
Residential DR Program	66.50	52.37*	79%
Business DR Program	100.00	131.43	131%
Total DR Portfolio	**166.50**	**183.80**	**110%**
Energy Savings (MWh)			
Residential DR Program	6,547.00	846.59	13%
Business DR Program	2,000.00	925.63	46%
Total DR Portfolio	**8,547.00**	**1,772.22**	**21%**

*Includes a very small number (~35) of accounts that unenrolled prior to the end of the year.

In addition to the event season performance and resource capability performance, we also calculated cumulative DR capability (Table 4). For the Residential DR Program, the cumulative DR capability mirrors the resource capability; however, per the MEEIA III Plan, the cumulative DR capability is based on the performance of tested participants only, as opposed to all participants enrolled in the program at year-end.[6] In PY2023, all

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

Business DR participating customers were tested as part of either summer or winter test events. Therefore, cumulative DR capability is equal to resource capability.

Table 4. PY2023 Event Season Performance Summary

Program	Target (MW)	PY2023 Performance (MW)	% of Target Achieved
Residential DR Program	66.50	52.37	79%
Business DR Program	100.00	131.43	131%
Total DR Portfolio	**166.50**	**183.80**	**110%**

2.3 PORTFOLIO PROCESS FINDINGS AND RECOMMENDATIONS

In PY2023, the fifth year of operation for Ameren Missouri's DR 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 evaluation team presents the following key program-specific conclusions and recommendations:

RESIDENTIAL DR PROGRAM

- Conclusion 1: The Residential DR Program succeeded in enrolling 13,689 new devices into the program in PY2023. This is a substantial number of new enrollees; however, they were not sufficient to achieve program impact goals. The program achieved 79% of its target DR capability goal and resource capacity goal and 13% of its energy savings goal. Expanding the program to incorporate Honeywell devices creates an opportunity to connect with the previously untapped customer base, potentially leading to a significant increase in the participant population. The success of the expansion will rely on ensuring that the performance of Honeywell devices is in line with or above historically observed trends.
  - 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: Over the course of the PY2023 summer event season Ameren Missouri continued to test alternative dispatch strategies aimed at establishing locational capabilities of the program and exploring opportunities to increase consistency of demand impacts hour-to-hour. To that end, Ameren Missouri successfully dispatched three locational events targeting capacity-constrained circuits. Notably, Ameren Missouri was able to dispatch those events in an experimental fashion following the best-in-class practices. In addition, Ameren Missouri tested an innovative staggered event dispatch design. The event dispatch resulted in important lessons learned about the limitations and opportunities associated with staggered event dispatches, paving the way for further opportunities to explore and refine staggered dispatch strategies. Through these efforts Ameren Missouri continued advancing program capability to support emerging system needs in order to position the program for future success.
  - Recommendation 2: Ameren Missouri should continue testing the locational capabilities of the program and further explore opportunities to ensure consistent, steady, and deep demand impacts across event hours of longer events.

- **Conclusion 3**: Optimization of Sensi devices on non-event days resulted in an additional 3% reduction in energy usage per day during the days when the optimization algorithms ran. The implementer ran optimization using a thoughtful experimental design, allowing for a rigorous and straightforward evaluation of program impacts.
  - **Recommendation 3:** The program should continue deploying optimization algorithms on Sensi devices using experimental design as a pathway to achieve additional energy savings.
- **Conclusion 4**: Completion of AMI rollout and the emergence of various TOU rates, along with Ameren Missouri's choice to default customers into time-varying rates, may have impacts on the baseline load available for the program to control longer-term. In the future, as participants adopt and habituate load-shifting behaviors in response to rate-based price signals (which coincide with event dispatch time), it can result in different amounts of load available for the program to curtail.
  - **Recommendation 4**: Ameren Missouri should carefully monitor the adoption of the various TOU rates among the participant population and explore differences in baseline loads and impacts experienced by customers enrolled in TOU rates. This will allow Ameren Missouri to better anticipate and plan for any changes, both positive and negative, in demand impacts resulting from growing TOU rate adoption.

BUSINESS DR PROGRAM

- **Conclusion 1:** The Business DR Program exceeded its PY2023 cumulative target of 100 MW by 31.43 MW. The newly eligible MEEIA energy efficiency opt-out participants accounted for nearly half (61 MW) of the PY2023 cumulative capability. With an incremental goal of 37.04 MW in PY2024, the DR capability of 131.43 MW represents 96% of the PY2024 cumulative DR capability target. Given low levels of participant attrition over time, the program is positioned well to meet and exceed the PY2024 target. As such, the primary focus of the program can shift from recruitment to working with existing participants to maintain their performance and on enrolling some new program entrants to meet future goals.
  - **Recommendation 1:** Program staff should continue proactive outreach to existing and newly qualified customers. Program staff should also work with the program aggregator, Enel X, to continue to capitalize on existing relationships and processes, including their partnership with Enersponse to engage small and medium-sized businesses, and ongoing communication with participants to increase their comfort level with the program**.** Tapping into not yet enrolled newly eligible customers following the tariff change should allow for additional strong nominations to supplement the existing participant population.
- **Conclusion 2:** Only 20% of Business DR Program participants maintained consistent event performance in PY2023, and the average performance rate of these participants was well below the average performance rate of all other participants. The stability of performance event-to-event, alongside the alignment of performance with nominated capacity, are key to more accurate planning of the program capability and adapting more efficient recruitment and engagement strategies. Variation in performance by industry type can present an opportunity to further tap into existing data and insights to identify underperforming customers and deploy course-corrective actions aimed at deeper and more consistent performance.
  - **Recommendation 2:** Program staff should work with the program aggregator, Enel X, to continue efforts to align nominations with observed performance with a special focus on customers and industry segments with consistently low performance to determine whether those customers remain a viable target for the program and to identify opportunities to strengthen and improve their

performance. In addition, future evaluation should include additional process research to better understand these sites and how these participants respond to DR events.

- **Recommendation 3:** In addition to focusing on negative and top performers, program staff should work with the program aggregator, Enel X, to conduct outreach to customers to understand reasons for highly variable performance, and to identify whether there are opportunities for improvements in consistency event-to-event. Program staff should target industry segments with meaningful volumetric presence (participant counts and kW nominations) and inconsistent performance.

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 costs-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 nonparticipants) in the utility service territory
- **Utility Cost Test (UCT):** Perspective of utility, government agency, or third-party program implementer
- **Ratepayer Impact Measure (RIM) Test:** Impact of efficiency measure on nonparticipating ratepayers overall
- **Participant Cost Test (PCT):** Perspective of the customers installing the measures
- **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 and UTC tests, while only the Business DR Program is cost effective under the RIM tests. 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	1.38	1.03	0.99	n/a
Business Demand Response	4.26	2.43	2.35	n/a

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

[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.

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.

3. EVALUATION APPROACH

This section presents the evaluation approach for the Ameren Missouri PY2023 Residential DR Program and the Business DR Program. The evaluation team assessed each program separately. The activities and results of each program-level evaluation are presented individually in subsequent chapters 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 impact objectives. An additional objective is focused on responding to the five key research questions stipulated by the Missouri Code of State Regulations (CSR).[9] The research objectives addressed by the PY2023 DR portfolio evaluation are described in greater detail below.

3.1.1 PROCESS OBJECTIVES

Process-related activities were limited in PY2023 and focused on targeted review and analysis of participation data streams to address the following key process evaluation objectives:

- Understand participant composition and its changes over time.
- Assess participant enrollment and unenrollment behaviors.
- 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 associated with the optimization of Sensi 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 Sensi devices.

Notably, PY2023 marked the first year when we relied solely on AMI data to develop impact estimates for the Residential DR Program.

[9] The Missouri Code of State Regulations (20 CSR 4240.22.070(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 using industry-standard cost-effectiveness tests.
- Ensure alignment of cost-effectiveness testing assumptions and parameters with the PY2023 DR evaluation results, Ameren Missouri's TRM Version 6.0, 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 required questions:

- 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

Table 6 shows the research activities included in the two evaluations. Additional details, where relevant, are included in the program-specific chapters.

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	✓	✓
Gross Impact Analysis		
Database Review	✓	✓
Ex Post Event DR Impacts	✓	✓
Ex Post Event Energy Impacts	✓	✓
Resource Capability Assessment	✓	✓
Energy Optimization Impacts	✓	-

Note: Energy Optimization Impacts were only completed for Sensi 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 PY2023. We explored details of the design and planned implementation for the two programs; ongoing changes in design, marketing, targeting, and event dispatch occurring over the course of the year; and program staff's feedback on the programs' performance and evaluation priorities.

The evaluation team also conducted focused interviews with program and implementation staff at the end of PY2023 to develop an overall assessment of PY2023 processes and plans for programmatic changes in PY2024.

3.2.2 PROGRAM MATERIAL REVIEW

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

3.2.3 TRACKING SYSTEM REVIEW

In the spring of 2023, the evaluation team revisited program-tracking, interval data systems, and data provision processes across Ameren Missouri, Franklin Energy, Uplight, Nest, ecobee, Sensi, as well as Enel X. The goals of this review were to (1) capitalize upon lessons learned through previous evaluations, (2) ensure the data extracts and frequency of data provision are aligned with evaluation goals and timelines, and (3) ensure the data extracts contained the necessary data to complete our evaluation accurately.

3.2.4 GROSS IMPACT ANALYSIS

We performed the following key gross impact analyses for the PY2023 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 Sensi devices.
- Determined resource capability for all participants enrolled throughout PY2023.

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 (RCT), producing net energy impacts, which already reflect free ridership and participant spillover, if any.

CSR-MANDATED RESEARCH OBJECTIVES

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

4. RESIDENTIAL DEMAND RESPONSE PROGRAM

This chapter summarizes the PY2023 evaluation methodology and results for the Residential DR Program.

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 fifth year in PY2023. Eligible customers included Ameren Missouri electric customers with central air conditioning systems (including heat pumps) who either had or were ready to receive a direct install of an eligible smart thermostat and enroll in the program. Qualifying smart thermostats in PY2023 included ecobee, Nest, and Sensi devices.[10] Additionally, Honeywell devices were added to the program in October, 2023. Customers could either enroll their existing devices (BYOT channel) or have a device directly installed. The direct install option was introduced in PY2023. Historically, customers had the option to purchase, install, and enroll a device through the Ameren Missouri Online Marketplace (Marketplace channel) in the DR Program; however, this channel was modified in PY2022. Customers could enroll multiple devices in the program and receive a $50 sign-up bonus for enrolling their device(s) in the program and $25 for each year they remain in the program, provided they actively participate in events. Historically, customers purchasing participating devices through the Online Marketplace were eligible to receive a $50 incentive for purchasing the device and the $50 sign-up bonus available through the DR Program. In PY2023, customers purchasing a Marketplace device received a $100 incentive for the purchase of the device without the requirement to participate in the DR Program. These participants could receive an additional $50 sign-up bonus for enrolling in the Residential DR Program.

The program was administered by Franklin Energy, which was 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, as the overall residential portfolio implementation contractor, was responsible for coordinating the overall management and data systems for the residential portfolio. The focus of the program in PY2023 was on delivering demand and energy impacts. Event dispatch platforms varied by device manufacturer and as a result, so did participant notifications, precooling strategies, and event hour thermostat adjustment algorithms.

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 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 providing data to Uplight for final verification and enrollment, whereas Uplight conducted all verification and enrollment for Sensi devices. Uplight sent successful enrollments to Franklin Energy daily for official records and incentive payments.

Historically, the share of Residential DR participants on a time of use (TOU) rate has been minimal. As AMI meters are installed, however, customers receiving these meters are defaulted into the DayNight Evening/Morning Saver TOU rate six months after AMI meter installation.[11] As the widespread AMI meter roll out nears completion, a much larger share of Residential DR participants are on the Evening/Morning Saver

[10] Sensi was a former Emerson brand that was purchased by Copeland.

[11] The default Evening/Morning Saver TOU rate defines peak hours as 9am to 9pm on all days. The energy adjustment per kWh for on-peak is 0.50 cents in the summer (June – September) and 0.25 cents in the winter (October – May).

TOU rate. In addition, customers have an option to enroll in more complex TOU rates, including the Smart Saver, Overnight Saver, and Ultimate Saver TOU rates. Over time these enhancements and changes can impact customer load and demand savings from the program.

4.1 EVENT DISPATCH PROCESSES

Program delivery in PY2023 included a RCT design, wherein devices were randomly assigned into treatment and control groups. Treatment group devices received event notifications and event signals, while control group devices did not. Participants were assigned into treatment and control groups for each manufacturer independently. Control group sizes varied by manufacturer. Consistent with the contractual requirement to dispatch a system-wide event, one of the events did not include a control group. In addition, Ameren Missouri tested additional and innovative dispatch strategies to ensure preparedness for future integration of the program with the MISO markets and to test the program's flexibility to support locational system needs. Overall, over the course of the event season, Ameren Missouri successfully dispatched a total of ten demand response events, broken down as follows:

- **Peak load-shaving events** – Ameren Missouri dispatched three peak load-shaving events triggered by day ahead load forecasts. The three events were three and four hours in duration. Dispatch of the four-hour events was prompted by the forecasts and the desire to test the program preparedness for MISO emergency events.
- **Test Events** – Ameren Missouri dispatched seven test events ranging in duration from two to four hours.
  - **Standard events** – Ameren Missouri dispatched three standard events ranging from two to three hours in duration. The events were dispatched in an experimental fashion wherein a dedicated control group was dispatched at random ahead of each event for each device manufacturer.
  - **Locational events** – Ameren Missouri dispatched three two-hour locational events, all of which were test events. The events were focused on participants located at certain capacity-constrained feeders. Ameren Missouri identified feeders with the highest load (~100 feeders) and dispatched only the participants on these feeders. The events were dispatched in an experimental fashion, consistent with the standard event dispatches; however, the number of participants was limited.
  - **Staggered event** – Ameren Missouri dispatched one staggered four-hour event wherein half of participants eligible for dispatch were dispatched for the first two hours and the other half were dispatched for the second two hours of the event. The goal of this dispatch was to test the ability to sustain consistent load curtailment over the course of a four-hour event.
  - **Full Population Event** - Ameren Missouri dispatched one system-wide event that was three hours in duration. The event was dispatched among the entire population of participating customers.

Figure 4 documents successfully dispatched event days and times alongside the average temperature during the event dispatch hours.

Figure 4. Residential DR Program: Event Days with Average Maximum Temperatures and Event Hours

Table 7 details the platforms Uplight relied on to dispatch events in PY2023. Specifically, Uplight relied on the Rush Hour Rewards (RHR) platform to dispatch events among Nest devices, the eco+ platform for ecobee devices, and the Orchestrated Energy (OE) platform for Sensi 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
Sensi	Orchestrated Energy (OE)	Uplight DR Platform	All events except 7/27/2023[A]

Note: Honeywell devices will likely be dispatched by the Vendor DR platform in PY2024 but will eventually be dispatched by Uplight through Orchestrated Energy.

[A] On July 27, 2023, Sensi devices were dispatched by the Vendor DR Platform.

The Residential DR Program was initially designed as an integrated demand response and energy efficiency program aimed at achieving demand reductions and harvesting energy savings on non-event days. To that end, Uplight started using its OE platform to optimize devices at the beginning of the PY2019 summer season (May 2019). Nest and ecobee optimization platforms (eco+ and Seasonal Savings) are broadly available, therefore, Uplight could not deploy program-driven energy optimization algorithms on either Nest or ecobee devices. In PY2023, Uplight ran OE optimization algorithms on Sensi devices only, starting in early June. Consistent with PY2022, weekends were excluded from the optimization of Sensi devices in PY2023.

FUTURE EVENT DISPATCHES

In PY2024, eligible devices will include Nest, ecobee, Sensi, and Honeywell Wi-Fi-connected smart thermostats. Program staff anticipate continuing dispatching events in a locational and staggered fashion. In addition, following the tariff change that allows 15 events in PY2024 and to prepare for MISO emergency events, Ameren Missouri plans to reserve five event days to dispatch consistent with MISO emergency event

dispatch practices and policies. This includes dispatching the events with a potentially shorter notification window (6-hour as opposed to 24-hour) and a four-hour event duration. To that end, Ameren Missouri has developed processes and customer-facing communications to support the dispatch of these events.

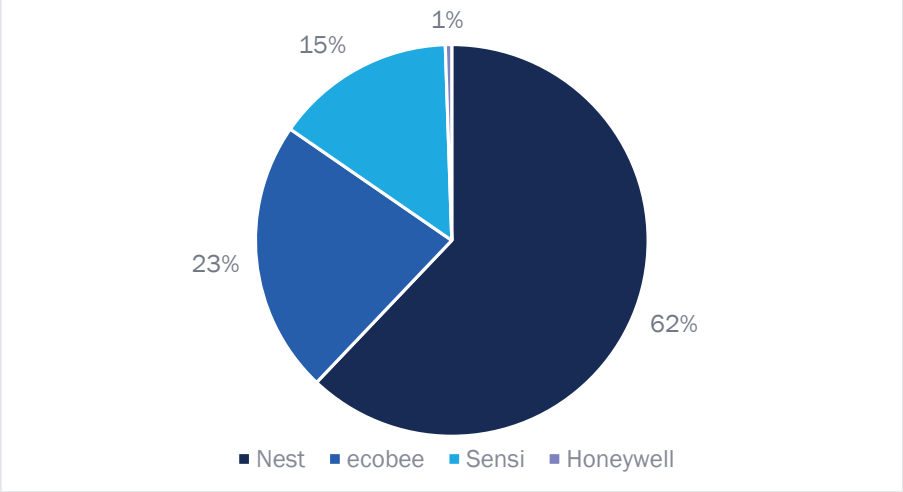
The program implementer is anticipating changing the Sensi OE algorithm comfort model in PY2024 to apply deeper machine learning and to consider the weather when optimizing devices both on event and non-event days.

Program staff also plan to dispatch winter DR events starting in the winter of 2024-2025, pending a tariff change. As with summer DR, the dispatch will differ by vendor. Program staff anticipate that for customers to participate in the winter season events, they must have eligible systems to participate in the summer event season as well. Additionally, Ameren Missouri is considering optimizing Sensi devices on non-event days in future seasons.

4.2 PARTICIPATION SUMMARY

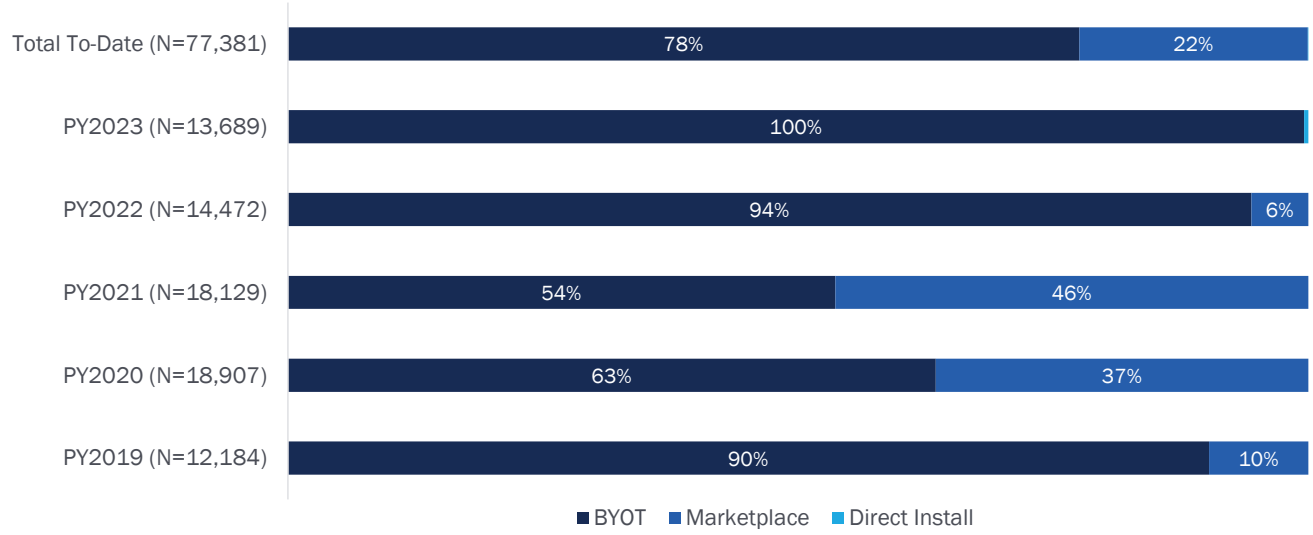
There were 46,213 active customers as of the end of 2023, with 43,180 enrolled before the end of the PY2023 event season and an additional 3,033 customers who enrolled between October and December 2023. Active participants had 54,808 devices enrolled and active in the program at the end of PY2023, an average of 1.19 devices per household. Participating devices in PY2023 represented a mix of manufacturers. More specifically, close to two-thirds of participating devices (62%) were Nest devices, close to one-quarter (23%) were ecobee devices, 15% were Sensi devices, and only 1% were Honeywell devices (Figure 5).

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



In PY2022, the REP Online Store channel modified the requirement for customers to enroll in the Residential DR Program to receive the thermostat incentive. The removal of the bundled incentives was to improve customer experience. Accordingly, starting in early PY2022, the marketplace channel was removed. In PY2023, the program introduced a direct installation channel. Direct installs account for only a handful of devices enrolled in the program (Figure 6).

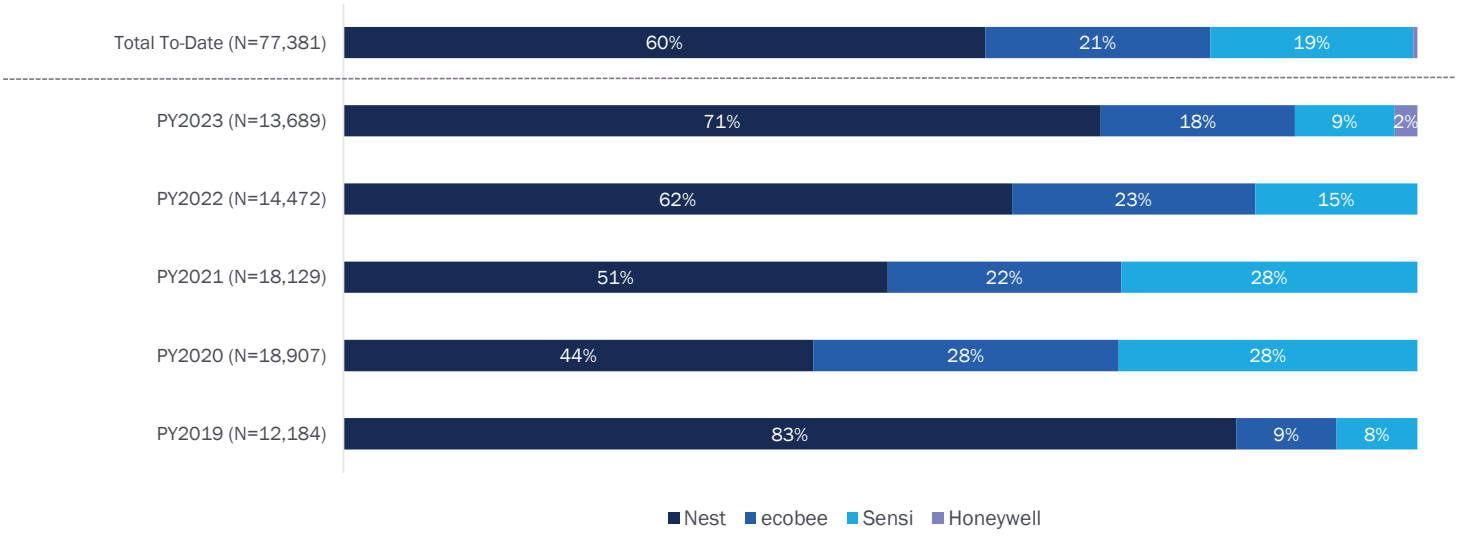
Figure 6. Residential DR Program: Device Enrollment Trends by Channel



Note: Device counts include devices that unenrolled from the program over the course of five years and are not reflective of the active device counts as of the end of the program years.

The manufacturer mix of participating devices in PY2023 was relatively consistent with previous years (Figure 7). The PY2023 device mix mostly mimicked that of PY2020, PY2021, and PY2022, except for the addition of Honeywell devices in PY2023. Honeywell devices were added to the program in late PY2023 and accounted for 2% of enrolled devices as of the end of the Program Year. Honeywell devices accounted for <1% of the total device mix.

Figure 7. Residential DR Program: Device Enrollment Trends by Manufacturer

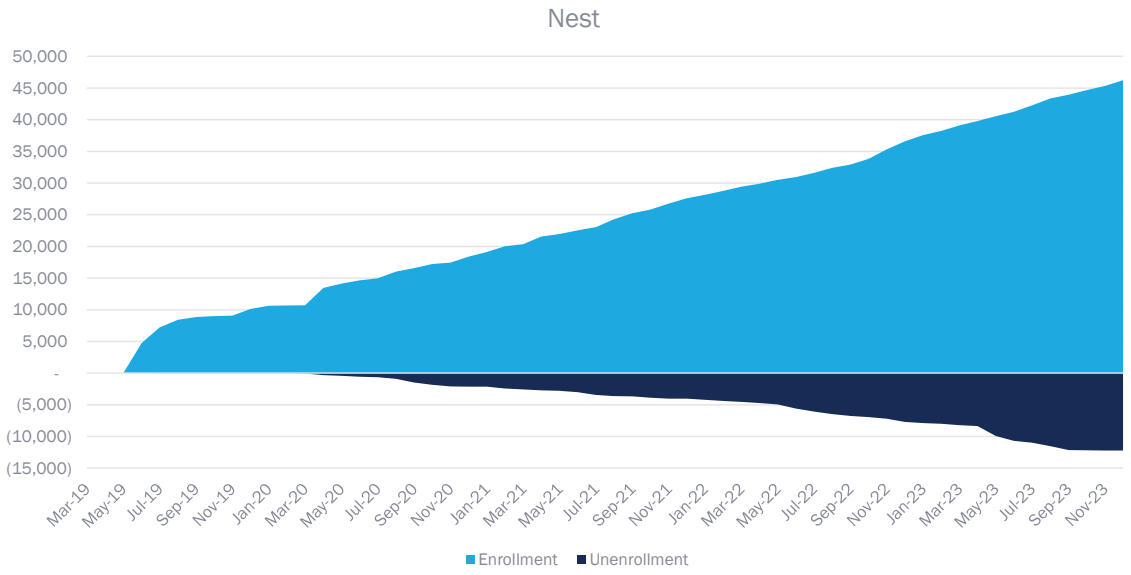


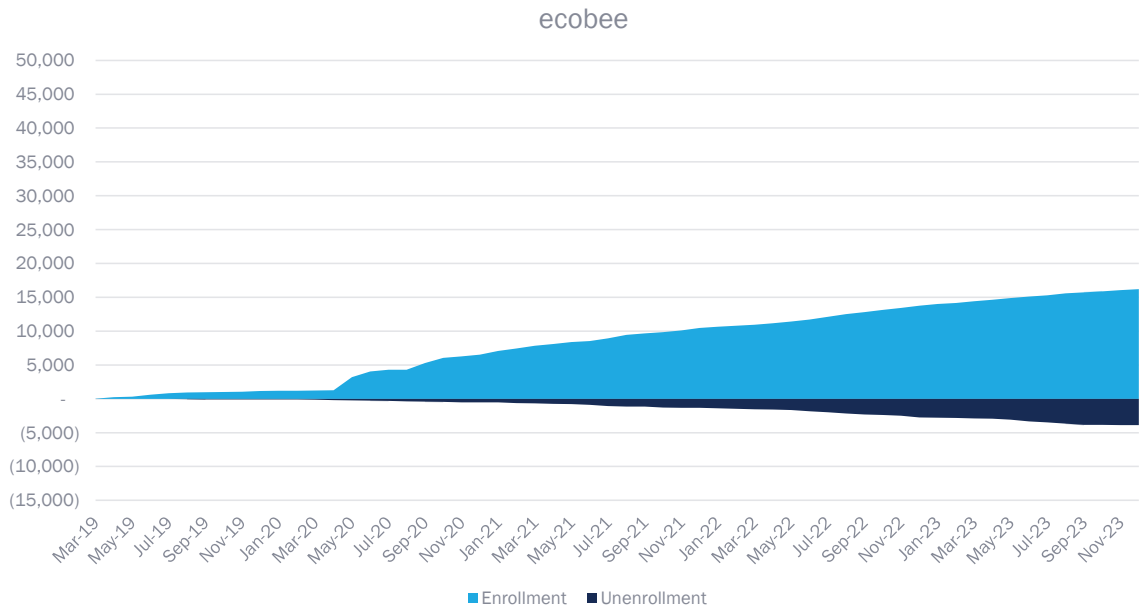
Note: Device counts include devices that unenrolled from the program over the course of five years and are not reflective of the active device counts as of the end of the program years.

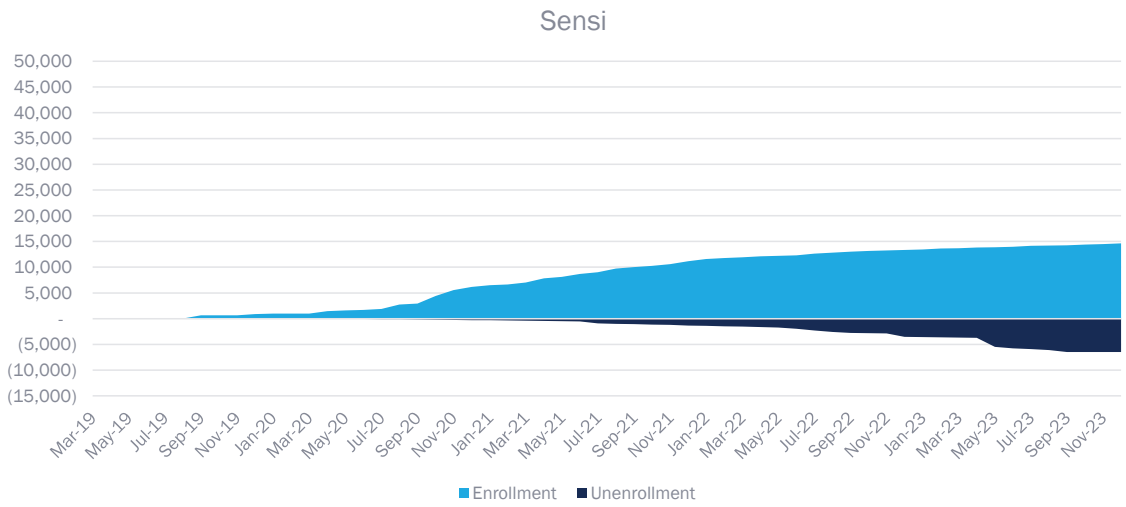
Figure 8 summarizes cumulative device enrollment and unenrollment trends by device manufacturer over the course of five program years. Enrollment and unenrollment trends are shown for each device manufacturer.

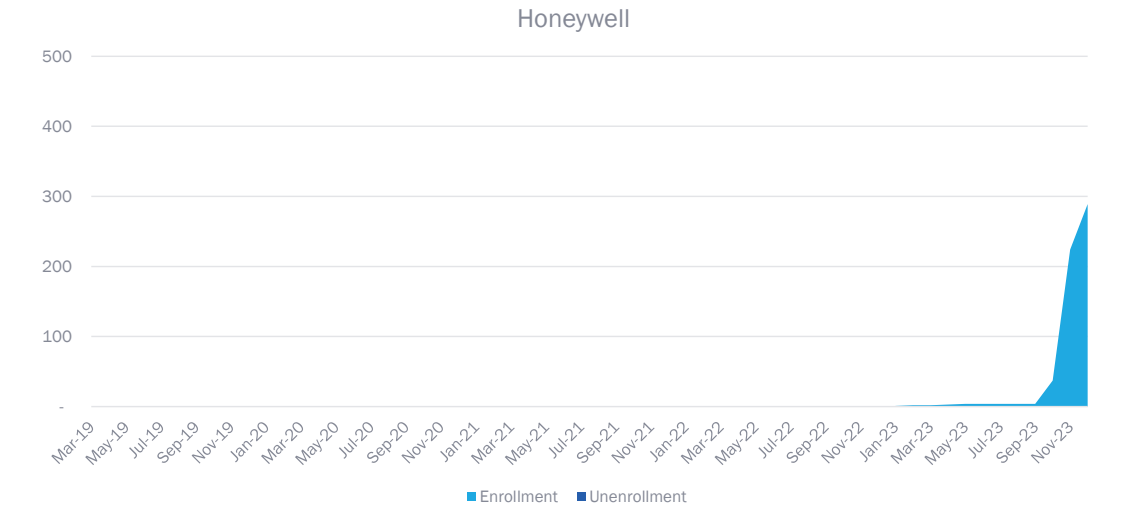
Enrollment trends for Nest devices show steady gains over time, with a slight increase prior to the PY2020 event season. Ecobee device enrollment experienced a significant spike prior to the start of the PY2020 event season, with steady gains over time. Enrollment of Sensi devices, which include devices enrolled when Sensi was owned by Emerson, continued to increase moderately over the course of PY2023. Sensi devices experienced a significant increase in unenrollment at the start of the PY2023 event season. This bump in unenrollment was due to an implementer true-up process and is not representative of the actual unenrollment date. A similar but smaller bump can be observed for Nest devices for the same reason. Honeywell devices were added to the program in PY2023, with enrollment spiking in October and November coincident with the email marketing campaign.

Figure 8. Residential DR Program: Device Enrollment over Time by Device Manufacturer









Note: Axes differ between graphs.

A total of 29% of participants unenrolled from the Residential DR Program since its launch in PY2019 (Table 8). Sensi participants unenroll at a higher rate than other participants.

Table 8. Residential DR Program: Customer Unenrollment Trends

Device Manufacturer	PY2023	Cumulative as of End of PY2023
Nest	10%	26%
ecobee	13%	24%
Sensi	14%	44%
Honeywell	0%	0%
Total	**10%**	**29%**

Note: PY2023 unenrollment rates include customers who enrolled and unenrolled within 2023 but do not include customers who enrolled during previous years and unenrolled during PY2023.

4.3 EVALUATION METHODOLOGY

The PY2023 evaluation focused on impact evaluation activities to assess the performance of the Residential DR Program. The evaluation team explored the following research objectives:

- Characterize program participation concerning the devices selected, event participation, and other relevant characteristics.
- Estimate first year ex post gross energy (kWh) and demand (kW) savings.
- Determine weather-normalized DR capability for all participants enrolled at the end of PY2023.
- Provide evaluation results to improve the design and implementation of the program.

Table 9 provides an overview of the program evaluation activities. Following the table, we provide a detailed description of our impact analysis approach. The Appendix volume submitted alongside this report (hereafter referred to as the Appendix) contains additional methodological detail.

Table 9. Residential DR Program: PY2023 Evaluation Activities for the Demand Response Program

Evaluation Activity	Column
Program Manager and Implementer Interviews	▪ Feedback was gathered continuously 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 systems to ensure that data required for the evaluation were 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 PY2023

4.3.1 PROGRAM MANAGER AND IMPLEMENTER INTERVIEWS

Throughout PY2023, the evaluation team, Uplight, Franklin Energy, and Ameren Missouri staff met monthly to discuss the ongoing administration of the program, any changes or anticipated challenges to program delivery and goal achievement, and to provide data status updates. In addition to these conversations, the evaluation team conducted formal interviews with Ameren Missouri, Uplight, and Franklin Energy staff at the end of the 2023 event season to debrief on PY2023 experiences and understand any programmatic changes going into PY2024.

4.3.2 IMPACT ANALYSIS

SUMMARY OF IMPACT ANALYSIS APPROACH

Impact Analysis Data Pathways

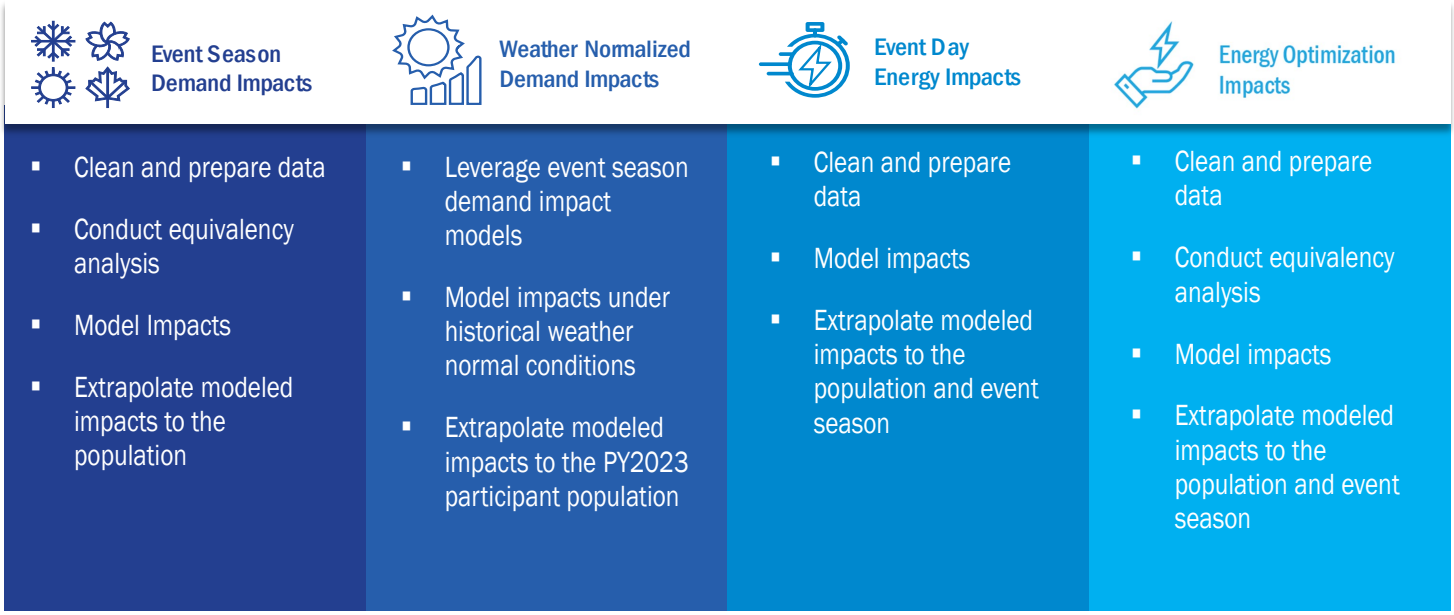
Impact analysis for the program consisted of several components, namely event season demand impacts, weather normalized resource capability impacts, event day energy impacts, and non-event energy impacts. Notably, the evaluation team conducted impact analysis leveraging Advanced Metering Infrastructure (AMI) interval load data.

The evaluation team had historically leveraged telemetry data for load impact evaluation purposes and conducted analyses using both telemetry and AMI data as part of the PY2022 evaluation. Prior to conducting the PY2023 impact analysis, the evaluation team reviewed AMI data coverage among the eligible participant population and assessed any biases resulting from incomplete coverage.

Of program participants active at any point during the PY2023 event season, 67% had AMI data. We assessed the extent to which participants with available AMI data were representative of the overall program participant population across available observable information (e.g., geographic distribution, enrollment channel, device manufacturer, enrollment year, and rate schedule). The Appendix contains the results of the analysis. Other than differences in rate enrollment, we did not find any large or meaningful differences in the composition of participants with and without AMI data. We identified that, as expected, a larger percentage of participants with AMI data were enrolled on a TOU rate. However, through data exploration and comparisons of load shapes across rates, we determined that the incomplete coverage of AMI data was unlikely to bias the impact results. Throughout the evaluation year, Ameren Missouri, Uplight, Franklin Energy, and the evaluation team collaborated to ensure data completeness, accuracy, and validity, including reviewing AMI data part-way through the season, and resolving discrepancies in event dispatch and participation.

Figure 9 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 and summarize our approach.

Figure 9. 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 participant, experimental assignment, weather, and AMI data. We processed data from each source separately before integrating them into analytic databases to support the impact analysis and modeling efforts. We provide details on each source below.

Weather Data

We used weather data from the nearest weather station for each account. 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 those stations for 2023. As part of the data preparation, we calculated cooling degree hours with an outdoor base temperature of 75°F for use in the model. We chose 75°F as the base temperature because that is the approximate point at which participants start using their central air conditioners 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 unenrollment records for five program years. Each record contained associated customer information, enrollment dates, unenrollment 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 values, and unreasonable values, where possible and feasible. We also conducted a careful review of accounts associated with participating devices and ensured all participating devices were associated with Ameren Missouri electric accounts. Finally, we verified the accuracy of the customer program enrollment date. This date was essential to validate participant counts for the impact analysis.

Customer AMI Data

We received 15-minute interval whole house AMI data for 67% of program participants active during the PY2023 summer event season. The AMI data contained account-level interval load data. As part of the AMI data cleaning, we scrutinized the data for duplicate records, missing records, and invalid records. Detailed data-cleaning steps are included in the Appendix.

Experimental Assignment Data

We received a separate set of files containing participant assignments into treatment and control groups for each event. We scrutinized the data for duplicate records and conflicting assignments and merged the data with the participant and AMI files to ensure completeness and validity. Detailed data-cleaning steps are included in the Appendix.

EVENT SEASON DEMAND IMPACTS

The event season DR impact analysis estimated event period demand impacts for accounts that were in place and operational during the PY2023 event season. In the summer 2023 season, there were four types of event dispatch, as described in section 4.1 Below, we outline analytical activities that were a part of the analysis for these four types of events.

Conduct Equivalency Analysis

Before running the models, we performed an equivalency analysis to ensure treatment and control groups were equivalent in terms of load shapes on non-event days. This approach was applicable to routine, locational, and staggered events. For the full-population event, we compared the loads of the treatment group on the event day and the proxy day during non-event hours to ensure that the two days were equivalent in terms of energy consumption. A separate experimental design was dispatched on each event day and by each manufacturer. As such, we performed a separate equivalency analysis for each event for each manufacturer

to ensure the fidelity of each experimental design. The analysis was performed at the account level. The Appendix of this report contains detailed results from the equivalency analysis.

Proxy Day Matching

For the full-population dispatch, a control group was not available. We therefore relied on a quasi-experimental design to evaluate the system-wide event day impacts. Weather was used to select the best proxy day. Given the high temperature of the event hours on the event day, the event season days with the highest temperatures during those same hours were selected. We then visually inspected the 24-hour weather profile to select the best matching non-event day that were similar in weather profile to the event day. The Appendix contains detailed results from the proxy day selection.

Model Impacts

We used linear fixed effects regression (LFE) modeling to develop event season demand impacts. The model estimated the hourly kW demand impacts on a per-account level. Across all device manufacturers, we included treatment accounts as part of the modeling dataset, regardless of whether the dispatch signal was received or not. As such, our modeled impacts reflect an intent to treat (ITT). Accounts assigned as control were used to construct the baseline or counterfactual load for the routine, locational, and staggered event, while the proxy days were used to construct the baseline or counterfactual load for the full-population event.

Event impacts were calculated as the mean difference between the modeled (predicted) baseline kW and the actual event kW over the event period. For Nest, Sensi, and Ecobee devices, we incorporated fixed effects terms to control for time-invariable, unobservable, account-level factors affecting demand (i.e., factors that do not change over the study period, such as the square footage of the 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 contains the final model specifications and model fit outputs.

Extrapolate Modeled Impacts to Population

We calculated the total impacts for each event by multiplying the per-account per-event modeled impacts by the number of accounts assigned as treatment for each event day. Total event-season demand impacts, expressed as the weighted average of impacts across events, were calculated by thermostat manufacturer, weighted by the number of treated accounts in each event.

WEATHER NORMALIZED RESOURCE CAPABILITY

An estimate of weather-normalized resource capability reflects estimated demand impacts from accounts enrolled as of the end of PY2023 under peak weather conditions.

Model Impacts Under Peak Weather Normals

To determine weather-normalized resource capability, we fit a series of fixed-effects models for each device manufacturer, pooling all event-day data to create a single model for each device manufacturer. We trained the models on 2023 weather data and evaluated them at a peak temperature of 99°F (24 Cooling Degree Hours), 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 hourly load data separately for each device manufacturer. Upon fitting these models, we estimated the predicted event impact for each of the event hours (hours 1 through 4). The predicted event impact is the predicted baseline demand minus the predicted event demand for each of the event hours. Following that, we developed an estimate of resource capability impacts for an average event. We used an event duration of 2.8 hours, which reflects the average event duration for the 2023 summer season.

Extrapolate Modeled Impacts to Population

We calculated total weather-normalized resource capability by multiplying the weather-normalized per-account impacts for each manufacturer by the number of accounts enrolled in the program at the end of PY2023. We used participant data extracts to derive the total number of enrolled devices and accounts. Enrolled Honeywell devices were not dispatched in PY2023 but will be dispatched by the Vendor DR platform in PY2024. Since the Vendor DR platform dispatch most closely resembles the dispatch of Nest devices, the Nest resource capability estimate was applied to enrolled Honeywell devices.

CUMULATIVE DR CAPABILITY

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 methodology similar to that used in the event season demand impact analysis, except we compared the predicted baseline load to the actual 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 account based on the regression model outlined in the Event Season Demand Impacts section above. We multiplied the predicted impacts for each event by the number of accounts that 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, modeled impacts to estimate event day energy impacts, and extrapolated modeled savings to participating accounts.

NON-EVENT DAY ENERGY IMPACTS

Energy Optimization Impacts

In addition to DR events, Uplight deployed OE algorithms on Sensi devices during non-event non-holiday weekdays over the course of the summer. The algorithms adjusted thermostat temperature setpoints over the course of the day to harvest additional energy savings. Uplight launched the PY2023 optimization interventions on June 1, 2023, and ran them until the end of the event season (September 30, 2023). The non-event energy optimization design for Sensi devices were structured as a crossover design, where Uplight randomly assigned 20% of Sensi devices into a control group. Assignments were performed in two-day blocks. For accounts assigned to the control group for a given two-day block, no optimization was performed until the end of the two-day block. At the end of the two-day block, new randomization assignments were made into the treatment and control groups. Since no optimization was performed on weekends or holidays, those days are

excluded from both treatment and control assignments. As part of our analysis, we modeled savings using a linear fixed effects regression model.

Clean and Prepare Data

To support this analysis, we leveraged the same AMI data we used for the event season demand impact analysis. As part of the data cleaning process, we identified and removed accounts that were not part of the experimental design, as well as accounts without experimental assignments. We also removed accounts assigned to only control or treatment categories and not both over the course of the summer. Detailed data-cleaning steps are included in the Appendix.

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. The Appendix contains detailed results from the equivalency analysis.

Model Impacts

We relied on the control days to establish the counterfactual (i.e., the baseline load that participants likely would have used in the absence of the optimization intervention). We specified an LFE model. Our analysis resulted in energy savings per treatment day and account. The Appendix of this report contains the model specification.

Extrapolate Modeled Impacts to Population

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

4.4 EVALUATION RESULTS

This section presents our response to the five CSR process questions as well as detailed impact evaluation results for the Residential DR Program.

4.4.1 PROCESS RESULTS

The Missouri Code of State Regulations 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 10 summarizes responses to the CSR process evaluation requirements for the Residential DR Program.

Table 10. Residential DR Program: Summary of Responses to CSR Process Evaluation Requirements

CSR Required Process Evaluation Questions	Findings
What are the primary market imperfections that are common to the target market segment?	Based on research conducted in PY2019, customers have a variety of concerns about participating in the central air conditioning 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 barrier 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 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. As the program contemplates the addition of winter DR, however, it will be important to revisit eligibility criteria to maximize effects.
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. The addition of Honeywell devices in PY2023 in addition to Nest, ecobee, and Sensi brands further expanded program reach.
Are the communication channels and delivery mechanisms appropriate for the target market segment?	E-mail outreach, along with outreach via devices, device apps, and manufacturers, is cost-effective and targeted, given the program design and the target market segment. PY2022 changes to customer channeling into the Marketplace channel present challenges to the effective enrollment of customers with newly purchased devices into the program. The choice of pre-conditioning strategies can impact both the depth of load impacts, customer experiences, and total energy consumption.
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?	Aligning acquisition channels and introducing new device manufacturers into the program could help capture more customers as well as different customers, thus ensuring the achievement of participation goals in future years and serving a broad spectrum of Ameren Missouri customer segments. Additionally, as the program contemplates a transition to the dual season paradigm, it will be important to identify barriers and market imperfections specific to winter DR participation.

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 39.53 MW in average event season demand impacts across all treated accounts. Table 11 provides event season demand impacts by event and device manufacturer. Event day demand impacts represent average impacts across all event hours. Per-account impacts ranged from 0.41 kW to 1.31 kW. Notably, across all events, baseline load remained relatively consistent, with some variation due to weather patterns. In fact, weather, event duration, and event type are all likely key drivers of the average event impacts. Events dispatched on days with lower temperatures generally result in lower impacts, which is not surprising given that cooling load is highly temperature dependent. Events with longer duration also experience lower per-account average hourly load impacts. Load impacts decline in later event hours, as participants opt out and air conditioning systems cycle to maintain temperature setpoints. A deeper discussion on event attrition follows later in this section.

Locational events resulted in per-account load impacts similar to routine test events. This suggests that participants on the constrained feeders are not fundamentally different in terms of load impacts. The staggered event, on the other hand, resulted in considerably lower per-account impacts, likely due to the snapback effect of the first participant and the precooling effect of the second participant cohort coinciding with the event hours.

At the start of the PY2023 summer event season, nearly 60% of enrolled participants were already defaulted into the DayNight Evening/Morning Saver TOU rate following the roll-out of the AMI meters. Load-shifting behaviors following the TOU rate adoption can take some time to become habituated; as such we do not believe that the wider adoption of the TOU rate has had an impact on the demand impacts presented in the table below. That said, further default enrollment of participants onto TOU rates and availability of more TOU rate choices may have impacts on available baseline load and therefore load curtailment opportunities longer-term. As participants adopt and habituate load shifting behaviors in response to the TOU pricing signals, baseline load available to shed may be impacted.

The Appendix contains detailed tables with hourly demand impacts by event and device manufacturer.

Table 11. Residential DR Program: Demand Impacts by Event and Manufacturer

Event	Event Duration (Hours)	Event Type	Manuf-acturer	Total Number of Enrolled Accounts	Total Number of Accounts Participating in Event	Aggregate (MW)		Per Account (kW)		% Load Impact	Average Event Hour Temp (°F)
						Baseline Load	Load Impact	Baseline Load	Load Impact		
Event 1: 6/2/2023	2	Test - Standard	Nest	25,755	24,427	71.41	27.22	2.92	1.11	38%	92
			ecobee	9,691	8,718	28.19	10.73	3.23	1.23	38%	92
			Sensi	7,658	6,792	20.00	6.62	2.94	0.97	33%	92
			Total	**43,103**	**39,936**	**119.61**	**44.57**	**2.99**	**1.12**	**37%**	**92**
Event 2: 6/29/2023	2	Test - Standard	Nest	26,267	24,434	75.11	28.76	3.07	1.18	38%	84
			ecobee	9,850	8,674	27.86	10.38	3.21	1.20	37%	84
			Sensi	7,738	6,512	19.63	7.78	3.01	1.19	40%	84
			Total	**43,854**	**39,620**	**122.60**	**46.91**	**3.09**	**1.18**	**38%**	**84**
Event 3: 6/30/2023	2	Test-Locational	Nest	25,639	2,106	7.60	2.75	3.61	1.31	36%	94
			ecobee	9,635	697	2.59	0.83	3.71	1.20	32%	94
			Sensi	7,482	406	1.39	0.43	3.42	1.07	31%	94
			Total	**42,756**	**3,208**	**11.58**	**4.02**	**3.61**	**1.25**	**35%**	**94**
Event 4: 7/5/2023	2	Test-Locational	Nest	25,764	2,098	6.80	2.49	3.24	1.19	37%	90
			ecobee	9,667	690	2.29	0.83	3.32	1.20	36%	90
			Sensi	7,488	410	1.31	0.50	3.21	1.23	38%	90
			Total	**42,918**	**3,197**	**10.41**	**3.82**	**3.25**	**1.20**	**37%**	**90**
Event 5: 7/27/2023	4	Peak Shaving	Nest	26,128	24,834	89.29	26.44	3.60	1.06	30%	98
			ecobee	9,709	8,751	33.37	9.51	3.81	1.09	29%	98
			Sensi	7,503	6,501	22.57	5.58	3.47	0.86	25%	98
			Total	**43,339**	**40,085**	**145.23**	**41.54**	**3.62**	**1.04**	**29%**	**98**
Event 6: 7/28/2023	3	Test - System Wide	Nest	26,155	25,819	107.05	31.22	4.15	1.21	29%	99
			ecobee	9,711	9,671	42.26	12.53	4.37	1.30	30%	99
			Sensi	7,500	7,431	28.09	8.09	3.78	1.09	29%	99

Event	Event Duration (Hours)	Event Type	Manuf-acturer	Total Number of Enrolled Accounts	Total Number of Accounts Participating in Event	Aggregate (MW)		Per Account (kW)		% Load Impact	Average Event Hour Temp (°F)
						Baseline Load	Load Impact	Baseline Load	Load Impact		
			Total	**43,365**	**42,920**	**177.40**	**51.84**	**4.13**	**1.21**	**29%**	**99**
Event 7: 8/11/2023	4	Test - Staggered	Nest	26,270	24,027	78.65	11.80	3.27	0.49	15%	93
			ecobee	9,689	7,809	26.86	4.02	3.44	0.51	15%	93
			Sensi	7,446	5,598	17.35	2.28	3.10	0.41	13%	93
			Total	**43,404**	**37,433**	**122.87**	**18.10**	**3.28**	**0.48**	**15%**	**93**
Event 8: 8/23/2023	3	Peak Shaving	Nest	26,383	25,045	95.79	26.20	3.82	1.05	27%	96
			ecobee	9,702	8,743	35.04	9.50	4.01	1.09	27%	96
			Sensi	7,404	6,406	23.71	7.61	3.70	1.19	32%	96
			Total	**43,488**	**40,193**	**154.54**	**43.31**	**3.85**	**1.08**	**28%**	**96**
Event 9: 8/24/2023	4	Peak Shaving	Nest	26,397	25,047	97.60	21.85	3.90	0.87	22%	100
			ecobee	9,705	8,730	36.02	8.04	4.13	0.92	22%	100
			Sensi	7,407	6,416	24.41	6.81	3.80	1.06	28%	100
			Total	**43,508**	**40,192**	**158.04**	**36.71**	**3.93**	**0.91**	**23%**	**100**
Event 10: 9/19/2023	2	Test - Locational	Nest	26,661	2,010	4.19	1.48	2.09	0.73	35%	85
			ecobee	9,712	667	1.56	0.54	2.33	0.80	35%	85
			Sensi	7,292	386	0.79	0.22	2.04	0.58	28%	85
			Total	**43,664**	**3,063**	**6.53**	**2.24**	**2.13**	**0.73**	**34%**	**85**

Note: The total number of accounts participating in an event excludes accounts assigned as control for that event.

Table 12 provides a summary of average demand impacts by device manufacturer for the event season. Across the PY2023 season events, the program achieved 1.01 kW in per-account demand impacts. Accounts with ecobee devices achieved slightly higher average per-account demand impacts than Nest and Sensi accounts (1.06 kW vs. 1.00 kW and 0.98 kW, respectively), which could be a function of ecobee participants' higher baseline load. Demand impacts as a percent of the baseline load are very similar across the three device manufacturers and range from 28% to 29%.

Table 12. Residential DR Program: Average Event Season Demand Impacts by Manufacturer

Manufacturer	Total Number of Enrolled Accounts	Total Number of Accounts Participating in Event	Aggregate (MW)		Per Account (kW)		% Load Impact	Average Event Temp (°F)
			Baseline Load	Load Impact	Baseline Load	Load Impact		
Nest	26,142	17,985	85.26	24.08	3.52	1.00	28%	93
ecobee	9,707	6,315	32.04	9.09	3.74	1.06	28%	93
Sensi	7,491	4,686	21.90	6.35	3.40	0.98	29%	93
All	**43,340**	**28,985**	**139.20**	**39.53**	**3.55**	**1.01**	**28%**	**93**

Note: The total number of accounts participating in an event excludes accounts assigned as control for that event.

Table 13 summarizes the average percent of impact attrition by manufacturer from one event hour to the next. The staggered event is excluded given the unique nature of the dispatch. The number of events included in the calculation decreases since not all events were 4 hours. The per-account load impacts decline in hours

two, three, and four. Sensi accounts experience the least amount of impact attrition between event hours, and Nest accounts experience the most.

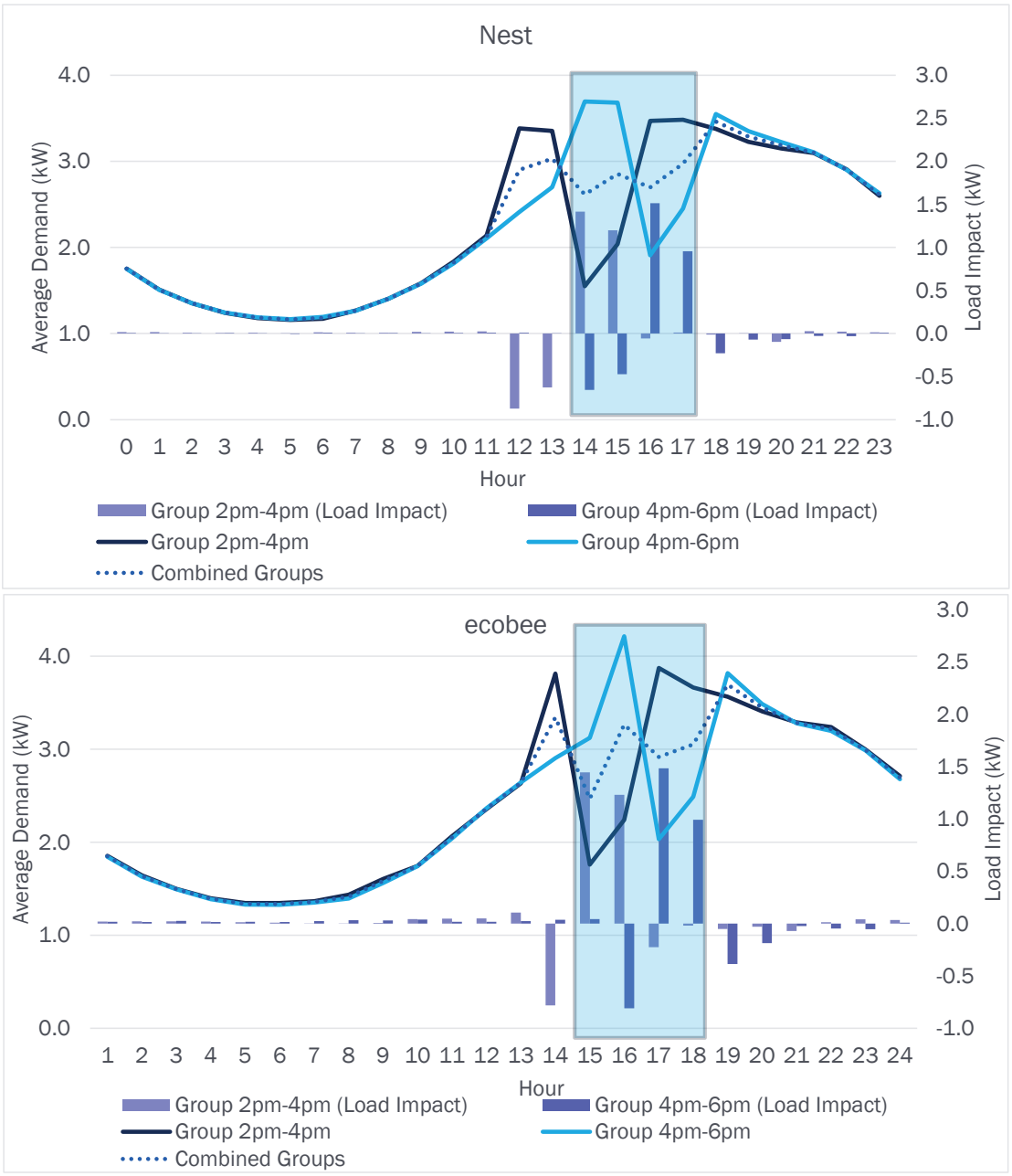
Table 13. Residential DR Program: Per-Account Percent Impact Reduction by Manufacturer and Hour

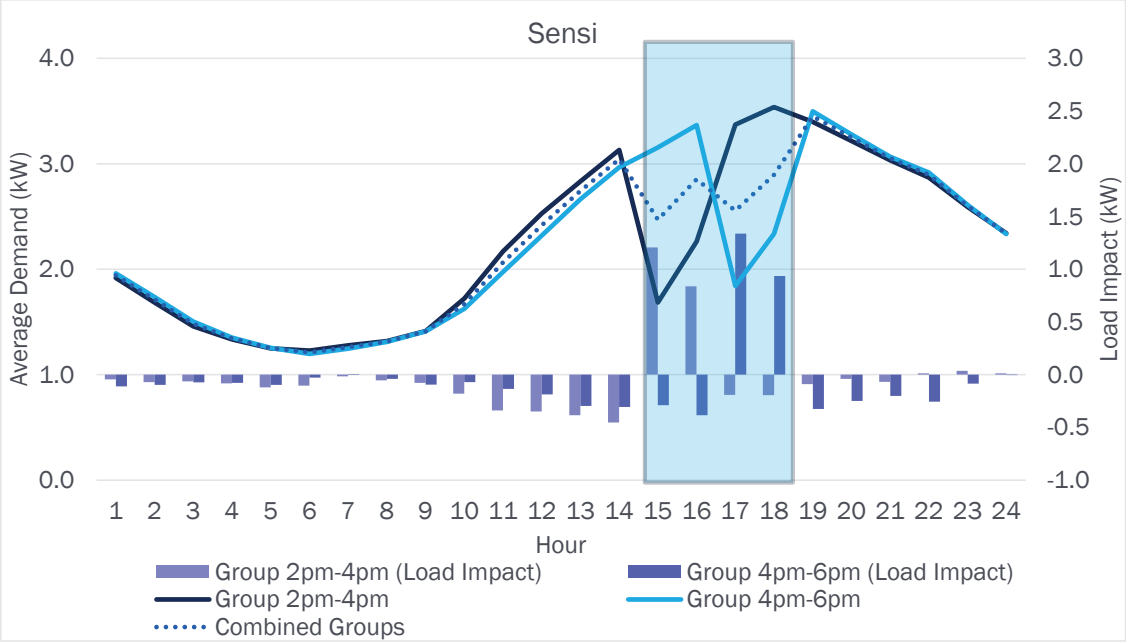
Manufacturer	% Change in Impacts Hour 1 to Hour 2 (Number of Events=9)	% Change in Impacts Hour 2 to Hour 3 (Number of Events=4)	% Change in Impacts Hour 3 to Hour 4 (Number of Events=2)
Nest	-29%	-38%	-41%
ecobee	-29%	-34%	-31%
Sensi	-17%	-23%	-26%

Note: Excludes staggered event.

As previously discussed, in an effort to achieve consistent load curtailment effects, Ameren Missouri tested a staggered event dispatch wherein half of eligible participants were dispatched for the first two hours and the other half were dispatched for the second two hours of the event. Figure 10 illustrates the average load shapes for each dispatch group and the per-account staggered event impacts of the groups individually for each manufacturer. The dotted line represents the aggregated load shape across the two groups. Despite the individual groups achieving per-account load impacts in line with a two-hour event dispatch for their respective event blocks, precooling and snapback dampened the overall event impacts. This trend was consistent across all device manufacturers.

Figure 10. Residential DR Program: Staggered Event Group Load Shapes and Load Impacts





The Appendix contains detailed plots and tables of per-account demand impacts by device manufacturer and event.

RESOURCE CAPABILITY ESTIMATES

Resource capability estimates reflect weather-normalized demand impacts applied to accounts enrolled as of the end of PY2023 that are anticipated to participate in events. Table 14 details resource capability impacts by device manufacturer as well as cumulatively across all manufacturers.

Anticipated demand impacts are 52.37 MW. Average per-account impacts under TRM-defined peak weather conditions are estimated at 1.13 kW and are lowest for Sensi devices, likely due to lower baseline load and lower participant weather sensitivity.

Table 14. Residential DR Program: Resource Capability Impacts

Manufacturer	Total Number of Accounts Enrolled*	Aggregate (MW)*		Per Account (kW)		% Load Impact
		Baseline Load	Load Impact	Baseline Load	Load Impact	
Nest	28,432	111.74	33.14	3.93	1.17	30%
ecobee	10,127	41.63	11.80	4.11	1.17	28%
Sensi	7,405	27.38	7.14	3.70	0.96	26%
Honeywell [A]	250	0.98	0.29	3.93	1.17	30%
All	**46,213**	**181.74**	**52.37**	**3.93**	**1.13**	**29%**

*Includes a very small number (~35) of accounts that unenrolled prior to the end of the year.

[A] Accounts with Honeywell devices receive the per-account (kW) applied to Nest accounts since it most closely reflects their anticipated 2024 dispatch.

Table 15 compares the resource capability impacts to the PY2023 MEEIA III targets. The weather-normalized demand impact of 52.37 MW represent 79% of the cumulative PY2023 target.

Table 15. Residential DR Program: Comparison of Resource Capability Impacts to Goal

Metric	Result
Resource capability load impact (MW)*	52.37
Cumulative PY2023 MEEIA III goal/target (MW)	66.50
Percent of PY2023 goal/target	79%

*Includes a very small number (~35) of accounts that unenrolled prior to the end of the year.

CUMULATIVE DR CAPABILITY

PY2023 cumulative DR capability for the Residential DR Program mirrors resource capability and is presented in Table 16.

Table 16. Residential DR Program: Comparison of Cumulative DR Capability to Target

Metric	Result
Cumulative DR capability (MW)*	52.37
PY2023 target (MW)	66.50
Percent of PY2023 target	79%

*Includes a very small number (~35) of accounts that unenrolled prior to the end of the year.

SUMMARY OF ENERGY IMPACTS

Energy impacts in PY2023 included event day impacts across all devices as well as non-event impacts resulting from the optimization activity performed on Sensi devices. Table 17 summarizes energy savings achieved during event days as well as energy savings achieved through the optimization of Sensi devices. As can be seen in the table, the total energy savings achieved during the PY2023 event season was 847 MWh, which is 13% of the MEEIA III target. The MEEIA III target relied on the expectation that device optimization through the program would be performed across all participating devices. However, following the release of the energy optimization algorithms by Nest and ecobee across all their devices, program-driven optimization was no longer possible. As such, MEEIA targets are not feasible for the program to achieve.

Table 17. Residential DR Program: Energy Savings Summary

Metric	Result
Event season energy savings (MWh)	847
Event day energy savings (MWh)	*344*
Energy savings from the optimization component (MWh)	*503*
PY2023 MEEIA III goal/target (MWh)	6,547
Percent of PY2023 goal/target	13%

Event Day Energy Impacts

In addition to demand reductions, DR events resulted in moderate energy savings during event days. Achieving energy savings via DR events is not the primary goal of the DR programs.

Table 18 presents average per-account event day energy savings achieved over the course of the PY2023 summer event season along with aggregate savings across all participating accounts. As can be seen in the table, event-day energy savings averaged 11.87 kWh per-account and represented 2% of the total baseline usage. As a result of the ten dispatched events, 334 MWh of energy was conserved. Accounts with Nest and ecobee devices contributed 99% of total event day energy savings achieved over the event season, while accounts with Sensi devices resulted in negligible event day energy savings, likely due to aggressive preconditioning strategies. [12] An average participating Nest account delivered 12.47 kWh of event day energy savings while an average participating ecobee account delivered 18.23 kWh of energy savings. The average participating accounts with Sensi devices delivered just 1.01 kWh of event day energy savings.

Table 18. Residential DR Program: Event Day Energy Savings by Device Manufacturer

Manufacturer	Average Number of Enrolled Accounts	Average Number of Accounts Participating in Event	Aggregate (MWh)		Per Account (kWh)		% Savings
			Baseline Usage	Energy Savings	Baseline Usage	Energy Savings	
Nest	26,142	17,985	11,420.29	224.20	635.01	12.47	2%
ecobee	9,707	6,315	4,280.32	115.09	677.84	18.23	3%
Sensi	7,491	4,686	2,876.01	4.73	613.80	1.01	<1%
All	**43,340**	**28,985**	**18,576.62**	**344.02**	**640.91**	**11.87**	**2%**

Table 19 details event day per-account and total energy savings by manufacturer. Energy savings presented in the table reflect cumulative reductions in energy over the 24-hour period across all ten events. Energy savings range from −4.48 kWh to 3.34 kWh per treated account, depending on the 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 achieved during event hours. Notably, negative savings were most prominent for accounts with Sensi devices, with half of the events delivering negative energy savings. Energy savings may be smaller in shorter events because participants do not have as many event hours to realize additional energy savings.

Table 19. Residential DR Program: Event Day Energy Savings by Event and Device Manufacturer

Event	Event Duration (Hours)	Manuf-acturer	Total Number of Enrolled Accounts	Total Number of Accounts Participating in Event	Aggregate (MWh)		Per Account (kWh)		% Saving	Average Event Day Temp (°F)
					Baseline Usage	Energy Savings	Baseline Usage	Energy Savings		
Event 1: 6/2/2023	2	Nest	25,755	24,427	1,218.60	-0.47	49.89	-0.02	0%	82
		ecobee	9,691	8,718	476.17	11.21	54.62	1.29	2%	82
		Sensi	7,658	6,792	334.66	-3.21	49.28	-0.47	-1%	82
		Total	**43,103**	**39,936**	**2,029.44**	**7.53**	**50.82**	**0.19**	**0%**	**82**
Event 2: 6/29/2023	2	Nest	26,267	24,434	1,418.13	16.00	58.04	0.65	1%	84
		ecobee	9,850	8,674	535.50	5.55	61.74	0.64	1%	84
		Sensi	7,738	6,512	368.58	-3.62	56.60	-0.56	-1%	84
		Total	**43,854**	**39,620**	**2,322.20**	**17.92**	**58.61**	**0.45**	**1%**	**84**

[12] Based on feedback provided by Uplight, Sensi preconditioning is driven by proprietary machine learning algorithms and may start as early as midnight of the event day.

Event	Event Duration (Hours)	Manuf-acturer	Total Number of Enrolled Accounts	Total Number of Accounts Participating in Event	Aggregate (MWh)		Per Account (kWh)		% Saving	Average Event Day Temp (°F)
					Baseline Usage	Energy Savings	Baseline Usage	Energy Savings		
Event 3: 6/30/2023	2	Nest	25,639	2,106	124.80	2.63	59.27	1.25	2%	84
		ecobee	9,635	697	43.47	0.75	62.41	1.08	2%	84
		Sensi	7,482	406	22.10	-1.82	54.43	-4.48	-8%	84
		Total	**42,756**	**3,208**	**190.37**	**1.56**	**59.34**	**0.49**	**1%**	**84**
Event 4: 7/5/2023	2	Nest	25,764	2,098	120.66	0.29	57.51	0.14	0%	84
		ecobee	9,667	690	42.15	0.52	61.14	0.75	1%	84
		Sensi	7,488	410	22.58	0.08	55.13	0.21	0%	84
		Total	**42,918**	**3,197**	**185.39**	**0.89**	**57.99**	**0.28**	**0%**	**84**
Event 5: 7/27/2023	4	Nest	26,128	24,834	1,720.52	47.96	69.28	1.93	3%	91
		ecobee	9,709	8,751	641.95	23.28	73.36	2.66	4%	91
		Sensi	7,503	6,501	433.94	8.64	66.75	1.33	2%	91
		Total	**43,339**	**40,085**	**2,796.41**	**79.88**	**69.76**	**1.99**	**3%**	**91**
Event 6: 7/28/2023	3	Nest	26,155	25,819	1,917.92	69.90	74.28	2.71	4%	93
		ecobee	9,711	9,671	758.70	32.26	78.46	3.34	4%	93
		Sensi	7,500	7,431	517.17	-1.19	69.60	-0.16	0%	92
		Total	**43,365**	**42,920**	**3,193.79**	**100.96**	**74.41**	**2.35**	**3%**	**93**
Event 7: 8/11/2023	4	Nest	26,270	24,027	1,304.39	26.26	54.29	1.09	2%	84
		ecobee	9,689	7,809	454.67	12.88	58.23	1.65	3%	84
		Sensi	7,446	5,598	292.46	-5.49	52.25	-0.98	-2%	84
		Total	**43,404**	**37,433**	**2,051.52**	**33.65**	**54.81**	**0.90**	**2%**	**84**
Event 8: 8/23/2023	3	Nest	26,383	25,045	1,742.79	27.90	69.59	1.11	2%	90
		ecobee	9,702	8,743	645.63	14.24	73.85	1.63	2%	90
		Sensi	7,404	6,406	428.39	0.69	66.88	0.11	0%	90
		Total	**43,488**	**40,193**	**2,816.82**	**42.84**	**70.08**	**1.07**	**2%**	**90**
Event 9: 8/24/2023	4	Nest	26,397	25,047	1,787.35	34.23	71.36	1.37	2%	91
		ecobee	9,705	8,730	657.23	13.55	75.29	1.55	2%	91
		Sensi	7,407	6,416	444.03	10.62	69.21	1.65	2%	91
		Total	**43,508**	**40,192**	**2,888.61**	**58.40**	**71.87**	**1.45**	**2%**	**91**
Event 10: 9/19/2023	2	Nest	26,661	2,010	65.13	-0.49	32.40	-0.24	-1%	74
		ecobee	9,712	667	24.83	0.84	37.23	1.26	3%	74
		Sensi	7,292	386	12.11	0.04	31.38	0.09	0%	74
		Total	**43,664**	**3,063**	**102.08**	**0.39**	**33.33**	**0.13**	**0%**	**74**

Impacts from Device Optimization

Optimization of Sensi devices ran from June 1, 2023, through September 30, 2023. Table 20 summarizes energy savings from the device optimization component achieved during that time period. The program achieved 1.2 kWh in per-account, per-day savings and 502.57 MWh in total energy savings across all days and devices. The average per-account, per-day savings rate was 3%.

Table 20. Residential DR Program: Device Optimization Energy Savings Summary

Manufacturer	Number of Account Days	Aggregate (MWh)		Per Account Per Day (kWh)		% Savings
		Baseline Usage	Energy Savings	Baseline Usage	Energy Savings	
Sensi	418,768	17,277.84	502.57	41.26	1.20	3%

4.5 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 13,689 new devices into the program in PY2023. This is a substantial number of new enrollees; however, they were not sufficient to achieve program impact goals. The program achieved 79% of its target DR capability goal and resource capacity goal and 13% of its energy savings goal. Expanding the program to incorporate Honeywell devices creates an opportunity to connect with the previously untapped customer base, potentially leading to a significant increase in the participant population. The success of the expansion will rely on ensuring that the performance of Honeywell devices is in line with or above historically observed trends.
  - **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**: Over the course of the PY2023 summer event season Ameren Missouri continued to test alternative dispatch strategies aimed at establishing locational capabilities of the program and exploring opportunities to increase consistency of demand impacts hour-to-hour. To that end, Ameren Missouri successfully dispatched three locational events targeting capacity-constrained circuits. Notably, Ameren Missouri was able to dispatch those events in an experimental fashion following the best-in-class practices. In addition, Ameren Missouri tested an innovative staggered event dispatch design. The event dispatch resulted in important lessons learned about the limitations and opportunities associated with staggered event dispatches, paving the way for further opportunities to explore and refine staggered dispatch strategies. Through these efforts Ameren Missouri continued advancing program capability to support emerging system needs in order to position the program for future success.
  - **Recommendation 2**: Ameren Missouri should continue testing the locational capabilities of the program and further explore opportunities to ensure consistent, steady, and deep demand impacts across event hours of longer events.
- **Conclusion 3**: Optimization of Sensi devices on non-event days resulted in an additional 3% reduction in energy usage per day during the days when the optimization algorithms ran. The implementer ran optimization using a thoughtful experimental design, allowing for a rigorous and straightforward evaluation of program impacts.
  - **Recommendation 3:** The program should continue deploying optimization algorithms on Sensi devices using experimental design as a pathway to achieve additional energy savings.
- **Conclusion 4**: Completion of AMI rollout and the emergence of various TOU rates, along with Ameren Missouri's choice to default customers into time-varying rates, may have impacts on the baseline load available for the program to control longer-term. In the future, as participants adopt and habituate load-

shifting behaviors in response to rate-based price signals (which coincide with event dispatch time), it can result in different amounts of load available for the program to curtail.

- **Recommendation 4**: Ameren Missouri should carefully monitor the adoption of the various TOU rates among the participant population and explore differences in baseline loads and impacts experienced by customers enrolled in TOU rates. This will allow Ameren Missouri to better anticipate and plan for any changes, both positive and negative, in demand impacts resulting from growing TOU rate adoption.

5. BUSINESS DEMAND RESPONSE PROGRAM

This chapter summarizes the PY2023 evaluation methodology and results for the Business DR Program.

The Business DR Program was in its fifth year of deployment in PY2023. The program was designed to reduce load during periods of peak demand. Enel X acted as the program aggregator in PY2023 and was 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 and manual response. 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 PY2023, as in 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 process 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 total MWh reduced during all events) developed and negotiated by Enel X. Participants were not subject to performance penalties.

Three DR events were called during the summer event season, which lasted from May 1 through September 30, 2023. Enel X also called an additional test event in December to test the capability of the customers enrolled in the program after the completion of the summer season and before the end of the program year. Enel X could call up to five peak shaving events and up to two test events. Events could last for up to four hours in duration each, regardless of event type. No more than two events could be called on consecutive days.

Figure 11 provides a visual overview of the event notification process that Enel X followed in PY2023 to prepare customers for events and communicate event start and end dates. A week before a DR event was 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 the start and end time of the event. Where possible, Enel X requested and recorded participant confirmation of the intent to participate. After the event ended, Enel X sent a final e-mail confirming the end of the DR event dispatch.

Figure 11. Business DR Program: Event Notification Flow

Prior to September 2023, the only eligibility requirement for the Business DR Program was that the customer had not elected to opted out of Ameren Missouri's MEEIA energy efficiency programs, as allowed under 20

CSR 4240-20.094(7). However, in September 2023, tariffs were approved to allow opt-out customers participate in Ameren Missouri's DR programs. This opened the doors to a new pool of customers to engage with the program, some of whom enrolled in time for the December test event.

Once a customer agrees to participate in the program, 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.

Ameren Missouri registered the Business DR Program as a Load Modifying Resource in the MISO market in PY2020.

5.1 PARTICIPATION SUMMARY

Based on the Stipulation PY2023, the Business DR Program cumulative target for PY2023 was 100 MW of capacity reduction. Enel X had enrolled 1,025 customers by the end of the PY2023 event season with a total nominated capacity of 140.48 MW, which represents 140% of the PY2023 target of 100 MW (Table 21).[13]

Table 21. Business DR Program: Event Season Goals/Targets and Participation Summary

Metric	Cumulative MEEIA III Goal/Target	Enrollment	% of Goal/Target
Accounts		1,025	
Enrolled Nominated Capacity (MW)	100	140.48	140%

In PY2023, Ameren Missouri used the program for peak shaving purposes. To assess participant performance, Enel X called one four-hour peak shaving event, one three-hour peak shaving event, and one two-hour peak shaving event during the event season. Following the completion of the event season, Enel X dispatched one three-hour test event to ascertain nominated capacity values for customers enrolled in the program after the end of the 2023 event season. Figure 12 provides details for each event.

[13] Customers are defined as unique accounts.

Figure 12. Business DR Program: Overview of PY2023 Events

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

PY2023 PARTICIPANT COMPOSITION

At the end of PY2023, a total of 1,066 accounts were enrolled in the program with a nominated capacity of 237.57 MW. A total of 1,069 accounts were active at some point in 2023, with a nominated capacity of 237.75. Customers spanned a range of industry segments, including manufacturing, mining, consumer services, and transportation. Table 22 summarizes the participation distribution by industry segment for customers active in PY2023. As can be seen in the table, the manufacturing and education segments accounted for over half of participating accounts and nominations. The agriculture and mining segment, while accounting for 6% of accounts, contributed to 16% of program nominated capacity. Notably, transportation and storage, media and entertainment, as well as the healthcare, pharmaceuticals and biotech segments have some of the highest per-account nominations, though combined they account for a small share of participating accounts and nominations.

Table 22. Business DR Program: Participation Distribution by Segment

Industry	% of Accounts	% of Nomination	Average Nomination per Account (kW)
Manufacturing	14%	35%	541
Education	42%	18%	95
Agriculture and Mining	6%	16%	570
Energy and Utilities	19%	8%	96
Business and Consumer Services	5%	5%	223

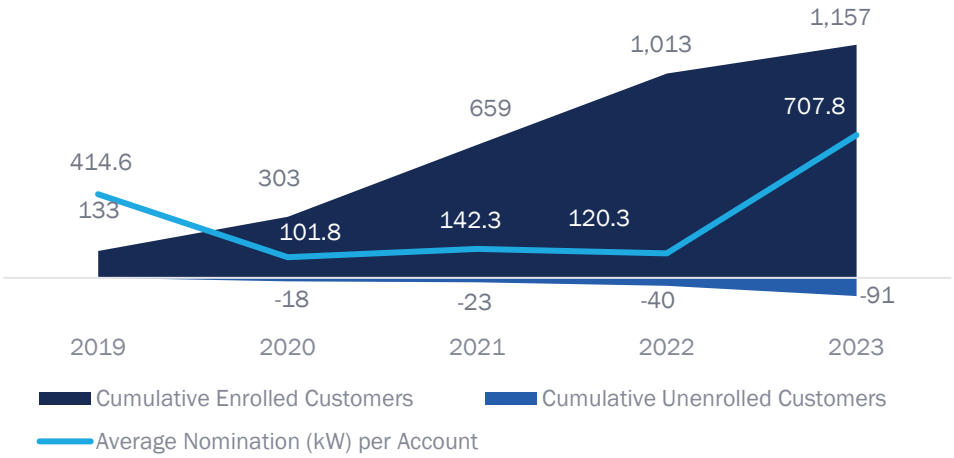
Industry	% of Accounts	% of Nomination	Average Nomination per Account (kW)
Healthcare, Pharmaceuticals, and Biotech	1%	3%	508
Real Estate and Construction	2%	2%	251
Retail	3%	2%	158
Government	2%	2%	172
Wholesale and Distributors	1%	1%	415
Primary and Secondary Education	2%	1%	66
Transportation and Storage	<1%	<1%	675
Media and Entertainment	<1%	<1%	693
Miscellaneous Plastics Products	<1%	<1%	235
Travel and Recreation	<1%	<1%	90
Metal Forgings and Stampings	<1%	<1%	46
Mining and Quarrying of Nonmetallic Materials	<1%	<1%	55
Surgical	<1%	<1%	11
Motor Vehicle Parts Manufacturing	<1%	<1%	48
Other	1%	7%	1,158
Overall	**100%**	**100%**	**222**

Note: 20 accounts were missing industry information or were not classifiable.

PROGRAM ENROLLMENT TRENDS OVER FOUR YEARS

Since the program's inception in PY2019, a total of 1,157 customers have been enrolled in the program by Enel X, with 91 having unenrolled by the end of PY2023. Figure 13 shows customer enrollment and unenrollment trends overlayed with the average per-customer nomination by program year. Customer average nominations in 2019 were 414.6 kW; however, the average customer nomination remained lower than 2019 levels for the next three years. This trend was not surprising and was consistent with Enel X's targeting strategies, which focused on the largest accounts first, followed by outreach and marketing to smaller customers. In 2023, the average customer nomination increased and surpassed 2019 levels for the first time in program history. This increase in nominations was driven by the influx of newly eligible participants with high nominations following the tariff change that allowed opt-out customers to participate in the program. The average nomination of these previously ineligible enrollees was 2,677 kW, while the average nomination of the other new 2023 enrollees was only 145 kW. This is not surprising, given that C&I customers opting out of the MEEIA energy efficiency programs tended to be industrial customers with large loads.

Figure 13. Business DR Program: PY2019–PY2023 Customer Enrollment



CUSTOMER ENGAGEMENT

Enel X follows a multi-step process for engaging with new customers, which involves a range of touchpoints. The purpose of these touchpoints is to inform customers of the program, learn about customers' business operations, work with the customers to identify load curtailment opportunities, and onboard them into the program. Enel X targets all of Ameren Missouri's commercial and industrial customers with over 100 kW in peak demand. Additionally, Enel X leverages a channel partnership with Enersponse to target and engage small- and mid-sized customers (generally, 1kW–5kW sites) belonging to business chains. In PY2023, Enel X focused on leveraging their partnership with Enersponse and their existing customer relationships for enrolling new sites, which is a shift from previous years when the focus was on identifying new sites and nonparticipating customers. Additionally, Enel X adjusted its strategy to target improving the performance of existing customers by conducting targeted outreach and support. This adjustment was driven by anticipated program changes in PY2024, which are covered in more detail later in this chapter.

Enel X does both scheduled and unscheduled outreach to existing customers. Scheduled engagements are seasonally occurring readiness outreach and include verifying customer contact information, working to adjust load curtailment plans and nominations as necessary, and testing notification communications. Unscheduled engagement is outreach related to customer performance during the event season. This includes deeper engagement with customers to understand reasons for low performance, make adjustments, and explore opportunities for even higher performance with well-performing customers.

In PY2023, Enel X launched targeted outreach to three groups of customers. The first group was the top performers who were targeted to strengthen customer engagement and ensure customer retention and performance. The second group consisted of customers with a significant gap between their nominations and their event performance, who were targeted to identify any missed load curtailment opportunities and operational changes and to right-size nomination values if needed. The third group was comprised of customers who had negative performance in PY2022, i.e., customers with *increased* load during PY2022 event hours. Enel X targeted them to identify ways to improve their participation and ultimately determine if they were a good fit for the program.

PROGRAM UNENROLLMENT

A total of 91 accounts have unenrolled from the program over the course of the five program years. This represents 8% of all accounts enrolled between PY2019 and PY2023. Unenrolled accounts span a range of segments, including manufacturing, education, business, and media and entertainment. Based on our review of unenrollment records, there are a variety of reasons for unenrollment including the cost of curtailing, site shutdown, and onsite construction. Additionally, some unenrollment were a function of Enel X flagging and removing unresponsive participants and participants with poor event performance.

FUTURE PROGRAM IMPLEMENTATION

The change in the tariff allowing previously ineligible customers to participate in the DR program will likely continue the additional enrollment of large C&I accounts, which presents an opportunity for the program.

Additionally, Enel X and Ameren Missouri plan to continue exploring emerging opportunities related to program participation in the MISO markets considering the FERC 2222 order, including any additional needed customer engagement and messaging.

Finally, the Business DR Program will continue to deploy existing best practices for customer engagement, update customer nominations for PY2024, and be available for MISO emergency events.

5.2 EVALUATION METHODOLOGY

This section summarizes the key objectives and methods for the PY2023 Business DR Program evaluation. The key evaluation objectives included the following:

- Ascertain changes to program delivery, customer enrollment, load reduction strategies, and nominated capacities.
- Understand and describe participant mix in terms of size, industry segment, and other available characteristics.
- Identify program successes and challenges.
- Determine DR capability for all participants enrolled in PY2023.
- Estimate first year ex post gross energy (kWh) and demand (kW) savings.
- Provide evaluation results to improve the design and implementation of the program.

Table 23 provides an overview of the Business DR Program evaluation activities. Following the table, we outline program-specific aspects of key evaluation methodologies.

Table 23. Business DR Program: PY2023 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 PY2023.

	▪ Supported bidding of DR program impacts as a load modifying resource into the MISO market.

5.2.1 PROGRAM MANAGER AND IMPLEMENTER INTERVIEWS

Throughout PY2023, the evaluation team, Enel X, and Ameren Missouri staff met monthly to discuss the ongoing administration of the program, any changes or anticipated challenges to program delivery and target achievement, and to help finalize results after DR events. In addition to these monthly conversations, the evaluation team conducted a formal interview with Enel X staff at the end of 2023 to debrief on PY2023 experiences and understand any programmatic changes going into PY2024.

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.

DATA SOURCES AND DATA CLEANING

The evaluation team relied on four 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.
- Non-revenue quality interval data: In cases where revenue quality interval data were not available, the evaluation team used non-revenue quality interval data supplied by Ameren Missouri.
- Enel X KYZ data: In cases where interval data were missing, the evaluation team worked with Enel X to obtain interval data collected through KYZ pulse outputs at participating facilities.
- Participation data: The evaluation team obtained participation data from Enel X. For each customer, Enel X recorded customer account numbers, customer name and facility address, customer industry segment information, load reduction nomination, and load reduction strategy.

The evaluation team ingested the data from Enel X and Ameren Missouri, 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; and
- Exploring and correcting data irregularities, including missing interval periods, missing accounts, periods with zero usage, low usage, or unreasonably high usage.

EVENT DAY DEMAND IMPACTS ESTIMATION

For each of the three event season events and the December test event, we estimated demand impacts by comparing actual interval meter readings during the event to the customer's baseline, which we used 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

included in the event. We calculated total event season performance by taking the average event performance of each account and summing it across all accounts.[14]

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

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

The baseline calculation uses 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 most recent five non-holiday, non-event weekdays before the event day. North American Reliability Corporation (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. 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 the 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

Some participating accounts in PY2023 were completely missing from the interval data or only had partial interval data available to calculate demand impacts using the above-described approach. To mitigate data gaps, the evaluation team applied the following approaches for calculating demand impacts:

- For accounts without available bill grade interval data, the evaluation team relied on non-bill grade interval data. If those data were not available, the evaluation team relied on the KYZ data collected by Enel X.
- For accounts with interval data available for four, as opposed to five, baseline days, we included those four days in the baseline calculation (a four-in-four baseline day approach instead of a four-in-five).
- For accounts with no interval data for one event but data present for the other events, the evaluation team imputed performance for the event with missing data based on the events with available data.

The evaluation team had to impute demand savings for only two accounts. Imputations for these two accounts were required for the August events, but both accounts had interval data for the July 27 event. These two accounts, accounted for less than 0.04% of PY2023 nominations. Missing data can occur for a variety of

[14] For accounts with only one event dispatched, we used that event's performance.

reasons, including non-operational meter equipment or interval metering equipment not deployed in advance of the DR event. To further ensure the above-described imputations were reasonable, the evaluation team worked with Enel X to obtain participant confirmation of event participation and validate that all accounts with missing data actively confirmed their intent to participate in the event(s).[15]

EVENT DAY ENERGY IMPACT ESTIMATION

The evaluation team calculated event day energy savings by comparing the 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 the baseline period, wherein we averaged total daily energy consumption for the four days with the highest consumption of the most recent five non-holiday, non-event, weekdays prior to the event day. NERC holidays were excluded from the baseline calculation. Additionally, we used the baseline adjustment for demand savings to calculate energy savings for each account.

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

$$\begin{aligned} &Event\ Day\ Energy\ Impact\ (kWh) \\ &\quad = Average\ Daily\ Final\ Baseline\ Consumption\ (kWh) \\ &\quad - Daily\ Event\ Day\ Consumption\ (kWh) \end{aligned}$$

Missing Data

Similar to demand savings, not every participating account in PY2023 had interval data available to calculate energy savings. We used the same imputation processes to calculate energy savings as we did for demand savings.

The evaluation team imputed energy savings for the same number of accounts as in the case of the demand savings imputations. Imputed energy savings totaled 10,438 kWh and represented 1% of total energy savings achieved for the year.

[15] 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. Both accounts with imputations actively confirmed their intent to participate in the respective events, per the Enel X records shared with us.

RESOURCE CAPABILITY ESTIMATION

Annual resource capability is the sum of the demand response impacts each facility can provide, as demonstrated during the events called in a year. Resource capability is calculated by averaging the evaluated impacts across events (if a facility participated in multiple events) and summing across 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.[16]

CUMULATIVE DR CAPABILITY

The evaluation team calculated the cumulative DR capability in alignment with the approach specified in the MEEIA III Plan. Cumulative DR capability included demand impacts from participants tested either during the event season events or during the December test event only:

- For accounts that participated in the PY2023 event season, we used average event season performance to estimate cumulative DR capability.
- For accounts whose performance was tested during the December test event, we used the results of the test event to estimate cumulative DR capability. No account participated in both the event season and the December test event, so averaging performance was not necessary.

ATTRIBUTION/NET IMPACT ANALYSIS

Per industry-standard practices, we assumed a net-to-gross ratio of 1.0 for impacts from DR events, indicating there was no free ridership or spillover.

5.3 EVALUATION RESULTS

5.3.1 PROCESS RESULTS

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 24 summarizes responses to the CSR process evaluation requirements.

Table 24. Business DR Program: Summary of Responses to CSR Process Evaluation Requirements

CSR Required Process Evaluation Questions	Findings
What are the primary market imperfections that are common to the target market segment?	Ameren Missouri customers generally lack experience with DR programs and are, therefore, not used to the load reduction strategies and unlikely to be skilled at estimating their load reduction potential during peak periods in the summer. As the program enters its fifth year, some program participants have gained more experience. Incentive levels relative to costs of curtailment impact customer willingness to curtail load.

[16] 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. In 2023, all accounts participated in at least one event.

CSR Required Process Evaluation Questions	Findings
Is the target market segment appropriately defined, or should it be further subdivided or merged with other market segments?	Targeting 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 the unique energy demands of medium and large business 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 to explore ways to achieve better performance among already enrolled participants. Enel X plans to continue deploying additional customer engagement to provide training and education and update customer contacts to increase performance and retention.

5.3.2 IMPACT RESULTS

EVENT SEASON DEMAND SAVINGS

The Business DR Program achieved 63.87 MW in total demand savings during the PY2023 event season. The load reduction of 63.87 MW represents 45% of the total nominated capacity from customers, among which the events were called (Table 25). The event performance calculated by the evaluation team matches Enel X's calculations of event performance. Event performance was generally consistent across events. Longer duration events resulted in lower performance.

Table 25. Business DR Program: Event Season 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	July 27, 2023	3–5 pm CST	1,019	140.42	74.30	53%	72.91
2	August 23, 2023	3–6 pm CST	1,022	140.30	60.57	43%	59.26
3	August 24, 2023	2–6 pm CST	1,022	140.30	56.69	40%	55.47
Overall Event Season Result				**140.48**	**63.87**	**45%**	**62.31**

Note: Participating accounts include those among which the event was called.

A total of 1,022 customers participated in two or more events over the course of the PY2023 event season. Of these accounts, 7% delivered negative impacts across all events, indicating that these participants not only failed to curtail load during event hours, but increased their energy consumption during that time. Almost half of the participants (45%) that participated in more than one event delivered positive load reductions for all events that they participated in during the event season. The remaining participants delivered mixed load reductions. Of those that participated in more than one event, only 202 customers (20%) performed

consistently across events.[17] Consistently performing customers also performed well below the average event season performance rate[18], collectively averaging a 29% performance rate. Twenty-seven of these 202 customers had a consistently negative performance. The stability of performance event-to-event alongside the alignment of performance with nominated capacity is key to anticipating and adapting the program to ensure continued success.

Figure 14 displays the number of accounts, nominated capacity, and kW performance distribution of PY2023 program participants across industry segments. The figure also shows the average per-account kW performance for each segment through participation in PY2023 events, as well as average weighted performance rate for each industry segment.[19] Most customers in PY2023 were in the following industries: education, energy and utilities, and manufacturing facilities. These segments, along with agriculture and mining, were key contributors to total kW impacts. On a per-account basis, however, healthcare offered deeper load reductions compared to other segments. Manufacturing, business and customer services, and healthcare segments constituted nearly half of all nominations and provided, on average, deep load reductions. Customers in the education industry, despite making up nearly half of all customers (42%) and a fifth of nominations (18%) delivered only 8% of the total impact with a weighted average performance rate of only 27%. This performance suggests that despite comprising a large percentage of participants, customers in the education industry do not achieve initially anticipated performance levels.

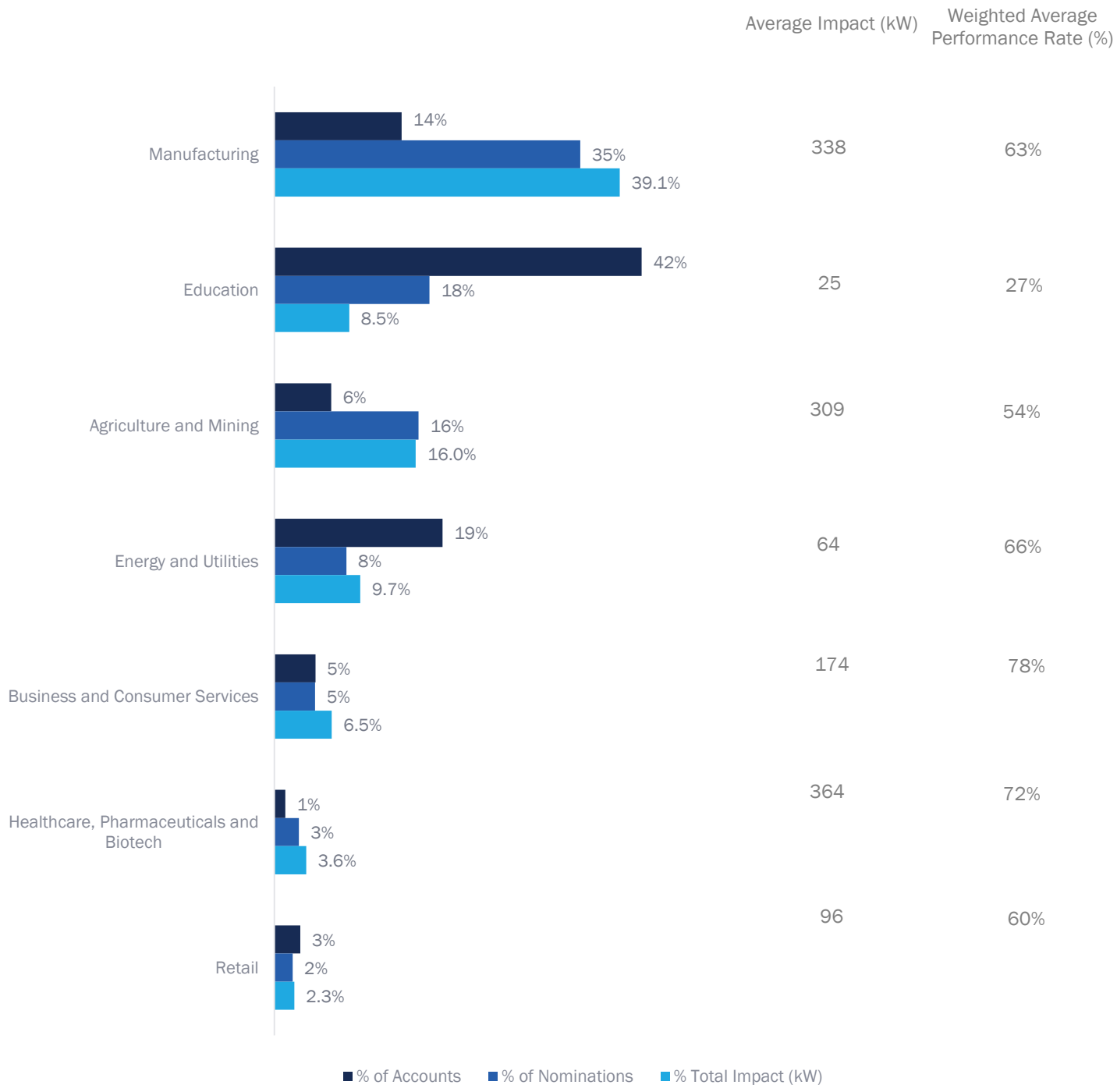
Enel X's focus in the coming years will be on working with existing customers to improve their program performance, while continuing to engage new customers.

[17] Consistent performance is defined as performance rates within 20 percentage points of one another.

[18] The performance rate is calculated by dividing the achieved event impact (kW) by the nominated capacity.

[19] Average weighted performance rate was calculated by dividing the sum of kW performance by the sum of nominated capacity for each industry segment. As such, in cases where performance is dominated by a handful of accounts with larger nominations, variation among smaller account s may not be fully reflected in the performance rate.

Figure 14. Business DR Program: PY2023 Customer Distribution by Segment



Note: Includes industries with the largest percent of contributions to total impacts. Industry segments may not always be accurate.

DECEMBER EVENT DEMAND SAVINGS

The December event achieved 67.58 MW in total demand savings, representing 69% of the total nominated capacity from customers among whom the event was called (see Table 26). The event performance calculated by the evaluation team matches Enel X's calculations of event performance. Notably, the December event achieved a similar load reduction to the average event in the PY2023 event season with just a fraction of participants. The newly eligible accounts were a key driver of these impacts. Participants that opted out of the MEEIA energy efficiency programs had a significantly higher total nominated capacity and event performance than the remaining participants enrolled into the program following the event season.

Table 26. Business DR Program: December Event Performance Summary, Demand Savings

MEEIA EE Opt-Out Status	Event Date	Time	Participating Accounts	Total Nominated Capacity (MW)	Event Performance (MW)	Share of Nominated Capacity	Average Per Account Performance (kW)
No	December 13, 2023	3–6 pm CST	12	11.62	6.35	55%	528.76
Yes	December 13, 2023	3–6 pm CST	32	85.65	61.24	71%	1,913.64
Overall December Event Result			**44**	**97.27**	**67.58**	**69%**	**1,535.94**

Note: Participating accounts include those among which the event was called.

ENERGY SAVINGS

Achieving energy savings during DR events was not the primary goal of the Business DR Program. As a result of the three events during the event season and the additional test event dispatched in December, participants decreased consumption by a total of 926 MWh. The energy savings fell short of the target of 2,000 MWh and represent 46% of the cumulative target for PY2023 (Table 27).

Table 27. Business DR Program: Energy Savings Comparison to PY2023 Goal/Target

Event	MEEIA III Goal/Target (MWh)	Event Season Energy Savings (MWh)	Percent of Goal/Target
Event 1 (July 27, 2023)		186.43	
Event 2 (August 23, 2023)		306.58	
Event 3 (August 24, 2023)		289.55	
Event 4 (December 13, 2023)		143.07	
Total	**2,000.00**	**925.63**	**46%**

The average per-account energy savings was 0.87 MWh. Savings were relatively consistent across event season events, with the December audit realizing higher per-account absolute energy savings (Table 28). All events, including the December event, had consistent savings relative to baseline load. Energy savings represented around 3% of the baseline load across all events. In general, energy savings were lower for shorter events, this is likely because participants did not have as many event hours to realize additional energy savings.

Table 28. 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	Event 1 (July 27, 2023)	3–5 pm CST	1,019	186.43	0.18	2.26%
2	Event 2 (August 23, 2023)	3–6 pm CST	1,022	306.58	0.30	3.37%
3	Event 3 (August 24, 2023)	2–6 pm CST	1,022	289.55	0.28	3.22%
4	Event 4 (December 13, 2023)	3–5 pm CST	44	143.07	3.25	3.08%
			Overall Result	**925.63**	**0.87**	**2.99%**

Note: Savings as a percentage of baseline load is calculated excluding imputations.

RESOURCE CAPABILITY ESTIMATE

Table 29 presents resource capability estimates. These estimates reflect available capacity from all accounts enrolled at the end of the PY2023 event season.

For accounts participating in the event season, resource capability represents the average event performance during the season summed across accounts. For accounts untested during the PY2023 event season that had participated in earlier years (e.g., had unenrolled at the start of PY2023 and not re-enrolled until after the summer event season), resource capability represents their average event performance during the event seasons that they were active. For accounts untested during the 2023 event season that had not participated in earlier years (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 PY2023, there were no accounts enrolled by the end of the year that were untested. We did not weather normalize resource capability since in previous years we have tested weather sensitivity of the participating accounts and generally found little to no correlation between load and weather. Total estimated resource capability is 131.43 MW, representing 55% of the nominated capacity of the accounts enrolled as of the end of PY2023.

Table 29. Business DR Program: PY2023 Resource Capability Estimate

Metric	Result
Total accounts enrolled as of the end of 2023	1,066
Total nominated capacity (MW)	237.57
PY2023 resource capability estimate (MW)	131.43
PY2023 per-account resource capability estimate (kW)	123.29

The Business DR Program resource capability of 131.43 MW represents 131% of the cumulative PY2023 target of 100 MW (Table 30). Looking ahead to PY2024, the resource capability of 131.43 MW represents 96% of the cumulative PY2024 target of 137.04 MW. Given enrollment to-date, and low levels of unenrollment Enel X is well-positioned to meet the PY2024 demand response target provided sustained performance in PY2024 and successful efforts to enroll additional customers in the program.

Table 30. Business DR Program: Comparison of Resource Capability to Goal/Target

Metric	Result
PY2023 resource capability estimate (MW)	131.43
PY2023 goal/target (MW)	100.00

Percent of PY2023 goal/target	131%

CUMULATIVE DR CAPABILITY ESTIMATE

Table 31 presents the PY2023 cumulative DR capability. The values in the table represent demand impacts from tested accounts, either during the PY2023 event season or during the December test event.[20] The program's cumulative DR capability is 131.43 MW and represents 131% of the target.

Table 31. Business DR Program: Comparison of Cumulative DR Capability to Target

Metric	Result
PY2023 cumulative DR capability (MW)	131.43
PY2023 target	100.00
Percent of PY2023 target	131%

5.4 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 PY2023 cumulative target of 100 MW by 31.43 MW. The newly eligible MEEIA energy efficiency opt-out participants accounted for nearly half (61 MW) of the PY2023 cumulative capability. With an incremental goal of 37.04 MW in PY2024, the DR capability of 131.43 MW represents 96% of the PY2024 cumulative DR capability target. Given low levels of participant attrition over time, the program is positioned well to meet and exceed the PY2024 target. As such, the primary focus of the program can shift from recruitment to working with existing participants to maintain their performance and on enrolling some new program entrants to meet future goals.
  - **Recommendation 1:** Program staff should continue proactive outreach to existing and newly qualified customers. Program staff should also work with the program aggregator, Enel X, to continue to capitalize on existing relationships and processes, including their partnership with Enersponse to engage small and medium-sized businesses, and ongoing communication with participants to increase their comfort level with the program. Tapping into not yet enrolled newly eligible customers following the tariff change should allow for additional strong nominations to supplement the existing participant population.
- **Conclusion 2:** Only 20% of Business DR Program participants maintained consistent event performance in PY2023, and the average performance rate of these participants was well below the average performance rate of all other participants. The stability of performance event-to-event, alongside the alignment of performance with nominated capacity, are key to more accurate planning of the program capability and adapting more efficient recruitment and engagement strategies. Variation in performance by industry type can present an opportunity to further tap into existing data and insights to identify underperforming customers and deploy course-corrective actions aimed at deeper and more consistent performance.
  - **Recommendation 2:** Program staff should work with the program aggregator, Enel X, to continue efforts to align nominations with observed performance with a special focus on customers and industry segments with consistently low performance to determine whether those customers remain a

[20] 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.

viable target for the program and to identify opportunities to strengthen and improve their performance. In addition, future evaluations should include additional process research to better understand these sites and how these participants respond to DR events.

- **Recommendation 3:** In addition to focusing on negative and top performers, program staff should work with the program aggregator, Enel X, to conduct outreach to customers to understand reasons for highly variable performance, and to identify whether there are opportunities for improvements in consistency event-to-event. Program staff should target industry segments with meaningful volumetric presence (participant counts and kW nominations) and inconsistent performance.

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