Demand Side Analytics
DATA DRIVEN RESEARCH AND INSIGHTS

DRAFT REPORT
CALMAC ID: PGE0498.01

2022-2023 Load Impact Evaluation of Pacific Gas and Electric's Smart Thermostat Control Pilot

Prepared for Pacific Gas & Electric

By Demand Side Analytics, LLC

May 2024

ACKNOWLEDGEMENTS

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ABSTRACT

This report presents the outcomes of Pacific Gas and Electric's (PG&E) Smart Thermostat Control Pilot conducted during the summers of 2022 and 2023. The Pilot comprised two components: demand response (DR) events and daily automated time-of-use (TOU) rate plan optimization. A key focus of this Pilot was the enrollment and effectiveness of various smart thermostat brands and the impact of temperature-based demand reduction strategies. At the close of 2023, the Pilot observed a significant market dominance of Nest thermostats (72.4%), followed by ecobee (26.0%), Emerson (1.6%), and newly introduced Honeywell Home thermostats (0.4%).Because ecobee thermostats offered the most effective functionality for TOU automation, the Pilot focused on the effects on those thermostats. The Pilot revealed that around 58% of ecobee users utilized TOU automation consistently in 2022 and 47% by the end of 2023. On high-load days, the smart thermostats demonstrated an average demand reduction of 0.13 kW per site during TOU control hours, with the effect diminishing over longer periods, especially during the net load peak hours (7–9 PM).

The Pilot underscores the variance in impacts due to geographic dispatch and temperature conditions. In 2022, the highest demand reduction was observed on September 6, a day of extreme heat and high system load, highlighting the correlation between temperature and DR effectiveness. The 2023 data further reinforced this, showing the most substantial impacts in hot regions such as the Central Valley and Sierras. The Pilot concluded that 90% of the variation in dispatchable demand reduction can be attributed to weather conditions, the duration of the event, and the time of day.

TABLE OF CONTENTS

1 EXECUTIVE SUMMARY 8
2 INTRODUCTION 13
2.1 Technology Description 13
2.2 Key Research Questions 14
2.3 System Peaking Conditions 15
2.4 Participant Characteristics and Enrollment 17
2.5 Intentional Event Variation 21
3 METHODOLOGY 23
3.1 2022 Demand Reponse Event Operations Plan 25
3.2 2023 Event Operations Plan 26
3.3 2022 Demand Response Randomized Control Trial 28
3.4 2023 Demand Response with Matched Controls 30
3.5 Automated TOU Impacts with Matched Controls 31
4 2022 EVENT BASED LOAD IMPACTS 33
4.1 Event Day Reduction Summary 33
4.2 Impacts by Segment 35
5 2023 EVENT BASED LOAD IMPACTS 37
5.1 Event Day Reduction Summary 37
5.2 Impacts by Segment 40
6 DAILY LOAD SHIFTING AUTOMATION 42
6.1 Hourly and Daily Energy Savings 42
6.2 Event Performance with and without Automated Daily Shifting 47
6.3 Load impacts Response by Customer Type 48
6.4 End-Use Analysis 50
7 EX ANTE IMPACTS FOR PLANNING AND OPERATIONS 55
7.1 Process 55
7.2 Weather Sensitivity of Resources 56
7.3 Load Impacts Predictive Model 58
7.4 Time Temperature Matrix 58
7.5 Annual Peak Day DR Event Performance 59

7.6 Key Findings 60
8 CUSTOMER SURVEY 61
8.1 Demographics 61
8.2 Overall Customer Satisfaction 61
8.3 TOU Optimization 65
8.4 Incentives 65
8.5 Feedback on Program design 66
9 KEY FINDINGS AND RECOMMENDATIONS 67
APPENDIX A: RESULT SUMMARY BY SEGMENT FOR EACH EVENT 71
APPENDIX B: EVENT IMPACTS MATCHED CONTROL GROUP TOURNAMENT RESULTS 89
APPENDIX C: AUTOMATED DAILY LOAD SHIFTING MATCHED CONTROL GROUP TOURNAMENT 91
APPENDIX D: ANALYSIS WITH DELIVERED LOADS VERSUS NET LOADS 94
APPENDIX E: EX-ANTE REGRESSION OUTPUT 96
APPENDIX F: AIR CONDITIONER LOADS IN PG&E TERRITORY 98

FIGURES

Figure 1: 2022-2023 System Load Duration Curves 16
Figure 2: Comparison of Pilot Period Temperature Conditions to Historical Years....16
Figure 3: Top Ten System Load Days for 2022 and 2023 17
Figure 4: Participating Devices Over Time by Brand....18
Figure 5: Weather Sensitivity, Delivered Loads, and Cooling Loads Per Site 19
Figure 6: Geographic distribution of customers 19
Figure 7: Differences by Brand 20
Figure 8: 2022 Events and System Conditions 21
Figure 9: Geographic Dispatch (Sub-LAPs) by 2023 Event 22
Figure 10: Map of CAISO Sub-LAPs in the PG&E Service Territory....27
Figure 11: Randomized Control Trial Conceptual Example 29
Figure 12: Diagram of Event Estimation Using a Matched Control Group 30
Figure 13: Example Difference-in-Difference Adjustment....31
Figure 14: Daily Load Shifting Impacts Methodology Summary 32
Figure 15: Hourly 2022 Load Impacts for Events with Greatest Reference Load 33
Figure 16: Hourly 2022 Event Impacts versus Temperature....35
Figure 17: Hourly 2022 Load Impacts for Events with Greatest Reference Load 37
Figure 18: First Hour Impacts versus Temperature by Geographic Region – 2023 Events 40
Figure 19: Difference-in-Differences Calculation for Hourly Loads for TOU Automation - Year 1 43
Figure 20: Difference-in-Differences Calculation for Hourly Loads for TOU Automation - Year 2....43
Figure 21: Daily Peak Average Demand Reduction Due to TOU Automation (4-8 pm)....44
Figure 22: Heat Map of Demand Reduction Due to Daily TOU Automated Response 44
Figure 23: Event Day Impacts for Sites with and Without Automated Daily Shifting....47
Figure 24: Average Reductions in Cooling Demand using Uplight Runtime Data....50
Figure 25: Variation in Cooling Setpoints For Participants and Controls 51
Figure 26: Comparison of September 2023 Runtimes for Participants and Controls 52
Figure 27: Heatmap of Runtime Reductions 53
Figure 28: Average Per-Site Reductions versus Temperature by Hour 53
Figure 29: Cooling Runtimes by Temperature Bins 54
Figure 30: 2021-2023 Event Impacts Over Temperature by Event Hour....57

Figure 31: First-Hour Impacts versus Temperature by Sub-LAP 57
Figure 32: Average Per-Site Load Predictions for PG&E August Monthly System Peak, 1-in-2 weather conditions, 5:00PM-9:00PM 58
Figure 33: Survey Demographics 61
Figure 34: Overall Customer Satisfaction 62
Figure 35: Customer Experience Associated with Various Aspects of the Pilot 63
Figure 36: Reasons Customers Signed Up for the Pilot 64
Figure 37: Awareness of DR Events 64
Figure 38: Customer Responses on TOU Optimization 65
Figure 39: Customer Feedback on Incentives 66

TABLES

Table 1: 2022 DR Events and Per Site Impacts (kW) 9
Table 2: 2023 DR Events and Per Site Impacts (kW) 10
Table 3: TOU per Site Impacts (kW) 10
Table 4: Key Findings Summary 11
Table 5: Smart Thermostats Brands Included in Pilot 14
Table 6: Key Research Questions 15
Table 7: Summary of Methodology 24
Table 8: 2022 Event Operations Plan 26
Table 9: 2023 Events and Details of Dispatch 28
Table 10: Summary of 2022 Event Impacts Per Site (kW) 34
Table 11: Average Impacts by Segment – 2022 Events 36
Table 12: Summary of 2023 Event Per Site Impacts (kW) 39
Table 13: Average kW Impacts by Segment – 2023 Events 41
Table 14: Daily TOU Automation Peak Period kW Impacts by Day Type 46
Table 15: Daily TOU Automation kW Impact by Segment – CAISO Net Loads Top 20 Days 49
Table 16: Methods for Estimating Ex Ante Reference Loads and Impacts 56
Table 17: Time-Temperature Matrix – Selected Sub-LAP with kW Impacts 59
Table 18: June System Peak Impacts per site (kW) - PG&E Weather Conditions, Average over 4-Hour Event 60
Table 19: Key Findings 67
Table 20: Recommendations 69

1 EXECUTIVE SUMMARY

This report presents the results of PG&E's Smart Thermostat Control Pilot for the 2022 and 2023 DR seasons. The Pilot was branded under the "SmartAC" trademark name and provided incentives to residential customers who allowed PG&E to reduce or shift their electricity use during peak hours (4:00 PM – 9:00 PM) by communicating with WiFi-enabled smart thermostats. PG&E worked with four types of connected thermostats – Nest, ecobee, Emerson, and Honeywell Home – that reduce or shift electricity load during demand response (DR) events. Additionally, two thermostat manufacturers – ecobee and Emerson – offered automated daily shifting in response to time-of-use (TOU) rates, shedding customer load daily during peak hours. Notably, most customers were already on TOU rates, and the automated daily shifting was over and above the customer behavioral response to time-of-use prices.

The primary objectives of this Pilot were to:

- Understand how enrollment rates vary by thermostat brand and what share of customers elect the daily TOU automation option.
- Quantify the magnitude of thermostat-enabled daily TOU demand reduction over and above customer behavioral response to the rates.
- Quantify the magnitude of dispatchable demand reduction for each DR event called including the incremental value for ecobee customers who elected daily TOU automation.
- Quantify how dispatchable reductions vary as a function of weather, event start, hours into the event, and daily TOU automation.
- Understand how demand reductions vary across customers by geography, income status, solar, and thermostat brand.
- Assess demand reduction persistence across the event hours.
- Assess the ability of the Pilot to deliver locational dispatch.

The Pilot was preceded by a DR Emerging Technology study which was initially launched in the middle of the 2021 summer. The purpose of the study was to assess the incremental value of DR events for customers on TOU rate plans. Only 14,000 customers on TOU rate plans were allowed onto the Pilot. As part of Rulemaking 20-11-003,, PG&E's proposal for a follow-on Pilot was authorized to further study smart thermostats in PG&E service territory.[1] At the beginning of the 2022 season, almost 13,000

[1] Rulemaking 20-11-003, Phase 2 Decision 21-12-015, Directing Pacific Gas and Electric Company, Southern California Edison Company, and San Diego Gas & Electric Company to Take Actions to Prepare for Potential Extreme Weather in the Summers of 2022 and 2023

controllable thermostats were enrolled, which then grew to 109,802 devices by the end of the 2023 season.

In 2022, PG&E intentionally called events over a wide range of weather conditions, event start times, and event durations in order to fully understand device performance under different conditions. PG&E executed 19 territory-wide events in 2022, six in response to emergency notices from the California Independent System Operator (CAISO). In 2023, the CPUC authorized PG&E to integrate the Pilot into the CAISO wholesale market and the focus shifted to market integration. PG&E pilot resources were dispatched in response to market operator instructions by grid areas knows as Sub-Load Aggregation Points (SubLAPs). In total, the market operator called events on nine days in 2023, with 16 unique dispatch periods, but none were territory-wide.

The 2022 DR impact analysis relied on randomized control trials. As customers enrolled, DSA randomly assigned them to one of ten groups. Except for CAISO emergencies, a subset of the ten randomly assigned groups were dispatched for each event while the remaining groups were held back as control groups. As a result, while 19 events were called, individual customers experienced fewer than eight events each during the summer. The event impacts were estimated using whole-home hourly data and a difference-in-differences panel regression. In 2023, the DR analysis solely relied on a difference-in-differences calculation using a matched control group. The daily TOU automation analysis included over 11,000 sites and was analyzed using a matched control group and difference-in-differences for both years.

Table 1 and Table 2 summarize the event-based demand reductions from the 2022 and 2023 seasons, respectively. Table 3 summarizes the results from the analysis of the daily TOU automation. Finally, Table 4 summarizes the key findings from the Pilot.

Table 1: 2022 DR Events and Per Site Impacts (kW)

					Hourly Impacts (kW)				Event Average				
Date	Event Hours	Event hours Avg. Temp	Max Temp (Participant weighted)	Dispatched Sites	Hour 1	Hour 2	Hour 3	Hour 4	Reference Load (Baseline)	Impact	% Impact	se	t
06/22/2022	18:00 to 20:00	85.6	88.1	1,455	0.41	0.23	0.14		1.74	0.26	15.0%	0.038	6.84
06/27/2022	17:00 to 19:00	89.3	90.2	1,470	0.56	0.30	0.25		1.44	0.37	25.9%	0.036	10.45
07/11/2022	17:00 to 19:00	91.4	92.2	1,441	0.91	0.55	0.38		1.63	0.61	37.6%	0.041	14.99
07/16/2022	19:00 to 21:00	88.7	91.9	1,584	0.72	0.40	0.19		2.14	0.43	20.2%	0.038	11.31
07/18/2022	19:00 to 21:00	85.6	89.0	1,622	0.66	0.39	0.27		2.07	0.44	21.2%	0.036	12.37
07/21/2022	18:00 to 21:00	84.3	87.7	1,598	0.53	0.30	0.21	0.13	1.67	0.29	17.4%	0.032	9.17
07/28/2022	17:00 to 20:00	81.4	84.0	3,333	0.58	0.38	0.27	0.18	1.33	0.35	26.5%	0.023	15.37
08/03/2022	18:00 to 21:00	87.4	90.7	2,835	0.70	0.40	0.24	0.22	2.00	0.39	19.6%	0.030	13.13
08/04/2022	19:00 to 21:00	80.8	84.2	3,617	0.63	0.36	0.22		1.87	0.40	21.5%	0.025	15.90
08/15/2022	17:00 to 20:00	91.7	93.9	3,852	0.40	0.25	0.21	0.13	1.92	0.25	13.0%	0.026	9.61
08/16/2022	20:00 to 21:00	89.7	92.4	19,377	0.73	0.34			2.48	0.54	21.7%	0.008	64.96
08/17/2022	18:00 to 21:00	85.7	88.5	15,650	0.57	0.41	0.30	0.18	1.89	0.36	19.2%	0.024	15.26
08/21/2022	19:00 to 21:00	79.0	82.6	3,941	0.68	0.35	0.22		1.90	0.42	21.8%	0.026	15.94
09/04/2022	18:00 to 21:00	94.5	99.4	4,311	1.05	0.62	0.39	0.26	2.43	0.58	23.9%	0.026	22.28
09/05/2022	21:00 to 21:00	93.2	93.2	10,979	0.27				3.16	0.27	8.5%	0.018	14.90
09/06/2022	18:00 to 20:00	101.7	105.6	21,334	1.38	0.90	0.61		3.34	0.96	28.9%	0.014	66.69
09/07/2022	18:00 to 21:00	94.5	100.5	21,310	1.11	0.74	0.51	0.38	2.89	0.68	23.6%	0.012	57.68
09/08/2022	18:00 to 21:00	97.3	103.4	21,261	1.21	0.75	0.47	0.29	3.04	0.68	22.3%	0.013	53.26
09/09/2022	20:00 to 21:00	83.6	86.3	2,756	0.57	0.32			2.19	0.44	20.2%	0.030	14.75
Average		**88.7**	**91.8**	**7,565**	**0.88**	**0.58**	**0.42**	**0.27**	**2.57**	**0.59**	**22.8%**	**0.028**	**21.15**

Table 2: 2023 DR Events and Per Site Impacts (kW)

Date	Event Hours	Event hours Avg. Temp	Max Temp (Participant weighted)	Dispatched Sites	Hourly Impacts (kW) Hour 1	Hour 2	Hour 3	Hour 4	Event Average Reference Load (Baseline)	Impact	% Impact	se	t
06/30/2023	16:00 to 17:00	99.6	99.6	14,119	0.73				2.03	0.73	35.9%	0.018	40.96
06/30/2023	17:00 to 18:00	82.0	82.0	26,708	0.44				1.44	0.44	30.9%	0.012	37.28
06/30/2023	18:00 to 19:00	92.4	92.4	6,075	0.70				2.32	0.70	30.3%	0.032	21.85
06/30/2023	19:00 to 20:00	82.7	82.7	24,224	0.69				2.23	0.69	31.1%	0.016	43.21
07/15/2023	16:00 to 19:00	99.5	100.7	43,000	0.82	0.59	0.41		2.50	0.61	24.3%	0.011	53.21
07/17/2023	17:00 to 19:00	101.3	102.1	11,817	1.10	0.65			3.28	0.87	26.6%	0.022	39.51
08/15/2023	16:00 to 18:00	100.5	100.8	14,472	1.09	0.76			2.87	0.92	32.1%	0.019	48.84
08/15/2023	17:00 to 19:00	104.2	104.7	7,694	1.15	0.60			3.40	0.88	25.8%	0.025	34.84
08/16/2023	16:00 to 20:00	98.8	101.4	5,615	0.96	0.59	0.39	0.29	2.94	0.56	19.0%	0.028	19.97
08/16/2023	17:00 to 20:00	100.7	102.6	13,878	1.24	0.79	0.43		3.30	0.82	24.8%	0.020	41.23
08/16/2023	18:00 to 20:00	80.5	82.4	54,248	0.67	0.37			2.13	0.52	24.4%	0.009	57.95
08/16/2023	19:00 to 20:00	102.0	102.0	2,936	1.11				3.23	1.11	34.2%	0.037	29.56
08/23/2023	17:00 to 19:00	91.6	93.4	2,326	0.59	0.29			2.27	0.44	19.4%	0.046	9.62
10/05/2023	17:00 to 19:00	81.5	82.7	32,035	0.45	0.28			1.52	0.36	24.0%	0.011	34.27
10/06/2023	17:00 to 19:00	81.7	83.1	29,747	0.55	0.36			1.73	0.46	26.4%	0.012	38.41
10/19/2023	17:00 to 19:00	78.0	79.5	30,420	0.36	0.25			1.36	0.30	22.2%	0.009	32.64
Average		**92.3**	**93.3**	**19,957**	**0.69**	**0.45**	**0.41**	**0.29**	**2.23**	**0.57**	**25.5%**	**0.023**	**24.74**

Table 3: TOU per Site Impacts (kW)

System	Day Type	Accounts (Average)	4:00-5:00 PM	5:00-6:00 PM	6:00-7:00 PM	7:00-8:00 PM	Average 4-8 PM
ALL	AVERAGE DAY JULY	3,557	0.14	0.08	0.05	0.03	0.07
	AVERAGE DAY AUGUST	3,766	0.14	0.11	0.08	0.06	0.10
	AVERAGE DAY SEPTEMBER	3,735	0.09	0.08	0.05	0.06	0.07
PG&E	PEAK DAY JULY	2,971	0.14	0.12	0.10	0.01	0.09
	PEAK DAY AUGUST	3,575	0.10	0.05	0.04	-0.02	0.04
	PEAK DAY SEPTEMBER	3,552	0.10	0.07	0.04	0.05	0.06
	TOP 20 DAYS	3,659	0.13	0.10	0.04	-0.03	0.06
CAISO	PEAK DAY JULY	2,935	0.05	0.10	0.08	0.01	0.06
	PEAK DAY AUGUST	3,596	0.18	0.18	0.15	0.03	0.13
	PEAK DAY SEPTEMBER	3,562	0.13	0.08	0.03	0.02	0.07
	TOP 20 DAYS	3,710	0.12	0.09	0.08	0.03	0.08
CAISO Net Loads	PEAK DAY JULY	2,935	0.05	0.10	0.08	0.01	0.06
	PEAK DAY AUGUST	3,617	0.18	0.18	0.19	0.09	0.16
	PEAK DAY SEPTEMBER	3,568	0.07	0.04	0.03	0.07	0.05
	TOP 20 DAYS	3,904	0.13	0.09	0.05	-0.02	0.06

Table 4: Key Findings Summary

Key Finding	Additional Detail
Of the 108,190 devices enrolled at the end of the 2023 season, 72.4% were Nest thermostats, 26.0% were ecobee thermostats, 1.6% were Emerson, and 0.4% were Honeywell Home thermostats.	Nest devices were the most popular by the end of the 2023 season. However, in the 2022 Nest and ecobee had similar enrollment numbers. Marketing for ecobee devices occurred throughout the 2022 spring and fall periods, explaining their surge in enrollment. In 2023, most of the new enrollment was from Nest devices, which coincided with the marketing efforts. While the manufacturers did not share all the details about their marketing efforts, ecobee devices allowed in-app enrollment, while Nest customers could enroll on the Nest website. Emerson and Honeywell Home devices routed potential enrollees to the implementation vendor's enrollment web page.
Approximately 58% of ecobee participants utilized TOU automation at the beginning of the 2022 season, which declined to approximately 47% by the end of the 2023 season.	There were two device brands – Emerson and ecobee – that offered automated TOU response in 2022 and 2023, with ecobee customers making up the majority of enrollees. While Emerson offered automated TOU response, the number of participants was small and were therefore excluded from the analysis.
The thermostats enabled automated daily shifting that delivered daily demand reductions over and above customer response to TOU rates.	Thermostats reduced demand by 0.13 kW per site, on average, on the non-event days when PG&E loads were highest (Top 20 Load Days). The load impacts were measured using smart meter data and vary by hour, with larger results in the first hour and decreasing demand reduction in later hours. The device demand reduction was limited to four hours despite the five-hour peak. The thermostats did not deliver demand reduction for the 8:00 - 9:00 PM hour. Because thermostat demand reductions decay with longer durations, the demand reduction for net load peak hours (7:00 -9:00 PM) was substantially smaller than for the 4:00 – 7:00 PM period.
The algorithms automated the DR around the correct peak hours	Most participants were on rates with a 4-9 PM peak. For those sites, the data shows pre-cooling from 3-4 PM and snapback after 9 PM. However, the TOU-D rate had a shorter 5-8 PM peak. For TOU-D, the data shows re-cooling from 4-5 PM and snapback after 8 PM.
2022 events intentionally introduced wide variation in temperatures, event start time, and event duration, allowing us to quantify how performance varies as function of those factors fully	On September 6, 2022, one of the hottest and highest PG&E load days, the thermostats delivered an average impact of 0.96 kW over the DR event window, with the largest impacts, 1.38 kW per site, occurring in the first event hour. These impacts were much higher than cooler event days. Generally, hotter days with high system loads experienced the greatest impacts.
2023 events focused on CAISO market integration and locational dispatch. There was wide geographic variation in the event dispatch from CAISO, with most events called in hotter parts of the service territory.	Due to CAISO wholesale market integration, impacts were mostly driven by the temperature within the CAISO sub-LAPs in which participants were dispatched. While there was significant participation throughout the PG&E service territory, the largest concentration of participants resided in South Bay area. Those who delivered the largest impacts resided in the Central Valley and Sierras areas.

Key Finding	Additional Detail
The demand reduction is largest when temperatures are hottest, but the magnitude of the reduction decays across the event period	Over 90% of the variation in dispatchable demand reduction is explained by weather, the number of hours into the event, and the hour of the day. The biggest driver is the number of hours into the event. No matter the weather conditions or the event start time, we observed decay in the reduction over the event duration. The second-largest driver is the weather. The thermostats deliver larger demand reduction when temperatures are hotter.
For sites with automated daily shifting, the overall demand reduction is split into two distinct components – the daily shifting – and the event-based load reduction over and above the daily response.	Both the automated daily shifting and the event-based response are due to thermostat control. The combined total of the two components – daily shifting and incremental event-based response – is equivalent to the event impacts for sites without automated daily shifting. However, neither vendor nor PG&E receive capacity credits for technology enabled daily shifting.
The daily shifting algorithms effectively automated the response around the correct TOU peak hours	The thermostats correctly automated the daily load shifting for sites with 4-9 pm and 5-8 pm peak periods.

2 INTRODUCTION

This report presents the results of the 2022-2023 Smart Thermostat Control Pilot, which PG&E branded under its "SmartAC" trademark name, which used smart thermostats to automate daily TOU load shifting as well as dispatch for demand response (DR) events. The Pilot provided enrollment and annual incentives to residential customers who allowed PG&E to reduce or shift the use of electricity during peak hours (4:00 PM–9:00 PM) by communicating with Wi-Fi-enabled smart thermostats. Four different thermostat brands could be enrolled by participants – Nest, ecobee, Emerson, and Honeywell Home. PG&E sought to understand the magnitude of dispatchable (event-based) and daily (scheduled) peak demand reduction these devices can deliver.

The Pilot was conducted in the context of a significant energy transformation in California driven by several factors:

- The penetration of renewable resources is leading to a transformation in grid planning and operations, including:
  - ✓ A shift in the focus of planning and operations from net loads – actual system demand minus intermittent renewable resources – to gross loads;
  - ✓ Changes in the timing of when system loads peak;
  - ✓ Increased need for fast response resources to follow net loads and counterbalance variability in solar and wind resources;
  - ✓ Over-generation during the middle of the day, particularly on weekends in spring and fall months.
- PG&E began defaulting over three million residential customers to TOU rates starting April 2021. Thus, it has become important for PG&E to understand how smart technologies with automatic "set it and forget" features can help customers succeed on these rates.
- Connected devices with the ability to schedule or shift loads are becoming more ubiquitous, and their penetration in the marketplace is growing. However, communication with new devices and vendors requires continuous integration to achieve effective benefit to the grid.
- As part of de-carbonization efforts, California is encouraging beneficial electrification that shifts energy consumption from fossil-based fuels to electricity generated using clean resources for vehicle, space heating, and water heating. As a result, the overall electric loads are expected to change and winter loads are expected to grow over time.

2.1 TECHNOLOGY DESCRIPTION

Residential customers were recruited for this Pilot by one of two means: 1) customers could receive an incentive to enroll with an existing and eligible Wi-Fi-enabled thermostat or 2) customers could receive a rebate for a new, eligible Wi-Fi-enabled thermostat. Enrolled customers agreed to automated adjustments to the setpoints of their cooling unit – central air conditioning (AC), single-stage heat pump, or multi-stage heat-pump cooling units – lowering cooling load during events and times of high system load. PG&E contracted with Uplight, Inc. to provide recruitment services, support Pilot participants, manage enrollments and dispatch the smart thermostats through its demand response management system (DRMS) platform, Orchestrated Energy (OE).

The Pilot included four distinct thermostat brands: Nest, ecobee, Emerson, and Honeywell Home. All the devices are internet-connected and record thermostat run times and temperature set points. They also can receive remote signals to adjust the thermostat operations. While all the thermostats delivered demand reduction, there were nuanced differences in each thermostat's recruitment, functionality, and dispatch strategy, as summarized in Table 5. Notably, ecobee devices allowed customers to automate daily shifting in response to TOU rates and also delivered event-based reductions through the ecobee technology while Emerson allowed this functionality through OE.

Table 5: Smart Thermostats Brands Included in Pilot

		Marketing and enrollments	Functions	Event day Strategy
Nest		▪ Marketing: email and in-app notices ▪ Enrollment: web-based Nest site	▪ Event response	▪ Pre-cooling 2 hours – 3F ▪ Event: + 3F
ecobee		▪ Marketing: email and in-app notices ▪ Enrollment: mobile app enrollment	▪ Event response ▪ Daily TOU response	▪ Pre-cooling: based on customers energy savings preferences ▪ Event: based on customers energy savings preferences
Emerson		▪ Marketing: email and in-app notices ▪ Enrollment: Uplight owned web-based site	▪ Event response	▪ Proprietary optimization based on the premise's thermal model, occupant comfort bands, and a synthetic DR price signal.
Honeywell		▪ Marketing: email and in-app notices ▪ Enrollment: PG&E web-based site	▪ Event response	▪ Setpoint cycling during event

2.2 KEY RESEARCH QUESTIONS

For clarity, we separate the Pilot's research questions into three main categories in Table 6:

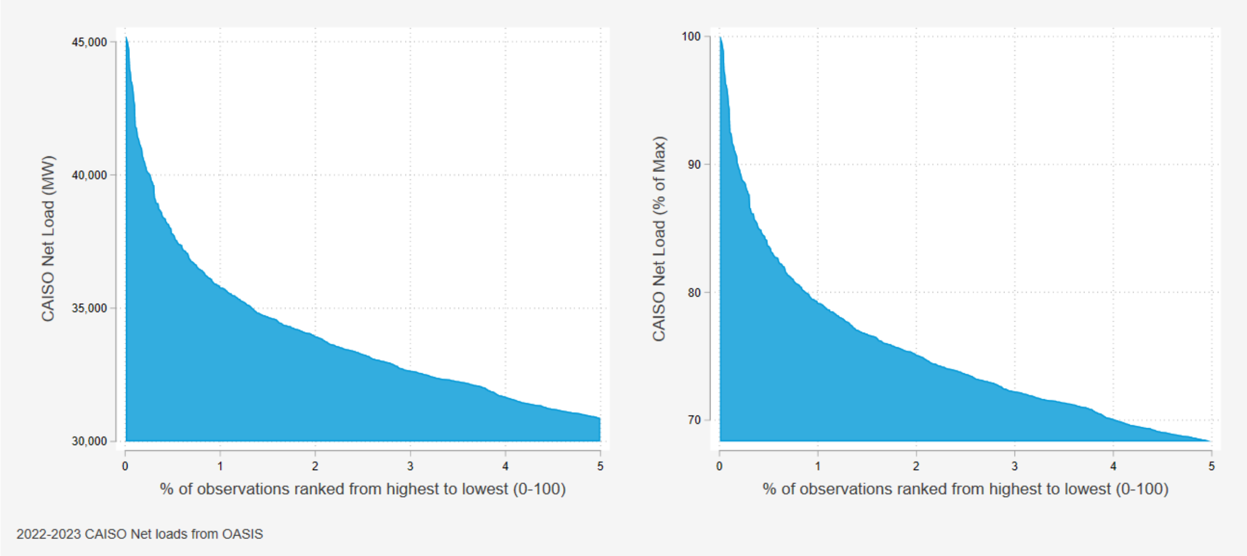
Table 6: Key Research Questions

Category	Research Questions
Pilot Participation	▪ How do enrollment rates vary by thermostat brand?
	▪ What are TOU optimization enrollment rates?
	▪ What are the characteristics of Pilot participants?
Event-based demand reduction	▪ What are the event (dispatchable) load impacts for each event called?
	▪ How do the dispatchable event load impacts vary by: ✓ By manufacturer? ✓ TOU auto-programming? ✓ By geography? ✓ By temperature conditions? ✓ Low-income status?
	▪ Does demand reduction persist across the event hours?
	▪ How did variation in event dispatch affect impacts?
Automated Daily TOU Response	▪ What is the TOU device response incremental to the behavioral price response?
	▪ Do the load impacts vary by: ✓ By manufacturer? ✓ By geography? ✓ By temperature conditions? ✓ Low-income status? ✓ Number of devices at the site?
	▪ Do daily shifting TOU demand reduction persist across the peak hours?

2.3 SYSTEM PEAKING CONDITIONS

PG&E's peak loads exhibit a significant concentration within a limited number of hours, as illustrated in the load duration curves in Figure 1. This plot arranges demand in descending order, plotting the highest load hours first. Throughout the 2022-2023 Pilot period, the CAISO net system load rarely surpassed 40,000 MW, emphasizing the condensed distribution of high-demand hours. In 2022, a new record high for the CAISO system peak occurred on September 6th reaching 52,061 MW during an extreme multi-day weather event. The net system peak high occurred on September 5th and reached 45,192 while in 2023, the peak occurred on August 15th with a total demand of 40,979 MW.

Figure 1: 2022-2023 System Load Duration Curves



The weather over the Pilot period, particularly, 2022, was considerably more extreme than in historical years. Figure 2 compares the annual maximum temperature days from 1991-2021 to the conditions over the 2022 to 2023 Pilot period. For the purpose of DR bidding and event dispatch, PG&E monitors the average of the temperatures at Sacramento, San Jose, Concord (East Bay), Fresno (South Central Valley), and Red Bluff (North Central Valley), a metric that PG&E refers to as DR-5 temperatures. In 2022, the annual max temperature, occurring on September 6th, was the highest temperature in the past 30 years.

Figure 2: Comparison of Pilot Period Temperature Conditions to Historical Years

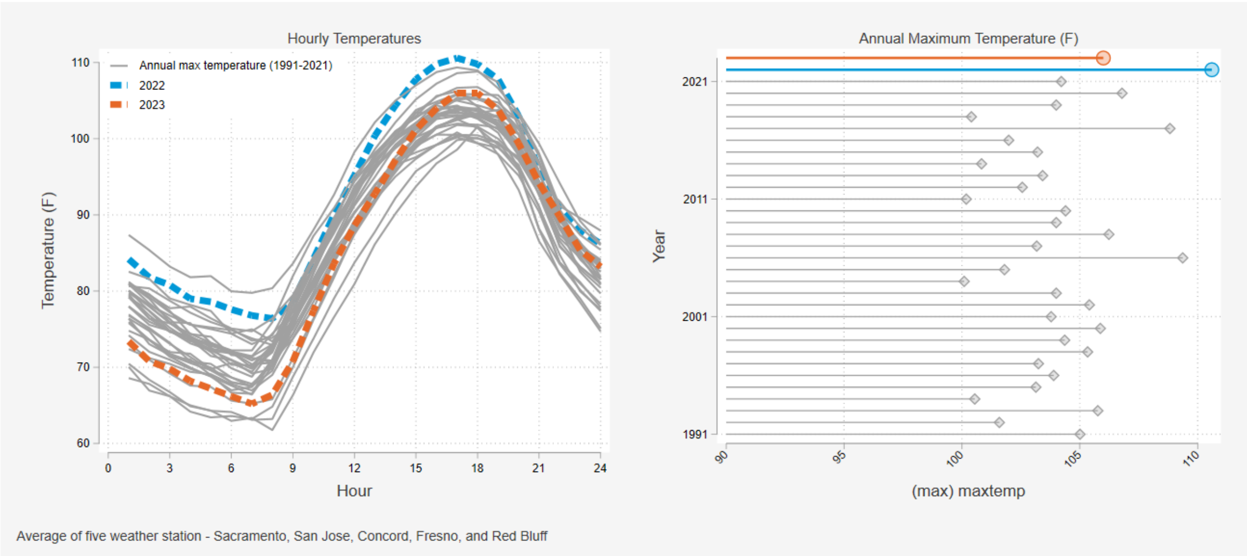
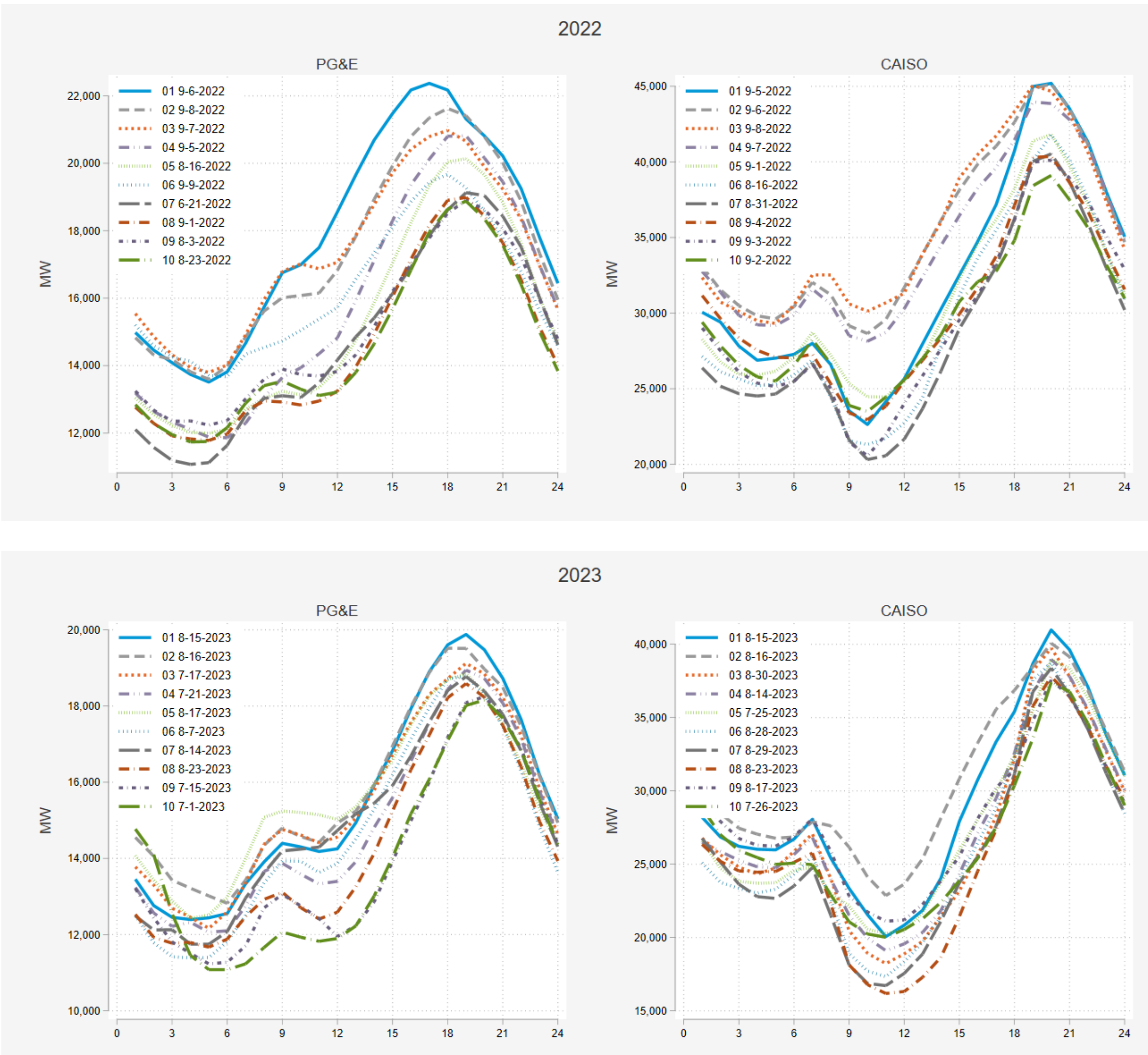


Figure 3contrasts the top ten days with the highest PG&E loads against the ten days with the highest CAISO net loads in both 2022 and 2023. Many of these days were selected as DR events in each season. The 2022 summer had more extreme loads, and hotter weather than 2023.

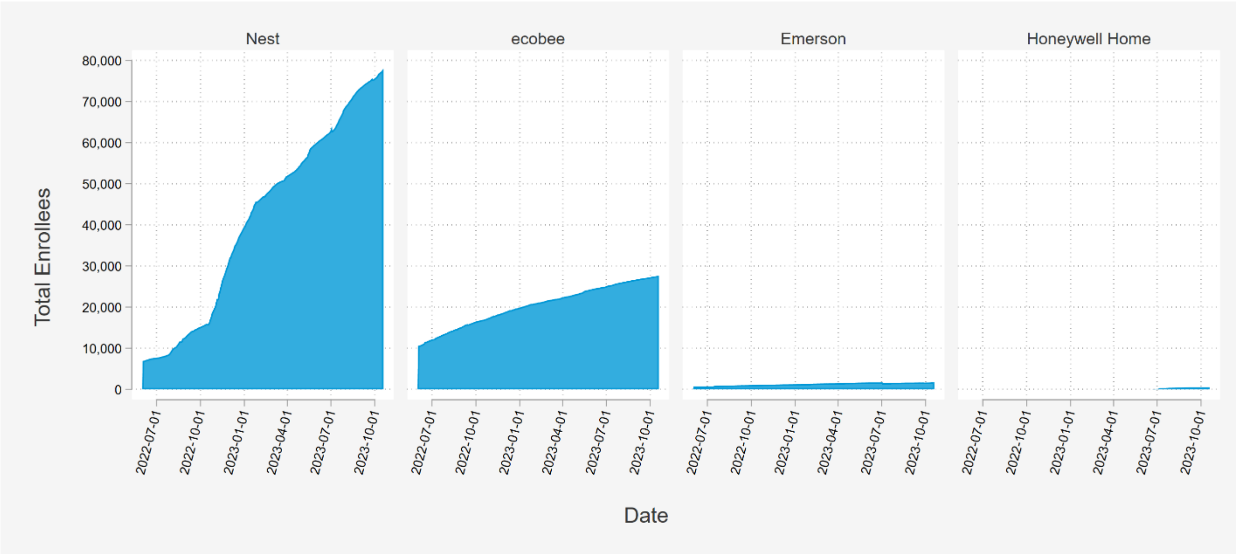
Figure 3: Top Ten System Load Days for 2022 and 2023



2.4 PARTICIPANT CHARACTERISTICS AND ENROLLMENT

By the end of the 2023 season, PG&E had over 89,000 active participants with nearly 110,000 thermostats. Figure 4 illustrates the enrollment trend over time, categorized by device brand. In 2022, Nest and ecobee devices showed comparable enrollment figures. However, in late 2022 and throughout 2023, Nest had a surge in enrollment, accounting for over 72% of all enrollments by the end of the season. In contrast, Emerson and Honeywell Home had fewer enrollments. Notably, Honeywell Home, a newcomer in 2023, started with low market penetration but managed to surpass 500 enrollments by the season's end.

Figure 4: Participating Devices Over Time by Brand



During the most intense weather days (as measured by DR-5), with temperatures ranging from 100 to 104 °F, a notable pattern emerged in energy usage. The average per-participant loads peaked at nearly 2.5 kW, and cooling loads reached just above 1.5 kW. However, as depicted in Figure 5 , these cooling loads fluctuate throughout the day, decreasing in the evening when temperatures drop, and air conditioners operate less intensively.

Figure 5: Weather Sensitivity, Delivered Loads, and Cooling Loads Per Site

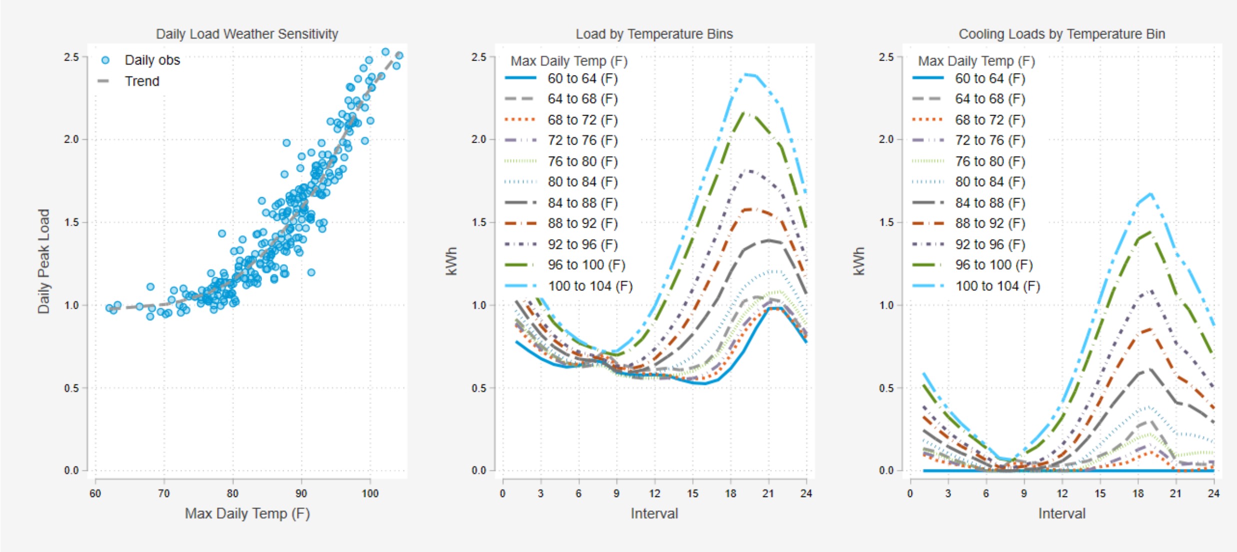


Figure 6 shows that the geographic distribution of devices was similar across each brand. Figure 7 shows additional comparisons by brand. Some key highlights include:

- 47% of participants with ecobee devices were enrolled in daily TOU automation by the end of the 2023 season.
- The greatest concentration of participants resided in the South Bay area.
- Participants had a higher penetration of rooftop solar than the overall PG&E population.
- Emerson and ecobee had higher penetration for low-income consumers than the other device brands

Figure 6: Geographic distribution of customers

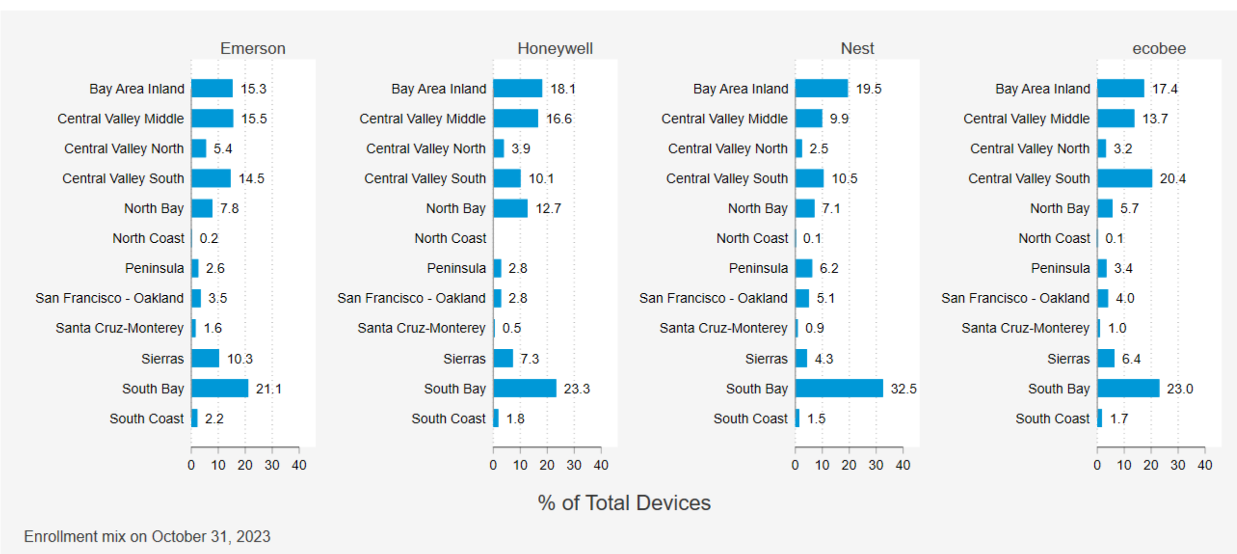


Figure 7: Differences by Brand

2.5 INTENTIONAL EVENT VARIATION

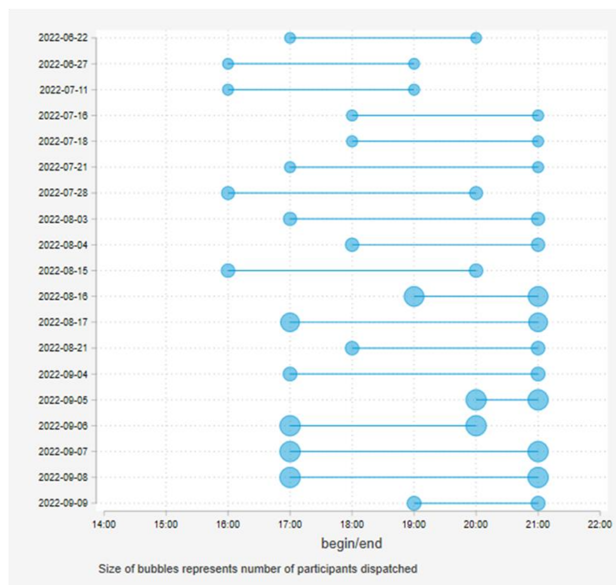
A key goal in 2022 was to learn as much as possible about performance during different event conditions – defined by weather, hours of dispatch, event duration, and day type (weekdays vs. weekends). DSA and PG&E developed a systematic operations plan for DR events to achieve this goal over the course of the 2022 summer. The objective was to collect a body of evidence over a short period to understand how and why load reduction performance varied.

Figure 8 visualizes the variation in event times, day type, and weather conditions of 2022 events. The figure also includes weather, market prices, and system loads for context. PG&E intentionally dispatched the thermostats under a wide range of conditions (including cooler days) for research purposes. The need for resources was highest on September 5th, 6th, 7th and 8th, which had the highest PG&E loads and, as mentioned earlier, CAISO recorded the highest net loads in history in 2022.

A total of 19 events were called over roughly two months, in addition to an early test to ensure operations and communications worked. The events vary in start time, duration, and temperature. They include four events when all resources were dispatched (August 17, September 6, September 7 and September 8) and three events called on weekends (July 16, August 21, September 4). September 5th featured an emergency event where only ecobee participants were called due to a technical glitch.

Figure 8: 2022 Events and System Conditions

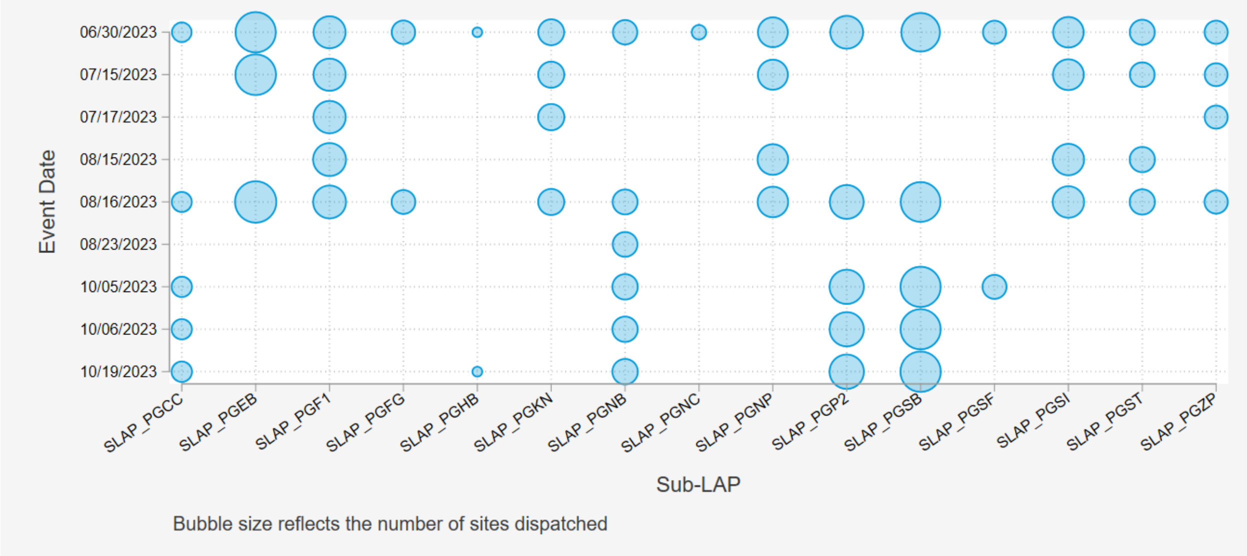
	Daily Peak...				
Event Date	CAISO Net Demand	PG&E Demand	Market price (PG&E DLAP)	DR-5 Max Temperature	Participant temperature (weighted)
6/22/2022	34,620	17,281	$167.90	96.4	93
6/27/2022	36,239	17,786	$176.07	97.4	91
7/11/2022	35,011	18,698	$188.97	99.8	93
7/16/2022	34,239	17,514	$158.22	100.4	94
7/18/2022	37,079	18,254	$161.80	97.4	92
7/21/2022	32,399	17,319	$149.74	95.8	88
7/28/2022	32,194	16,727	$168.53	92.2	85
8/3/2022	36,617	18,902	$147.71	98.0	91
8/4/2022	35,267	18,026	$163.03	96.2	90
8/15/2022	38,585	18,686	$232.96	99.4	94
8/16/2022	41,793	20,138	$328.82	103.0	99
8/17/2022	37,406	17,947	$318.50	95.2	89
8/21/2022	31,029	16,032	$129.88	92.4	87
9/4/2022	40,364	18,302	$443.55	102.8	100
9/5/2022	45,196	20,816	$859.29	108.2	106
9/6/2022	45,169	22,371	$1,220.00	110.6	108
9/7/2022	43,968	20,974	$1,324.24	104.4	101
9/8/2022	45,060	21,627	$1,049.64	107.8	105
9/9/2022	38,397	19,673	$358.35	101.4	96



In 2023, the Pilot focused on CAISO wholesale market integration and locational dispatch by sub-LAP. PG&E tested bidding into the market and followed dispatch awards from CAISO. In part because 2023 was a cooler year, at no point did CAISO dispatch all resources across all locations and, generally, hotter locations were dispatched more frequently. Section 3.2 of the report offers a more comprehensive expansion on this methodology.

Figure 9 presents a visual representation of this approach, illustrating which sub-LAPs were activated on each event day. In total, there were 9 event days in the summer of 2023, with each sub-LAP being dispatched at least twice throughout the season. The first event on 6/30 was a test event in which all sub-LAPs were dispatched. This figure provides an overview of the geographic spread and frequency of event dispatches.

Figure 9: Geographic Dispatch (Sub-LAPs) by 2023 Event



3 METHODOLOGY

The primary challenge of impact evaluation is the need to accurately detect changes in energy consumption while systematically eliminating plausible alternative explanations for those changes, including random chance. Did the dispatch of DR resources or the introduction of automated daily shifting cause a decrease in hourly demand? Or can the differences be explained by other factors? To estimate demand reduction and daily load shifting, it is necessary to estimate what demand patterns would have been in the absence of the intervention – this is called the counterfactual or reference load.

Table 7 presents a detailed summary of the methodologies used in this Pilot, highlighting the different approaches for estimating DR impacts in 2022 and 2023. In 2022, the assessment of DR impacts was conducted through a Randomized Control Trial (RCT). Within a week of enrollment, each participant was randomly assigned to one of ten groups, and for each event (except CAISO emergencies), a subset of the groups was dispatched while the remainder were withheld as control groups. The load impacts were analyzed using a difference-in-differences panel regression which included the treatment and control groups event days and hot non-event days. For CAISO emergencies, in which all groups were dispatched, the estimation relied exclusively on panel regressions with fixed effect and time effects to estimate the counterfactual as a function of weather, hour of day, and day of week. In addition, the model incorporated the territory-wide residential hourly load profiles (8760) as a right-hand side variable to model effects that were not captured by weather and other explanatory variables.

In 2023, all event impacts were estimated using a matched control group in conjunction with a difference-in-differences approach. The matched control groups were updated for each event days as the Pilot population grew, and the difference in difference calculation included both the event day and similar hot non-event days. The estimation of TOU automation impacts in both years also employed a matched control group and a difference-in-difference calculation. In instances wherein differences-in-differences was used, we ensured the data was balanced: with the same count of event and non-event (or before and after) observations for the control and treatment groups and comparable periods.

Table 7: Summary of Methodology

COMPONENT	2022 Event-based DR	2023 Event-based DR	2022 and 2023 Daily TOU Automation
Population analyzed	Full population of enrolled sites. Varied by event date but reached over 36,500 sites by the end of September of 2022	Full population of enrolled sites plus a matched control pool. Participation varied by event date, but enrollments reached over 85,000 sites by end of October 2023	Full population of ecobee devices with TOU automation, which included over 11,000 sites by the end of October 2023
Data source	PG&E AMI data – Net Loads	PG&E AMI data – Delivered Loads	PG&E AMI data – Net Loads
Operations	Based on an operations plan that was intentionally designed to introduce variation in weather, event start times, event durations, and weekend vs weekday conditions	Variation was introduced based on market segment. Each event dispatched a different make-up of the sub-LAPs in PG&E's territory	Daily. Once a site enrolled on daily automation of TOU response via thermostats, algorithms were in operation each day.
Control group	Randomly assign customers to ten groups. For each event dispatch a subset of the ten groups and withhold the remainder as a control group. The exception was system emergencies, in which case, all groups were dispatched.	Match control group selected based on a tournament of matching models and techniques. Control candidates were selected from a pool of 25,000 non-enrolled customers who had similar consumption patterns to enrollees.	Matched control group selected based on a tournament of matching models and techniques. The control candidates were selected from a pool of ecobee participants without TOU automation, matched to mirror TOU automation participant characteristics.
Analysis technique	Difference-in-differences panel regression with fixed effect and time-effects, except for CAISO emergency events. For CAISO emergencies, all groups were also dispatched, the estimation relied exclusively on panel regressions with fixed effect and time effects to estimate the counterfactual as a function of weather, hour of day, and day of week, and general residential load profiles.	Simple difference-in-differences calculation between the average consumption of participant and control subjects. Same hour patterns on similar days were used to net out pre-existing differences between control and treated customers	Difference-in-differences for same hour on similar days. Impacts were estimated for all hours of each day post-enrollment and for specific day types (e.g., high PG&E load days)

3.1 2022 DEMAND REPONSE EVENT OPERATIONS PLAN

Due to the future potential of a smart thermostat program at PG&E, the goal in 2022 was to gain as much insight as possible about how participants would respond to events. The key purpose of this was to inform operations and decisions about how to scale the Pilot to a fully operational program. To achieve this goal, DSA and PG&E produced a systematic operations plan for DR events. If left to weather and market operations alone, it can take multiple years to capture sufficient variability in event conditions to adequately model performance under a range of conditions so 2022 presented a unique opportunity to study these elements.

The operations plan intentionally varied event start times and event durations. It intentionally included a wide range of weather conditions, including cooler than peaking conditions, as well as weekday and weekend dispatch. The objective was to collect a body of evidence to understand how load reduction performance varied as function of the aforementioned factors.

The table below details the operations plan and maps it to the events called. The operations plan was grounded on a base event – the most common expected dispatch. Each subsequent event varies one element at a time. In addition, the plan incorporated full resources dispatch events for testing purposes and in the case of CAISO system emergencies.

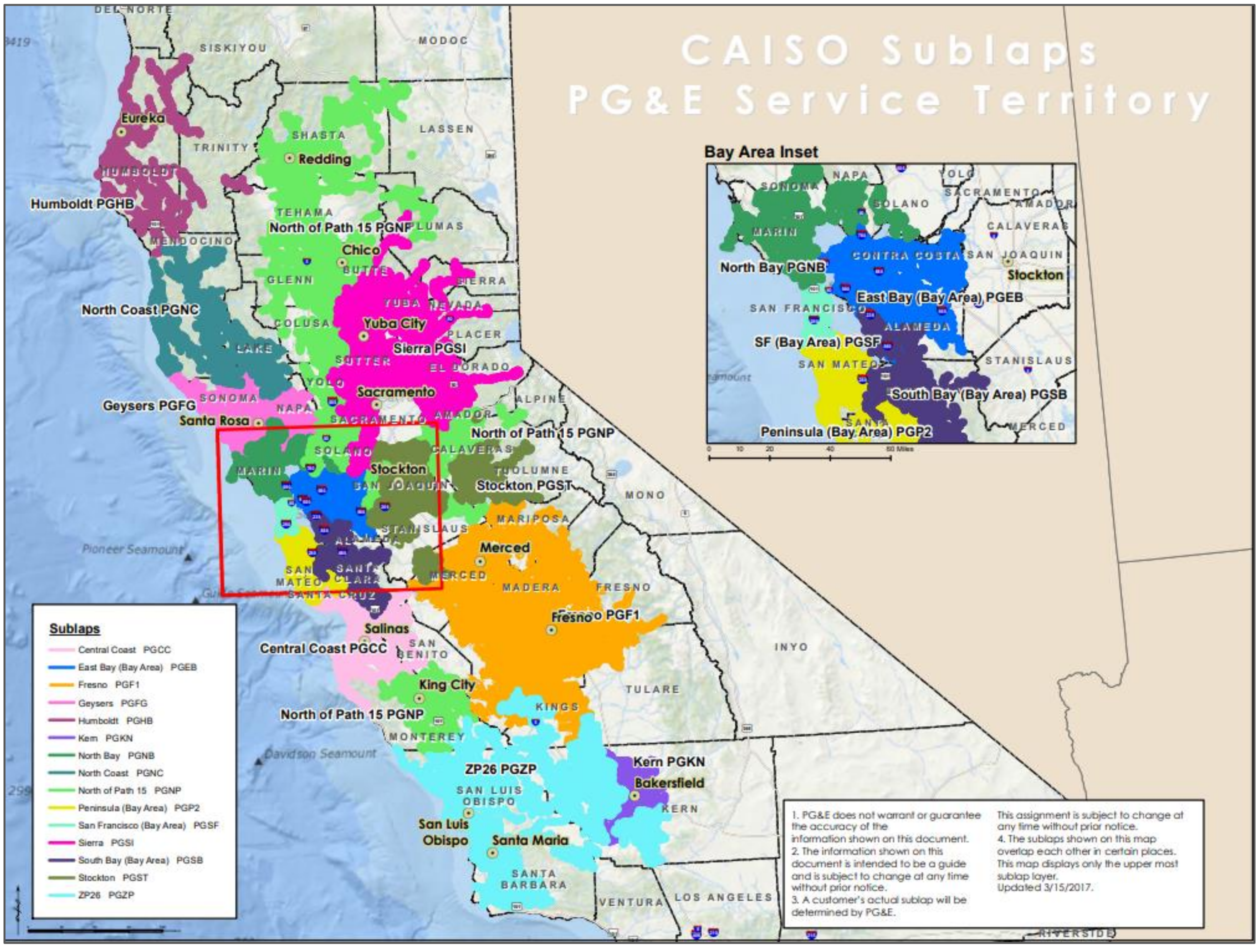
Table 8: 2022 Event Operations Plan

Date	Test Element	Temperature	Event Start	Event Duration (hours)	Weekday or weekend	Groups Dispatched
6/22/2022	Event start - 5 PM	Very hot	5:00 PM	3	Weekday	1
6/27/2022	Event start - 4 PM	Very hot	4:00 PM	3	Weekday	2
7/11/2022	Event duration forward fill - 3 hour	Very hot	4:00 PM	3	Weekday	3
7/16/2022	Weekend - 3 hour	Very hot	6:00 PM	3	Weekend	4
7/18/2022	Event start - 6 PM	Very hot	6:00 PM	3	Weekday	5
7/21/2022	Event duration backward fill - 4 hour	Very hot	5:00 PM	4	Weekday	6
7/28/2022	Event duration forward fill- 4 hour	Hot	4:00 PM	4	Weekday	7, 8
8/3/2022	Event duration backward fill - 4 hour	Hot	5:00 PM	4	Weekday	9, 10
8/4/2022	Event duration backward fill - 3 hour	Very hot	6:00 PM	3	Weekday	1, 2
8/15/2022	Event duration forward fill - 4 hour	Very hot	4:00 PM	4	Weekday	3, 4
8/16/2022	Full Dispatch (Don't hold back control)	Very hot	7:00 PM	2	Weekday	1-10
8/17/2022	10% Control	Very hot	5:00 PM	4	Weekday	1-2, 5-10
8/21/2022	Weekend - 3 hour	Hot	6:00 PM	3	Weekend	5, 6
9/4/2022	Weekend - 4 hour	Very hot	5:00 PM	4	Weekend	3, 4
9/5/2022	Emergency	Very hot	8:25 PM	0.5	Holiday	ecobee
9/6/2022	Full Dispatch (Don't hold back control)	Very hot	5:00 PM	3	Weekday	1-10
9/7/2022	5-9 PM	Very hot	5:00 PM	4	Weekday	1-10
9/8/2022	5-9 PM	Very hot	5:00 PM	4	Weekday	1-10
9/9/2022	Event duration backward fill - 2 hour	Very hot	7:00 PM	2	Weekday	7, 8

3.2 2023 EVENT OPERATIONS PLAN

In the 2023 DR season, the primary focus of the Pilot was to test market integration, including locational dispatch. Thus, Pilot resources were grouped by subsets of the PG&E service territory based on their CAISO sub-LAP. These sub-LAPs are grouped pricing nodes within PG&E's service territory, providing insights into the distinct geographic and meteorological conditions for service points within the territory. PG&E bid all resources into CAISO, and resources were dispatched based on CAISO awards. Since emergency or extreme pricing conditions were not experienced in 2023, CAISO did not dispatch all resources across all sub-LAPs at any point, and called specific sub-LAPs more frequently. Figure 10 displays a map of the sub-LAPs in PG&E's service territory.

Figure 10: Map of CAISO Sub-LAPs in the PG&E Service Territory



On event days, PG&E selected specific subsets of sub-LAPs to undergo dispatch, resulting in all customers within these areas experiencing a DR event. Throughout the 2023 season, events were called on 10 different days, there were 16 unique combinations of dispatch times. Notably, events on the same day varied in terms of dispatch times. For instance, an event for a set of sub-LAPs could be scheduled from 4 pm to 8 pm, while a different group of sub-LAPs might be called between 7 pm and 8 pm.

Table 9: 2023 Events and Details of Dispatch

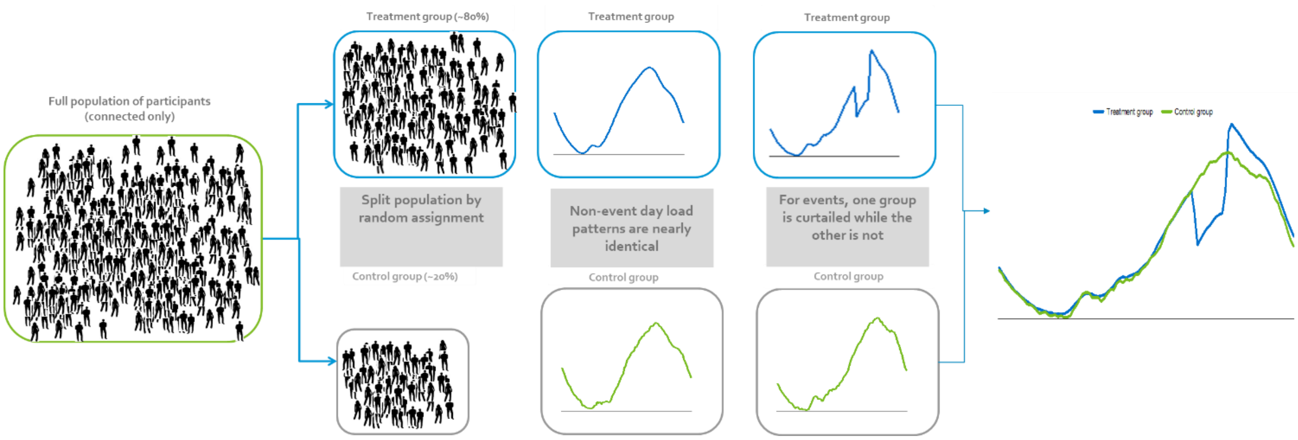
Date	Event Window	Number of Sub-LAPs Dispatched	Max Temperature on Event Day (F)
6/30/2023	4:00PM to 5:00PM	3	103.6
6/30/2023	5:00PM to 6:00PM	4	104.2
6/30/2023	6:00PM to 7:00PM	3	99.2
6/30/2023	7:00PM to 8:00PM	4	94.7
7/15/2023	4:00PM to 7:00PM	7	107.9
7/17/2023	5:00PM to 7:00PM	3	104.9
8/15/2023	4:00PM to 6:00PM	1	102.8
8/15/2023	5:00PM to 7:00PM	1	104.2
8/16/2023	4:00PM to 8:00PM	1	98.8
8/16/2023	5:00PM to 8:00PM	2	103.7
8/16/2023	6:00PM to 8:00PM	8	96.0
8/16/2023	7:00PM to 8:00PM	1	102.0
8/23/2023	5:00PM to 7:00PM	1	91.6
10/5/2023	5:00PM to 7:00PM	5	80.1
10/6/2023	5:00PM to 7:00PM	4	81.1
10/19/2023	5:00PM to 7:00PM	4	80.1
Average		**3.4**	**97.2**

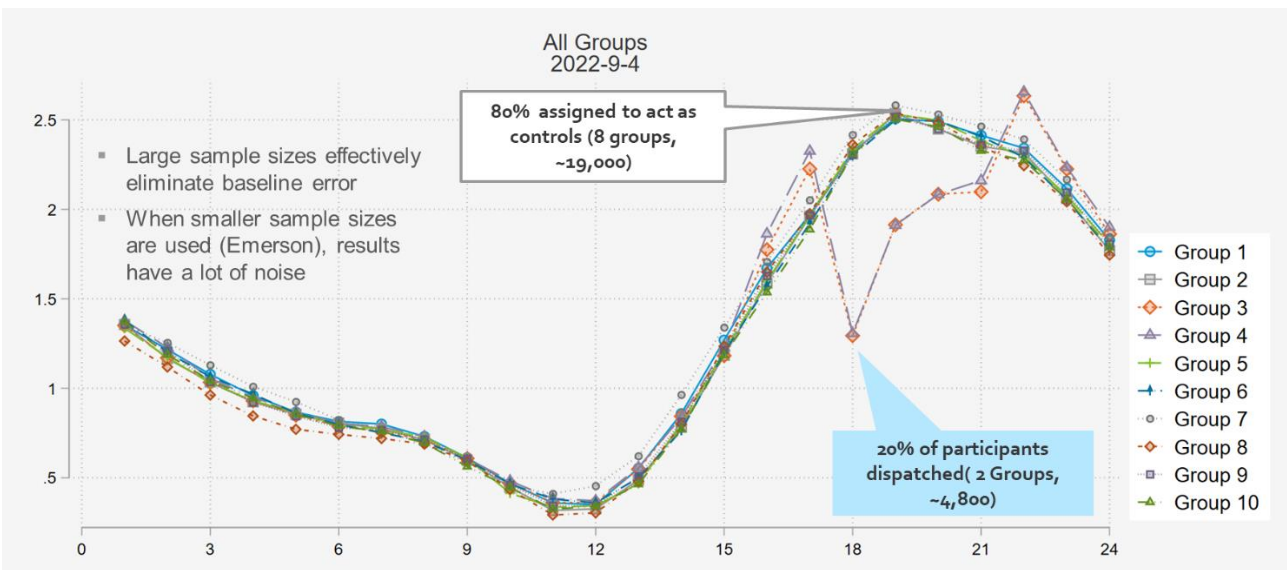
These events were predominantly called on hot days relative to the general climate within the dispatched sub-LAPs. While, on the surface, there was a range of temperatures on event days, it is crucial to note that the temperatures varied based on the specific areas in which customers were dispatched. For example, 85 degrees Fahrenheit in Bakersfield might be considered mild, but it could be considered extreme for the coastal bay area. In general, hotter inland areas were dispatched more frequently than milder coastal areas.

3.3 2022 DEMAND RESPONSE RANDOMIZED CONTROL TRIAL

Identifying the capability of DR events is crucial for understanding the impact on customers' electricity consumption. The primary evaluation method employed in 2022 was a randomized control trial analyzed through a difference-in-differences panel regression, as depicted in Figure 11. Within a week of customer enrollment, each participant was randomly assigned to one of ten groups. During each event day, a subset of the groups was dispatched, while the remaining groups served as control groups. Random assignment ensured equivalency in all aspects, though some noise remains due to sampling when smaller segments of the population are analyzed. The control group establishes the baseline for loads in the absence of dispatch, located in the same geographic areas, experiencing the same weather, and possessing similar characteristics. The only distinction lies in the dispatch assignment, providing a comparative measure for assessing the impact of DR events on customers' electricity consumption.

Figure 11: Randomized Control Trial Conceptual Example



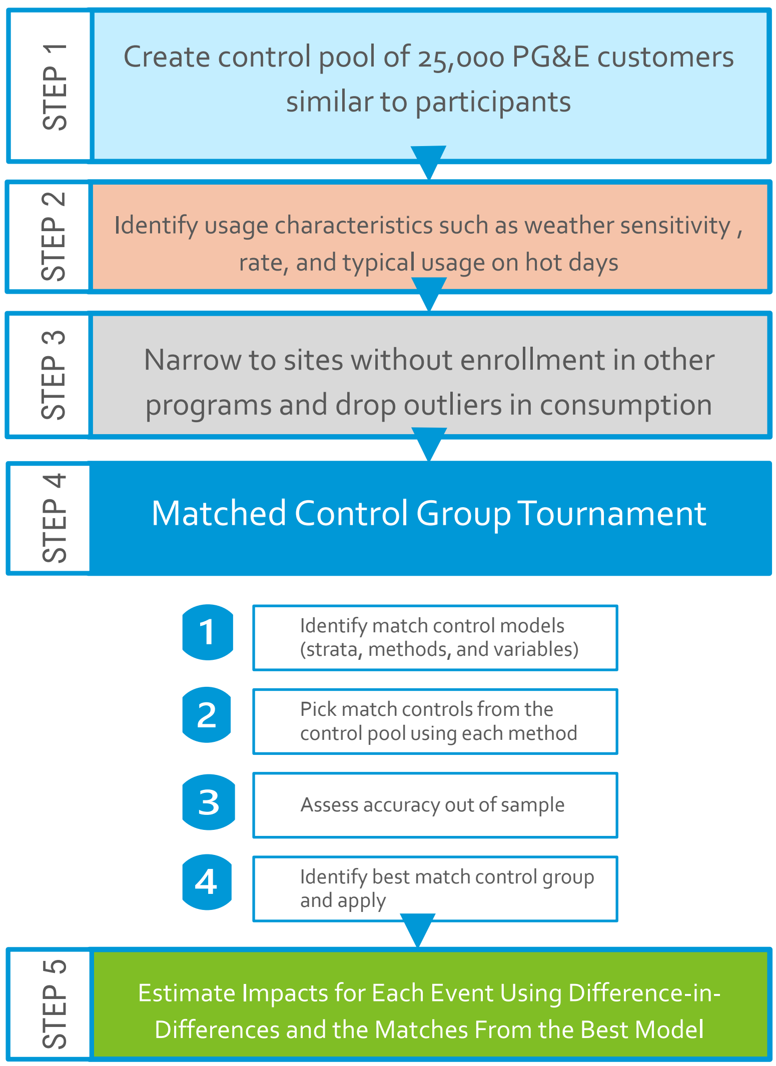


With large enough sample sizes, the approach produces very precise load impacts estimates. However, differences can arise between the treatment and control groups due to the random sampling inherent to random assignment. Thus, as part of the analysis we compared the treatment and control group during hot non-event days and netted out the pre-existing differences – a technique known as difference-in-differences. The approach simply reduces noise so the signal – the load impact – can be better detected.

3.4 2023 DEMAND RESPONSE WITH MATCHED CONTROLS

In 2023, DSA and PG&E concluded the ability to use randomly assigned control groups in the CAISO markets was limited by technical constraints of the bidding platform. As a result, all impacts were evaluated using a difference-in-differences with matched controls. As part of the evaluation, PG&E also asked for prompt results after each event, withing a week of the events. Thus, a key focus of 2023 was in automating data transfers and analysis. Due to the substantial evolution of the customer mix during the 2023 summer, the match control group was updated for each event. Figure 12 displays the steps taken to estimate DR impacts in 2023.

Figure 12: Diagram of Event Estimation Using a Matched Control Group

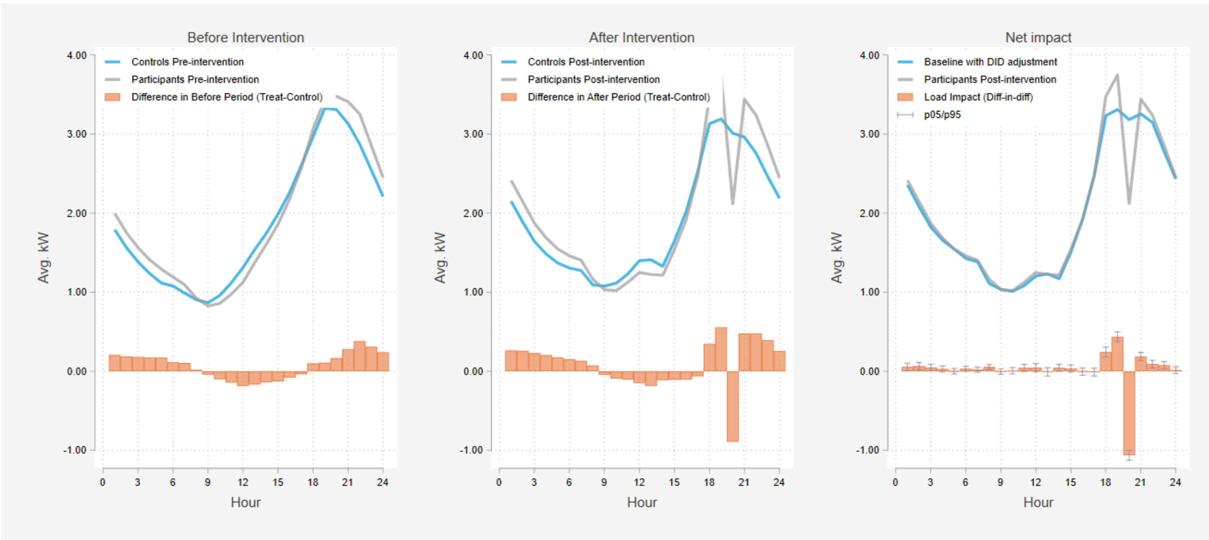


At the beginning of the 2023 season, DSA selected a matched control pool from customers in PG&E's service territory. This involved comparing participants and non-participants based on AC usage, annual kWh consumption, annual gas usage, and solar capacity. Segmentation occurred within categories defined by AC usage bins, solar technology ownership, and electric vehicle (EV) ownership. Subsequently, for each treatment customer, a propensity score model identified five control customers that were as similar to the treatment customer as possible based on these aforementioned factors. These control customers were then pooled together and 25,000 were randomly chosen to form the comparison group for the entire season.

For each event, controls were selected from this pool in a similar fashion to how they were selected to be in the pool in the first place. For each participant, one matched control was selected from this pool, identified as the most similar customer by a similar propensity score model. The matched control model, however, was updated during the summer. Matching was done within sub-LAP and solar ownership segments to identify the control most similar to the participant in terms of solar capacity, a weather sensitivity coefficient, the likelihood the customer owned an electric vehicle, and the average hourly kWh consumption on the previous 10 hottest days. This model emerged as the most effective after a rigorous comparison with other models featuring similar variables.

Once a matched control group was established, impacts were assessed by comparing the usage of participants in the treatment group to that of the control group, both on the event day and on similar non-event days preceding the event. In instances where the treated and control groups closely aligned on non-event days, minimal adjustments were necessary on the event day. However, when substantial differences existed, netting these out from the event day differences facilitated precise impact estimation. Figure 13 shows an example of how the differences in consumption on non-event days were netted out from the event days. The first pane in each shows the pre-event differences, the second pane shows the differences on the event day, and the third pane represents the net effect obtained by subtracting the pre-event differences from the control's event day performance.

Figure 13: Example Difference-in-Difference Adjustment

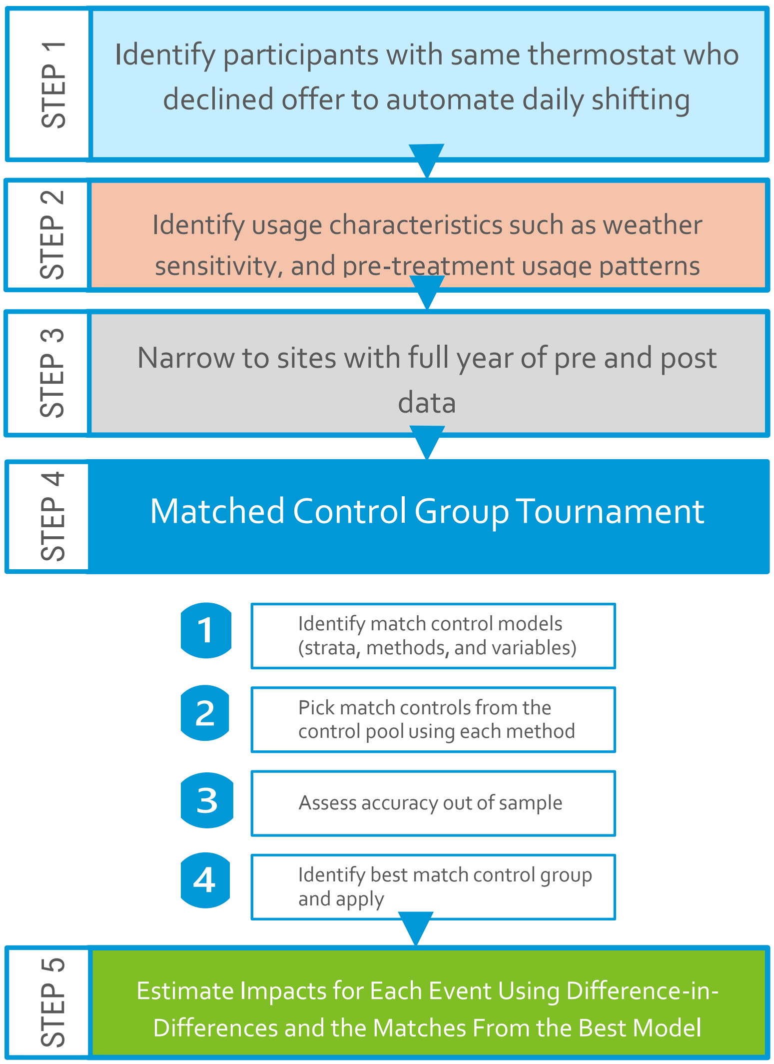


3.5 AUTOMATED TOU IMPACTS WITH MATCHED CONTROLS

To estimate the daily impacts from the TOU optimization, we employed a comprehensive approach leveraging the full deployment of ecobee devices with TOU automation, encompassing over 11,000 sites by the end of October 2023. Once a site enrolled in TOU automation, ecobee thermostats would automatically adjust thermostat setpoints based on our TOU optimization algorithms. This meant that every day, adjustments were made to align with the most efficient energy usage patterns according to the pricing of TOU rates.

We employed a matched control group with difference in differences to estimate impacts. The matched control group was selected from Pilot participants that did not elect the ecobee daily shifting feature. This ensured that the control group closely mirrored the characteristics of the TOU automation participants. The difference-in-differences involved a comparison of energy consumption at similar times and on similar days before and during the implementation of TOU automation for both the treatment and control group. In all cases, we ensured the data was balanced. For each site, we required that data for the same time period was included for the treatment and matched control before and after the daily shifting algorithm went into effect.

Figure 14: Daily Load Shifting Impacts Methodology Summary



4 2022 EVENT BASED LOAD IMPACTS

This section focuses on the magnitude of demand reduction delivered by the Pilot during 2022 event days. The magnitude of demand reduction was a function of several factors – temperature, time of day, hours into the event, and customer behavior. This section documents the demand reduction for each event, the load impacts for different customer segments, and the weather sensitivity of the resource.

4.1 EVENT DAY REDUCTION SUMMARY

Figure 15 visualizes per device DR event impacts on September 6 and September 8, and includes customers both with and without daily TOU automation. These days are notable because they were the two days with the highest PG&E system load over the Pilot period. On September 8, both the PG&E and CAISO Net load reached their peak for the year, and the thermostats were dispatched from 5:00 pm through 9:00 pm. Similarly, on September 6, the thermostats were scheduled to be dispatched from 5:00 to 8:00 pm, however, there was evidence that impacts persisted until 9:00 pm.

Figure 15: Hourly 2022 Load Impacts for Events with Greatest Reference Load

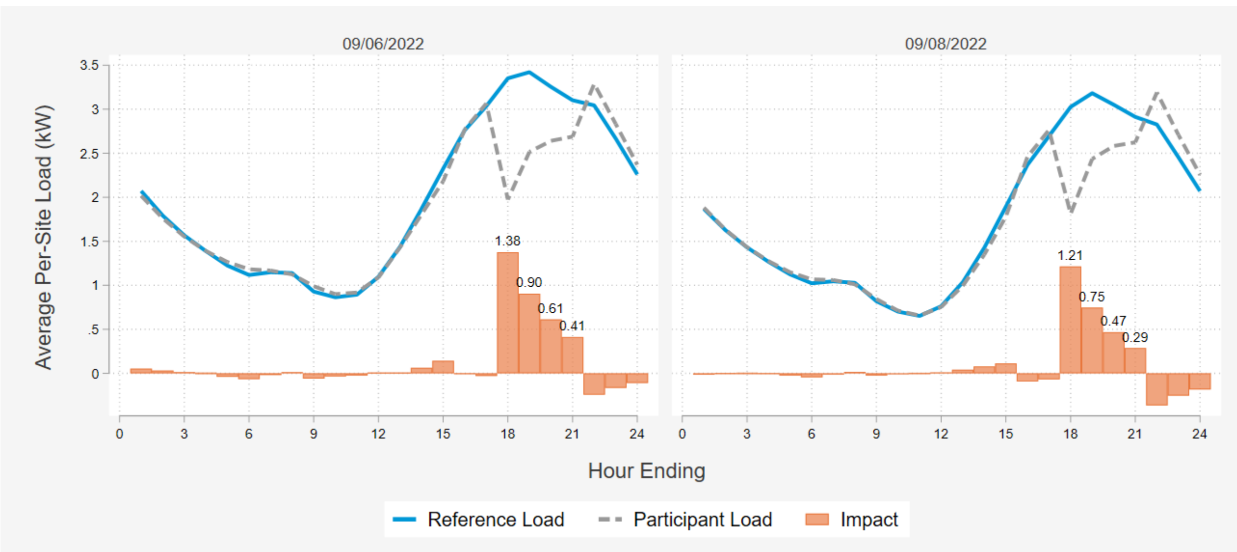
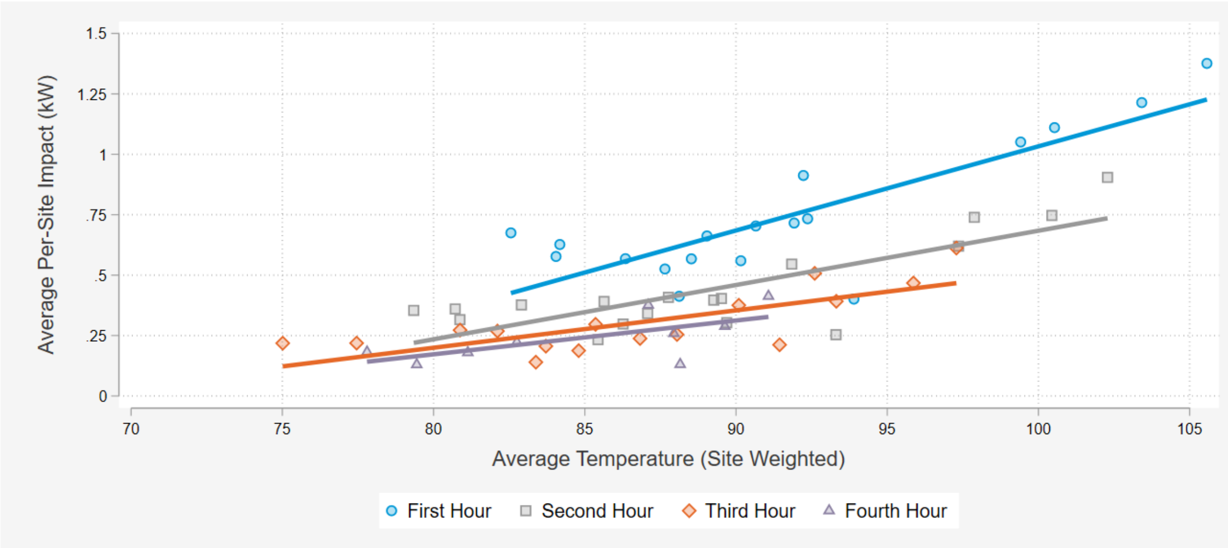


Table 10 presents data on reference loads, observed loads, impacts, and percent impacts for all nineteen PG&E summer 2022 DR events, including customers with and without TOU automation. As mentioned in Section 3.1, the Pilot deliberately introduced variation in temperature conditions, event start times, and event durations to examine how performance differed under diverse circumstances. It was noted that events occurring during high temperatures demonstrated more significant impacts. The extent of impacts also varied significantly based on the duration of the event. In Figure 16, the relationship between impacts in 2022 and temperature is illustrated, with color shading indicating the hour into the event. First-hour impacts were consistently found to be higher than impacts in subsequent event hours. Regardless, for each hour, a positive correlation was observed between impacts and temperature.

Table 10: Summary of 2022 Event Impacts Per Site (kW)

Date	Event Hours	Event hours Avg. Temp	Max Temp (Participant weighted)	Dispatched Sites	Hourly Impacts (kW) Hour 1	Hour 2	Hour 3	Hour 4	Event Average Reference Load (Baseline)	Impact	% Impact	se	t
06/22/2022	18:00 to 20:00	85.6	88.1	1,455	0.41	0.23	0.14		1.74	0.26	15.0%	0.038	6.84
06/27/2022	17:00 to 19:00	89.3	90.2	1,470	0.56	0.30	0.25		1.44	0.37	25.9%	0.036	10.45
07/11/2022	17:00 to 19:00	91.4	92.2	1,441	0.91	0.55	0.38		1.63	0.61	37.6%	0.041	14.99
07/16/2022	19:00 to 21:00	88.7	91.9	1,584	0.72	0.40	0.19		2.14	0.43	20.2%	0.038	11.31
07/18/2022	19:00 to 21:00	85.6	89.0	1,622	0.66	0.39	0.27		2.07	0.44	21.2%	0.036	12.37
07/21/2022	18:00 to 21:00	84.3	87.7	1,598	0.53	0.30	0.21	0.13	1.67	0.29	17.4%	0.032	9.17
07/28/2022	17:00 to 20:00	81.4	84.0	3,333	0.58	0.38	0.27	0.18	1.33	0.35	26.5%	0.023	15.37
08/03/2022	18:00 to 21:00	87.4	90.7	2,835	0.70	0.40	0.24	0.22	2.00	0.39	19.6%	0.030	13.13
08/04/2022	19:00 to 21:00	80.8	84.2	3,617	0.63	0.36	0.22		1.87	0.40	21.5%	0.025	15.90
08/15/2022	17:00 to 20:00	91.7	93.9	3,852	0.40	0.25	0.21	0.13	1.92	0.25	13.0%	0.026	9.61
08/16/2022	20:00 to 21:00	89.7	92.4	19,377	0.73	0.34			2.48	0.54	21.7%	0.008	64.96
08/17/2022	18:00 to 21:00	85.7	88.5	15,650	0.57	0.41	0.30	0.18	1.89	0.36	19.2%	0.024	15.26
08/21/2022	19:00 to 21:00	79.0	82.6	3,941	0.68	0.35	0.22		1.90	0.42	21.8%	0.026	15.94
09/04/2022	18:00 to 21:00	94.5	99.4	4,311	1.05	0.62	0.39	0.26	2.43	0.58	23.9%	0.026	22.28
09/05/2022	21:00 to 21:00	93.2	93.2	10,979	0.27				3.16	0.27	8.5%	0.018	14.90
09/06/2022	18:00 to 20:00	101.7	105.6	21,334	1.38	0.90	0.61		3.34	0.96	28.9%	0.014	66.69
09/07/2022	18:00 to 21:00	94.5	100.5	21,310	1.11	0.74	0.51	0.38	2.89	0.68	23.6%	0.012	57.68
09/08/2022	18:00 to 21:00	97.3	103.4	21,261	1.21	0.75	0.47	0.29	3.04	0.68	22.3%	0.013	53.26
09/09/2022	20:00 to 21:00	83.6	86.3	2,756	0.57	0.32			2.19	0.44	20.2%	0.030	14.75
Average		**88.7**	**91.8**	**7,565**	**0.88**	**0.58**	**0.42**	**0.27**	**2.57**	**0.59**	**22.8%**	**0.028**	**21.15**

Figure 16: Hourly 2022 Event Impacts versus Temperature



4.2 IMPACTS BY SEGMENT

Table 11 illustrates insights gained from 2022 events across various customer segments, considering factors such as device brand, income status, ownership of solar technology, and distinctive sub-LAPs. One noteworthy finding is the contrast in impacts between customers with solar installations and those without. It appears that the presence of solar technology increases impacts, suggesting a potential avenue for future research into the interplay between renewable energy adoption and response to DR events. Zooming in on specific sub-LAPs, PGF1 and PGSI emerge as focal points of interest, standing out with notably heightened impacts. The association with these areas being hotter adds a layer of intuitive understanding; however, it also prompts deeper questions about the intersection of climatic conditions, geographical variation, and the observed impacts.

Table 11: Average Impacts by Segment – 2022 Events

Category	Sub-category	Event hours Avg. Temp	Max Temp (Participant weighted)	Hour into event (Avg. kW)[1]				Event Hour Average[2]		
				Hour 1	Hour 2	Hour 3	Hour 4	Reference Load (Baseline)	Impact	% Impact
All	All	88.7	91.8	0.72	0.44	0.30	0.22	2.17	0.46	21.5%
Device Brand	Emerson	89.0	92.1	0.66	0.50	0.39	0.32	2.15	0.50	23.1%
	Nest	87.4	90.7	0.79	0.50	0.33	0.22	1.96	0.51	26.3%
	ecobee	89.4	92.4	0.70	0.40	0.28	0.21	2.27	0.44	19.0%
Low Income	N	87.6	90.8	0.71	0.45	0.31	0.22	2.07	0.46	22.3%
	Y	95.6	98.0	0.81	0.45	0.30	0.22	2.75	0.49	18.0%
Number of Thermostats	1	88.7	91.8	0.67	0.41	0.27	0.19	2.09	0.42	20.2%
	2	88.7	91.9	0.93	0.60	0.44	0.32	2.42	0.63	26.8%
	3+ thermostats	87.6	90.7	0.94	0.60	0.40	0.37	2.86	0.63	22.7%
Solar	No Solar	87.4	90.6	0.64	0.40	0.27	0.19	2.11	0.41	19.0%
	Solar	91.6	94.4	0.93	0.56	0.38	0.29	2.41	0.59	27.9%
SubLAP	None	86.9	90.0	0.68	0.49	0.27	0.25	1.98	0.45	23.3%
	SLAP_PGCC	72.9	75.9	0.32	0.19	0.09	0.11	1.36	0.19	6.2%
	SLAP_PGEB	85.3	89.5	0.66	0.41	0.28	0.22	1.99	0.43	21.8%
	SLAP_PGF1	102.1	103.8	1.05	0.62	0.41	0.33	3.00	0.66	22.3%
	SLAP_PGFG	81.4	84.6	0.62	0.41	0.41	0.20	1.81	0.44	23.1%
	SLAP_PGHB	64.7	66.9	0.03	-0.02	-0.01	0.10	0.55	0.02	31.7%
	SLAP_PGKN	102.8	104.3	1.04	0.59	0.37	0.33	3.08	0.63	20.9%
	SLAP_PGNB	86.7	90.4	0.45	0.30	0.18	-0.05	1.61	0.25	16.3%
	SLAP_PGNC	91.7	94.9	0.88	0.66	0.41	0.26	2.45	0.63	25.9%
	SLAP_PGNP	97.5	99.8	0.87	0.53	0.36	0.34	2.57	0.57	22.1%
	SLAP_PGP2	81.4	84.6	0.52	0.30	0.17	0.02	1.76	0.29	17.0%
	SLAP_PGSB	82.9	86.4	0.47	0.30	0.19	0.07	1.57	0.29	18.9%
	SLAP_PGSF	66.9	69.3	-0.04	-0.04	0.01	0.00	0.68	-0.04	-8.9%
	SLAP_PGSI	96.1	98.9	1.12	0.69	0.50	0.43	2.92	0.75	25.7%
	SLAP_PGST	95.2	97.5	0.91	0.56	0.39	0.31	2.66	0.59	22.0%
	SLAP_PGZP	88.9	92.3	0.87	0.60	0.39	0.26	2.48	0.58	23.7%

[1] The average reduction for the hour into the event. The dates included differ for 3 and 4 hours events since not all events lasted that long.

[2] The average across all event hours regardless of timing or duration of events

5 2023 EVENT BASED LOAD IMPACTS

This section analyzes the demand reduction achieved during event days in 2023 through the Pilot. The magnitude of demand reduction is shaped by factors such as temperature, time of day, event duration, and customer behavior. A pivotal aspect of the 2023 analysis involves the strategic dispatch by sub-LAP, aiming to glean insights into where the program achieves optimal effectiveness and assess the success of market integration.

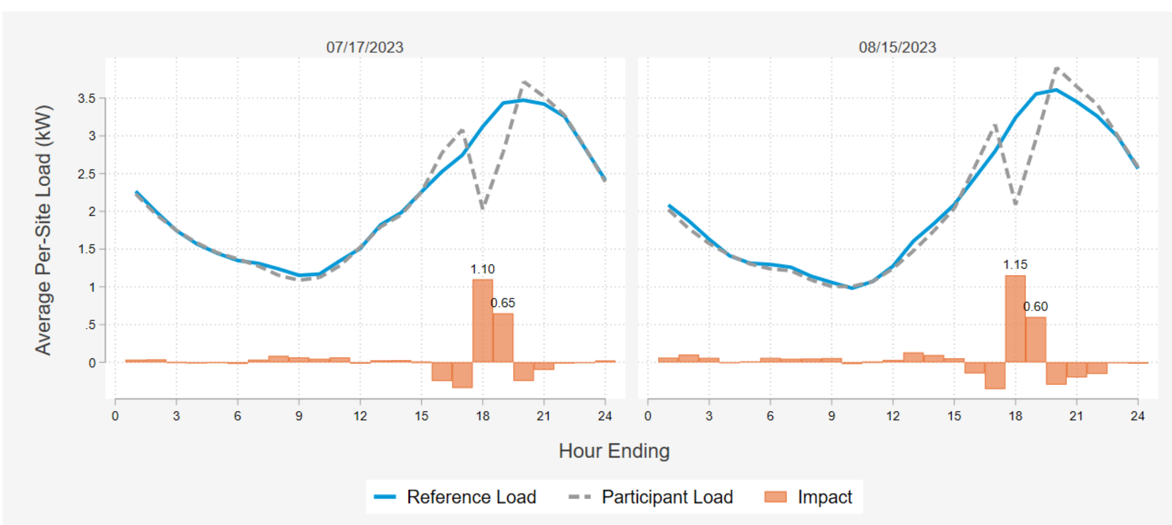
The content of this section provides an examination of the demand reduction observed for each event. It evaluates the impacts on a sub-LAP basis, scrutinizes load impacts across diverse customer segments, and delves into the resource's sensitivity to weather conditions. The objective is to unravel the dynamics that contribute to the overall success of the Pilot in curbing demand during events in 2023.

It is important to note, the impacts in 2023 were calculated using delivered loads (export channel is excluded), while impacts in 2022 were calculated using net loads (includes energy import and export data). The use of delivered loads leads to lower impacts than net loads. For details on performance using net versus delivered loads see Appendix C.

5.1 EVENT DAY REDUCTION SUMMARY

Figure 16 illustrates the hourly impacts of the two events with the highest average per-site reference load. These incidents occurred on 7/17/2023 and 8/15/2023, where the average per-site reference loads reached a peak of around 3.5 kW. Both events coincided with exceptionally hot days and involved the dispatch of sub-LAPs located in geographically warm areas. Each event was two-hours in length, taking place from 5:00 pm to 7:00 pm, and included all customers regardless of participation in automated TOU response.

Figure 17: Hourly 2022 Load Impacts for Events with Greatest Reference Load



A distinctive feature of the 2023 events was an uptick in pre-cooling load, or the load in the hours immediately preceding the events. This surge can be attributed largely to the escalated enrollments of Nest devices in the program. As detailed in Section2.1, Nest's event strategy relies on pre-cooling homes to uphold customer comfort during the event. This approach results in a surge in electricity consumption just before the event, a phenomenon less prevalent in the 2022 events.

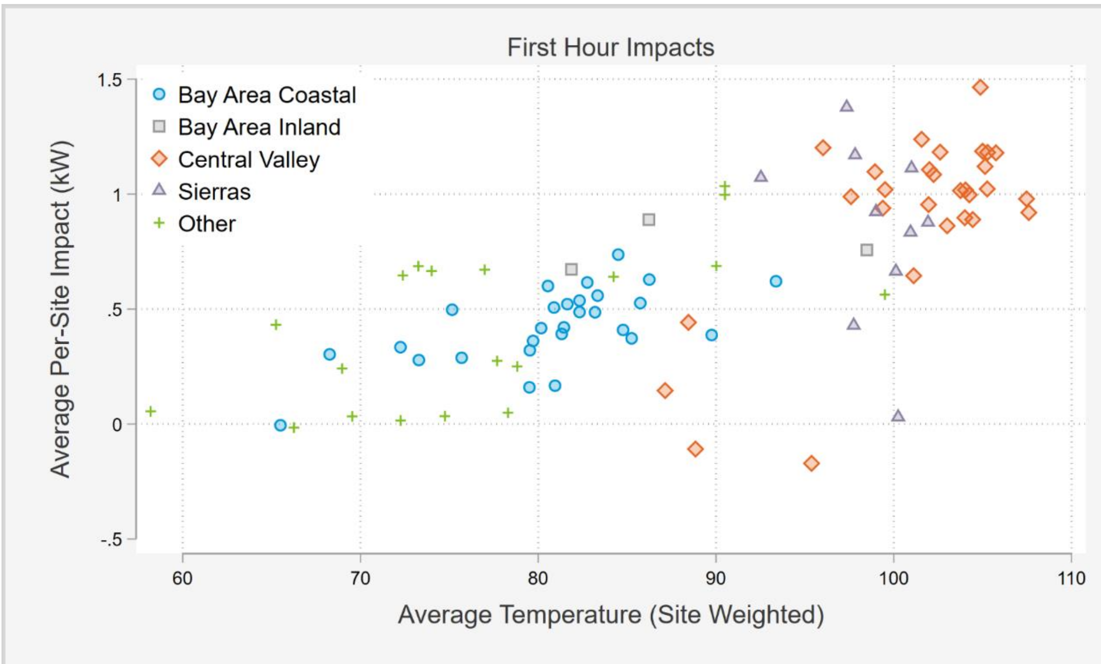
Table 12 comprehensively presents reference loads, observed loads, impacts, and percent impacts for each of the sixteen PG&E summer 2023 DR events. The standard duration for events was two hours, although there were variations, including five one-hour events, two three-hour events, and one four-hour event. The most substantial impacts consistently correlated with extreme temperatures and were notably concentrated in the initial event hour.

Table 12: Summary of 2023 Event Per Site Impacts (kW)

					Hourly Impacts (kW)				Event Average				
Date	Event Hours	Event hours Avg. Temp	Max Temp (Participant weighted)	Dispatched Sites	Hour 1	Hour 2	Hour 3	Hour 4	Reference Load (Baseline)	Impact	% Impact	se	t
06/30/2023	16:00 to 17:00	99.6	99.6	14,119	0.73				2.03	0.73	35.9%	0.018	40.96
06/30/2023	17:00 to 18:00	82.0	82.0	26,708	0.44				1.44	0.44	30.9%	0.012	37.28
06/30/2023	18:00 to 19:00	92.4	92.4	6,075	0.70				2.32	0.70	30.3%	0.032	21.85
06/30/2023	19:00 to 20:00	82.7	82.7	24,224	0.69				2.23	0.69	31.1%	0.016	43.21
07/15/2023	16:00 to 19:00	99.5	100.7	43,000	0.82	0.59	0.41		2.50	0.61	24.3%	0.011	53.21
07/17/2023	17:00 to 19:00	101.3	102.1	11,817	1.10	0.65			3.28	0.87	26.6%	0.022	39.51
08/15/2023	16:00 to 18:00	100.5	100.8	14,472	1.09	0.76			2.87	0.92	32.1%	0.019	48.84
08/15/2023	17:00 to 19:00	104.2	104.7	7,694	1.15	0.60			3.40	0.88	25.8%	0.025	34.84
08/16/2023	16:00 to 20:00	98.8	101.4	5,615	0.96	0.59	0.39	0.29	2.94	0.56	19.0%	0.028	19.97
08/16/2023	17:00 to 20:00	100.7	102.6	13,878	1.24	0.79	0.43		3.30	0.82	24.8%	0.020	41.23
08/16/2023	18:00 to 20:00	80.5	82.4	54,248	0.67	0.37			2.13	0.52	24.4%	0.009	57.95
08/16/2023	19:00 to 20:00	102.0	102.0	2,936	1.11				3.23	1.11	34.2%	0.037	29.56
08/23/2023	17:00 to 19:00	91.6	93.4	2,326	0.59	0.29			2.27	0.44	19.4%	0.046	9.62
10/05/2023	17:00 to 19:00	81.5	82.7	32,035	0.45	0.28			1.52	0.36	24.0%	0.011	34.27
10/06/2023	17:00 to 19:00	81.7	83.1	29,747	0.55	0.36			1.73	0.46	26.4%	0.012	38.41
10/19/2023	17:00 to 19:00	78.0	79.5	30,420	0.36	0.25			1.36	0.30	22.2%	0.009	32.64
Average		**92.3**	**93.3**	**19,957**	**0.69**	**0.45**	**0.41**	**0.29**	**2.23**	**0.57**	**25.5%**	**0.023**	**24.74**

Given the geographic basis for event dispatch, the association between higher temperatures and warmer climates is evident. Figure 18 delves into this intersection, plotting first-hour impacts against temperature while shading by geographic region. Generally, events occurring in the Sierras or the Central Valley exhibit heightened impacts, a trend emphasized by concurrently higher temperatures. This analysis illuminates the Pilot's viability in these regions, as hotter areas within the PG&E service territory are anticipated to experience greater impacts, offering valuable insights for program optimization.

Figure 18: First Hour Impacts versus Temperature by Geographic Region – 2023 Events



5.2 IMPACTS BY SEGMENT

Table 13 compiles averaged outcomes from the 2023 events, analyzing a variety of customer segments, including factors such as device brand, income status, ownership of solar technology, and sub-LAP categorization. Echoing the trends observed in 2022, it was found that customers equipped with solar installations continued to exhibit higher impacts when compared to their counterparts without solar technology. Another significant observation was the performance of Honeywell Home devices, which consistently demonstrated higher average impacts than other brands. However, interpreting this data warrants caution; the disparity in performance could be influenced by the smaller sample size of these devices within the Pilot. Furthermore, participants who owned batteries showed varied performance, often underperforming compared to those without batteries. This inconsistency could be linked to the relatively small segment of participants owning batteries, resulting in fluctuating impact measurements across different events. Despite these variations, the analysis suggested that battery discharge generally enabled more sustained impacts throughout the duration of an event compared to other segments, pointing to its potential effectiveness and importance in managing sustained DR scenarios.

Table 13: Average kW Impacts by Segment – 2023 Events

Category	Sub-category	Event hours Avg. Temp	Max Temp (Participant weighted)	Hour into event (Avg. kW)[1] Hour 1	Hour 2	Hour 3	Hour 4	Event Hour Average[2] Reference Load (Baseline)	Impact	% Impact
All	All	92.3	93.3	0.79	0.50	0.41	0.29	2.41	0.65	27.0%
Device Brand	Emerson	92.6	93.6	0.70	0.61	0.76	0.47	2.33	0.64	26.7%
	Honeywell	92.2	93.2	0.90	0.54	0.56	0.59	2.52	0.64	27.0%
	Nest	92.1	93.0	0.77	0.47	0.38	0.26	2.38	0.63	26.5%
	ecobee	92.8	93.7	0.83	0.56	0.44	0.34	2.46	0.69	27.9%
Low Income	N	91.9	92.8	0.82	0.55	0.44	0.32	2.38	0.68	28.5%
	Y	93.9	94.7	0.70	0.36	0.32	0.22	2.56	0.57	21.5%
Number of Thermostats	1	92.4	93.3	0.73	0.45	0.35	0.27	2.32	0.60	25.7%
	2	92.1	93.1	1.08	0.73	0.65	0.38	2.76	0.92	32.4%
	3+ thermostats	91.7	92.7	1.33	0.85	0.87	0.91	3.46	1.13	30.7%
Solar	No Solar	92.1	93.0	0.74	0.45	0.36	0.28	2.40	0.60	24.7%
	Solar	92.8	93.7	0.88	0.60	0.49	0.32	2.43	0.75	31.6%
SubLAP	SLAP_PGCC	73.9	75.0	0.18	0.09	0.00	0.00	1.31	0.14	10.8%
	SLAP_PGEB	84.7	86.1	0.66	0.44	0.29	0.00	2.16	0.55	25.3%
	SLAP_PGF1	104.5	105.1	1.03	0.65	0.38	0.00	3.02	0.80	27.0%
	SLAP_PGFG	82.2	83.3	0.50	0.33	0.00	0.00	1.75	0.42	24.2%
	SLAP_PGHB	64.6	65.1	0.30	0.14	0.00	0.00	1.23	0.32	24.7%
	SLAP_PGKN	104.8	105.1	1.10	0.74	0.52	0.00	3.11	0.97	31.4%
	SLAP_PGNB	82.9	84.5	0.48	0.27	0.00	0.00	1.79	0.39	22.2%
	SLAP_PGNC	88.0	88.0	0.59	0.00	0.00	0.00	2.66	0.59	22.1%
	SLAP_PGNP	101.1	102.0	0.88	0.64	0.43	0.29	2.57	0.68	27.3%
	SLAP_PGP2	79.5	80.5	0.51	0.29	0.00	0.00	1.70	0.42	24.4%
	SLAP_PGSB	80.5	81.6	0.47	0.34	0.00	0.00	1.51	0.41	27.2%
	SLAP_PGSF	71.8	72.5	0.11	0.01	0.00	0.00	0.81	0.08	9.6%
	SLAP_PGSI	98.4	99.3	1.18	0.84	0.55	0.00	3.12	0.97	31.3%
	SLAP_PGST	100.6	101.3	1.00	0.63	0.56	0.00	2.91	0.82	28.2%
	SLAP_PGZP	88.8	90.0	0.79	0.48	0.46	0.00	2.33	0.65	28.0%

[1] The average reduction for the hour into the event. The dates included differ for 3 and 4 hours events since not all events lasted that long.
[2] The average across all event hours regardless of timing or duration of events

Important to the analysis of this season were the performance variations observed across sub-LAPs. While not every area hosted a full four-hour event, the insights drawn from the results above are instrumental. Like the trends identified in 2022, sub-LAPs experiencing lower temperatures during events generally exhibited diminished impacts, while hotter sub-LAPs demonstrated the opposite trend. Notably, the sub-LAPs with the most substantial first-hour impacts were PGKN, PGF1, and PGSI, situated in the Central Valley and the Sierras regions of California. These geographical zones are recognized for their propensity to experience extremely high temperatures during the summer months in California. The correlation between climatic conditions and impact levels in these specific sub-LAPs underscores the regional nuances that significantly influence the outcomes of the program.

6 DAILY LOAD SHIFTING AUTOMATION

This section delves into the daily automated response to TOU rates facilitated by ecobee thermostats[2]. Two thermostat manufacturers, Ecobee and Emerson, enable daily automated load shifting around time of use rates. The analysis focuses on the Ecobee devices because the number of Emerson sites was too small to produce precise estimates. In 2022, approximately 58% of ecobee thermostat users opted for automated TOU response, a figure that decreased to about 47% by the end of the 2023 season. Regardless, there were over 11,000 participants by the end of the season. This automation involved daily adjustments to thermostat setpoints, with each customer balancing their preference between comfort and savings.

As detailed in Section 3.5, the Pilot employed propensity score matching to compare the behavior of customers who enrolled in TOU automation with those who did not. This comparison was made between a matched control group and the TOU automation group, where both groups possessed a smart thermostat, consented to participate in the Pilot, exhibited similar load patterns and characteristics before the implementation of TOU automation, and were subscribed to the same rate plan. The impact of TOU automation on energy load was ultimately assessed using a difference-in-differences approach comparing both the treatment and control group before and after activation of the daily shifting algorithm.

The analysis was conducted with varying levels of time granularity, such as by date, by day-of-year, by peak period, and by hour, and it spanned different customer segments. In addition, the impacts were evaluated using both AMI data, which included pre-treatment data, and end use thermostat data. The end use thermostat data enables a focus on the energy use patterns of the AC unit and produces bigger signal-to-noise ratio, which enables load impacts to be more easily detected. However, due to the lack of pre-treatment data a difference-in-difference calculation cannot be employed. Notably, the analysis excluded event days to ensure a fair comparison, as both sites with and without TOU automation (the control group) were dispatched during these periods. This comprehensive approach allowed for an in-depth understanding of the effects of daily TOU automation on energy consumption patterns.

6.1 HOURLY AND DAILY ENERGY SAVINGS

Figure 19 presents the average hourly loads between participants and the matched control group during the summer season of their first year, post-enrollment. Initially, both groups displayed similar load patterns, but a distinct change emerged once the TOU automation algorithm was implemented. The group with TOU automation notably reduced their demand each day from 4-8 pm, indicative of effective demand management. This reduction is characterized by a pattern of pre-cooling prior to the peak period and a subsequent increase in load following the peak. In contrast, Figure 20 shifts focus to the second-year impacts for those enrolled in the program for a second year. It reveals a trend that the

[2] Emerson also offered automatic TOU response to their customers, however, due to their small sample size, they were excluded from this analysis.

load reduction observed in the first year of enrollment were more significant than those in the second year. This pattern is likely due to differences in weather – the 2022 summer was substantially hotter than 2023.

Figure 19: Difference-in-Differences Calculation for Hourly Loads for TOU Automation - Year 1

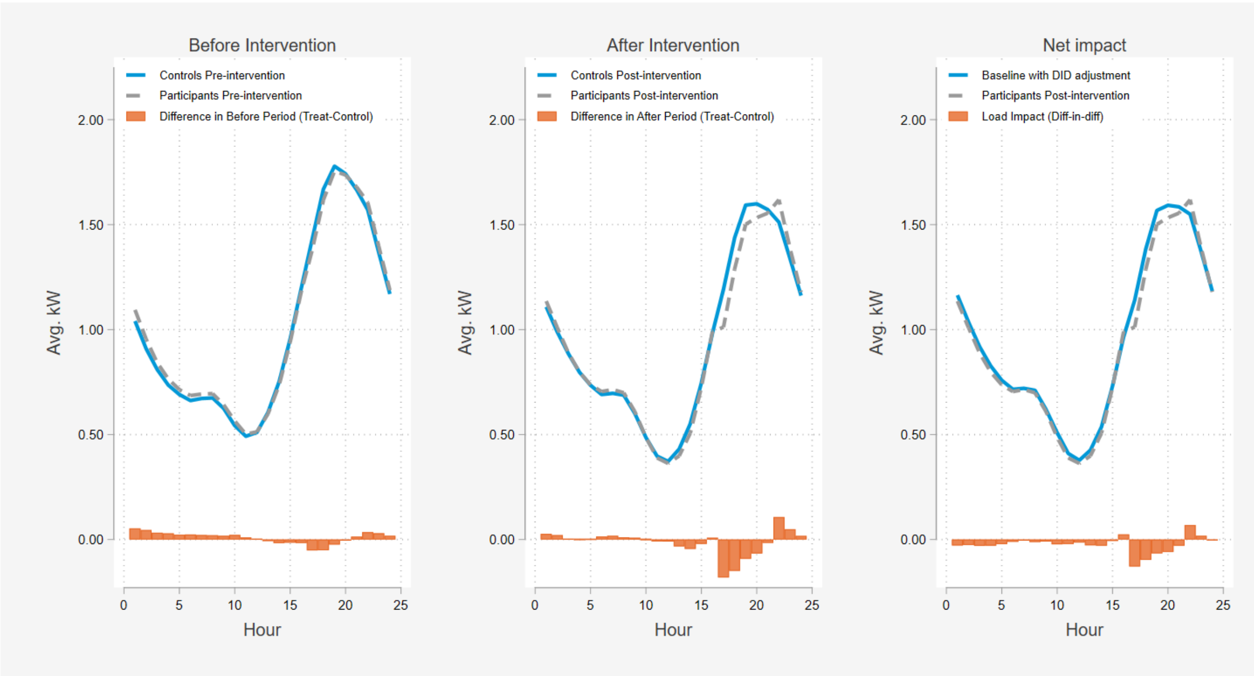


Figure 20: Difference-in-Differences Calculation for Hourly Loads for TOU Automation - Year 2

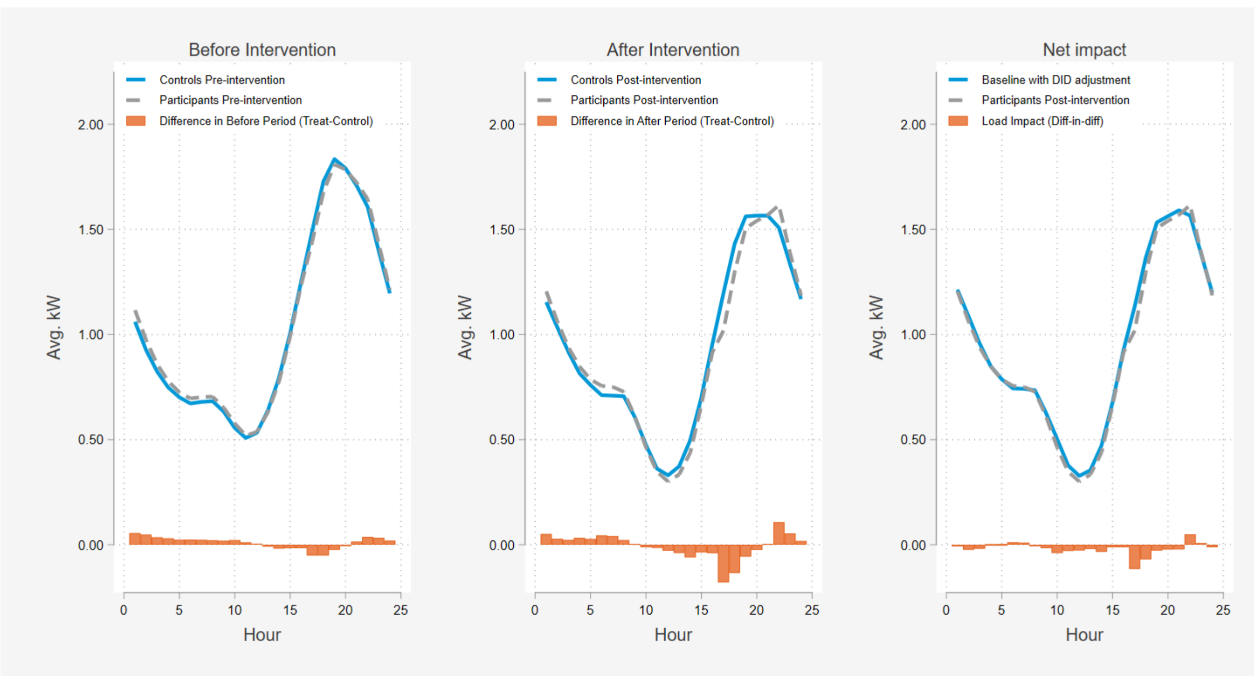
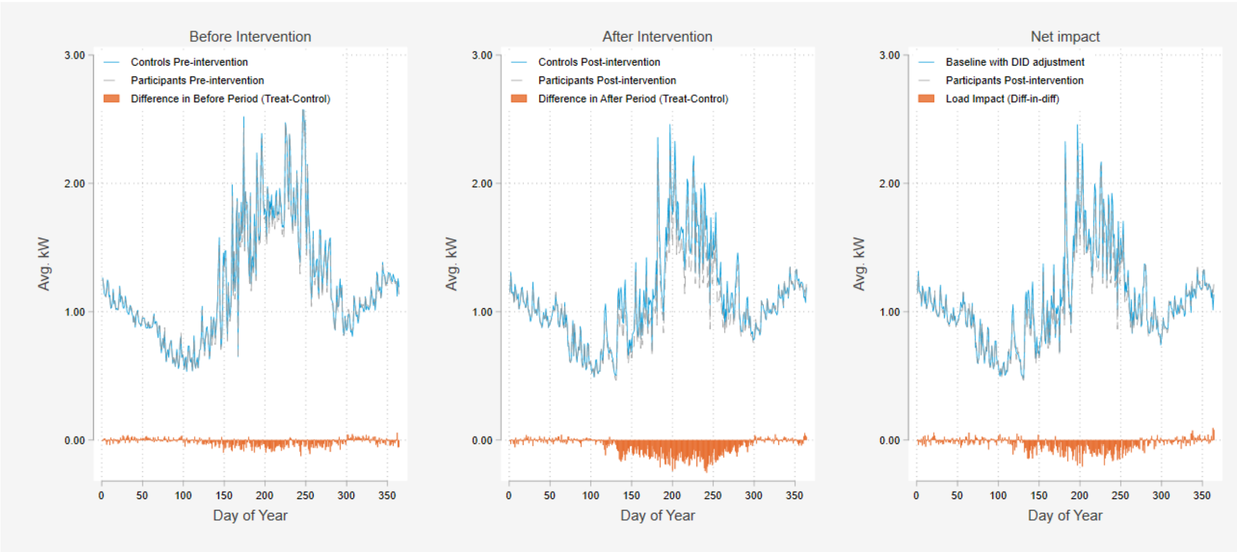


Figure 21: Daily Peak Average Demand Reduction Due to TOU Automation (4-8 pm)



In addition, we conducted a detailed estimation of load impacts for each specific day and hour of the year. Depicted in Figure 21 is the average reduction in demand by participants from 4-8 PM. This representation shows that the most substantial demand reductions tend to occur during the summer months. Reinforcing this finding are the results for individual hours as show in the heatmap in Figure 21. This figure illustrates that the demand reduction is most pronounced during the 4–8 PM summer peak period.

Figure 22: Heat Map of Demand Reduction Due to Daily TOU Automated Response

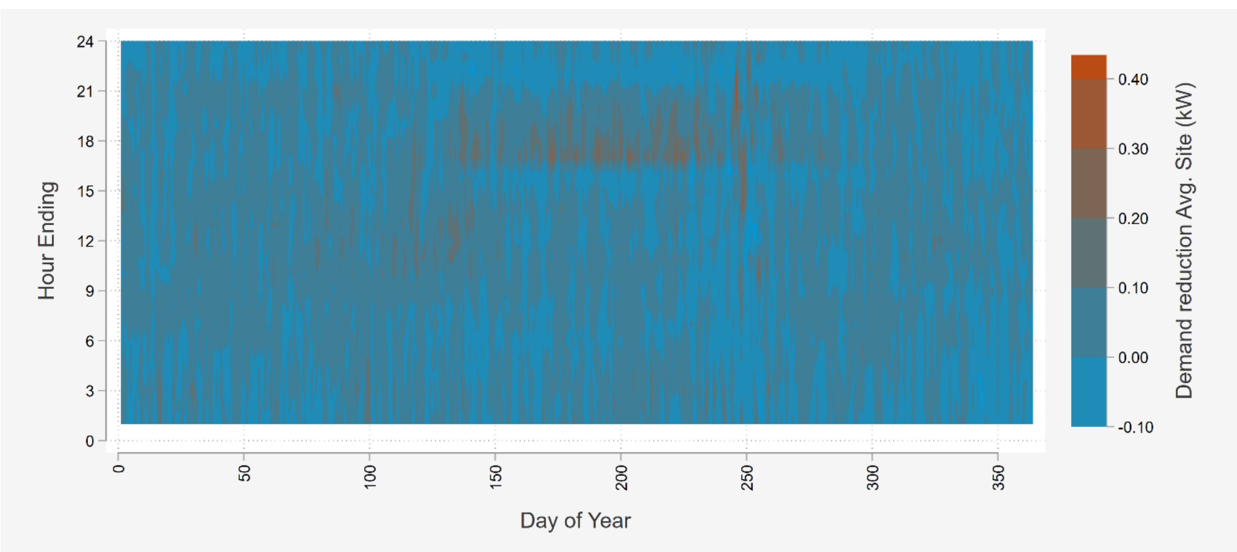


Table 14 presents an analysis of hourly load impacts, focusing on both the peak days and the average days of each month. This analysis is comprehensive, encompassing the demand reduction patterns observed during the peak load periods in the PG&E territory as well as during the times when CAISO gross and net loads reach their peak. A key observation from this data is the trend in load impacts during these periods. Specifically, the data indicates that the load impacts tend to be more substantial during the initial hour of the peak periods. This pattern of higher load reduction at the beginning of peak times is consistent across the different scenarios analyzed. This observed behavior is associated with thermostat control strategies, also known as temperature setbacks strategies. Thermostat manufacturers deploy an approach where the greatest temperature increase will be programmed for the first hour because the premise will be reaping the benefits of pre-cooling. Subsequent hours lower the incremental temperature target. A common set-back strategy is a 2-1-1 where the thermostat increases the targeted temperature by 2 degrees in the first hour, and one degree in the second and third hours. While set-back strategies can be more aggressive, customer satisfaction is important to manufacturers, program implementers and utilities.

Table 14: Daily TOU Automation Peak Period kW Impacts by Day Type

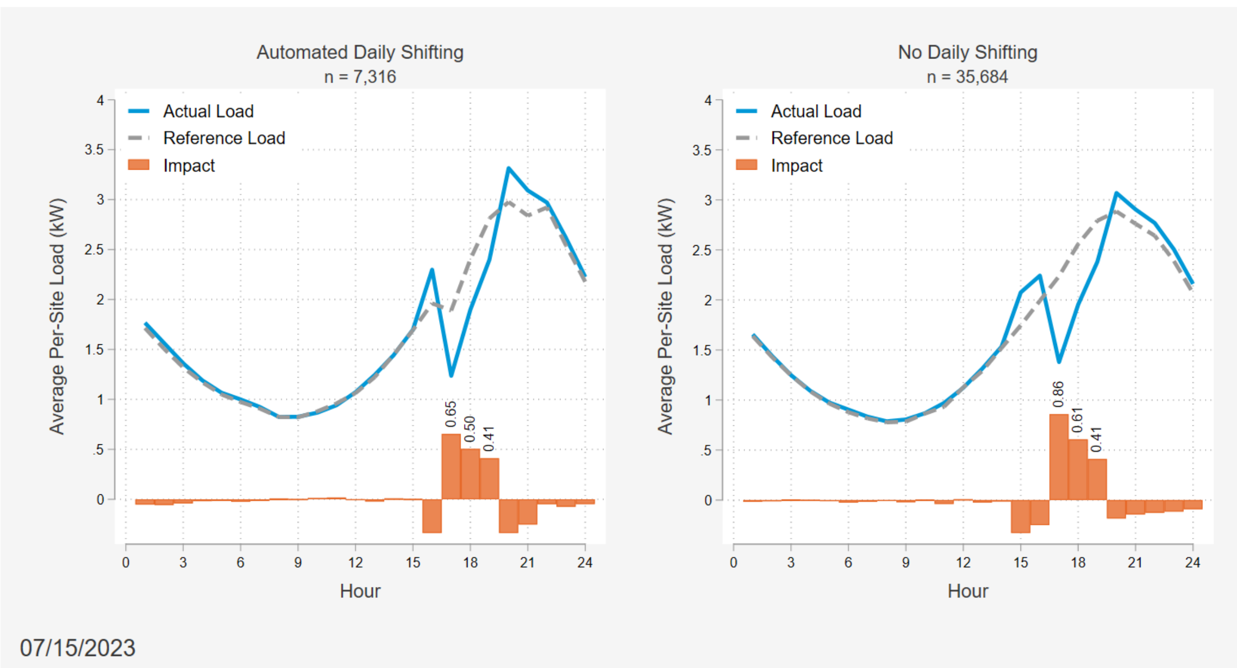
System	Day Type	Accounts (Average)	4:00-5:00 PM	5:00-6:00 PM	6:00-7:00 PM	7:00-8:00 PM	Average 4-8 PM
ALL	AVERAGE DAY JULY	3,557	0.14	0.08	0.05	0.03	0.07
	AVERAGE DAY AUGUST	3,766	0.14	0.11	0.08	0.06	0.10
	AVERAGE DAY SEPTEMBER	3,735	0.09	0.08	0.05	0.06	0.07
PG&E	PEAK DAY JULY	2,971	0.14	0.12	0.10	0.01	0.09
	PEAK DAY AUGUST	3,575	0.10	0.05	0.04	-0.02	0.04
	PEAK DAY SEPTEMBER	3,552	0.10	0.07	0.04	0.05	0.06
	TOP 20 DAYS	3,659	0.13	0.10	0.04	-0.03	0.06
CAISO	PEAK DAY JULY	2,935	0.05	0.10	0.08	0.01	0.06
	PEAK DAY AUGUST	3,596	0.18	0.18	0.15	0.03	0.13
	PEAK DAY SEPTEMBER	3,562	0.13	0.08	0.03	0.02	0.07
	TOP 20 DAYS	3,710	0.12	0.09	0.08	0.03	0.08
CAISO Net Loads	PEAK DAY JULY	2,935	0.05	0.10	0.08	0.01	0.06
	PEAK DAY AUGUST	3,617	0.18	0.18	0.19	0.09	0.16
	PEAK DAY SEPTEMBER	3,568	0.07	0.04	0.03	0.07	0.05
	TOP 20 DAYS	3,904	0.13	0.09	0.05	-0.02	0.06

6.2 EVENT PERFORMANCE WITH AND WITHOUT AUTOMATED DAILY SHIFTING

The overall demand reduction for these sites with automated daily shifting have two distinct components – the daily shifting – and the event-based load reduction over and above the daily response. The daily shifting demand reduction is due to the thermostat algorithms and not because of behavioral response to TOU rates. Both the participants and the matched control group were on similar rates and had similar load patterns before the automated shifting algorithms was activated. The only difference between the two groups was that one had the technology enabled automated daily shifting activated and the other group did not.

In addition, sites with daily load shifting were also able to deliver, event-based response over and above the daily response enabled by the thermostats. However, the overall impact of the thermostats was divided into two components, the daily shifting and the incremental event based reduction. Figure 23 compares impacts on an event for sites with and without automated daily shifting. The sites with the automated daily shifting have a distinct notch during the peak period for the counterfactual (the reference load) due to the daily shifting and appear to have lower impacts at first glance. However, when the impact of the daily shifting is algorithm is added to the event-based response, the total demand reductions are nearly identical.

Figure 23: Event Day Impacts for Sites with and Without Automated Daily Shifting



6.3 LOAD IMPACTS RESPONSE BY CUSTOMER TYPE

As a final step, we evaluated the variation in load reductions across different customer characteristics. This assessment, summarized in Table 15, focused on various customer segments. For a robust comparison, we specifically examined the top 20 CAISO net load days within the evaluation period. It's important to note a word of caution regarding the interpretation of these results: they tend to be less precise when based on smaller customer counts. One key observation from this analysis is that load reductions are generally more pronounced in the first hour of the peak period and tend to diminish as the peak period progresses.

Table 15: Daily TOU Automation kW Impact by Segment – CAISO Net Loads Top 20 Days

Category	Sub-category	% of Accounts	Hour into event (Avg. kW) 4-5 PM	5-6 PM	6-7 PM	7-8 PM	Event Hour Average Reference Load (Baseline)	Impact	% Impact
ALL	All	100.0%	0.13	0.09	0.05	-0.02	1.77	0.06	3.6%
Electric Vehicle	NO	86.9%	0.13	0.11	0.04	-0.02	1.85	0.06	3.4%
	YES	13.1%	0.13	-0.08	0.13	0.06	1.30	0.06	4.5%
GEOGRAPHIC AREA	Bay Area Inland	18.2%	0.11	0.13	0.08	-0.01	1.78	0.08	4.4%
	Central Valley Middle	14.6%	0.12	-0.02	-0.01	0.01	2.17	0.03	1.2%
	Central Valley North	1.5%	0.27	-0.15	-0.12	-0.17	2.04	-0.04	-2.1%
	Central Valley South	16.0%	0.37	0.21	0.10	-0.05	2.84	0.16	5.6%
	North Bay	5.1%	0.37	0.38	0.21	0.10	1.57	0.27	16.9%
	Peninsula	3.7%	0.35	0.26	0.33	-0.11	1.24	0.20	16.5%
	San Francisco - Oakland	4.1%	-0.27	-0.16	-0.19	-0.25	0.55	-0.22	-39.3%
	Sierras	5.4%	0.18	0.11	0.08	0.20	2.30	0.14	6.1%
	South Bay	29.6%	-0.03	0.04	0.01	-0.02	1.22	0.00	0.2%
	South Coast	1.8%	0.23	0.15	0.11	-0.01	1.66	0.12	7.2%
LOW INCOME	NO	82.9%	0.16	0.10	0.07	0.00	1.68	0.08	4.9%
	YES	17.1%	0.04	0.06	-0.04	-0.06	2.27	0.00	0.1%
NUMBER OF DEVICES	1 thermostat	82.5%	0.17	0.11	0.06	-0.01	1.75	0.08	4.7%
	2 thermostats	15.8%	-0.08	0.00	-0.05	-0.03	1.78	-0.04	-2.1%
	3 thermostats	1.7%	0.14	0.41	0.00	-0.27	2.66	0.07	2.6%
SOLAR	NO	76.7%	0.11	0.09	0.07	-0.02	1.90	0.06	3.3%
	YES	23.3%	0.20	0.10	-0.04	0.01	1.37	0.06	4.7%

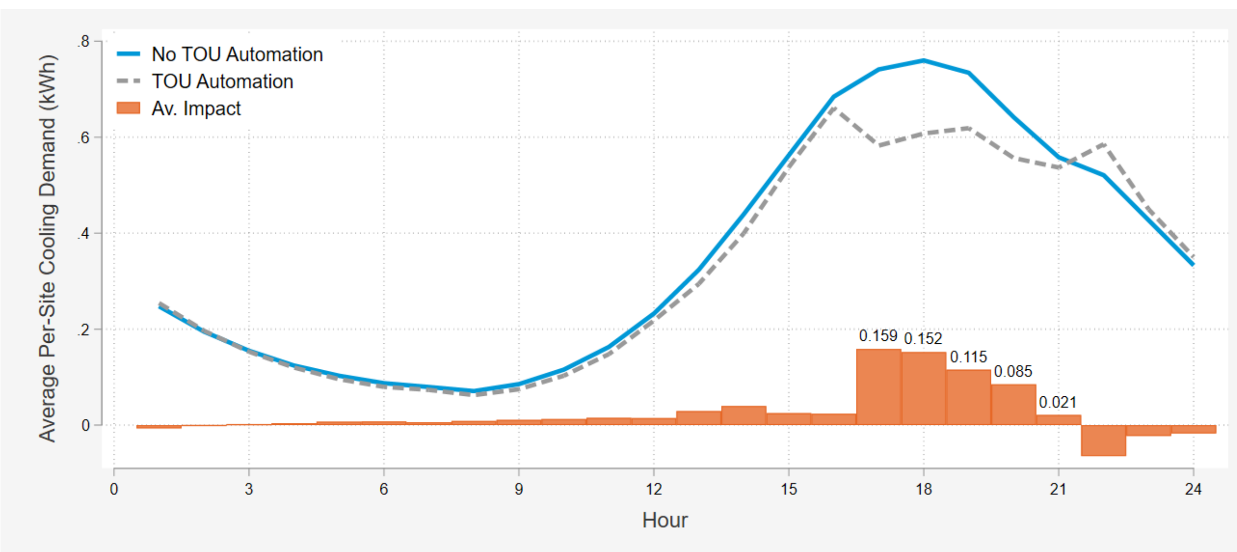
6.4 END-USE ANALYSIS

This section delves into an analysis using thermostat end-use data directly extracted from communication with the participants' thermostats, offering a granular view of usage patterns, thermostat set points, and temperature conditions. This data spans hourly observations for each day throughout both the 2022 and 2023 seasons. Key variables in this analysis included the air conditioning unit's runtime, expressed as a percentage of each hour, a kWh value derived from the runtime, temperature setpoints, and the ambient temperature within the home. To estimate the kWh, DSA assumed an average connected load of 3 kW.

A key finding from this analysis is that the reductions in energy use observed in the thermostat data were comparable to those indicated by the AMI data. However, it's important to note that the thermostat-based data provides insights from the direct source, thereby offering a precise reflection of individual consumption patterns. More specifically, the data does not include noise from other end uses. As a result, the data is less noisy and the percentage change in demand is larger, making it easier to detect the load impacts. This direct data source presents an opportunity for a deeper and more nuanced analysis. However, there are downsides of end use data is it does not include pre-treatment data and, thus, does not enable a difference-in-differences calculation.

Figure 24 displays the average hourly reductions for during the summer months. It is estimated that approximately 0.160 kW is being reduced at the beginning of the peak period due to the TOU automation on the average summer day. This is reflective of our results that were estimated using PG&E AMI data.

Figure 24: Average Reductions in Cooling Demand using Uplight Runtime Data



Displayed in Figure 25 and Figure 26 are the setpoints and runtimes for days in September 2023, illustrating the effects of the auto-TOU algorithm on the Pilot's participants. Figure 25 shows routine peaks in temperature setpoints among participants, notably occurring when the algorithm is actively reducing these setpoints. This pattern suggests that the auto-TOU algorithm is effectively lowering AC load at times when AC usage would ordinarily be increasing. Figure 26 highlights a significant daily reduction in AC runtimes among the treated individuals. This reduction is most pronounced during the periods when the control group's AC units, which are not managed by the algorithm, are at their peak usage. The figure thus demonstrates that the TOU algorithm is successfully reducing load during these critical peak periods, underlining its efficacy in managing energy consumption during times of high demand.

Figure 25: Variation in Cooling Setpoints For Participants and Controls

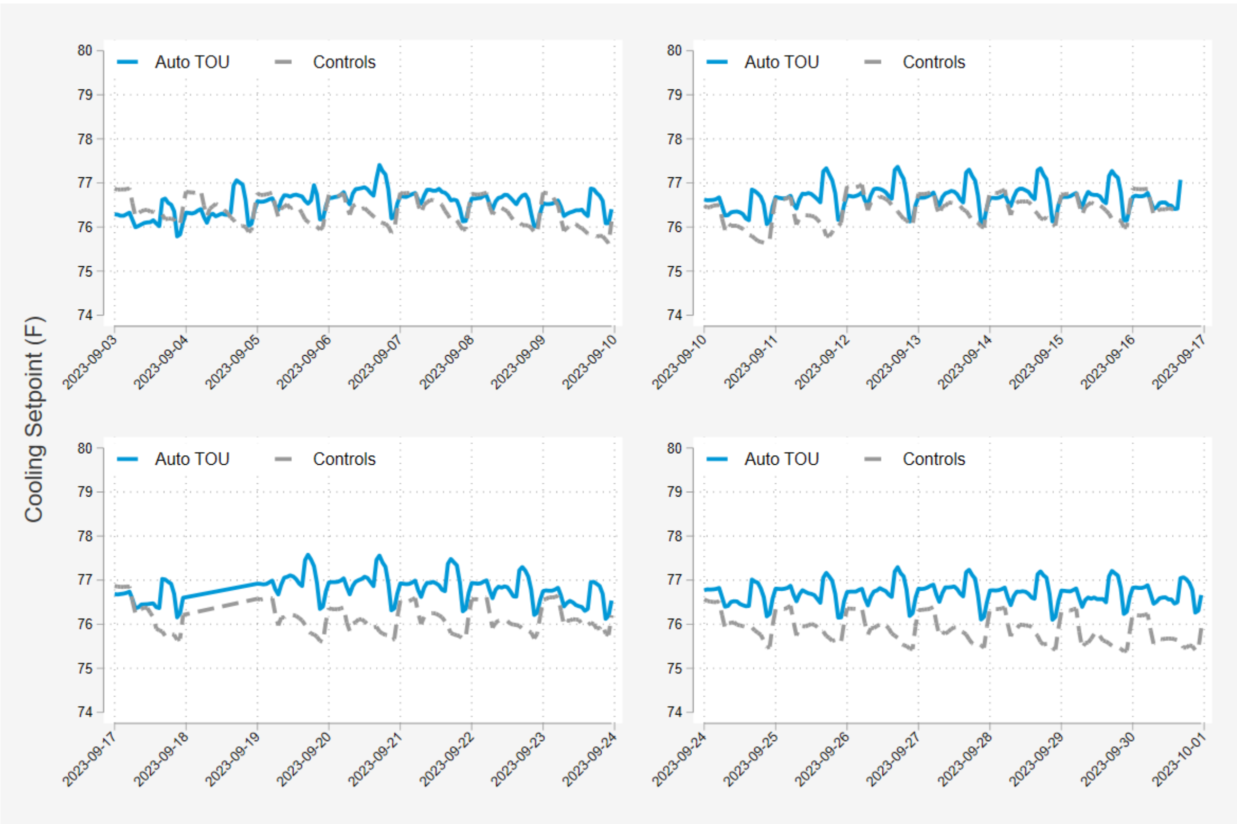


Figure 26: Comparison of September 2023 Runtimes for Participants and Controls

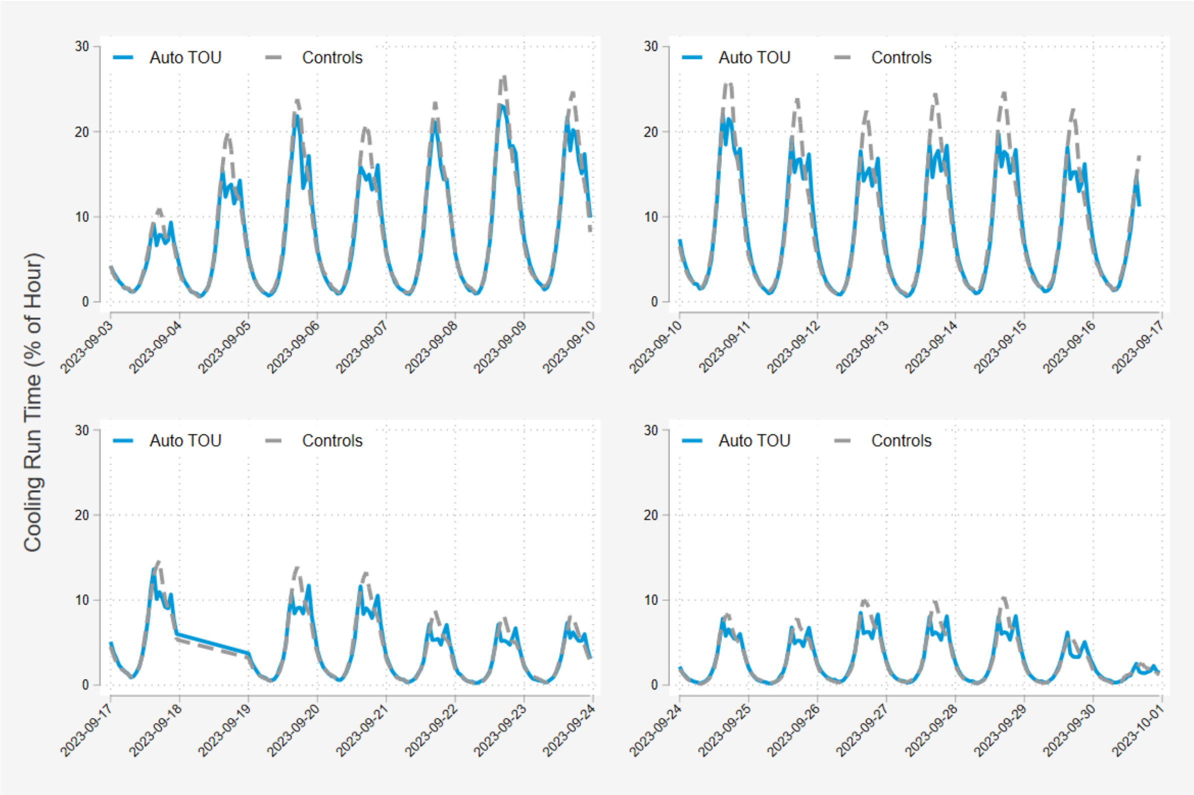


Figure 27 presents a heatmap for the 2023 season, effectively highlighting the specific dates and hours when cooling runtimes were reduced. These reductions predominantly occurred during the designated peak period. The heatmap's visual representation allows for an intuitive understanding of the patterns of runtime reduction, emphasizing the times when the cooling demand was strategically lowered. This visualization provides a clear indication of the Pilot's impact on energy usage, particularly during critical peak times, and serves as a useful tool for analyzing the effectiveness of cooling management strategies implemented throughout the season.

Figure 27: Heatmap of Runtime Reductions

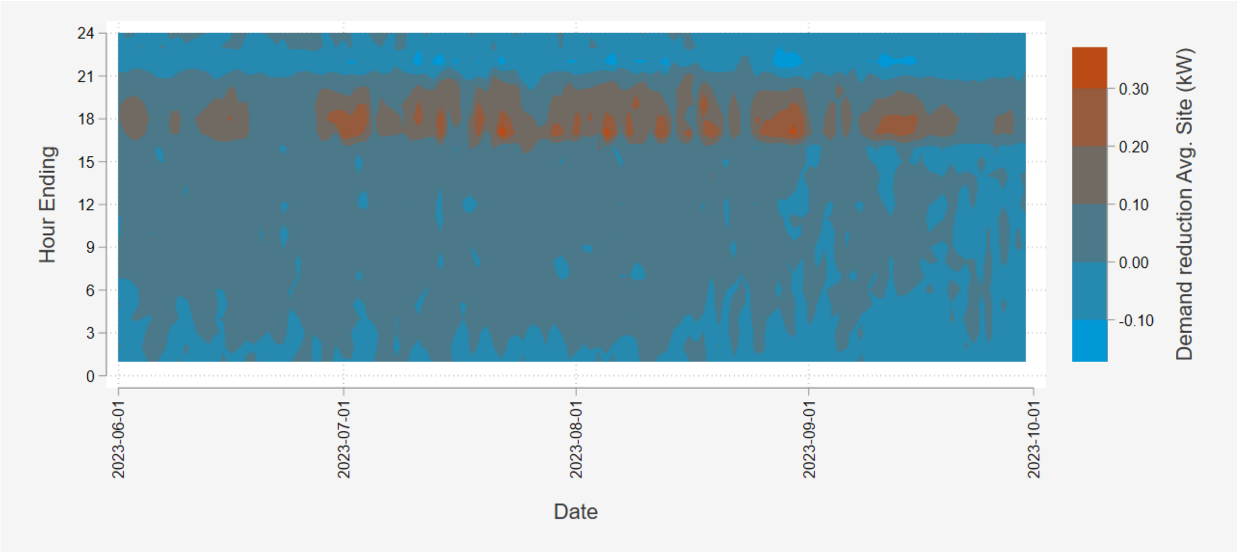


Figure 29 provides an in-depth visualization of the weather sensitivity of cooling runtimes during each hour of the summer peak period, using an array of daily observations to illustrate the variations. The earlier hours within the peak period consistently exhibit greater reductions in runtime than the later hours, suggesting a strategic approach to cooling management that targets the initial hours for more significant energy use adjustments. This pattern indicates a proactive response to anticipated temperature rises, optimizing cooling system operations to effectively manage energy demand during these critical times.

Figure 28: Average Per-Site Reductions versus Temperature by Hour

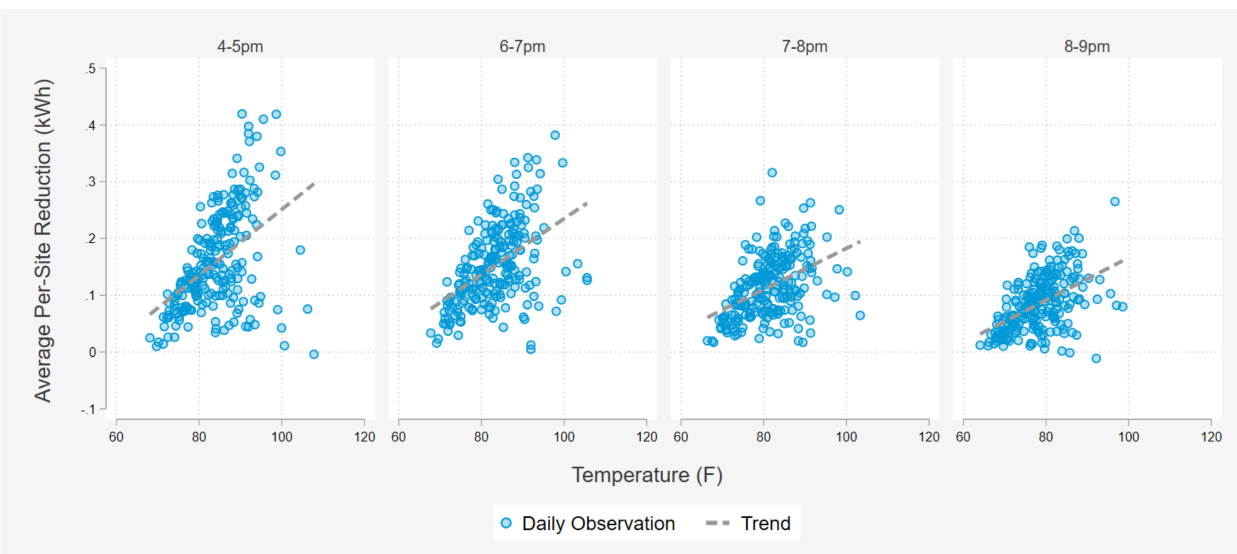
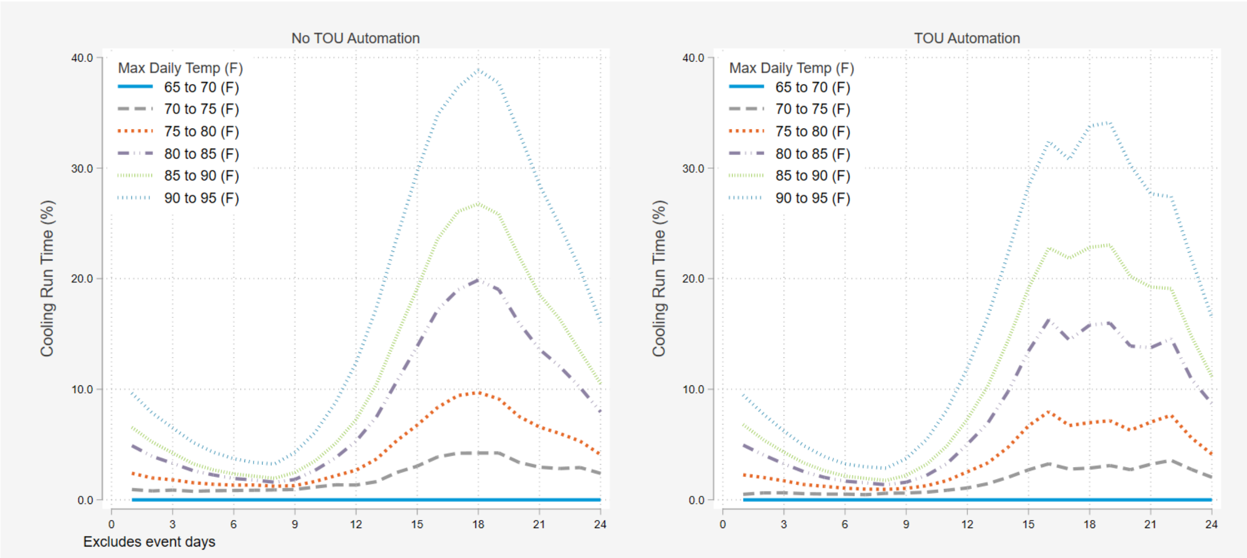


Figure 29 includes plots average thermostat runtimes, excluding days with DR events. These plots are categorized according to various temperature bins, offering a clear view of the runtime adjustments made in response to different temperature ranges. The data from these plots distinctly shows that the auto-TOU algorithm plays a pivotal role in reducing runtimes during peak hours, particularly under extreme temperature conditions.

Figure 29: Cooling Runtimes by Temperature Bins



Ultimately, the analysis above has yielded significant insights into the operational effectiveness of the auto-TOU algorithm. Leveraging data directly from participants' thermostats, not only corroborates the broader trends identified in AMI data but also provides a more detailed perspective on individual consumption behaviors. This analysis affirms the success of the TOU program in achieving energy savings. By integrating detailed, real-time thermostat data with broader AMI data, this analysis provides a solid foundation for enhancing understanding and improving energy consumption patterns, contributing significantly to the goals of the Pilot.

7 EX ANTE IMPACTS FOR PLANNING AND OPERATIONS

The electric grid is designed to maintain reliability under peaking conditions when temperatures are typically hottest. Thus, the magnitude and performance of DR resources under peaking conditions used for planning is critical for understanding the degree they can offset other resources, such as peaking gas power plant. Load impacts under planning conditions are referred to as ex-ante impacts and are informed by performance during historical events. They are an estimate of the load reduction capability that align with peak day weather, standardized the hours and length of dispatch.

DSA leveraged the systematic testing of the program under different weather conditions, different start times, and different event durations to develop a predictive model of SmartAC BYOT load reductions. The model was used to estimate demand reductions under planning conditions, including 1-in-2 (normal) versus 1-in-10 (extreme) annual peak day weather conditions, for CAISO and PG&E peaking conditions. The estimates of reduction capability under planning conditions are provided for each month of the year and hour of the day. In addition, DSA used the predictive model to produce a time-temperature matrix, which is simple a set of dynamic tables that show the expected impacts under different event conditions, defined by weather, start hour, and event duration.

7.1 PROCESS

We organized our approach to implement the findings from the Pilot program into a series of steps, as outlined in Table 16. First, we calculated reference loads to establish a baseline for forecasting event days. Next, we determined impacts by analyzing historical event performance for 2021-2023. Finally, we estimated pre-cooling and snapback loads for the two hours preceding the event and the four hours following its conclusion. These estimations were made based on the weather conditions given for each of the different planning scenarios.

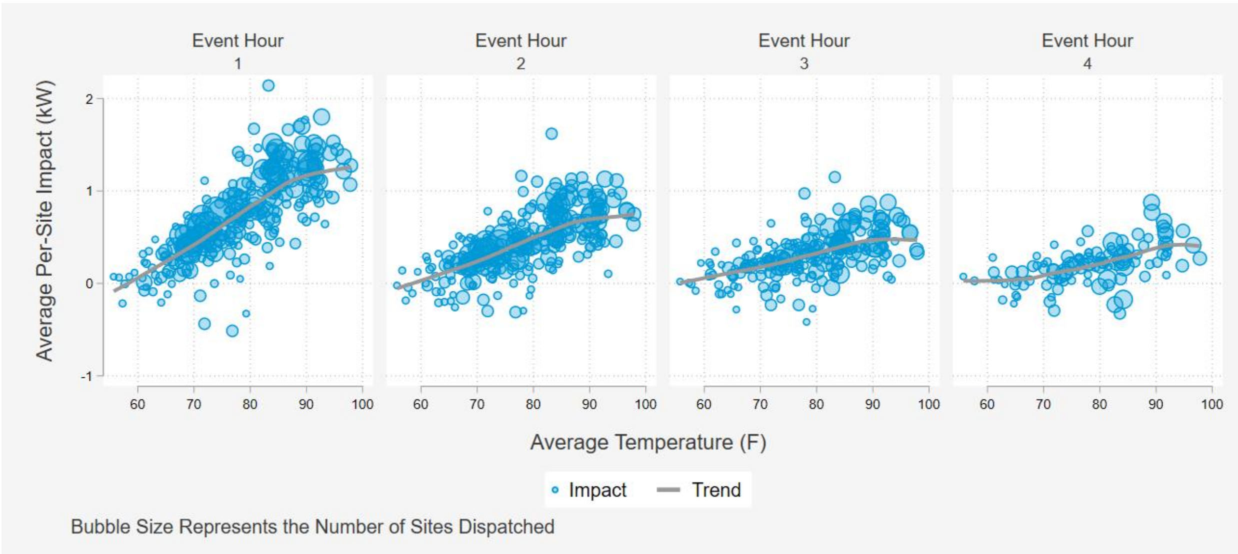
Table 16: Methods for Estimating Ex Ante Reference Loads and Impacts

Component	Reference Loads	Load Impacts	Pre-cooling and Snapback Loads
Data source	PG&E 2023 AMI Data – Net Loads	Impact data during events from 2021-2023 ex-post results	Pre and Post event data from 2021-2023 ex-post results
Analysis technique	Temperature spline model. Bins are created for temperatures lower than 60 degrees, 60-65 degrees, 65-70 degrees, and greater than 70 degrees. Individual regressions are run for each sub-LAP, day type (weekday vs weekend), and hour.	Impacts are regressed against the daily average temperature, the percentage of sites enrolled in TOU optimization, impact hour, hour of day, sub-LAP, day type, and analysis method used (these differed from year to year).	Similar to the load impacts model. Regressions were run separately for the two hours prior to events and for four hours following events.
Application	Applied to ex-ante weather conditions for hours not associated with an event, pre-cooling, and snapback. Conditions are segmented by 1-in-2 versus 1-in-10 weather days, Typical Event Day versus Monthly System Peak, CAISO versus PG&E weather, and sub-LAP.	Applied to ex-ante weather conditions for event hours. Conditions are segmented by 1-in-2 versus 1-in-10 weather days, Typical Event Day versus Monthly System Peak, CAISO versus PG&E weather, and sub-LAP.	Applied to ex-ante weather conditions for two hours pre-event and four hours post-event. Conditions are segmented by 1-in-2 versus 1-in-10 weather days, Typical Event Day versus Monthly System Peak, CAISO versus PG&E weather, and sub-LAP.

7.2 WEATHER SENSITIVITY OF RESOURCES

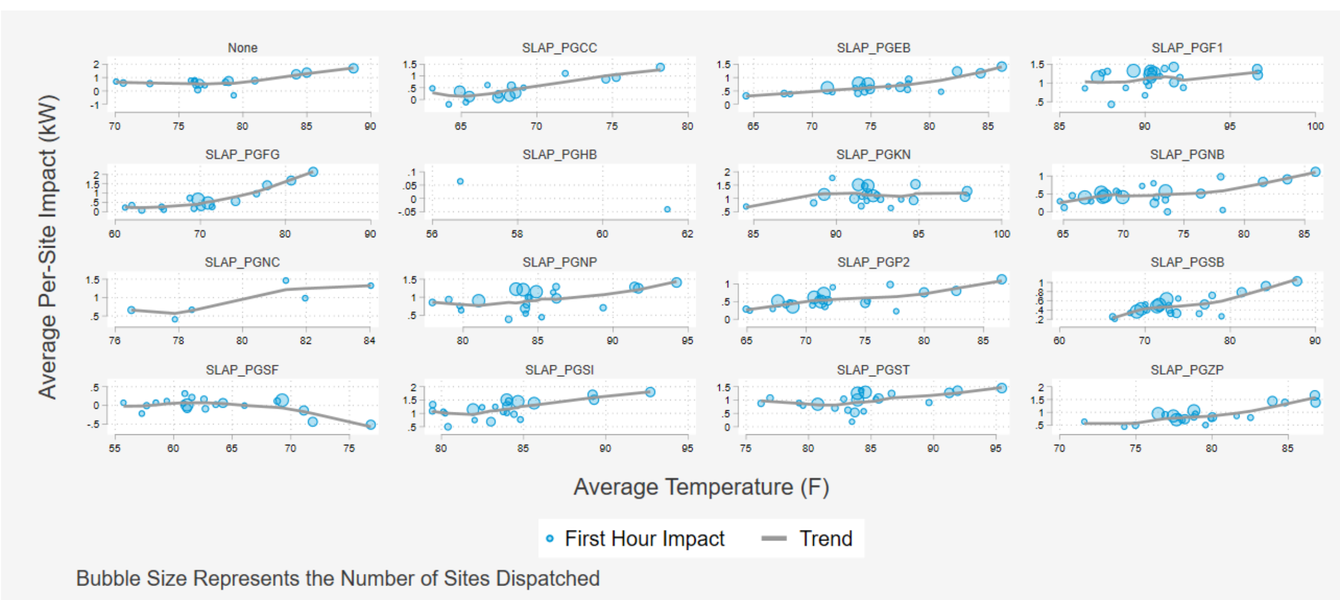
At the core of the predictive is determining how various factors explain the variability in event-day impacts. Weather and event hour are the a primary catalysts for variation in load impacts. Figure 30 illustrates the relationship between impacts and temperature by event hour. Broadly, impacts are larger when temperatures are higher. However, impacts decay over the length of the event, with the initial hour registering the highest impacts and the fourth hour witnessing the lowest.

Figure 30: 2021-2023 Event Impacts Over Temperature by Event Hour



As highlighted in Section 4 and Section 5, PG&E is diverse territory and there are significant meteorological differences by grid area (sub-LAP). Displayed in Figure 31 are the correlations between first-hour impacts and temperature for each sub-LAP. Notably, there exists a diverse range of temperatures on event days, contingent upon the customers' sub-LAP.

Figure 31: First-Hour Impacts versus Temperature by Sub-LAP

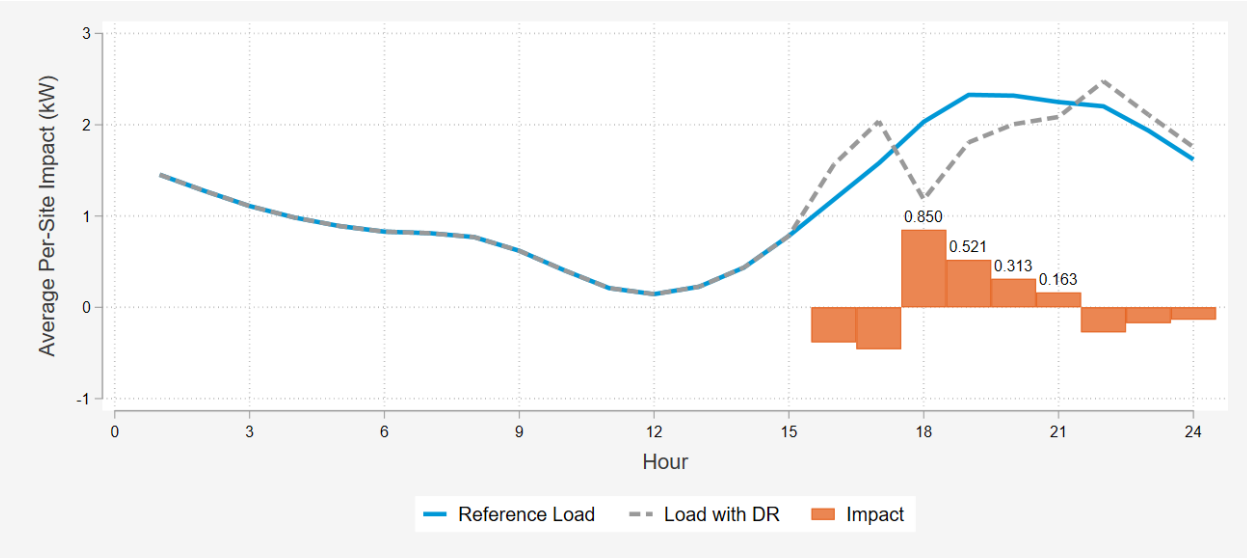


7.3 LOAD IMPACTS PREDICTIVE MODEL

DSA engineered a model to estimates the relationship between impacts, temperature, and geographic region. The final specification estimate average per-site impacts as a function of sub-LAP, average temperature on the event day, hour of the day, hour into the event, percentage of sites with TOU automation, the estimation method employed, and whether the event occurred on a weekend or weekday.

The model demonstrated robust predictive power, with an out-of-sample adjusted R-squared value of 91%, attesting to its ability to effectively capture and explain the variability in impacts across the specified parameters. Figure 32 illustrates the predicted per-site load impacts for a 5:00 PM to 9:00 PM during a 1-in-2 PG&E weather year peak day in August. These predictions are weighted by the number of enrollments in each sub-LAP at the conclusion of the 2023 season.

Figure 32: Average Per-Site Load Predictions for PG&E August Monthly System Peak, 1-in-2 weather conditions, 5:00PM-9:00PM



Under these specific conditions, the model anticipates a first-hour impact of 0.85 kW, with an average reduction over the event duration estimated at 0.46 kW. It's essential to underscore that these impact projections are contingent upon the nature of the event being predicted by the model. Different event types may yield varying impact expectations, emphasizing the importance of considering event-specific characteristics in the interpretation of these predictions.

7.4 TIME TEMPERATURE MATRIX

DSA also developed a Time-Temperature Matrix using the regression model mentioned above. This tool for predicting performance for actual conditions when DR event are called

Table 17 shows a view of the Time-Temperature Matrix with a selected sub-LAP, demonstrating the expected performance impacts across a spectrum of temperatures for this area. This aspect of the matrix is helpful for understanding localized responses to DR events under varying conditions. The strategic application of this matrix in DR event planning not only allows for more tailored and effective strategies but also leverages the power of predictive analytics for proactive decision-making.

Table 17: Time-Temperature Matrix – Selected Sub-LAP with kW Impacts

Sub-LAP	SLAP_PGF1
duration	4
Event Start	16
weekday	1

Average of impact	Event Hour									
Temperature	-2	-1	1	2	3	4	+1	+2	+3	+4
76	-0.449	-0.549	0.973	0.684	0.486	0.415	-0.335	-0.176	-0.142	-0.103
77	-0.439	-0.544	0.996	0.697	0.490	0.409	-0.338	-0.182	-0.146	-0.107
78	-0.429	-0.539	1.018	0.709	0.494	0.403	-0.341	-0.189	-0.151	-0.112
79	-0.419	-0.534	1.040	0.722	0.498	0.398	-0.344	-0.195	-0.156	-0.116
80	-0.409	-0.529	1.062	0.734	0.502	0.392	-0.348	-0.201	-0.160	-0.120
81	-0.399	-0.525	1.084	0.746	0.506	0.386	-0.351	-0.208	-0.165	-0.124
82	-0.388	-0.520	1.106	0.759	0.509	0.381	-0.354	-0.214	-0.170	-0.128
83	-0.378	-0.515	1.128	0.771	0.513	0.375	-0.357	-0.220	-0.175	-0.132
84	-0.368	-0.510	1.150	0.784	0.517	0.370	-0.360	-0.227	-0.179	-0.137
85	-0.358	-0.506	1.172	0.796	0.521	0.364	-0.363	-0.233	-0.184	-0.141
86	-0.348	-0.501	1.194	0.808	0.525	0.358	-0.366	-0.239	-0.189	-0.145
87	-0.337	-0.496	1.216	0.821	0.529	0.353	-0.369	-0.246	-0.193	-0.149
88	-0.327	-0.491	1.238	0.833	0.533	0.347	-0.373	-0.252	-0.198	-0.153
89	-0.317	-0.487	1.261	0.846	0.537	0.342	-0.376	-0.258	-0.203	-0.157
90	-0.307	-0.482	1.283	0.858	0.541	0.336	-0.379	-0.265	-0.208	-0.161
91	-0.297	-0.477	1.305	0.870	0.544	0.330	-0.382	-0.271	-0.212	-0.166
92	-0.287	-0.472	1.327	0.883	0.548	0.325	-0.385	-0.277	-0.217	-0.170
93	-0.276	-0.468	1.349	0.895	0.552	0.319	-0.388	-0.284	-0.222	-0.174
94	-0.266	-0.463	1.371	0.908	0.556	0.313	-0.391	-0.290	-0.227	-0.178
95	-0.256	-0.458	1.393	0.920	0.560	0.308	-0.394	-0.296	-0.231	-0.182
96	-0.246	-0.453	1.415	0.932	0.564	0.302	-0.398	-0.302	-0.236	-0.186
97	-0.236	-0.449	1.437	0.945	0.568	0.297	-0.401	-0.309	-0.241	-0.190
98	-0.226	-0.444	1.459	0.957	0.572	0.291	-0.404	-0.315	-0.245	-0.195
99	-0.215	-0.439	1.481	0.970	0.576	0.285	-0.407	-0.321	-0.250	-0.199
100	-0.205	-0.434	1.503	0.982	0.579	0.280	-0.410	-0.328	-0.255	-0.203

7.5 ANNUAL PEAK DAY DR EVENT PERFORMANCE

The table below presents the anticipated impacts for each sub-LAP under the planning scenarios for PG&E weather conditions and the June system peak. For these weather conditions, the expected average DR event impacts over a four-hour event are 0.471 kW and 0.454 kW for the 1-in-2 and 1-in-10 scenarios, respectively.

Table 18: June System Peak Impacts per site (kW) - PG&E Weather Conditions, Average over 4-Hour Event

Sub-LAP	Sites Enrolled (End of 2023 Season)	1-in-2 Weather Conditions		1-in-10 Weather Conditions	
		Average Impact (kW)	Average Temperature (F)	Average Impact (kW)	Average Temperature (F)
SLAP_PGCC	939	-0.306	67.424	0.574	77.864
SLAP_PGEB	18,679	0.502	84.838	0.724	95.588
SLAP_PGF1	7,105	0.614	101.767	0.614	102.479
SLAP_PGFG	1,901	0.672	82.357	1.330	95.226
SLAP_PGHB	49	-0.237	61.266	-0.020	71.003
SLAP_PGKN	3,064	0.687	102.031	0.730	101.282
SLAP_PGNB	2,357	0.266	82.772	0.383	93.185
SLAP_PGNC	274	0.501	87.607	0.550	94.414
SLAP_PGNP	5,414	0.598	95.953	0.618	99.460
SLAP_PGP2	8,189	0.286	78.708	0.376	90.954
SLAP_PGSB	15,806	0.274	80.933	0.386	91.721
SLAP_PGSF	1,887	0.179	63.312	-0.415	81.765
SLAP_PGSI	5,931	0.777	94.528	0.764	95.610
SLAP_PGST	2,455	0.644	95.262	0.660	98.963
SLAP_PGZP	1,757	0.376	80.330	0.655	90.666
Weighted Average		**0.457**	**86.545**	**0.571**	**94.763**

7.6 KEY FINDINGS

The analysis of weather trends reveals a few key patterns:

- The magnitude of impacts is larger when it hotter, precisely when grid resources are needed the most.
- The impacts are highly dependent on the hours into the event, decaying in the later event hours.
- There is substantial weather variation across PG&E grid areas and, as a result, substantial variation in load impacts by location.

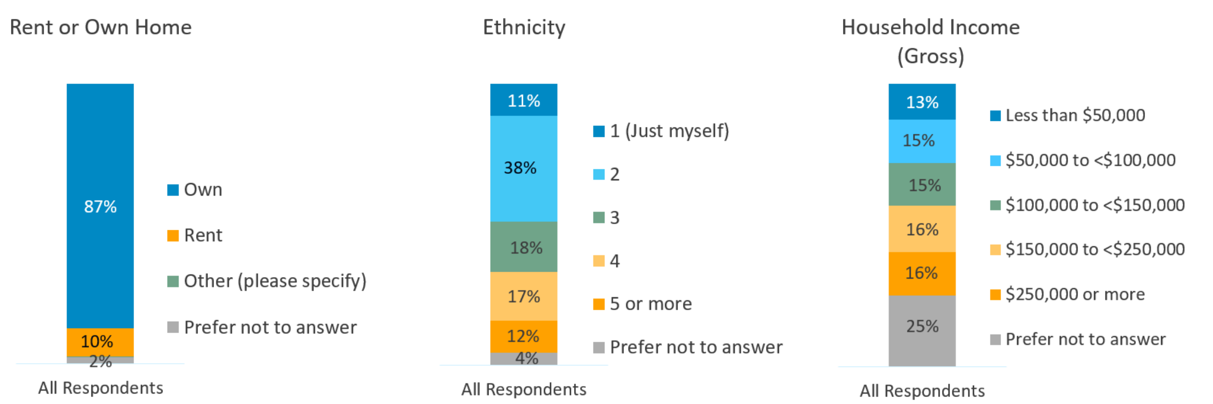
8 CUSTOMER SURVEY

This section provides an in-depth analysis of the end-of-year customer satisfaction survey that was given to customers at the end of both the 2022 season and the 2023 season. The short, 3-minute survey, aimed at understanding the participants' experiences and satisfaction levels, gathered valuable feedback from a diverse group of users who were integrated in the Pilot. The following sections delve into the survey's methodology, including the demographic breakdown of participants and the range of questions posed. The results offer insights into customer satisfaction, the effectiveness of the technology, and areas for potential improvement. Furthermore, this section compares the findings from the two seasons, shedding light on trends, evolving user preferences, and the overall impact of the Pilot on customer experiences. These insights not only reflect the success of effective implementation but also guide future enhancements to PG&E's residential program offerings.

8.1 DEMOGRAPHICS

At the end of each program year, PG&E sent out a brief survey, which lasted approximately 3 minutes, targeting all participants of the Pilot. In 2022, the survey received responses from 2,163 customers. This participation further increased in 2023, with 3,264 customers providing their feedback. The demographic composition of the respondents, as detailed in Figure 33, reflected a broad spectrum in terms of ethnicity and household income. Moreover, a predominant portion of the respondents were homeowners.

Figure 33: Survey Demographics

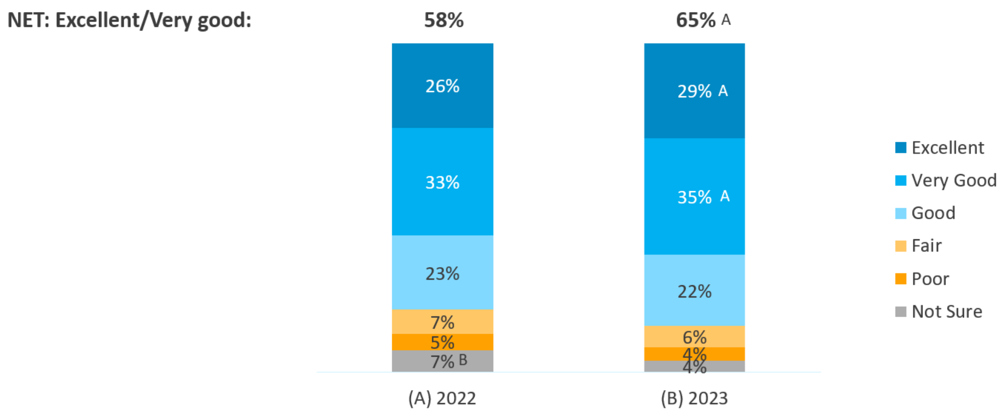


8.2 OVERALL CUSTOMER SATISFACTION

Figure 34 provides a comprehensive view of the overall customer satisfaction ratings for 2022 and 2023, highlighting the positive reception of the Pilot among its users. In 2022, a notable 58% of respondents rated the program as either 'Excellent' or 'Very Good', reflecting a strong approval of its features and benefits. This positive perception saw an upward trend in 2023, with the approval rating climbing to

65%, indicating an increase in customer satisfaction and possibly the Pilot's improvements or better alignment with customer needs over time. It's noteworthy that the Pilot seldom received low ratings, as customers rarely judged it as falling below 'Fair'. This trend suggests a consistently favorable view of the Pilot's effectiveness and its alignment with customer expectations. It was additionally reported that approximately two-thirds of customers in both years would recommend the Pilot to a friend.

Figure 34: Overall Customer Satisfaction



*A/B Letters indicate the value is significantly higher than the value in the corresponding column at the 95% confidence level

In 2023, as indicated in Figure 35, there was a notable increase in customer satisfaction in several aspects of the Pilot compared to 2022. This increase was observed in areas such as event notifications, daily demand impacts with automated TOU control, DR event control, and customer service support. The improved satisfaction levels suggest that customers found these elements of the program more effective or better aligned with their needs. The positive shift in customer perceptions, particularly in these operational areas, highlights the Pilot's ability to meet and potentially exceed user expectations.

Figure 35: Customer Experience Associated with Various Aspects of the Pilot

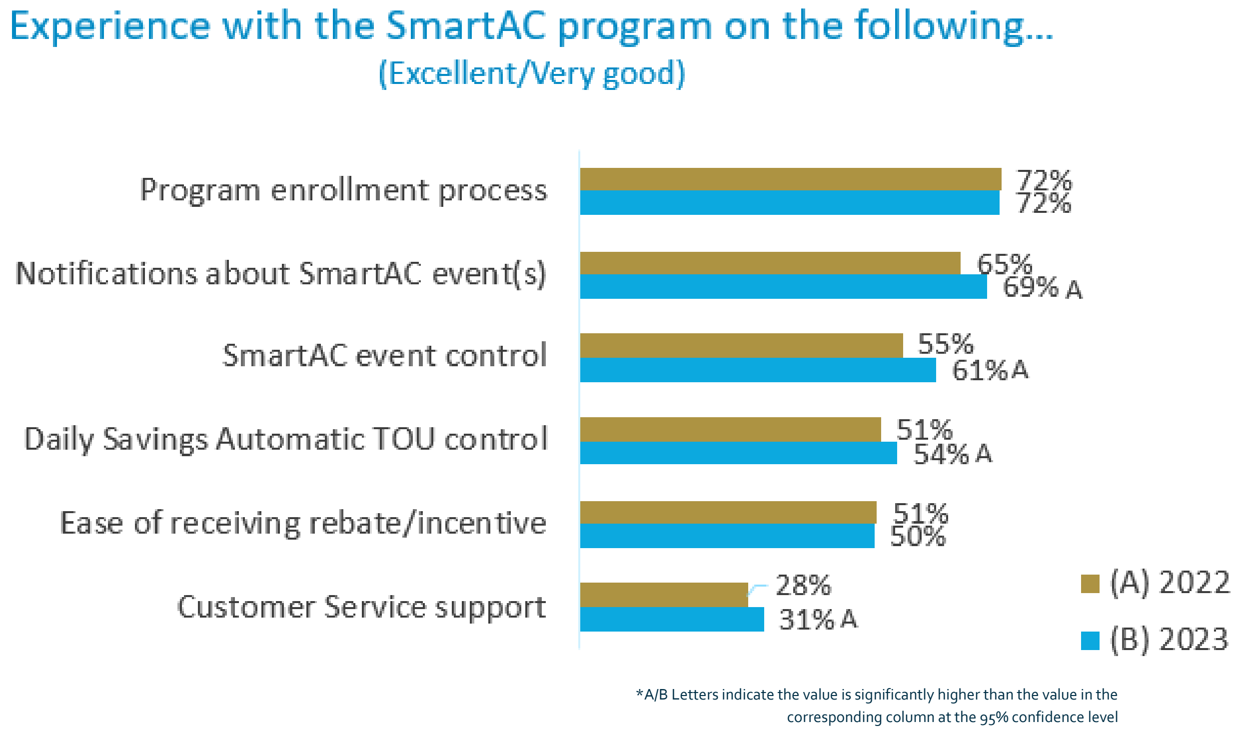
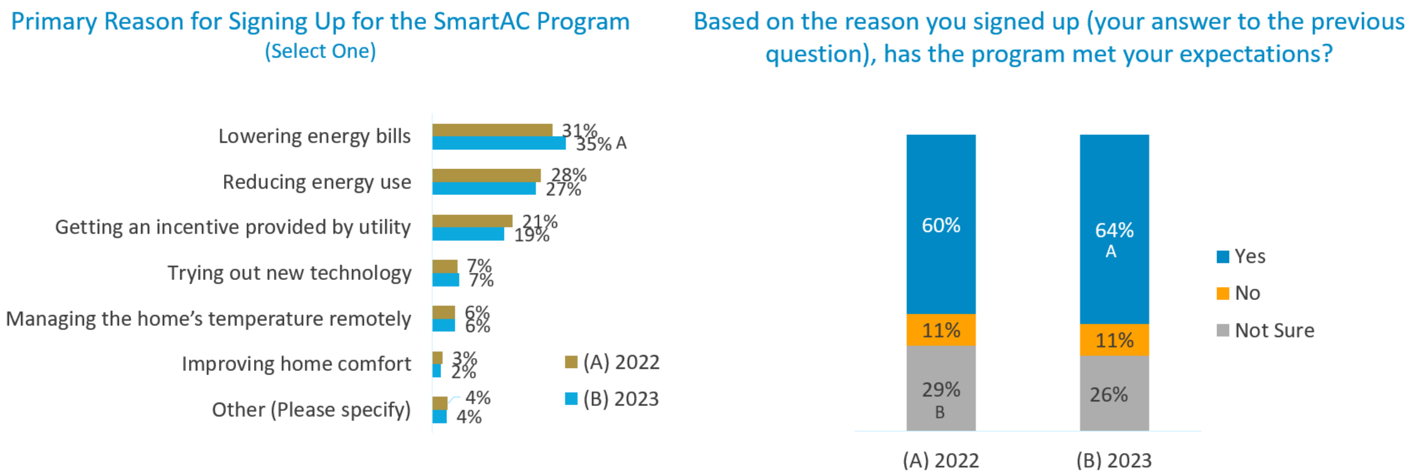


Figure 36 presents customer motivations for enrolling in the Pilot and their assessment of whether the Pilot met these expectations. The predominant reasons for enrollment included the desire to lower utility bills, reduce energy usage, or receive financial incentives. Most customers reported that the program had met their expectations in these regards. However, a segment of customers expressed uncertainty, indicated as 'Not sure' in their responses. This uncertainty could be attributed to various factors, such as a desire for more detailed information on the savings they achieved through the program or expectations of higher incentives. This feedback highlights areas where program communication or benefits could be further optimized to enhance overall customer satisfaction.

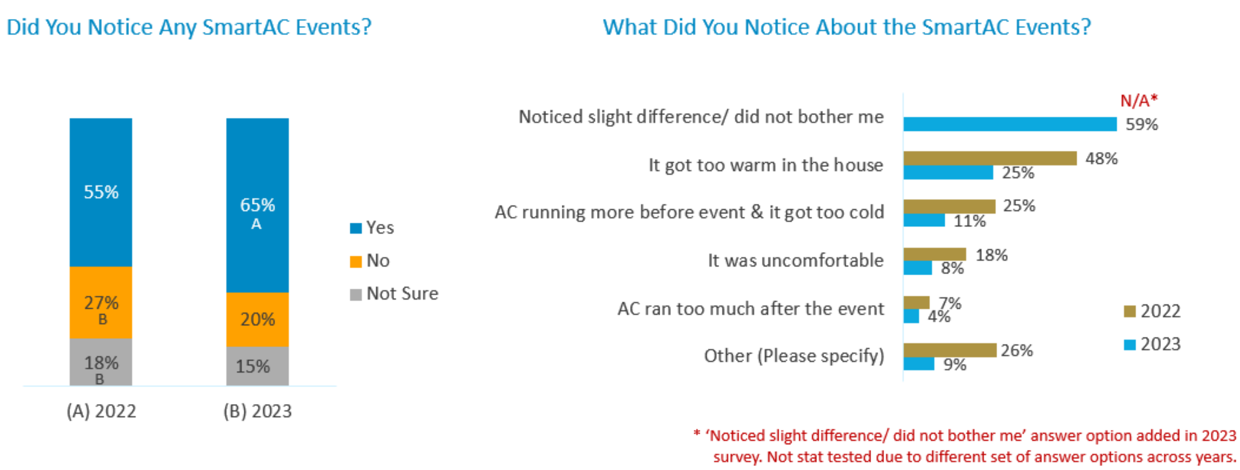
Figure 36: Reasons Customers Signed Up for the Pilot



*A/B Letters indicate the value is significantly higher than the value in the corresponding column at the 95% confidence level

Figure 37 illustrates the customer awareness of DR events. It reveals that most customers did notice when these events occurred, however; the adjustments in thermostat setpoints generally did not cause discomfort. Interestingly, a higher number of customers in 2023 reported noticing these events compared to 2022. Despite this increased awareness, there was a notable improvement in how customers perceived their comfort during these events. It is important to note that the primary reason for discomfort, cited by customers in both years, was an increase in indoor temperature, leading to conditions that were perceived as too warm. Regardless, it was reported that only 31% of customers who noticed events changed their thermostat settings to stop the event.

Figure 37: Awareness of DR Events



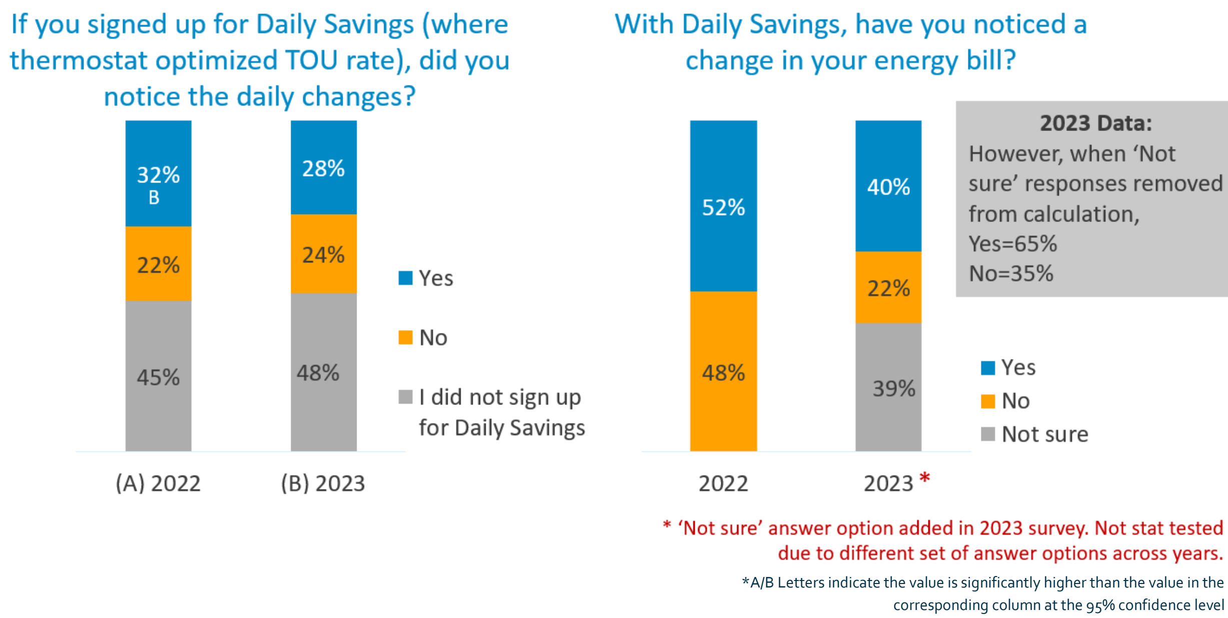
* 'Noticed slight difference/ did not bother me' answer option added in 2023 survey. Not stat tested due to different set of answer options across years.

*A/B Letters indicate the value is significantly higher than the value in the corresponding column at the 95% confidence level

8.3 TOU OPTIMIZATION

As displayed in Figure 38, one in three customers were enrolled in TOU optimization and noticed the daily thermostat changes, with about half of these customers noticing changes in their energy bills. This observation could indicate the effectiveness of the TOU optimization in terms of energy cost management for a substantial number of participants. However, it also highlights that the impact on energy bills may not be uniformly noticeable across all participants. This variation in customer experience could be due to differing usage patterns, the efficiency of their HVAC systems, or variations in the implementation of TOU adjustments.

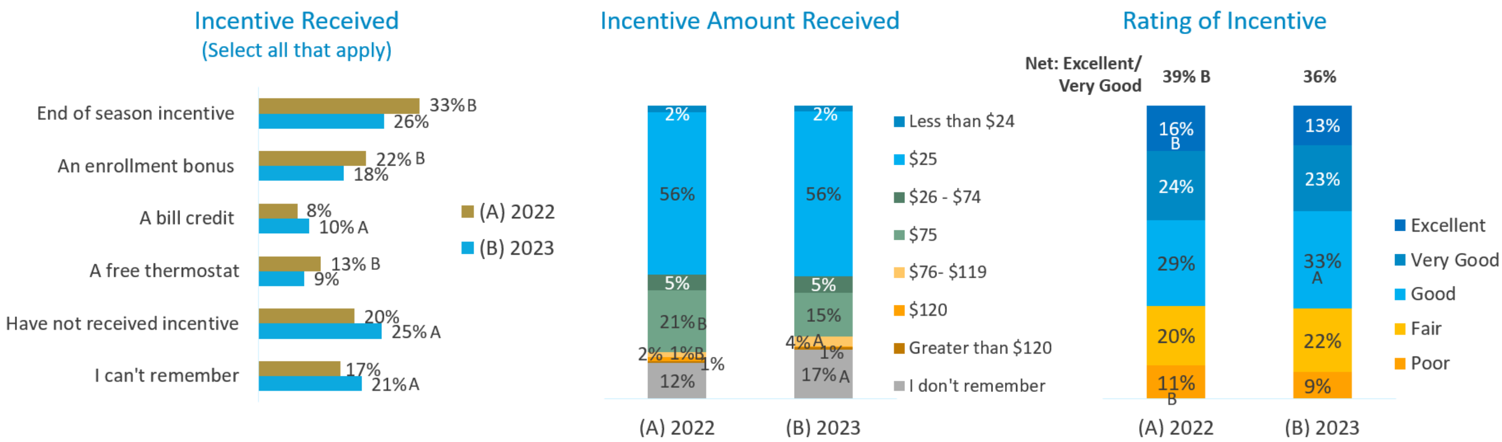
Figure 38: Customer Responses on TOU Optimization



8.4 INCENTIVES

Figure 39 highlights the diversity of incentives offered to customers as part of the Pilot. Although customers who already owned a thermostat received a standard $75 incentive to enroll, the data indicates that the incentives varied widely, catering to different aspects of customer participation. A significant majority of customers specifically recalled receiving the end-of-season incentive, which in fact was in the amount of $25. This incentive appears to have had a notable impact, as it was the most frequently remembered by the participants. Furthermore, the effectiveness of these incentives is reflected in customer satisfaction ratings. Nearly 40% of the respondents rated the incentives as 'Excellent' or 'Very Good'. This high rating suggests that a substantial proportion of the Pilot's participants found the incentives to be a compelling aspect, potentially influencing their continued engagement and positive perception.

Figure 39: Customer Feedback on Incentives



*A/B Letters indicate the value is significantly higher than the value in the corresponding column at the 95% confidence level

8.5 FEEDBACK ON PROGRAM DESIGN

In response to inquiries about potential improvements to the program design, customer feedback predominantly fell into three categories: lack of information, incentive levels, and improvement of thermostat settings. A notable segment of customers expressed a need for clearer information, particularly regarding the tangible savings achieved and the Pilot's activation during event days. This feedback suggests a gap in communication, with customers seeking more transparency and understanding of the direct benefits.

Regarding incentives, several customers voiced concerns about the perceived low value of the incentive amounts. Additionally, there were comments about the complexity and challenges associated with redeeming thermostat rebates, indicating a need for a more streamlined and user-friendly process.

The final significant area of feedback was related to thermostat settings. Some customers reported dissatisfaction with the preset temperature levels, noting that these did not align with their personal comfort preferences. Furthermore, they expressed discomfort due to the temperatures their homes reached during DR events, suggesting a need for more flexible or customizable thermostat controls to accommodate individual comfort needs.

9 KEY FINDINGS AND RECOMMENDATIONS

PG&E's Smart Thermostat Pilot, conducted during the summers of 2022 and 2023, has provided valuable insights into the role of smart thermostats not only for DR purposes, but in combination with TOU optimization. The Pilot, encompassing a diverse range of thermostat brands and geographic regions, has highlighted the intricacies of deploying technology-driven energy management solutions within a varied customer base. The findings underscore the effectiveness of smart thermostats in reducing energy demand, particularly in response to peak load conditions and extreme weather events. The Pilot has also revealed significant variations in effectiveness across different brands and regions, offering a nuanced understanding of the factors influencing Pilot success. As PG&E continues to navigate the evolving landscape of energy management and DR, the lessons learned from this Pilot serve as a cornerstone for future strategies. The following key findings and recommendations are derived from the Pilot, aiming to guide program design and implementation enhancements.

Table 19: Key Findings

Key Finding	Additional Detail
Of the 108,190 devices enrolled at the end of the 2023 season, 72.4% were Nest thermostats, 26.0% were ecobee thermostats, 1.6% were Emerson, and 0.4% were Honeywell Home thermostats.	Nest devices were the most popular by the end of the 2023 season. However, in 2022 Nest and ecobee had similar enrollment numbers. Marketing for ecobee devices occurred throughout the 2022 spring and fall periods, explaining their surge in enrollment. In 2023, most of the new enrollment was from Nest devices, which coincided with the marketing efforts. While the manufacturers did not share all the details about their marketing efforts, ecobee devices allowed in-app enrollment, while Nest customers could enroll on the Nest website. Emerson and Honeywell Home devices routed potential enrollees to the implementation vendor's enrollment web page.
Approximately 58% of ecobee participants utilized TOU automation at the beginning of the 2022 season, which declined to approximately 47% by the end of the 2023 season.	There were two device brands – Emerson and ecobee – that offered automated TOU response in 2022 and 2023, with ecobee customers making up the majority of enrollees. While Emerson offered automated TOU response, the number of participants was small and were therefore excluded from the analysis.
The thermostats enabled automated daily shifting that delivered daily demand reductions over and above customer response to TOU rates.	The automated daily shifting reduced demand by 0.13 kW per site, on average, on the non-event days when PG&E loads were highest (Top 20 Load Days). The load impacts vary by hour, with larger results in the first hour and decreasing demand reduction in later hours. The device demand reduction was limited to four hours despite the five-hour peak. The thermostats did not deliver demand reduction for the 8:00 - 9:00 PM hour. Because thermostat demand reductions decay with longer durations, the demand reduction for net load peak hours (7:00 -9:00 PM) was substantially smaller than for the 4:00 – 7:00 PM period.
The algorithms automated the DR around the correct peak hours	Most participants were on rates with a 4-9 PM peak. For those sites, the data shows pre-cooling from 3-4 PM and snapback after 9 PM. However, the TOU-D rate had a shorter 5-8 PM peak. For TOU-D, the data shows re-cooling from 4-5 PM and snapback after 8 PM.

Key Finding	Additional Detail
2022 events intentionally introduced wide variation in temperatures, event start time, and event duration, allowing us to quantify how performance varies as a function of those factors	On September 6, 2022, one of the hottest and highest PG&E load days, the thermostats delivered an average impact of 0.96 kW over the DR event window, with the largest impacts, 1.38 kW per site, occurring in the first event hour. These impacts were much higher than cooler event days. Generally, hotter days with high system loads experienced the most significant impacts.
2023 events focused on CAISO market integration and locational dispatch. There was wide geographic variation in the event dispatch from CAISO, with most events called in hotter parts of the service territory.	Impacts were mostly driven by the temperature within the areas in which participants were dispatched. While there was significant participation throughout the PG&E service territory, most participants resided in the South Bay. Those who delivered the largest impacts resided in the Central Valley and Sierras areas.
The demand reduction is largest when temperatures are hottest, but the magnitude of the reduction decays across the event period	Over 90% of the variation in dispatchable demand reduction is explained by weather, the number of hours into the event, and the hour of the day. The biggest driver is the number of hours into the event. No matter the weather conditions or the event start time, we observed decay in the reduction over the event duration. The second-largest driver is the weather. The thermostats deliver larger demand reductions when temperatures are hotter.
For sites with automated daily shifting, the overall demand reduction is split into two distinct components – the daily shifting – and the event-based load reduction over and above the daily response.	Both the automated daily shifting and the DR event-based response are due to thermostat control. The combined total of the two components – daily shifting and incremental event-based response – is equivalent to the event impacts for sites without automated daily shifting. However, vendors do not receive capacity credits for technology-enabled daily shifting, and PG&E does not have funding for those programs.
The daily shifting algorithms effectively automated the response around the correct TOU peak hours	The thermostats correctly automated the daily load shifting for sites with 4-9 pm and 5-8 pm peak periods.

Table 20: Recommendations

Recommendation	Additional Detail
Create a mechanism to credit utilities so they can incentivize vendors for technology-enabled daily shifting.	There is no mechanism to credit utility programs for the incremental capacity and reductions from technology enabled daily load shifting which could then be passed to incentivize vendors. There is no mechanism for utilities claim the benefits or for technology vendors to monetize these grid benefits delivered by the technology. The TOU evaluations estimate first-year savings immediately after a cohort transitions to TOU. They do not include technology-enabled reductions due to the activation of automation algorithms if those activations occur outside the initial year of transition. On the other hand, DR evaluations focus on the difference in load between event and non-event day loads. Thus, they do not account for technology that automates daily load shifting. Notably, the reductions delivered by the daily shifting thermostat algorithms are incremental to the customer TOU response but may go uncounted. Nearly all the customers in the treatment and control groups were already on TOU rates before the daily shifting algorithms were activated. Activating the daily shifting algorithms delivered incremental reductions.
Sites in the San Francisco-Oakland, Peninsula, and North Bay areas deliver small demand reductions and should be avoided in future enrollment efforts	When possible, PG&E should concentrate its targeting and enrollment efforts in the Central Valley, the Bay Area Inland area surrounding the I-680 corridor, areas of the South Bay, and the Sierras. So far, vendors have resisted efforts to concentrate recruitment in hotter zip codes with more AC load. The alternative is to switch to a pay-for-performance program design rather than per-device fees. Doing so will encourage providers to focus recruitment on customers that have bigger AC loads and larger impacts.
Conduct evaluations using net loads (both energy delivered to customers and exported by customers) and work to modify the CAISO policy because it introduces systematic downward bias in load impact estimates.	CAISO does not allow demand reductions to be counted if they lead to customer exports. As a result, the practice of zeroing out load impacts if they lead to exports has seeped into the evaluations. Using only delivered loads (and ignoring exports) leads to censoring of data and produces a downward bias in the results. Specifically, excluding export data undercounts demand reductions from sites with solar or battery storage. The undercounting can be substantial when a large share of participants have solar, as in this Pilot. We recommend that policymakers, utilities, and evaluators work to reverse the CAISO practice. To illustrate, a site with rooftop solar may have a 0.5 kW whole home load in the afternoon hours. A 1.0 kW drop in AC load, would lead to -0.5 kW whole home load. The CAISO policy of only counting delivered loads would ignore the exports and only count 0.5 kW of demand reduction even though demand was reduced by 1.0 kW.
Do not bid or dispatch thermostat resources on days when temperatures are not expected to exceed 85 degrees Fahrenheit.	Air conditioner loads are highly weather-sensitive and deliver bigger load reductions on the hottest days when resources are needed most. However, little to no demand reductions can be delivered by thermostats in dry heat when daily maximum temperatures are below 85°F. Resources should not be bid, and events should not be called, in areas where temperatures are not expected to exceed 85 degrees Fahrenheit.

Recommendation	Additional Detail
Enrollment should prioritize customers with more than 1kW of air conditioning load to ensure a significant curtailable load for DR events.	Specifically, we recommend continuing to use AMI data to estimate the hourly AC loads for all PG&E customers during the top ten peak days. Avoiding sites with too little air conditioning loads helps improve cost-effectiveness.
Develop event operations plans for each summer	It is critical to assess performance during different event conditions – defined by weather, hours of dispatch, event duration, and day type (weekdays vs. weekends). The variation in events is necessary to ensure the estimates of demand reduction capability under planning conditions are accurate. While PG&E collected a substantial body of evidence over a short period, it is necessary to restock the performance date. Notably, it may require some out-of-market testing and dispatch since the necessary variation in event conditions may not be achieved if PG&E solely relies on CAISO market awards.

APPENDIX A: RESULT SUMMARY BY SEGMENT FOR EACH EVENT

Table A- 1: 6/22/2022 17:00 – 19:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Average Performance: Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	1,455	85.6	0.41	0.23	0.14		1.74	0.26	15%	0.04	6.84
Device brand	ecobee	846	86.1	0.41	0.22	0.13		1.80	0.25	14%	0.05	5.05
Device brand	Emerson	56	86.1	0.50	0.39	0.33		1.60	0.41	25%	0.19	2.16
Device brand	Nest	553	84.9	0.41	0.23	0.13		1.67	0.26	15%	0.06	4.16
Device brand	Honeywell	0										
Number of thermostats	1	1,157	85.6	0.40	0.22	0.13		1.71	0.25	14%	0.04	6.14
Number of thermostats	2	265	86.1	0.48	0.29	0.26		1.89	0.34	18%	0.11	3.20
Number of thermostats	3+ thermostats	33	85.3	0.51	0.38	(0.32)		1.80	0.19	10%	0.36	0.52
Low income	N	1,262	84.7	0.40	0.23	0.13		1.68	0.25	15%	0.04	6.18
Low income	Y	193	91.7	0.50	0.26	0.19		2.18	0.32	15%	0.10	3.09
Solar	No solar	900	84.7	0.40	0.22	0.13		1.76	0.25	14%	0.04	5.84
Solar	Solar	493	87.4	0.55	0.30	0.16		1.89	0.34	18%	0.08	4.39
Sublap	SLAP_PGCC	19	65.4	(0.25)	(0.16)	(0.25)		0.63	-0.22	-35%	0.28	-0.78
Sublap	SLAP_PGEB	335	86.7	0.47	0.21	0.03		1.70	0.24	14%	0.08	2.94
Sublap	SLAP_PGF1	129	97.0	0.86	0.51	0.37		2.16	0.58	27%	0.13	4.37
Sublap	SLAP_PGFG	26	83.3	0.45	0.42	0.69		1.54	0.52	34%	0.27	1.94
Sublap	SLAP_PGHB	0										
Sublap	SLAP_PGKN	65	95.3	0.70	0.24	0.35		2.12	0.43	20%	0.18	2.38
Sublap	SLAP_PGNB	40	85.3	0.05	(0.29)	(0.42)		1.54	-0.22	-14%	0.24	-0.90
Sublap	SLAP_PGNC	2	92.0	2.73	1.60	1.12		2.68	1.82	68%	1.07	1.70
Sublap	SLAP_PGNP	127	93.6	0.45	0.54	0.37		2.24	0.45	20%	0.14	3.28
Sublap	SLAP_PGP2	141	78.2	0.23	0.09	0.07		1.65	0.13	8%	0.12	1.10
Sublap	SLAP_PGSB	263	78.7	0.26	0.14	0.07		1.37	0.16	11%	0.08	2.07
Sublap	SLAP_PGSF	44	63.9	(0.00)	(0.26)	(0.04)		0.83	-0.10	-12%	0.11	-0.88
Sublap	SLAP_PGSI	149	91.9	0.75	0.52	0.33		2.32	0.53	23%	0.14	3.76
Sublap	SLAP_PGST	43	89.6	0.19	0.14	0.25		1.92	0.19	10%	0.25	0.77
Sublap	SLAP_PGZP	34	82.2	0.64	0.50	0.45		1.76	0.53	30%	0.26	2.02
AC Propensity	Highest	0										
AC Propensity	High	477	90.0	0.60	0.33	0.23		2.63	0.39	15%	0.08	4.65
AC Propensity	Medium	451	86.6	0.45	0.23	0.11		1.66	0.27	16%	0.07	4.08
AC Propensity	Low	248	81.5	0.19	0.13	0.11		1.14	0.14	12%	0.07	2.05
AC Propensity	Lowest	0										
Electric Vehicle	EV	0										
Electric Vehicle	No EV	0										
TOU Automation	Y	0										
TOU Automation	N	0										

Table A- 2: 6/27/2022 17:00 – 19:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Average Performance: Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	1,470	89.3	0.56	0.30	0.25		1.44	0.37	26%	0.04	10.45
Device brand	ecobee	859	90.3	0.44	0.15	0.17		1.41	0.25	18%	0.05	5.40
Device brand	Emerson	50	91.2	0.61	0.44	0.26		1.72	0.44	25%	0.19	2.35
Device brand	Nest	561	87.6	0.73	0.53	0.39		1.46	0.55	38%	0.06	9.57
Device brand	Honeywell	0										
Number of thermostats	1	1,192	89.3	0.52	0.28	0.21		1.46	0.34	23%	0.04	8.92
Number of thermostats	2	252	89.2	0.71	0.40	0.45		1.31	0.52	40%	0.10	5.17
Number of thermostats	3+ thermostats	26	89.1	0.97	0.55	0.32		1.78	0.62	35%	0.34	1.80
Low income	N	1,277	88.2	0.53	0.29	0.23		1.31	0.35	27%	0.04	9.14
Low income	Y	193	96.7	0.77	0.40	0.42		2.25	0.53	23%	0.10	5.32
Solar	No solar	956	87.3	0.47	0.27	0.23		1.86	0.32	17%	0.04	8.24
Solar	Solar	463	93.5	0.77	0.39	0.33		0.83	0.50	60%	0.07	6.67
Sublap	SLAP_PGCC	12	73.6	(0.29)	(0.32)	(0.47)		0.78	-0.36	-46%	0.37	-0.98
Sublap	SLAP_PGEB	336	89.0	0.45	0.27	0.19		1.13	0.31	27%	0.07	4.07
Sublap	SLAP_PGF1	128	105.1	1.03	0.50	0.39		2.36	0.64	27%	0.13	4.85
Sublap	SLAP_PGFG	20	79.7	0.22	0.34	0.39		0.50	0.32	63%	0.29	1.10
Sublap	SLAP_PGHB	2	64.0	(0.59)	0.19	0.05		-0.03	-0.12	379%	0.46	-0.25
Sublap	SLAP_PGKN	63	104.7	1.06	0.49	0.62		2.73	0.73	27%	0.18	3.96
Sublap	SLAP_PGNB	31	84.6	0.29	0.48	0.28		0.92	0.35	38%	0.24	1.50
Sublap	SLAP_PGNC	9	88.3	1.00	0.58	0.63		1.32	0.73	56%	0.50	1.47
Sublap	SLAP_PGNP	118	98.0	0.64	0.06	(0.05)		1.71	0.21	13%	0.14	1.59
Sublap	SLAP_PGP2	151	78.3	0.29	0.14	0.18		1.14	0.20	18%	0.10	2.00
Sublap	SLAP_PGSB	266	80.1	0.34	0.24	0.20		1.04	0.26	25%	0.07	3.71
Sublap	SLAP_PGSF	45	62.8	(0.22)	(0.18)	0.01		0.30	-0.13	-44%	0.10	-1.35
Sublap	SLAP_PGSI	155	98.9	1.00	0.46	0.41		1.90	0.62	33%	0.13	4.82
Sublap	SLAP_PGST	59	93.6	0.79	0.34	0.43		1.97	0.52	26%	0.21	2.47
Sublap	SLAP_PGZP	45	97.5	0.75	0.86	0.51		2.16	0.71	33%	0.21	3.30
AC Propensity	Highest	0										
AC Propensity	High	473	95.0	0.87	0.41	0.32		2.36	0.53	23%	0.08	6.78
AC Propensity	Medium	467	89.9	0.60	0.39	0.35		1.35	0.45	33%	0.06	7.56
AC Propensity	Low	249	84.9	0.26	0.13	0.12		0.78	0.17	22%	0.06	2.63
AC Propensity	Lowest	0										
Electric Vehicle	EV	0										
Electric Vehicle	No EV	0										
TOU Automation	Y	0										
TOU Automation	N	0										

Table A- 3: 7/11/2022 17:00 – 19:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Average Performance: Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	1,441	91.4	0.91	0.55	0.38		1.63	0.61	38%	0.04	14.99
Device brand	ecobee	839	91.9	0.89	0.45	0.32		1.64	0.55	34%	0.05	10.58
Device brand	Emerson	56	93.0	1.06	0.79	0.69		1.96	0.85	43%	0.21	4.14
Device brand	Nest	546	90.5	0.93	0.66	0.43		1.56	0.67	43%	0.07	9.87
Device brand	Honeywell	0										
Number of thermostats	1	1,143	91.2	0.83	0.47	0.30		1.64	0.53	32%	0.04	12.34
Number of thermostats	2	262	92.2	1.19	0.91	0.64		1.54	0.91	59%	0.11	8.12
Number of thermostats	3+ thermostats	35	91.3	1.65	0.57	0.91		1.86	1.04	56%	0.37	2.82
Low income	N	1,255	90.3	0.88	0.53	0.35		1.51	0.59	39%	0.04	13.33
Low income	Y	186	98.6	1.13	0.67	0.53		2.42	0.78	32%	0.11	7.18
Solar	No solar	892	89.5	0.77	0.47	0.30		2.07	0.51	25%	0.05	10.73
Solar	Solar	488	95.2	1.28	0.72	0.54		1.08	0.84	78%	0.08	10.77
Sublap	SLAP_PGCC	24	72.6	(0.20)	(0.15)	0.05		0.55	-0.10	-18%	0.32	-0.31
Sublap	SLAP_PGEB	342	92.2	0.79	0.47	0.36		1.36	0.54	40%	0.09	6.28
Sublap	SLAP_PGF1	125	103.9	1.36	0.96	0.53		2.52	0.95	38%	0.13	7.07
Sublap	SLAP_PGFG	24	80.3	0.88	0.70	1.06		1.36	0.88	65%	0.34	2.60
Sublap	SLAP_PGHB	1	76.0	0.13	0.03	0.03		0.74	0.06	9%	0.43	0.15
Sublap	SLAP_PGKN	65	102.7	1.77	0.70	0.54		2.13	1.01	47%	0.18	5.52
Sublap	SLAP_PGNB	34	89.7	0.80	0.27	0.41		1.24	0.49	40%	0.31	1.59
Sublap	SLAP_PGNC	7	96.0	1.84	0.95	0.42		3.32	1.07	32%	0.57	1.87
Sublap	SLAP_PGNP	109	100.8	1.14	0.65	0.40		2.18	0.73	33%	0.15	4.81
Sublap	SLAP_PGP2	140	82.5	0.91	0.58	0.31		1.46	0.60	41%	0.14	4.36
Sublap	SLAP_PGSB	259	85.0	0.65	0.35	0.23		1.28	0.41	32%	0.09	4.73
Sublap	SLAP_PGSF	44	65.2	0.06	0.00	0.07		0.58	0.04	8%	0.14	0.31
Sublap	SLAP_PGSI	143	99.0	1.25	0.72	0.48		2.19	0.81	37%	0.14	5.87
Sublap	SLAP_PGST	54	99.4	1.04	0.94	0.46		1.92	0.81	42%	0.23	3.53
Sublap	SLAP_PGZP	37	85.8	0.44	0.37	0.30		1.05	0.37	35%	0.25	1.47
AC Propensity	Highest	0										
AC Propensity	High	451	96.2	1.41	0.79	0.56		2.72	0.92	34%	0.09	10.50
AC Propensity	Medium	438	92.8	0.96	0.59	0.37		1.53	0.64	42%	0.07	8.99
AC Propensity	Low	253	87.4	0.44	0.27	0.16		0.82	0.29	35%	0.08	3.66
AC Propensity	Lowest	0										
Electric Vehicle	EV	0										
Electric Vehicle	No EV	0										
TOU Automation	Y	0										
TOU Automation	N	0										

Table A- 4: 7/16/2022 19:00 – 21:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Average Performance: Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	1,584	88.7	0.72	0.40	0.19		2.14	0.43	20%	0.04	11.31
Device brand	ecobee	935	89.8	0.74	0.38	0.16		2.33	0.43	18%	0.05	8.66
Device brand	Emerson	66	89.4	0.27	0.18	0.10		1.93	0.18	9%	0.18	1.02
Device brand	Nest	583	86.8	0.72	0.45	0.24		1.86	0.47	25%	0.06	7.33
Device brand	Honeywell	0										
Number of thermostats	1	1,262	88.6	0.63	0.34	0.15		2.06	0.37	18%	0.04	9.28
Number of thermostats	2	284	89.7	1.03	0.61	0.31		2.42	0.65	27%	0.11	6.00
Number of thermostats	3+ thermostats	38	82.8	1.21	0.61	0.50		2.76	0.77	28%	0.33	2.31
Low income	N	1,370	87.2	0.69	0.40	0.19		2.00	0.42	21%	0.04	10.23
Low income	Y	214	97.9	0.91	0.40	0.18		3.03	0.50	16%	0.10	4.89
Solar	No solar	998	86.6	0.62	0.34	0.15		1.99	0.37	19%	0.04	8.57
Solar	Solar	525	93.1	0.97	0.54	0.28		2.58	0.60	23%	0.08	7.72
Sublap	SLAP_PGCC	17	67.6	0.24	0.30	0.28		1.12	0.27	24%	0.30	0.91
Sublap	SLAP_PGEB	382	87.8	0.61	0.31	0.14		1.89	0.35	19%	0.08	4.45
Sublap	SLAP_PGF1	143	105.0	1.18	0.58	0.37		3.33	0.71	21%	0.13	5.46
Sublap	SLAP_PGFG	30	82.3	0.51	0.58	0.09		1.83	0.39	21%	0.26	1.49
Sublap	SLAP_PGHB	3	63.7	0.72	0.27	(0.17)		0.81	0.27	33%	0.53	0.52
Sublap	SLAP_PGKN	58	104.3	0.64	0.11	0.04		3.16	0.26	8%	0.20	1.32
Sublap	SLAP_PGNB	31	85.4	0.53	0.48	0.38		1.44	0.46	32%	0.27	1.75
Sublap	SLAP_PGNC	2	89.3	0.18	0.91	(0.57)		2.24	0.18	8%	1.01	0.18
Sublap	SLAP_PGNP	117	100.5	0.55	0.43	0.20		2.56	0.39	15%	0.14	2.71
Sublap	SLAP_PGP2	157	77.4	0.48	0.29	0.07		1.63	0.28	17%	0.12	2.27
Sublap	SLAP_PGSB	279	78.6	0.52	0.30	0.22		1.47	0.35	24%	0.08	4.31
Sublap	SLAP_PGSF	43	62.2	0.07	(0.11)	(0.08)		0.68	-0.04	-5%	0.14	-0.27
Sublap	SLAP_PGSI	165	98.6	1.23	0.55	0.18		3.07	0.65	21%	0.14	4.78
Sublap	SLAP_PGST	62	98.8	1.37	0.95	0.48		2.84	0.93	33%	0.23	4.11
Sublap	SLAP_PGZP	49	86.8	0.95	0.54	0.30		2.46	0.60	24%	0.20	2.97
AC Propensity	Highest	0										
AC Propensity	High	550	94.7	1.18	0.68	0.32		3.36	0.73	22%	0.08	9.20
AC Propensity	Medium	474	88.4	0.63	0.36	0.21		1.86	0.40	22%	0.07	6.00
AC Propensity	Low	242	83.3	0.28	0.15	0.04		1.11	0.16	14%	0.08	2.05
AC Propensity	Lowest	0										
Electric Vehicle	EV	0										
Electric Vehicle	No EV	0										
TOU Automation	Y	0										
TOU Automation	N	0										

Table A- 5: 7/18/2022 19:00 - 21:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts				Average Performance				
				Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	1,622	85.6	0.66	0.39	0.27		2.07	0.44	21%	0.04	12.37
Device brand	ecobee	947	86.2	0.56	0.31	0.24		2.20	0.37	17%	0.05	8.03
Device brand	Emerson	68	85.8	0.60	0.55	0.26		2.11	0.47	22%	0.17	2.77
Device brand	Nest	607	84.6	0.82	0.50	0.32		1.87	0.55	29%	0.06	9.23
Device brand	Honeywell	0										
Number of thermostats	1	1,302	85.6	0.63	0.39	0.27		2.01	0.43	21%	0.04	11.46
Number of thermostats	2	278	85.3	0.85	0.43	0.25		2.31	0.51	22%	0.10	4.99
Number of thermostats	3+ thermostats	42	86.1	0.55	0.32	0.32		2.57	0.40	15%	0.31	1.28
Low income	N	1,391	84.3	0.66	0.40	0.28		1.99	0.45	22%	0.04	11.58
Low income	Y	231	93.5	0.72	0.35	0.16		2.58	0.41	16%	0.09	4.48
Solar	No solar	1,036	84.1	0.56	0.34	0.20		1.92	0.37	19%	0.04	9.15
Solar	Solar	529	88.7	0.87	0.51	0.41		2.46	0.60	24%	0.07	8.32
Sublap	SLAP_PGCC	21	69.0	0.30	(0.07)	(0.32)		1.04	-0.03	-3%	0.28	-0.10
Sublap	SLAP_PGEB	390	84.4	0.67	0.39	0.17		1.92	0.41	21%	0.07	5.52
Sublap	SLAP_PGF1	139	97.7	0.67	0.39	0.16		2.83	0.41	14%	0.13	3.21
Sublap	SLAP_PGFG	32	72.7	0.11	(0.12)	(0.28)		1.14	-0.10	-9%	0.25	-0.40
Sublap	SLAP_PGHB	0										
Sublap	SLAP_PGKN	64	101.7	0.96	0.98	0.46		3.27	0.80	25%	0.18	4.50
Sublap	SLAP_PGNB	34	84.8	0.72	0.43	0.27		1.66	0.47	29%	0.25	1.87
Sublap	SLAP_PGNC	9	89.3	1.73	1.32	1.79		2.60	1.61	62%	0.46	3.49
Sublap	SLAP_PGNP	118	94.8	1.00	0.59	0.53		2.38	0.71	30%	0.14	5.20
Sublap	SLAP_PGP2	149	77.1	0.51	0.28	0.24		1.68	0.34	20%	0.11	3.00
Sublap	SLAP_PGSB	298	77.9	0.51	0.33	0.24		1.50	0.36	24%	0.07	4.87
Sublap	SLAP_PGSF	42	62.1	0.12	0.13	0.22		0.85	0.16	18%	0.12	1.29
Sublap	SLAP_PGSI	171	94.6	1.02	0.60	0.49		2.78	0.70	25%	0.12	5.66
Sublap	SLAP_PGST	68	92.2	0.58	0.21	0.41		2.79	0.40	14%	0.20	2.03
Sublap	SLAP_PGZP	52	85.9	0.51	(0.06)	0.22		2.02	0.22	11%	0.19	1.14
AC Propensity	Highest	0										
AC Propensity	High	532	90.8	1.06	0.54	0.43		3.20	0.68	21%	0.08	8.82
AC Propensity	Medium	467	85.7	0.60	0.30	0.22		1.85	0.37	20%	0.06	5.91
AC Propensity	Low	292	81.0	0.40	0.30	0.16		1.16	0.29	25%	0.07	4.37
AC Propensity	Lowest	0										
Electric Vehicle	EV	0										
Electric Vehicle	No EV	0										
TOU Automation	Y	0										
TOU Automation	N	0										

Table A- 6: 7/21/2022 18:00 – 21:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts				Average Performance				
				Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	1,598	84.3	0.53	0.30	0.21	0.13	1.67	0.29	17%	0.03	9.17
Device brand	ecobee	934	85.0	0.47	0.25	0.17	0.14	1.76	0.26	15%	0.04	6.33
Device brand	Emerson	63	85.1	0.29	0.14	0.14	0.10	1.65	0.17	10%	0.16	1.04
Device brand	Nest	601	83.0	0.63	0.39	0.27	0.11	1.52	0.35	23%	0.05	6.69
Device brand	Honeywell	0										
Number of thermostats	1	1,279	84.3	0.51	0.28	0.19	0.08	1.66	0.26	16%	0.03	7.84
Number of thermostats	2	274	84.2	0.59	0.34	0.27	0.32	1.65	0.38	23%	0.09	4.23
Number of thermostats	3+ thermostats	45	83.8	0.67	0.40	0.36	0.57	2.00	0.50	25%	0.25	2.01
Low income	N	1,392	83.0	0.48	0.27	0.22	0.13	1.56	0.28	18%	0.03	8.25
Low income	Y	206	92.9	0.80	0.45	0.12	0.11	2.38	0.37	16%	0.09	4.05
Solar	No solar	1,032	82.4	0.45	0.26	0.16	0.09	1.68	0.24	14%	0.03	6.94
Solar	Solar	508	88.4	0.70	0.39	0.31	0.20	1.81	0.40	22%	0.07	5.90
Sublap	SLAP_PGCC	19	68.4	0.14	0.07	(0.11)	0.19	1.20	0.07	6%	0.30	0.25
Sublap	SLAP_PGEB	385	81.5	0.38	0.27	0.29	0.19	1.36	0.28	21%	0.06	4.56
Sublap	SLAP_PGF1	149	101.0	0.87	0.51	0.36	0.21	2.76	0.49	18%	0.11	4.25
Sublap	SLAP_PGFG	37	72.3	0.23	0.25	0.20	0.04	0.84	0.18	21%	0.20	0.88
Sublap	SLAP_PGHB	1	62.8	(0.18)	(0.29)	0.16	0.01	0.11	-0.07	-65%	0.45	-0.16
Sublap	SLAP_PGKN	68	102.8	0.91	0.51	0.22	0.09	2.96	0.43	15%	0.17	2.62
Sublap	SLAP_PGNB	33	80.3	0.30	0.19	(0.11)	(0.22)	0.94	0.04	4%	0.20	0.20
Sublap	SLAP_PGNC	5	85.5	0.91	0.28	0.40	(0.10)	1.29	0.37	29%	0.55	0.68
Sublap	SLAP_PGNP	125	94.6	0.75	0.45	0.33	0.24	2.30	0.44	19%	0.12	3.61
Sublap	SLAP_PGP2	160	73.4	0.25	0.09	0.08	0.02	1.05	0.11	10%	0.09	1.22
Sublap	SLAP_PGSB	287	74.8	0.21	0.17	0.11	(0.02)	0.97	0.12	12%	0.06	1.89
Sublap	SLAP_PGSF	38	58.9	0.07	(0.02)	0.02	0.08	0.54	0.04	7%	0.10	0.36
Sublap	SLAP_PGSI	166	94.5	1.06	0.49	0.24	0.29	2.54	0.52	21%	0.12	4.29
Sublap	SLAP_PGST	57	92.7	0.89	0.18	0.09	0.17	2.33	0.33	14%	0.20	1.68
Sublap	SLAP_PGZP	33	93.2	0.86	0.51	0.26	0.19	2.55	0.45	18%	0.24	1.89
AC Propensity	Highest	0										
AC Propensity	High	532	90.5	0.81	0.43	0.33	0.23	2.70	0.45	17%	0.07	6.52
AC Propensity	Medium	476	84.5	0.58	0.34	0.24	0.12	1.46	0.32	22%	0.05	5.91
AC Propensity	Low	267	78.6	0.19	0.18	0.13	0.12	0.88	0.15	17%	0.06	2.73
AC Propensity	Lowest	0										
Electric Vehicle	EV	0										
Electric Vehicle	No EV	0										
TOU Automation	Y	0										
TOU Automation	N	0										

Table A- 7: 7/28/2022 17:00 – 20:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Average Performance: Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	3,333	81.4	0.58	0.38	0.27	0.18	1.33	0.35	26%	0.02	15.37
Device brand	ecobee	1,939	82.3	0.56	0.32	0.25	0.15	1.38	0.32	23%	0.03	10.78
Device brand	Emerson	146	83.3	0.58	0.48	0.27	0.37	1.48	0.42	29%	0.11	3.97
Device brand	Nest	1,248	79.8	0.60	0.45	0.30	0.21	1.25	0.39	31%	0.04	10.36
Device brand	Honeywell	0										
Number of thermostats	1	2,729	81.7	0.55	0.38	0.28	0.19	1.35	0.35	26%	0.02	14.62
Number of thermostats	2	537	80.1	0.63	0.35	0.24	0.13	1.19	0.34	28%	0.07	5.09
Number of thermostats	3+ thermostats	67	80.9	1.04	0.47	0.29	0.36	1.83	0.54	29%	0.22	2.44
Low income	N	2,853	79.8	0.55	0.36	0.27	0.18	1.20	0.34	28%	0.02	13.86
Low income	Y	480	91.2	0.75	0.45	0.30	0.19	2.10	0.42	20%	0.06	6.65
Solar	No solar	2,163	80.0	0.49	0.34	0.26	0.16	1.57	0.31	20%	0.02	12.47
Solar	Solar	1,053	84.7	0.80	0.48	0.29	0.22	1.02	0.45	44%	0.05	9.24
Sublap	SLAP_PGCC	39	69.2	0.48	0.32	0.20	(0.01)	1.07	0.25	23%	0.18	1.39
Sublap	SLAP_PGEB	790	73.5	0.32	0.20	0.16	0.12	0.81	0.20	25%	0.04	4.68
Sublap	SLAP_PGF1	284	100.4	1.31	0.89	0.57	0.41	2.50	0.79	32%	0.09	8.70
Sublap	SLAP_PGFG	70	72.0	0.35	0.18	0.34	0.04	1.06	0.23	21%	0.16	1.41
Sublap	SLAP_PGHB	3	62.8	0.27	(1.02)	0.25	0.71	0.96	0.05	5%	0.41	0.13
Sublap	SLAP_PGKN	154	102.5	1.24	0.45	0.40	0.34	2.75	0.61	22%	0.12	5.20
Sublap	SLAP_PGNB	86	75.6	0.12	0.26	0.06	(0.13)	0.71	0.08	11%	0.13	0.58
Sublap	SLAP_PGNC	9	95.3	(0.39)	(0.09)	0.02	0.26	3.14	-0.05	-2%	0.49	-0.10
Sublap	SLAP_PGNP	284	92.6	0.86	0.52	0.33	0.28	1.59	0.49	31%	0.09	5.65
Sublap	SLAP_PGP2	316	70.9	0.29	0.19	0.10	(0.01)	0.81	0.14	17%	0.07	2.16
Sublap	SLAP_PGSB	593	73.2	0.26	0.23	0.22	0.13	0.80	0.21	26%	0.04	4.62
Sublap	SLAP_PGSF	78	60.0	(0.00)	(0.04)	(0.00)	0.03	0.49	-0.01	-1%	0.07	-0.08
Sublap	SLAP_PGSI	330	94.9	1.09	0.81	0.57	0.34	2.28	0.70	31%	0.09	7.73
Sublap	SLAP_PGST	122	89.1	0.88	0.48	0.23	0.27	1.89	0.46	25%	0.15	3.08
Sublap	SLAP_PGZP	82	88.4	0.70	0.47	0.33	0.33	1.74	0.46	26%	0.15	3.05
AC Propensity	Highest	0										
AC Propensity	High	1,092	87.1	0.96	0.60	0.42	0.25	2.16	0.56	26%	0.05	11.20
AC Propensity	Medium	1,048	81.4	0.53	0.36	0.27	0.18	1.17	0.34	29%	0.04	8.76
AC Propensity	Low	558	75.5	0.22	0.16	0.17	0.13	0.68	0.17	25%	0.04	4.15
AC Propensity	Lowest	0										
Electric Vehicle	EV	0										
Electric Vehicle	No EV	0										
TOU Automation	Y	0										
TOU Automation	N	0										

Table A- 8: 8/03/2022 18:00 – 21:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Average Performance: Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	2,835	87.4	0.70	0.40	0.24	0.22	2.00	0.39	20%	0.03	13.13
Device brand	ecobee	1,661	88.3	0.63	0.31	0.19	0.23	2.13	0.34	16%	0.04	8.86
Device brand	Emerson	105	87.4	0.95	0.59	0.36	0.31	2.14	0.55	26%	0.14	3.80
Device brand	Nest	1,069	86.1	0.80	0.52	0.30	0.20	1.77	0.46	26%	0.05	9.16
Device brand	Honeywell	0										
Number of thermostats	1	2,260	87.3	0.63	0.35	0.18	0.18	1.91	0.34	18%	0.03	10.72
Number of thermostats	2	519	88.4	1.06	0.61	0.49	0.41	2.29	0.64	28%	0.08	7.66
Number of thermostats	3+ thermostats	56	85.8	0.44	0.59	0.41	0.23	2.74	0.42	15%	0.29	1.42
Low income	N	2,451	86.4	0.69	0.42	0.25	0.23	1.90	0.40	21%	0.03	12.35
Low income	Y	382	94.0	0.77	0.30	0.14	0.16	2.64	0.34	13%	0.08	4.41
Solar	No solar	1,739	86.0	0.63	0.36	0.20	0.18	1.95	0.34	18%	0.03	9.98
Solar	Solar	956	90.6	0.90	0.48	0.32	0.29	2.26	0.50	22%	0.06	8.52
Sublap	SLAP_PGCC	30	72.3	(0.20)	(0.55)	(0.36)	(0.05)	1.43	-0.29	-20%	0.27	-1.08
Sublap	SLAP_PGEB	703	85.3	0.66	0.42	0.28	0.29	1.79	0.41	23%	0.06	6.58
Sublap	SLAP_PGF1	257	101.8	0.93	0.39	0.21	0.23	2.93	0.44	15%	0.10	4.43
Sublap	SLAP_PGFG	60	79.5	0.74	0.49	0.46	0.30	1.67	0.50	30%	0.23	2.20
Sublap	SLAP_PGHB	6	64.8	(0.04)	(0.25)	(0.33)	(0.13)	0.31	-0.19	-60%	0.29	-0.64
Sublap	SLAP_PGKN	119	101.3	1.17	0.82	0.51	0.40	3.00	0.73	24%	0.14	5.14
Sublap	SLAP_PGNB	65	84.9	0.40	0.10	(0.04)	0.03	1.11	0.12	11%	0.20	0.59
Sublap	SLAP_PGNC	7	90.5	(0.69)	(0.28)	0.36	0.44	1.75	-0.04	-3%	0.58	-0.08
Sublap	SLAP_PGNP	213	96.9	1.00	0.59	0.38	0.28	2.68	0.56	21%	0.11	5.09
Sublap	SLAP_PGP2	258	78.5	0.40	0.18	(0.04)	(0.02)	1.21	0.13	11%	0.10	1.31
Sublap	SLAP_PGSB	505	79.8	0.44	0.22	0.12	0.15	1.26	0.23	19%	0.06	3.76
Sublap	SLAP_PGSF	58	62.9	0.32	0.29	0.23	0.28	0.81	0.28	34%	0.12	2.27
Sublap	SLAP_PGSI	290	97.0	1.06	0.71	0.42	0.37	3.04	0.64	21%	0.10	6.19
Sublap	SLAP_PGST	107	92.7	1.04	0.55	0.40	0.26	2.66	0.56	21%	0.17	3.29
Sublap	SLAP_PGZP	80	84.6	0.82	0.33	0.19	0.01	2.51	0.34	13%	0.18	1.94
AC Propensity	Highest	0										
AC Propensity	High	904	92.6	1.18	0.65	0.45	0.38	3.28	0.67	20%	0.06	10.40
AC Propensity	Medium	856	88.1	0.71	0.42	0.19	0.16	1.77	0.37	21%	0.05	7.14
AC Propensity	Low	506	83.0	0.23	0.14	0.08	0.13	1.07	0.14	13%	0.06	2.55
AC Propensity	Lowest	0										
Electric Vehicle	EV	0										
Electric Vehicle	No EV	0										
TOU Automation	Y	0										
TOU Automation	N	0										

Table A- 9: 8/04/2022 19:00 – 21:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Average Performance: Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	3,617	80.8	0.63	0.36	0.22		1.87	0.40	21%	0.03	15.90
Device brand	ecobee	2,014	82.0	0.62	0.33	0.23		2.02	0.39	19%	0.03	11.63
Device brand	Emerson	140	80.9	0.53	0.44	0.39		1.82	0.45	25%	0.12	3.80
Device brand	Nest	1,463	79.2	0.65	0.39	0.19		1.68	0.41	24%	0.04	10.19
Device brand	Honeywell	0										
Number of thermostats	1	2,904	81.0	0.58	0.32	0.19		1.81	0.36	20%	0.03	13.61
Number of thermostats	2	640	79.9	0.79	0.49	0.35		2.12	0.54	26%	0.07	7.64
Number of thermostats	3+ thermostats	73	80.5	1.01	0.69	0.37		2.43	0.69	29%	0.24	2.87
Low income	N	3,113	79.5	0.60	0.36	0.23		1.77	0.39	22%	0.03	14.46
Low income	Y	504	89.0	0.80	0.36	0.17		2.50	0.44	18%	0.07	6.65
Solar	No solar	2,324	79.4	0.57	0.33	0.22		1.72	0.37	21%	0.03	13.12
Solar	Solar	1,163	83.8	0.79	0.44	0.22		2.31	0.48	21%	0.05	9.26
Sublap	SLAP_PGCC	39	68.9	0.62	0.51	0.15		1.26	0.43	34%	0.22	1.98
Sublap	SLAP_PGEB	830	74.1	0.47	0.28	0.17		1.35	0.30	22%	0.05	5.72
Sublap	SLAP_PGF1	335	98.4	1.15	0.53	0.31		3.20	0.66	21%	0.09	7.38
Sublap	SLAP_PGFG	58	66.3	0.26	0.03	0.16		1.14	0.15	13%	0.18	0.84
Sublap	SLAP_PGHB	1	64.7	0.21	0.03	(0.07)		0.03	0.05	159%	0.57	0.10
Sublap	SLAP_PGKN	170	97.7	0.97	0.44	0.08		3.18	0.50	16%	0.12	3.98
Sublap	SLAP_PGNB	87	72.4	0.57	0.33	0.36		1.26	0.42	33%	0.15	2.72
Sublap	SLAP_PGNC	16	83.4	0.70	0.65	(0.01)		1.93	0.45	23%	0.42	1.07
Sublap	SLAP_PGNP	306	89.7	0.79	0.44	0.36		2.38	0.53	22%	0.09	5.76
Sublap	SLAP_PGP2	346	73.0	0.57	0.34	0.27		1.56	0.40	25%	0.08	5.23
Sublap	SLAP_PGSB	657	74.5	0.40	0.25	0.09		1.27	0.25	19%	0.05	4.95
Sublap	SLAP_PGSF	100	63.9	0.17	0.08	(0.01)		0.75	0.08	10%	0.09	0.88
Sublap	SLAP_PGSI	370	91.8	0.97	0.65	0.52		2.72	0.71	26%	0.09	7.63
Sublap	SLAP_PGST	120	85.4	0.62	0.24	0.07		2.24	0.31	14%	0.15	1.99
Sublap	SLAP_PGZP	98	81.5	0.82	0.73	0.34		2.22	0.63	28%	0.16	3.95
AC Propensity	Highest	0										
AC Propensity	High	1,204	85.1	0.97	0.55	0.28		2.77	0.60	22%	0.05	11.13
AC Propensity	Medium	1,119	81.0	0.59	0.35	0.25		1.74	0.40	23%	0.04	9.26
AC Propensity	Low	603	76.3	0.38	0.25	0.16		1.14	0.26	23%	0.05	5.65
AC Propensity	Lowest	0										
Electric Vehicle	EV	0										
Electric Vehicle	No EV	0										
TOU Automation	Y	0										
TOU Automation	N	0										

Table A- 10: 08/15/2022 17:00 – 20:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Average Performance: Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	3,852	91.7	0.40	0.25	0.21	0.13	1.92	0.25	13%	0.03	9.61
Device brand	ecobee	2,074	92.4	0.04	(0.02)	0.02	0.01	1.99	0.01	1%	0.03	0.41
Device brand	Emerson	150	92.2	0.67	0.57	0.59	0.25	1.90	0.52	27%	0.13	4.13
Device brand	Nest	1,628	90.7	0.84	0.58	0.43	0.28	1.83	0.53	29%	0.04	12.84
Device brand	Honeywell	0										
Number of thermostats	1	3,064	91.6	0.39	0.24	0.20	0.14	1.91	0.24	13%	0.03	8.88
Number of thermostats	2	701	92.3	0.43	0.33	0.27	0.12	1.95	0.29	15%	0.07	3.96
Number of thermostats	3+ thermostats	87	89.1	0.39	0.22	0.10	0.03	1.96	0.19	9%	0.24	0.79
Low income	N	3,296	90.6	0.40	0.27	0.20	0.11	1.79	0.24	14%	0.03	8.65
Low income	Y	556	98.0	0.39	0.15	0.30	0.27	2.67	0.28	10%	0.07	4.26
Solar	No solar	2,455	90.4	0.38	0.25	0.21	0.12	2.12	0.24	11%	0.03	8.09
Solar	Solar	1,259	94.5	0.48	0.30	0.24	0.15	1.71	0.29	17%	0.05	5.67
Sublap	SLAP_PGCC	54	74.0	(0.12)	(0.19)	(0.03)	(0.15)	0.53	-0.12	-23%	0.21	-0.59
Sublap	SLAP_PGEB	908	89.3	0.41	0.28	0.19	0.12	1.88	0.25	13%	0.06	4.49
Sublap	SLAP_PGF1	341	102.2	0.43	0.29	0.19	0.08	2.48	0.25	10%	0.09	2.89
Sublap	SLAP_PGFG	69	90.3	0.27	0.12	0.28	(0.15)	1.75	0.13	7%	0.19	0.67
Sublap	SLAP_PGHB	4	62.8	(1.01)	(0.20)	(0.89)	0.03	0.99	-0.52	-52%	0.38	-1.38
Sublap	SLAP_PGKN	176	101.8	0.83	0.47	0.40	0.49	2.68	0.55	20%	0.11	4.92
Sublap	SLAP_PGNB	85	93.0	(0.00)	(0.13)	(0.17)	0.02	1.54	-0.07	-5%	0.19	-0.37
Sublap	SLAP_PGNC	14	89.7	0.46	0.74	0.25	0.07	2.15	0.38	18%	0.46	0.83
Sublap	SLAP_PGNP	294	99.9	0.39	0.18	0.11	0.27	2.40	0.24	10%	0.10	2.44
Sublap	SLAP_PGP2	372	85.7	0.36	0.26	0.25	0.05	1.68	0.23	14%	0.09	2.63
Sublap	SLAP_PGSB	689	87.5	0.33	0.17	0.16	0.07	1.42	0.18	13%	0.05	3.29
Sublap	SLAP_PGSF	99	68.4	(0.09)	(0.09)	(0.11)	(0.18)	0.52	-0.12	-22%	0.09	-1.30
Sublap	SLAP_PGSI	385	98.7	0.50	0.39	0.42	0.22	2.38	0.38	16%	0.09	4.35
Sublap	SLAP_PGST	153	97.1	0.70	0.37	0.46	0.36	2.45	0.47	19%	0.14	3.33
Sublap	SLAP_PGZP	106	87.0	0.50	0.30	0.17	0.03	2.00	0.25	12%	0.15	1.61
AC Propensity	Highest	0										
AC Propensity	High	1,306	95.4	0.65	0.45	0.36	0.28	2.98	0.43	15%	0.05	8.08
AC Propensity	Medium	1,144	92.4	0.45	0.23	0.21	0.10	1.74	0.25	14%	0.05	5.42
AC Propensity	Low	634	88.6	0.16	0.15	0.14	0.01	1.09	0.12	11%	0.05	2.23
AC Propensity	Lowest	0										
Electric Vehicle	EV	0										
Electric Vehicle	No EV	0										
TOU Automation	Y	0										
TOU Automation	N	0										

Table A- 11: 08/16/2022 20:00 – 21:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Average Performance: Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	19,377	89.7	0.73	0.34			2.48	0.54	22%	0.01	64.96
Device brand	ecobee	10,421	90.4	0.78	0.36			2.64	0.57	22%	0.01	51.22
Device brand	Emerson	733	89.7	0.71	0.36			2.43	0.53	22%	0.04	13.25
Device brand	Nest	8,223	88.8	0.68	0.31			2.28	0.50	22%	0.01	38.01
Device brand	Honeywell	0										
Number of thermostats	1	15,582	89.7	0.67	0.30			2.34	0.48	21%	0.01	56.08
Number of thermostats	2	3,363	89.8	1.00	0.54			2.99	0.77	26%	0.02	32.14
Number of thermostats	3+ thermostats	432	88.1	1.00	0.51			3.48	0.75	22%	0.08	9.61
Low income	N	16,558	88.6	0.72	0.35			2.40	0.53	22%	0.01	59.48
Low income	Y	2,819	96.2	0.80	0.33			2.93	0.56	19%	0.02	26.53
Solar	No solar	12,502	88.6	0.64	0.27			2.20	0.46	21%	0.01	49.78
Solar	Solar	6,163	92.4	0.95	0.49			3.13	0.72	23%	0.02	42.03
Sublap	SLAP_PGCC	241	73.5	0.58	0.45			1.69	0.52	30%	0.07	7.75
Sublap	SLAP_PGEB	4,579	84.8	0.65	0.26			2.45	0.45	18%	0.02	26.42
Sublap	SLAP_PGF1	1,736	102.9	1.13	0.57			3.25	0.85	26%	0.03	29.31
Sublap	SLAP_PGFG	380	85.9	0.56	0.16			2.17	0.36	17%	0.06	6.12
Sublap	SLAP_PGHB	16	63.0	0.10	(0.19)			0.60	-0.05	-8%	0.16	-0.29
Sublap	SLAP_PGKN	896	103.0	1.00	0.46			3.23	0.73	23%	0.04	19.12
Sublap	SLAP_PGNB	450	89.7	0.51	0.19			2.04	0.35	17%	0.05	6.44
Sublap	SLAP_PGNC	74	91.3	0.67	0.36			2.54	0.51	20%	0.14	3.62
Sublap	SLAP_PGNP	1,568	99.5	0.97	0.52			3.01	0.74	25%	0.03	24.12
Sublap	SLAP_PGP2	1,842	83.0	0.46	0.13			2.04	0.30	15%	0.03	11.22
Sublap	SLAP_PGSB	3,471	85.7	0.52	0.25			1.86	0.39	21%	0.02	22.84
Sublap	SLAP_PGSF	462	67.5	0.07	0.01			0.79	0.04	5%	0.03	1.21
Sublap	SLAP_PGSI	1,947	96.3	1.27	0.77			3.39	1.02	30%	0.03	33.50
Sublap	SLAP_PGST	720	97.9	1.06	0.58			3.02	0.82	27%	0.05	16.76
Sublap	SLAP_PGZP	508	83.7	0.73	0.43			2.43	0.58	24%	0.05	11.15
AC Propensity	Highest	0										
AC Propensity	High	6,470	93.3	1.18	0.55			3.68	0.86	23%	0.02	49.55
AC Propensity	Medium	5,842	90.2	0.67	0.29			2.27	0.48	21%	0.01	33.79
AC Propensity	Low	3,251	86.6	0.34	0.15			1.51	0.24	16%	0.02	15.62
AC Propensity	Lowest	0										
Electric Vehicle	EV	0										
Electric Vehicle	No EV	0										
TOU Automation	Y	0										
TOU Automation	N	0										

Table A- 12: 08/17/2022 18:00 – 21:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Average Performance: Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	15,650	85.7	0.57	0.41	0.30	0.18	1.89	0.36	19%	0.02	15.26
Device brand	ecobee	8,359	86.6	0.49	0.35	0.24	0.18	1.97	0.32	16%	0.03	9.89
Device brand	Emerson	585	86.1	0.63	0.52	0.46	0.17	2.00	0.44	22%	0.12	3.84
Device brand	Nest	6,706	84.5	0.67	0.47	0.35	0.18	1.78	0.41	23%	0.04	11.14
Device brand	Honeywell	0										
Number of thermostats	1	12,614	85.8	0.57	0.39	0.29	0.18	1.85	0.36	19%	0.03	14.24
Number of thermostats	2	2,692	85.4	0.56	0.51	0.39	0.19	2.02	0.41	20%	0.07	6.24
Number of thermostats	3+ thermostats	344	85.2	0.56	0.28	0.00	0.06	2.52	0.23	9%	0.22	1.05
Low income	N	13,360	84.4	0.54	0.41	0.30	0.19	1.79	0.36	20%	0.03	14.10
Low income	Y	2,290	93.2	0.70	0.38	0.27	0.12	2.48	0.37	15%	0.06	5.86
Solar	No solar	10,144	84.5	0.49	0.34	0.26	0.18	1.83	0.32	17%	0.03	11.78
Solar	Solar	4,933	88.6	0.73	0.56	0.38	0.19	2.14	0.47	22%	0.05	9.65
Sublap	SLAP_PGCC	187	74.1	0.22	0.30	0.17	0.03	1.05	0.18	17%	0.17	1.07
Sublap	SLAP_PGEB	3,700	82.2	0.57	0.43	0.28	0.19	1.72	0.37	21%	0.05	7.46
Sublap	SLAP_PGF1	1,403	101.8	1.01	0.66	0.52	0.43	2.93	0.66	22%	0.09	7.58
Sublap	SLAP_PGFG	315	76.0	0.28	0.24	0.09	0.16	1.47	0.19	13%	0.17	1.16
Sublap	SLAP_PGHB	12	65.0	0.11	0.20	0.06	0.80	0.67	0.29	44%	0.31	0.95
Sublap	SLAP_PGKN	728	105.0	0.93	0.46	0.25	0.19	3.21	0.46	14%	0.12	3.87
Sublap	SLAP_PGNB	365	82.2	0.25	0.07	(0.03)	(0.06)	1.24	0.06	5%	0.15	0.36
Sublap	SLAP_PGNC	60	93.6	0.41	0.65	0.72	0.10	2.44	0.47	19%	0.41	1.16
Sublap	SLAP_PGNP	1,288	91.6	0.69	0.46	0.34	0.22	2.13	0.43	20%	0.09	4.62
Sublap	SLAP_PGP2	1,482	77.9	0.52	0.33	0.23	0.13	1.53	0.30	20%	0.07	4.44
Sublap	SLAP_PGSB	2,806	79.9	0.33	0.26	0.27	0.12	1.35	0.25	18%	0.05	5.35
Sublap	SLAP_PGSF	365	63.0	(0.08)	(0.02)	0.10	0.12	0.63	0.03	5%	0.08	0.39
Sublap	SLAP_PGSI	1,578	91.4	0.69	0.55	0.46	0.22	2.37	0.48	20%	0.09	5.43
Sublap	SLAP_PGST	570	90.0	0.54	0.40	0.21	0.05	1.91	0.30	16%	0.14	2.15
Sublap	SLAP_PGZP	405	88.1	0.82	0.60	0.30	0.17	2.51	0.47	19%	0.15	3.06
AC Propensity	Highest	0										
AC Propensity	High	5,212	90.1	0.86	0.58	0.37	0.20	2.82	0.50	18%	0.05	9.97
AC Propensity	Medium	4,738	86.0	0.60	0.44	0.32	0.22	1.77	0.40	22%	0.04	9.74
AC Propensity	Low	2,636	81.7	0.29	0.26	0.27	0.15	1.17	0.24	21%	0.04	5.62
AC Propensity	Lowest	0										
Electric Vehicle	EV	0										
Electric Vehicle	No EV	0										
TOU Automation	Y	0										
TOU Automation	N	0										

Table A- 13: 08/21/2022 19:00 – 21:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts				Average Performance				
				Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	3,941	79.0	0.68	0.35	0.22		1.90	0.42	22%	0.03	15.94
Device brand	ecobee	2,097	80.0	0.83	0.43	0.28		2.09	0.51	24%	0.04	14.58
Device brand	Emerson	143	79.5	0.47	0.20	0.03		1.80	0.23	13%	0.12	1.86
Device brand	Nest	1,701	77.7	0.49	0.27	0.16		1.67	0.31	18%	0.04	7.49
Device brand	Honeywell	0										
Number of thermostats	1	3,160	79.2	0.65	0.35	0.19		1.83	0.40	22%	0.03	14.61
Number of thermostats	2	674	77.9	0.81	0.38	0.34		2.12	0.51	24%	0.08	6.79
Number of thermostats	3+ thermostats	107	78.5	0.47	0.24	0.12		2.70	0.28	10%	0.22	1.26
Low income	N	3,385	77.5	0.65	0.34	0.21		1.81	0.40	22%	0.03	14.25
Low income	Y	555	88.2	0.81	0.46	0.24		2.52	0.51	20%	0.07	7.33
Solar	No solar	2,566	77.7	0.56	0.31	0.20		1.72	0.36	21%	0.03	12.24
Solar	Solar	1,239	82.1	0.96	0.48	0.28		2.41	0.58	24%	0.05	10.73
Sublap	SLAP_PGCC	49	66.6	(0.21)	(0.20)	(0.07)		0.86	-0.16	-18%	0.22	-0.73
Sublap	SLAP_PGEB	935	70.8	0.40	0.19	0.18		1.45	0.26	18%	0.05	4.84
Sublap	SLAP_PGF1	355	98.4	1.27	0.66	0.40		3.22	0.77	24%	0.09	8.48
Sublap	SLAP_PGFG	83	65.0	0.09	(0.21)	(0.11)		0.99	-0.08	-8%	0.16	-0.46
Sublap	SLAP_PGHB	1	63.0	0.26	0.63	0.36		0.55	0.42	76%	0.67	0.62
Sublap	SLAP_PGKN	176	103.0	1.12	0.71	0.32		3.38	0.72	21%	0.13	5.69
Sublap	SLAP_PGNB	78	72.5	0.45	0.42	0.44		1.37	0.44	32%	0.18	2.38
Sublap	SLAP_PGNC	17	81.8	0.80	0.31	(0.60)		2.08	0.17	8%	0.45	0.37
Sublap	SLAP_PGNP	302	85.6	0.94	0.44	0.28		2.18	0.55	25%	0.10	5.63
Sublap	SLAP_PGP2	390	72.1	0.41	0.19	0.17		1.44	0.26	18%	0.08	3.24
Sublap	SLAP_PGSB	725	74.3	0.41	0.24	0.18		1.33	0.27	21%	0.05	5.10
Sublap	SLAP_PGSF	90	62.2	0.22	0.15	0.09		0.84	0.15	18%	0.10	1.58
Sublap	SLAP_PGSI	410	87.5	1.33	0.81	0.40		2.80	0.85	30%	0.09	9.29
Sublap	SLAP_PGST	150	81.9	1.08	0.51	0.15		2.54	0.58	23%	0.16	3.60
Sublap	SLAP_PGZP	98	83.8	0.90	0.50	0.21		2.21	0.54	24%	0.17	3.20
AC Propensity	Highest	0										
AC Propensity	High	1,322	83.3	1.06	0.57	0.30		2.84	0.64	23%	0.06	11.62
AC Propensity	Medium	1,167	78.5	0.62	0.31	0.18		1.68	0.37	22%	0.04	8.29
AC Propensity	Low	671	74.9	0.28	0.13	0.18		1.13	0.19	17%	0.05	3.95
AC Propensity	Lowest	0										
Electric Vehicle	EV	0										
Electric Vehicle	No EV	0										
TOU Automation	Y	0										
TOU Automation	N	0										

Table A- 14: 09/04/2022 18:00 – 21:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts				Average Performance				
				Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	4,311	94.5	1.05	0.62	0.39	0.26	2.43	0.58	24%	0.03	22.28
Device brand	ecobee	2,212	95.1	1.18	0.67	0.38	0.23	2.61	0.62	24%	0.04	17.33
Device brand	Emerson	156	94.9	0.58	0.35	0.37	0.36	2.35	0.41	18%	0.13	3.25
Device brand	Nest	1,943	93.9	0.93	0.58	0.41	0.29	2.24	0.55	25%	0.04	13.74
Device brand	Honeywell	0										
Number of thermostats	1	3,433	94.5	0.96	0.53	0.34	0.21	2.34	0.51	22%	0.03	18.61
Number of thermostats	2	773	94.8	1.40	0.96	0.55	0.41	2.74	0.83	30%	0.07	11.30
Number of thermostats	3+ thermostats	105	92.5	1.35	1.12	1.00	0.91	3.28	1.10	33%	0.24	4.60
Low income	N	3,655	93.7	1.03	0.63	0.40	0.27	2.33	0.58	25%	0.03	20.51
Low income	Y	656	99.3	1.16	0.56	0.35	0.18	3.00	0.57	19%	0.07	8.71
Solar	No solar	2,791	93.6	0.90	0.54	0.36	0.23	2.29	0.51	22%	0.03	17.21
Solar	Solar	1,367	96.5	1.41	0.82	0.47	0.32	2.86	0.76	27%	0.05	14.23
Sublap	SLAP_PGCC	58	81.1	1.11	0.78	0.65	0.42	2.07	0.74	36%	0.22	3.43
Sublap	SLAP_PGEB	1,017	90.3	0.94	0.61	0.36	0.22	2.29	0.53	23%	0.05	9.72
Sublap	SLAP_PGF1	384	104.3	1.39	0.71	0.48	0.32	3.27	0.72	22%	0.09	8.21
Sublap	SLAP_PGFG	81	96.3	0.97	0.33	0.44	0.45	2.16	0.55	25%	0.18	2.97
Sublap	SLAP_PGHB	4	66.8	0.05	(0.14)	(0.30)	0.14	0.75	-0.06	-8%	0.53	-0.12
Sublap	SLAP_PGKN	207	104.3	1.47	0.87	0.42	0.30	3.30	0.76	23%	0.12	6.57
Sublap	SLAP_PGNB	100	98.0	0.98	0.77	0.49	0.33	2.21	0.64	29%	0.17	3.74
Sublap	SLAP_PGNC	17	92.0	1.37	1.40	0.96	0.61	2.51	1.08	43%	0.45	2.42
Sublap	SLAP_PGNP	338	100.7	1.29	0.57	0.23	0.23	2.71	0.58	22%	0.10	6.12
Sublap	SLAP_PGP2	405	91.8	0.98	0.54	0.39	0.22	2.14	0.53	25%	0.08	6.45
Sublap	SLAP_PGSB	758	91.0	0.72	0.44	0.30	0.20	1.85	0.41	22%	0.06	7.38
Sublap	SLAP_PGSF	107	78.8	0.12	0.16	0.23	0.19	0.90	0.17	19%	0.09	1.97
Sublap	SLAP_PGSI	435	97.4	1.46	0.85	0.52	0.34	2.91	0.79	27%	0.09	8.55
Sublap	SLAP_PGST	169	99.8	1.24	1.02	0.69	0.31	2.95	0.82	28%	0.14	5.65
Sublap	SLAP_PGZP	113	96.8	1.38	0.63	0.45	0.33	3.16	0.70	22%	0.16	4.36
AC Propensity	Highest	0										
AC Propensity	High	1,466	96.8	1.57	0.89	0.58	0.37	3.56	0.85	24%	0.05	15.77
AC Propensity	Medium	1,286	94.8	0.98	0.60	0.36	0.24	2.24	0.54	24%	0.05	12.08
AC Propensity	Low	697	92.6	0.57	0.27	0.16	0.16	1.51	0.29	19%	0.05	5.66
AC Propensity	Lowest	0										
Electric Vehicle	EV	0										
Electric Vehicle	No EV	0										
TOU Automation	Y	0										
TOU Automation	N	0										

Table A- 15: 9/5/2022 21:00 – 21:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Average Performance: Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	10,979	93.2	0.27				3.16	0.27	9%	0.02	14.90
Device brand	ecobee	10,979	93.2	0.27				3.16	0.27	9%	0.02	14.90
Device brand	Emerson	0										
Device brand	Nest	0										
Device brand	Honeywell	0										
Number of thermostats	1	8,762	93.3	0.20				2.95	0.20	7%	0.02	10.40
Number of thermostats	2	1,956	93.0	0.56				3.94	0.56	14%	0.05	10.92
Number of thermostats	3+ thermostats	261	92.6	0.47				4.45	0.47	10%	0.16	2.90
Low income	N	9,322	92.6	0.27				3.11	0.27	9%	0.02	13.57
Low income	Y	1,657	96.6	0.31				3.49	0.31	9%	0.05	6.81
Solar	No solar	6,663	92.5	0.23				2.81	0.23	8%	0.02	11.09
Solar	Solar	3,908	94.7	0.32				3.79	0.32	8%	0.03	9.45
Sublap	SLAP_PGCC	170	75.0	0.05				2.14	0.05	2%	0.14	0.34
Sublap	SLAP_PGEB	2,515	87.7	0.32				3.21	0.32	10%	0.04	8.59
Sublap	SLAP_PGF1	1,251	100.1	0.41				3.67	0.41	11%	0.06	6.98
Sublap	SLAP_PGFG	199	96.8	0.41				3.25	0.41	12%	0.16	2.50
Sublap	SLAP_PGHB	8	60.0	(0.09)				0.65	-0.09	-13%	0.35	-0.24
Sublap	SLAP_PGKN	549	103.0	0.30				3.65	0.30	8%	0.08	3.95
Sublap	SLAP_PGNB	253	96.5	(0.56)				2.21	-0.56	-25%	0.13	-4.45
Sublap	SLAP_PGNC	45	95.3	0.31				2.90	0.31	11%	0.30	1.03
Sublap	SLAP_PGNP	974	100.5	0.45				3.57	0.45	12%	0.07	6.75
Sublap	SLAP_PGP2	836	89.9	(0.08)				2.72	-0.08	-3%	0.10	-0.80
Sublap	SLAP_PGSB	1,625	92.0	0.01				2.37	0.01	1%	0.06	0.25
Sublap	SLAP_PGSF	252	75.8	(0.54)				0.81	-0.54	-66%	0.15	-3.50
Sublap	SLAP_PGSI	1,256	94.1	0.85				4.22	0.85	20%	0.06	13.06
Sublap	SLAP_PGST	420	101.4	0.33				3.44	0.33	10%	0.11	3.13
Sublap	SLAP_PGZP	330	91.6	0.36				3.34	0.36	11%	0.11	3.36
AC Propensity	Highest	0										
AC Propensity	High	3,971	94.8	0.53				4.43	0.53	12%	0.04	15.02
AC Propensity	Medium	3,091	93.8	0.08				2.79	0.08	3%	0.03	2.46
AC Propensity	Low	1,537	91.8	(0.04)				2.00	-0.04	-2%	0.04	-1.08
AC Propensity	Lowest	0										
Electric Vehicle	EV	0										
Electric Vehicle	No EV	0										
TOU Automation	Y	0										
TOU Automation	N	0										

Table A- 16: 09/06/2022 18:00 – 20:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Average Performance: Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	21,334	101.7	1.38	0.90	0.61		3.34	0.96	29%	0.01	66.69
Device brand	ecobee	10,979	102.2	1.52	0.98	0.68		3.50	1.06	30%	0.02	54.46
Device brand	Emerson	761	101.7	0.91	0.90	0.68		3.45	0.83	24%	0.07	11.77
Device brand	Nest	9,594	101.1	1.24	0.82	0.52		3.15	0.86	27%	0.02	37.84
Device brand	Honeywell	0										
Number of thermostats	1	17,178	101.7	1.28	0.84	0.56		3.20	0.89	28%	0.02	59.22
Number of thermostats	2	3,672	101.9	1.82	1.18	0.82		3.85	1.27	33%	0.04	30.54
Number of thermostats	3+ thermostats	484	100.5	1.67	1.22	0.70		4.53	1.20	26%	0.15	8.23
Low income	N	18,078	100.8	1.42	0.95	0.65		3.29	1.01	31%	0.02	62.65
Low income	Y	3,256	106.9	1.18	0.73	0.48		3.71	0.80	21%	0.03	23.16
Solar	No solar	13,900	100.8	1.27	0.85	0.56		3.20	0.89	28%	0.02	54.67
Solar	Solar	6,682	104.0	1.64	1.03	0.73		3.76	1.13	30%	0.03	37.41
Sublap	SLAP_PGCC	255	83.6	1.38	0.99	0.67		2.50	1.01	40%	0.12	8.10
Sublap	SLAP_PGEB	5,041	98.1	1.42	0.95	0.66		3.37	1.01	30%	0.03	33.32
Sublap	SLAP_PGF1	1,932	112.4	1.37	0.79	0.55		3.70	0.91	24%	0.05	18.88
Sublap	SLAP_PGFG	427	92.3	2.14	1.62	1.15		3.80	1.64	43%	0.12	13.65
Sublap	SLAP_PGHB	17	65.0	0.19	0.17	0.32		0.60	0.23	38%	0.26	0.88
Sublap	SLAP_PGKN	1,035	112.7	1.28	0.75	0.33		3.74	0.79	21%	0.06	12.52
Sublap	SLAP_PGNB	493	98.7	1.12	0.70	0.38		2.84	0.73	26%	0.10	7.20
Sublap	SLAP_PGNC	87	104.6	1.33	0.54	0.32		3.21	0.73	23%	0.24	3.07
Sublap	SLAP_PGNP	1,757	109.2	1.41	0.90	0.74		3.60	1.02	28%	0.05	19.76
Sublap	SLAP_PGP2	1,995	96.3	1.14	0.71	0.34		2.97	0.73	24%	0.08	9.58
Sublap	SLAP_PGSB	3,753	98.5	1.03	0.65	0.34		2.68	0.67	25%	0.05	13.41
Sublap	SLAP_PGSF	494	79.6	(0.51)	(0.31)	(0.23)		0.56	-0.35	-63%	0.10	-3.47
Sublap	SLAP_PGSI	2,159	108.5	1.80	1.13	0.88		4.12	1.27	31%	0.05	25.21
Sublap	SLAP_PGST	793	108.4	1.45	0.98	0.67		3.75	1.03	28%	0.08	12.55
Sublap	SLAP_PGZP	559	98.5	1.66	1.13	0.75		3.62	1.18	33%	0.09	13.18
AC Propensity	Highest	0										
AC Propensity	High	7,183	105.1	1.91	1.22	0.89		4.81	1.34	28%	0.03	46.09
AC Propensity	Medium	6,422	102.2	1.27	0.80	0.48		3.08	0.85	28%	0.02	34.15
AC Propensity	Low	3,540	99.0	0.78	0.51	0.28		2.05	0.52	26%	0.03	17.51
AC Propensity	Lowest	0										
Electric Vehicle	EV	0										
Electric Vehicle	No EV	0										
TOU Automation	Y	0										
TOU Automation	N	0										

Table A- 17: 09/07/2022 18:00 – 21:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts				Average Performance				
				Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	21,310	94.5	1.11	0.74	0.51	0.38	2.89	0.68	24%	0.01	57.68
Device brand	ecobee	10,962	95.1	1.04	0.72	0.52	0.42	3.06	0.68	22%	0.02	42.21
Device brand	Emerson	760	94.7	1.00	0.88	0.70	0.52	2.96	0.78	26%	0.06	13.51
Device brand	Nest	9,588	93.8	1.19	0.75	0.47	0.31	2.69	0.68	25%	0.02	36.76
Device brand	Honeywell	0										
Number of thermostats	1	17,161	94.6	1.04	0.68	0.46	0.33	2.77	0.63	23%	0.01	50.68
Number of thermostats	2	3,665	94.3	1.44	1.02	0.71	0.58	3.36	0.94	28%	0.03	27.37
Number of thermostats	3+ thermostats	484	93.2	1.19	0.89	0.68	0.47	3.90	0.81	21%	0.12	6.99
Low income	N	18,057	93.5	1.12	0.76	0.52	0.38	2.81	0.69	25%	0.01	53.37
Low income	Y	3,253	100.3	1.08	0.66	0.46	0.36	3.39	0.64	19%	0.03	22.30
Solar	No solar	13,885	93.6	1.03	0.69	0.46	0.32	2.71	0.63	23%	0.01	47.50
Solar	Solar	6,674	96.8	1.35	0.87	0.63	0.51	3.40	0.84	25%	0.03	33.11
Sublap	SLAP_PGCC	255	79.6	0.87	0.67	0.43	0.19	2.16	0.54	25%	0.11	5.11
Sublap	SLAP_PGEB	5,034	90.1	1.23	0.88	0.60	0.44	2.84	0.79	28%	0.02	31.93
Sublap	SLAP_PGF1	1,932	106.9	1.22	0.78	0.55	0.41	3.61	0.74	21%	0.04	18.59
Sublap	SLAP_PGFG	427	86.2	1.42	1.16	0.97	0.57	2.88	1.03	36%	0.09	11.56
Sublap	SLAP_PGHB	17	63.8	0.31	0.22	0.16	(0.42)	0.55	0.07	12%	0.24	0.28
Sublap	SLAP_PGKN	1,033	107.5	1.07	0.64	0.36	0.27	3.63	0.59	16%	0.05	11.03
Sublap	SLAP_PGNB	492	93.6	0.84	0.57	0.38	(0.02)	2.31	0.44	19%	0.08	5.38
Sublap	SLAP_PGNC	86	94.7	1.47	0.82	0.54	0.32	2.98	0.79	26%	0.20	3.94
Sublap	SLAP_PGNP	1,756	101.7	1.29	0.86	0.69	0.67	3.28	0.88	27%	0.04	20.79
Sublap	SLAP_PGP2	1,991	88.9	0.77	0.40	0.13	(0.03)	2.36	0.32	13%	0.05	6.26
Sublap	SLAP_PGSB	3,751	91.2	0.79	0.45	0.23	0.05	2.12	0.38	18%	0.03	11.43
Sublap	SLAP_PGSF	493	74.4	(0.13)	(0.18)	(0.13)	(0.20)	0.70	-0.16	-23%	0.06	-2.45
Sublap	SLAP_PGSI	2,158	99.4	1.51	0.94	0.75	0.77	3.75	0.99	26%	0.04	23.80
Sublap	SLAP_PGST	790	100.0	1.27	1.00	0.73	0.62	3.36	0.90	27%	0.07	13.37
Sublap	SLAP_PGZP	558	95.3	1.39	1.06	0.72	0.53	3.53	0.93	26%	0.07	12.70
AC Propensity	Highest	0										
AC Propensity	High	7,173	97.7	1.63	1.06	0.78	0.61	4.26	1.02	24%	0.02	42.14
AC Propensity	Medium	6,414	94.9	1.06	0.68	0.41	0.26	2.63	0.60	23%	0.02	29.67
AC Propensity	Low	3,538	91.8	0.56	0.37	0.19	0.10	1.72	0.31	18%	0.02	12.97
AC Propensity	Lowest	0										
Electric Vehicle	EV	0										
Electric Vehicle	No EV	0										
TOU Automation	Y	0										
TOU Automation	N	0										

Table A- 18: 09/08/2022 18:00-21:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts				Average Performance				
				Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	21,261	97.3	1.21	0.75	0.47	0.29	3.04	0.68	22%	0.01	53.26
Device brand	ecobee	10,935	97.5	1.27	0.77	0.50	0.33	3.19	0.72	22%	0.02	41.65
Device brand	Emerson	755	97.3	0.93	0.73	0.68	0.48	3.07	0.71	23%	0.06	11.36
Device brand	Nest	9,571	97.1	1.16	0.72	0.41	0.22	2.86	0.63	22%	0.02	31.42
Device brand	Honeywell	0										
Number of thermostats	1	17,125	97.3	1.13	0.69	0.43	0.25	2.91	0.62	21%	0.01	46.97
Number of thermostats	2	3,655	97.7	1.60	0.99	0.64	0.43	3.55	0.92	26%	0.04	24.69
Number of thermostats	3+ thermostats	481	96.2	1.60	1.09	0.69	0.37	4.17	0.94	22%	0.12	7.54
Low income	N	18,013	96.8	1.23	0.75	0.47	0.28	2.98	0.68	23%	0.01	48.34
Low income	Y	3,248	100.5	1.12	0.74	0.51	0.37	3.40	0.68	20%	0.03	21.86
Solar	No solar	13,856	96.8	1.13	0.71	0.42	0.22	2.86	0.62	22%	0.01	43.80
Solar	Solar	6,657	98.7	1.44	0.84	0.57	0.42	3.51	0.82	23%	0.03	29.76
Sublap	SLAP_PGCC	254	81.6	0.94	0.73	0.42	0.22	2.33	0.58	25%	0.11	5.26
Sublap	SLAP_PGEB	5,022	95.0	1.16	0.73	0.43	0.19	3.07	0.63	20%	0.03	22.88
Sublap	SLAP_PGF1	1,929	102.2	1.43	0.91	0.68	0.57	3.44	0.90	26%	0.05	19.11
Sublap	SLAP_PGFG	426	98.7	1.67	1.10	0.69	0.22	3.22	0.92	29%	0.10	8.91
Sublap	SLAP_PGHB	17	63.3	0.34	0.11	0.18	(0.30)	0.53	0.08	16%	0.25	0.33
Sublap	SLAP_PGKN	1,029	103.5	1.53	1.11	0.69	0.57	3.53	0.98	28%	0.06	17.09
Sublap	SLAP_PGNB	492	101.3	0.91	0.46	0.14	(0.32)	2.50	0.30	12%	0.09	3.22
Sublap	SLAP_PGNC	86	98.6	0.99	0.45	0.25	0.40	3.06	0.52	17%	0.22	2.42
Sublap	SLAP_PGNP	1,750	105.0	1.25	0.72	0.56	0.53	3.40	0.77	23%	0.05	16.29
Sublap	SLAP_PGP2	1,986	93.8	0.81	0.28	(0.04)	(0.23)	2.56	0.20	8%	0.06	3.37
Sublap	SLAP_PGSB	3,746	95.7	0.92	0.49	0.10	(0.17)	2.34	0.33	14%	0.04	8.36
Sublap	SLAP_PGSF	493	76.0	(0.44)	(0.30)	(0.23)	(0.29)	0.59	-0.31	-53%	0.06	-4.95
Sublap	SLAP_PGSI	2,152	100.9	1.70	1.02	0.86	0.88	3.88	1.11	29%	0.05	23.95
Sublap	SLAP_PGST	786	103.8	1.35	0.81	0.52	0.42	3.47	0.78	22%	0.08	10.24
Sublap	SLAP_PGZP	557	90.6	1.44	1.08	0.80	0.46	3.20	0.95	30%	0.08	11.59
AC Propensity	Highest	0										
AC Propensity	High	7,155	99.4	1.73	1.05	0.73	0.52	4.39	1.01	23%	0.03	38.52
AC Propensity	Medium	6,399	98.0	1.12	0.65	0.32	0.13	2.79	0.56	20%	0.02	25.39
AC Propensity	Low	3,528	95.9	0.62	0.35	0.14	(0.01)	1.85	0.28	15%	0.03	10.58
AC Propensity	Lowest	0										
Electric Vehicle	EV	0										
Electric Vehicle	No EV	0										
TOU Automation	Y	0										
TOU Automation	N	0										

Table A- 19: 09/09/2022 20:00-21:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Average Performance: Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	2,756	83.6	0.57	0.32			2.19	0.44	20%	0.03	14.75
Device brand	ecobee	1,622	84.2	0.46	0.25			2.24	0.36	16%	0.04	9.28
Device brand	Emerson	106	83.8	0.63	0.56			2.33	0.59	25%	0.14	4.12
Device brand	Nest	1,028	82.6	0.73	0.39			2.10	0.56	27%	0.05	11.16
Device brand	Honeywell	0										
Number of thermostats	1	2,251	83.8	0.52	0.28			2.05	0.40	19%	0.03	12.78
Number of thermostats	2	449	82.9	0.75	0.45			2.73	0.60	22%	0.09	6.87
Number of thermostats	3+ thermostats	56	82.5	1.05	0.68			3.50	0.87	25%	0.31	2.77
Low income	N	2,391	82.4	0.55	0.31			2.14	0.43	20%	0.03	13.16
Low income	Y	365	91.3	0.70	0.38			2.54	0.54	21%	0.08	6.97
Solar	No solar	1,770	82.5	0.50	0.30			1.90	0.40	21%	0.03	11.74
Solar	Solar	891	86.3	0.70	0.38			2.83	0.54	19%	0.06	9.01
Sublap	SLAP_PGCC	34	69.6	0.51	(0.02)			1.44	0.24	17%	0.25	0.96
Sublap	SLAP_PGEB	659	78.8	0.55	0.30			2.17	0.42	20%	0.06	6.74
Sublap	SLAP_PGF1	230	98.6	0.88	0.52			2.96	0.70	24%	0.10	6.88
Sublap	SLAP_PGFG	59	70.0	0.18	(0.02)			1.60	0.08	5%	0.23	0.35
Sublap	SLAP_PGHB	3	68.0	(0.27)	(0.04)			0.60	-0.15	-25%	0.42	-0.36
Sublap	SLAP_PGKN	119	97.5	0.72	0.41			2.88	0.56	19%	0.14	4.03
Sublap	SLAP_PGNB	78	78.4	0.33	0.13			1.52	0.23	15%	0.19	1.22
Sublap	SLAP_PGNC	8	91.5	0.96	0.76			2.49	0.86	34%	0.40	2.14
Sublap	SLAP_PGNP	229	97.0	0.71	0.54			2.56	0.63	24%	0.11	5.81
Sublap	SLAP_PGP2	269	77.0	0.52	0.28			1.88	0.40	21%	0.10	4.12
Sublap	SLAP_PGSB	501	77.2	0.32	0.16			1.61	0.24	15%	0.06	3.84
Sublap	SLAP_PGSF	63	63.1	0.02	(0.09)			0.68	-0.03	-5%	0.12	-0.28
Sublap	SLAP_PGSI	267	89.9	0.77	0.40			2.82	0.58	21%	0.10	5.58
Sublap	SLAP_PGST	97	96.0	0.91	0.32			3.05	0.61	20%	0.18	3.40
Sublap	SLAP_PGZP	67	87.9	0.79	0.78			2.59	0.79	30%	0.19	4.04
AC Propensity	Highest	0										
AC Propensity	High	884	87.5	0.86	0.50			3.26	0.68	21%	0.06	10.52
AC Propensity	Medium	881	84.2	0.52	0.25			2.05	0.39	19%	0.05	7.50
AC Propensity	Low	464	79.6	0.34	0.19			1.33	0.27	20%	0.06	4.63
AC Propensity	Lowest	0										
Electric Vehicle	EV	0										
Electric Vehicle	No EV	0										
TOU Automation	Y	0										
TOU Automation	N	0										

Table A- 20: 06/30/2023 16:00 – 17:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Average Performance: Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	14,119	99.6	0.73				2.03	0.73	36%	0.02	40.96
Device brand	ecobee	5,109	100.8	0.75				2.10	0.75	35%	0.03	25.58
Device brand	Emerson	380	100.1	0.74				2.28	0.74	33%	0.11	6.55
Device brand	Nest	8,562	98.8	0.72				1.98	0.72	36%	0.02	31.10
Device brand	Honeywell	0										
Number of thermostats	1	11,791	99.9	0.70				2.06	0.70	34%	0.02	36.66
Number of thermostats	2	1,836	97.8	0.84				1.85	0.84	46%	0.05	16.79
Number of thermostats	3+ thermostats	228	97.0	1.06				2.13	1.06	50%	0.17	6.09
Low income	N	9,602	98.5	0.71				1.86	0.71	38%	0.02	32.89
Low income	Y	4,517	102.0	0.76				2.40	0.76	32%	0.03	24.49
Solar	No solar	8,849	99.1	0.80				2.47	0.80	32%	0.02	33.81
Solar	Solar	5,270	100.5	0.62				1.29	0.62	48%	0.03	23.20
Sublap	Other	0										
Sublap	SLAP_PGCC	0										
Sublap	SLAP_PGEB	0										
Sublap	SLAP_PGF1	6,774	103.6	0.87				2.32	0.87	37%	0.03	33.57
Sublap	SLAP_PGFG	0										
Sublap	SLAP_PGHB	43	69.2	0.55				1.35	0.55	40%	0.25	2.24
Sublap	SLAP_PGKN	0										
Sublap	SLAP_PGNB	2,193	85.6	0.41				1.30	0.41	32%	0.04	9.91
Sublap	SLAP_PGNC	0										
Sublap	SLAP_PGNP	5,109	100.5	0.68				1.97	0.68	34%	0.03	22.66
Sublap	SLAP_PGP2	0										
Sublap	SLAP_PGSB	0										
Sublap	SLAP_PGSF	0										
Sublap	SLAP_PGSI	0										
Sublap	SLAP_PGST	0										
Sublap	SLAP_PGZP	0										
AC Propensity	Highest	3,337	101.5	1.11				3.07	1.11	36%	0.05	24.28
AC Propensity	High	3,297	101.0	0.92				2.30	0.92	40%	0.04	25.48
AC Propensity	Medium	2,900	100.3	0.70				1.85	0.70	38%	0.04	19.17
AC Propensity	Low	2,172	98.8	0.46				1.40	0.46	33%	0.04	12.27
AC Propensity	Lowest	1,188	97.1	0.29				1.15	0.29	25%	0.04	6.38
AC Propensity	None	1,225	92.9	0.08				0.81	0.08	10%	0.04	2.09
Electric Vehicle	EV	2,974	92.4	0.65				1.59	0.65	41%	0.04	16.43
Electric Vehicle	No EV	11,145	101.5	0.75				2.15	0.75	35%	0.02	37.69
TOU Automation	Y	2,554	100.5	0.69				1.94	0.69	36%	0.04	16.92
TOU Automation	N	11,565	99.4	0.74				2.05	0.74	36%	0.02	37.33

Table A- 21: 06/30/2023 17:00-18:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Average Performance: Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	26,708	82.0	0.44				1.44	0.44	31%	0.01	37.28
Device brand	ecobee	5,746	83.9	0.49				1.56	0.49	32%	0.03	19.50
Device brand	Emerson	417	84.0	0.31				1.47	0.31	21%	0.09	3.54
Device brand	Nest	20,431	81.4	0.43				1.40	0.43	31%	0.01	31.62
Device brand	Honeywell	0										
Number of thermostats	1	21,304	82.3	0.42				1.41	0.42	30%	0.01	33.03
Number of thermostats	2	4,219	80.9	0.54				1.51	0.54	36%	0.03	16.37
Number of thermostats	3+ thermostats	737	79.5	0.54				1.81	0.54	30%	0.09	5.91
Low income	N	23,968	80.8	0.42				1.35	0.42	31%	0.01	33.19
Low income	Y	2,740	90.1	0.64				2.21	0.64	29%	0.04	17.86
Solar	No solar	19,226	81.2	0.41				1.52	0.41	27%	0.01	29.55
Solar	Solar	7,482	84.1	0.53				1.21	0.53	44%	0.02	22.99
Sublap	Other	0										
Sublap	SLAP_PGCC	0										
Sublap	SLAP_PGEB	0										
Sublap	SLAP_PGF1	0										
Sublap	SLAP_PGFG	0										
Sublap	SLAP_PGHB	0										
Sublap	SLAP_PGKN	2,813	104.2	1.00				2.68	1.00	37%	0.04	25.46
Sublap	SLAP_PGNB	0										
Sublap	SLAP_PGNC	0										
Sublap	SLAP_PGNP	0										
Sublap	SLAP_PGP2	7,521	78.4	0.43				1.43	0.43	30%	0.02	18.24
Sublap	SLAP_PGSB	14,617	81.6	0.39				1.30	0.39	30%	0.02	24.51
Sublap	SLAP_PGSF	1,757	66.0	0.06				0.57	0.06	11%	0.03	2.49
Sublap	SLAP_PGSI	0										
Sublap	SLAP_PGST	0										
Sublap	SLAP_PGZP	0										
AC Propensity	Highest	3,000	87.1	1.15				3.02	1.15	38%	0.05	22.13
AC Propensity	High	3,638	85.9	0.76				2.13	0.76	36%	0.04	19.97
AC Propensity	Medium	4,235	83.8	0.57				1.63	0.57	35%	0.03	17.80
AC Propensity	Low	4,675	81.8	0.35				1.26	0.35	28%	0.03	13.90
AC Propensity	Lowest	4,288	80.9	0.14				0.89	0.14	16%	0.02	6.49
AC Propensity	None	6,872	77.2	0.13				0.70	0.13	18%	0.01	8.48
Electric Vehicle	EV	17,605	79.8	0.44				1.40	0.44	32%	0.02	28.86
Electric Vehicle	No EV	9,103	86.4	0.44				1.50	0.44	30%	0.02	24.27
TOU Automation	Y	3,607	82.6	0.47				1.41	0.47	33%	0.03	14.84
TOU Automation	N	23,101	81.9	0.44				1.44	0.44	31%	0.01	34.23

Table A- 22: 06/30/2023 18:00-19:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Average Performance: Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	6,075	92.4	0.70				2.32	0.70	30%	0.03	21.85
Device brand	ecobee	1,775	93.2	0.70				2.36	0.70	30%	0.06	12.01
Device brand	Emerson	196	92.9	0.51				2.15	0.51	23%	0.17	3.06
Device brand	Nest	4,079	92.0	0.71				2.31	0.71	31%	0.04	17.89
Device brand	Honeywell	0										
Number of thermostats	1	5,122	92.3	0.68				2.27	0.68	30%	0.03	20.20
Number of thermostats	2	747	93.2	0.85				2.58	0.85	33%	0.11	8.00
Number of thermostats	3+ thermostats	97	89.8	0.82				3.29	0.82	25%	0.33	2.52
Low income	N	4,734	91.4	0.66				2.21	0.66	30%	0.04	17.86
Low income	Y	1,341	95.6	0.84				2.71	0.84	31%	0.06	13.15
Solar	No solar	3,799	91.5	0.53				2.24	0.53	24%	0.04	13.65
Solar	Solar	2,276	93.9	0.99				2.47	0.99	40%	0.06	17.75
Sublap	Other	0										
Sublap	SLAP_PGCC	0										
Sublap	SLAP_PGEB	0										
Sublap	SLAP_PGF1	0										
Sublap	SLAP_PGFG	1,870	85.2	0.37				1.61	0.37	23%	0.05	7.38
Sublap	SLAP_PGHB	0										
Sublap	SLAP_PGKN	0										
Sublap	SLAP_PGNB	0										
Sublap	SLAP_PGNC	0										
Sublap	SLAP_PGNP	0										
Sublap	SLAP_PGP2	0										
Sublap	SLAP_PGSB	0										
Sublap	SLAP_PGSF	0										
Sublap	SLAP_PGSI	0										
Sublap	SLAP_PGST	2,435	99.2	0.92				2.90	0.92	32%	0.06	16.51
Sublap	SLAP_PGZP	1,769	90.7	0.77				2.29	0.77	33%	0.06	13.03
AC Propensity	Highest	1,245	95.4	1.52				4.11	1.52	37%	0.09	16.78
AC Propensity	High	1,145	94.9	0.82				2.78	0.82	29%	0.08	10.43
AC Propensity	Medium	1,197	93.4	0.60				2.15	0.60	28%	0.08	7.72
AC Propensity	Low	967	90.9	0.52				1.70	0.52	30%	0.07	7.65
AC Propensity	Lowest	615	90.0	0.12				1.18	0.12	10%	0.07	1.70
AC Propensity	None	906	87.0	0.13				0.92	0.13	14%	0.05	2.65
Electric Vehicle	EV	1,914	88.0	0.67				2.12	0.67	32%	0.06	11.32
Electric Vehicle	No EV	4,161	94.4	0.72				2.42	0.72	30%	0.04	18.76
TOU Automation	Y	960	92.8	0.71				2.21	0.71	32%	0.08	8.99
TOU Automation	N	5,115	92.3	0.70				2.34	0.70	30%	0.04	19.90

Table A- 23: 06/30/2023 19:00 -20:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Average Performance: Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	24,224	82.7	0.69				2.23	0.69	31%	0.02	43.21
Device brand	ecobee	6,531	83.8	0.73				2.30	0.73	32%	0.03	24.01
Device brand	Emerson	547	84.3	0.44				2.28	0.44	19%	0.10	4.32
Device brand	Nest	17,015	82.2	0.69				2.20	0.69	31%	0.02	35.70
Device brand	Honeywell	21	85.5	0.34				2.16	0.34	16%	0.52	0.64
Number of thermostats	1	18,025	82.5	0.61				2.10	0.61	29%	0.02	35.68
Number of thermostats	2	5,089	83.3	0.90				2.51	0.90	36%	0.04	22.52
Number of thermostats	3+ thermostats	672	82.4	1.14				3.24	1.14	35%	0.13	8.43
Low income	N	21,498	82.4	0.69				2.19	0.69	32%	0.02	40.11
Low income	Y	2,726	84.4	0.69				2.54	0.69	27%	0.04	16.06
Solar	No solar	15,239	81.9	0.61				2.06	0.61	30%	0.02	33.65
Solar	Solar	8,985	84.0	0.83				2.50	0.83	33%	0.03	27.50
Sublap	Other	0										
Sublap	SLAP_PGCC	894	68.8	0.17				1.17	0.17	15%	0.06	2.99
Sublap	SLAP_PGEB	17,481	79.4	0.58				2.01	0.58	29%	0.02	31.41
Sublap	SLAP_PGF1	0										
Sublap	SLAP_PGFG	0										
Sublap	SLAP_PGHB	0										
Sublap	SLAP_PGKN	0										
Sublap	SLAP_PGNB	0										
Sublap	SLAP_PGNC	251	88.0	0.59				2.66	0.59	22%	0.17	3.50
Sublap	SLAP_PGNP	0										
Sublap	SLAP_PGP2	0										
Sublap	SLAP_PGSB	0										
Sublap	SLAP_PGSF	0										
Sublap	SLAP_PGSI	5,598	94.7	1.12				3.05	1.12	37%	0.04	31.58
Sublap	SLAP_PGST	0										
Sublap	SLAP_PGZP	0										
AC Propensity	Highest	4,978	85.1	1.27				3.84	1.27	33%	0.05	27.01
AC Propensity	High	4,598	84.3	0.96				2.74	0.96	35%	0.04	25.52
AC Propensity	Medium	4,371	83.7	0.69				2.14	0.69	32%	0.04	19.29
AC Propensity	Low	3,735	82.5	0.41				1.56	0.41	27%	0.03	12.23
AC Propensity	Lowest	2,722	80.9	0.29				1.23	0.29	23%	0.03	8.75
AC Propensity	None	3,820	77.8	0.17				0.95	0.17	18%	0.03	6.00
Electric Vehicle	EV	13,696	80.9	0.66				2.24	0.66	29%	0.02	28.49
Electric Vehicle	No EV	10,528	85.0	0.73				2.21	0.73	33%	0.02	34.55
TOU Automation	Y	3,915	83.3	0.71				2.22	0.71	32%	0.04	18.04
TOU Automation	N	20,309	82.5	0.69				2.23	0.69	31%	0.02	39.26

Table A- 24: 07/15/2023 16:00-19:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Average Performance: Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	43,000	99.5	0.82	0.59	0.41		2.50	0.61	24%	0.01	53.21
Device brand	ecobee	13,373	100.8	0.81	0.60	0.44		2.60	0.62	24%	0.02	31.72
Device brand	Emerson	947	100.6	0.95	0.91	0.81		2.69	0.89	33%	0.07	12.13
Device brand	Nest	28,307	98.8	0.83	0.57	0.38		2.45	0.59	24%	0.01	41.15
Device brand	Honeywell	164	99.1	1.04	0.79	0.67		2.44	0.83	34%	0.19	4.50
Number of thermostats	1	34,523	99.7	0.77	0.53	0.36		2.44	0.55	23%	0.01	45.29
Number of thermostats	2	7,532	98.7	1.02	0.81	0.60		2.67	0.81	30%	0.03	26.09
Number of thermostats	3+ thermostats	944	97.9	1.22	1.09	0.82		3.30	1.04	32%	0.11	9.71
Low income	N	33,298	98.4	0.82	0.60	0.42		2.40	0.61	26%	0.01	46.21
Low income	Y	9,702	103.1	0.84	0.56	0.37		2.84	0.59	21%	0.02	26.67
Solar	No solar	26,375	98.9	0.90	0.59	0.38		2.72	0.62	23%	0.01	42.62
Solar	Solar	16,625	100.4	0.71	0.58	0.46		2.16	0.58	27%	0.02	31.97
Sublap	Other	0										
Sublap	SLAP_PGCC	0										
Sublap	SLAP_PGEB	18,163	92.8	0.64	0.46	0.29		2.09	0.47	22%	0.02	25.82
Sublap	SLAP_PGF1	6,908	107.0	0.93	0.65	0.43		2.93	0.67	23%	0.03	24.78
Sublap	SLAP_PGFG	0										
Sublap	SLAP_PGHB	0										
Sublap	SLAP_PGKN	2,930	107.9	1.03	0.71	0.52		2.96	0.75	25%	0.04	18.31
Sublap	SLAP_PGNB	0										
Sublap	SLAP_PGNC	0										
Sublap	SLAP_PGNP	5,190	103.7	0.94	0.67	0.48		2.68	0.70	26%	0.03	22.07
Sublap	SLAP_PGP2	0										
Sublap	SLAP_PGSB	0										
Sublap	SLAP_PGSF	0										
Sublap	SLAP_PGSI	5,792	102.6	0.96	0.75	0.56		2.81	0.76	27%	0.03	23.94
Sublap	SLAP_PGST	2,315	104.5	1.07	0.74	0.56		2.90	0.79	27%	0.05	14.96
Sublap	SLAP_PGZP	1,703	94.0	0.79	0.47	0.46		2.30	0.57	25%	0.05	10.74
AC Propensity	Highest	10,199	101.4	1.37	0.92	0.60		3.91	0.96	25%	0.03	32.42
AC Propensity	High	9,464	101.1	0.94	0.66	0.42		2.79	0.67	24%	0.02	27.45
AC Propensity	Medium	8,364	100.3	0.75	0.54	0.46		2.28	0.58	26%	0.02	24.56
AC Propensity	Low	6,349	98.9	0.52	0.46	0.37		1.81	0.45	25%	0.03	17.66
AC Propensity	Lowest	3,986	97.0	0.44	0.30	0.16		1.40	0.30	21%	0.03	10.74
AC Propensity	None	4,638	93.2	0.24	0.20	0.15		1.09	0.20	18%	0.02	8.24
Electric Vehicle	EV	16,148	95.0	0.75	0.57	0.42		2.32	0.58	25%	0.02	28.26
Electric Vehicle	No EV	26,852	102.1	0.87	0.60	0.41		2.61	0.62	24%	0.01	46.25
TOU Automation	Y	7,316	100.0	0.65	0.50	0.41		2.37	0.52	22%	0.03	19.98
TOU Automation	N	35,684	99.4	0.86	0.61	0.41		2.53	0.63	25%	0.01	49.34

Table A- 25: 07/17/2023 17:00-19:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts				Average Performance				
				Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	11,817	101.3	1.10	0.65			3.28	0.87	27%	0.02	39.51
Device brand	ecobee	4,744	101.9	1.19	0.72			3.41	0.96	28%	0.03	28.06
Device brand	Emerson	257	100.7	0.96	0.82			3.14	0.89	28%	0.15	6.15
Device brand	Nest	6,730	100.9	1.04	0.59			3.20	0.81	25%	0.03	27.36
Device brand	Honeywell	29	97.6	1.14	0.39			3.55	0.76	22%	0.43	1.77
Number of thermostats	1	10,368	101.2	1.01	0.58			3.17	0.79	25%	0.02	35.26
Number of thermostats	2	1,250	101.7	1.59	1.03			3.88	1.31	34%	0.08	15.43
Number of thermostats	3+ thermostats	199	102.7	2.51	1.90			5.14	2.20	43%	0.24	9.23
Low income	N	6,680	100.2	1.19	0.78			3.20	0.98	31%	0.03	31.70
Low income	Y	5,137	102.9	0.98	0.48			3.38	0.73	22%	0.03	23.95
Solar	No solar	6,995	101.1	1.05	0.55			3.34	0.80	24%	0.03	29.03
Solar	Solar	4,822	101.6	1.16	0.80			3.20	0.98	31%	0.04	27.00
Sublap	Other	0										
Sublap	SLAP_PGCC	0										
Sublap	SLAP_PGEB	0										
Sublap	SLAP_PGF1	7,082	103.7	1.07	0.62			3.38	0.85	25%	0.03	29.49
Sublap	SLAP_PGFG	0										
Sublap	SLAP_PGHB	0										
Sublap	SLAP_PGKN	2,995	104.9	1.27	0.77			3.57	1.02	29%	0.05	22.76
Sublap	SLAP_PGNB	0										
Sublap	SLAP_PGNC	0										
Sublap	SLAP_PGNP	0										
Sublap	SLAP_PGP2	0										
Sublap	SLAP_PGSB	0										
Sublap	SLAP_PGSF	0										
Sublap	SLAP_PGSI	0										
Sublap	SLAP_PGST	0										
Sublap	SLAP_PGZP	1,740	85.4	0.92	0.53			2.38	0.73	30%	0.05	13.60
AC Propensity	Highest	3,393	102.9	1.38	0.80			4.49	1.09	24%	0.05	21.57
AC Propensity	High	3,065	102.3	1.21	0.74			3.47	0.97	28%	0.04	23.65
AC Propensity	Medium	2,429	101.7	1.13	0.61			2.93	0.87	30%	0.04	20.36
AC Propensity	Low	1,527	100.9	0.83	0.52			2.36	0.68	29%	0.05	13.44
AC Propensity	Lowest	731	98.5	0.59	0.36			1.80	0.48	26%	0.07	7.10
AC Propensity	None	673	91.3	0.19	0.23			1.28	0.21	17%	0.06	3.51
Electric Vehicle	EV	1,214	94.1	1.23	0.90			3.19	1.06	33%	0.08	13.17
Electric Vehicle	No EV	10,603	102.1	1.08	0.62			3.29	0.85	26%	0.02	37.32
TOU Automation	Y	2,248	101.4	1.27	0.84			3.37	1.06	31%	0.05	20.73
TOU Automation	N	9,569	101.3	1.06	0.60			3.26	0.83	25%	0.02	33.86

Table A- 26: 08/15/2023 16:00-18:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts				Average Performance				
				Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	14,472	100.5	1.09	0.76			2.87	0.92	32%	0.02	48.84
Device brand	ecobee	4,532	100.4	1.22	0.82			2.90	1.02	35%	0.03	31.54
Device brand	Emerson	450	100.7	0.95	0.81			2.77	0.88	32%	0.10	9.15
Device brand	Nest	9,341	100.5	1.04	0.73			2.86	0.88	31%	0.02	36.75
Device brand	Honeywell	82	100.9	0.89	0.38			2.54	0.64	25%	0.22	2.86
Number of thermostats	1	11,644	100.7	1.00	0.67			2.80	0.84	30%	0.02	41.30
Number of thermostats	2	2,576	99.8	1.40	1.07			3.08	1.23	40%	0.05	24.53
Number of thermostats	3+ thermostats	251	99.1	1.87	1.48			3.87	1.67	43%	0.19	9.00
Low income	N	11,206	100.3	1.16	0.83			2.83	0.99	35%	0.02	46.06
Low income	Y	3,266	101.2	0.82	0.49			2.99	0.66	22%	0.04	17.12
Solar	No solar	8,222	100.5	1.13	0.68			3.11	0.91	29%	0.03	36.16
Solar	Solar	6,250	100.5	1.03	0.85			2.55	0.94	37%	0.03	33.05
Sublap	Other	0										
Sublap	SLAP_PGCC	0										
Sublap	SLAP_PGEB	0										
Sublap	SLAP_PGF1	0										
Sublap	SLAP_PGFG	0										
Sublap	SLAP_PGHB	0										
Sublap	SLAP_PGKN	0										
Sublap	SLAP_PGNB	0										
Sublap	SLAP_PGNC	0										
Sublap	SLAP_PGNP	5,649	101.2	0.95	0.65			2.69	0.80	30%	0.03	28.01
Sublap	SLAP_PGP2	0										
Sublap	SLAP_PGSB	0										
Sublap	SLAP_PGSF	0										
Sublap	SLAP_PGSI	6,271	99.0	1.25	0.89			3.05	1.07	35%	0.03	36.31
Sublap	SLAP_PGST	2,552	102.8	1.00	0.65			2.82	0.83	29%	0.05	17.75
Sublap	SLAP_PGZP	0										
AC Propensity	Highest	3,716	100.6	1.68	1.10			4.28	1.39	33%	0.05	30.25
AC Propensity	High	3,441	100.7	1.11	0.69			3.00	0.90	30%	0.04	23.49
AC Propensity	Medium	3,004	100.5	0.91	0.75			2.48	0.83	33%	0.04	21.92
AC Propensity	Low	2,161	100.4	0.80	0.60			2.05	0.70	34%	0.04	17.58
AC Propensity	Lowest	1,189	100.4	0.52	0.37			1.59	0.44	28%	0.05	8.90
AC Propensity	None	961	100.0	0.44	0.42			1.47	0.43	29%	0.05	8.78
Electric Vehicle	EV	3,672	98.9	1.23	1.00			2.98	1.12	37%	0.04	26.64
Electric Vehicle	No EV	10,800	101.1	1.04	0.67			2.83	0.86	30%	0.02	41.03
TOU Automation	Y	2,549	100.3	1.15	0.79			2.80	0.97	35%	0.04	22.22
TOU Automation	N	11,923	100.6	1.08	0.75			2.88	0.91	32%	0.02	43.57

Table A- 27: 08/15/2023 17:00-19:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts				Average Performance				
				Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	7,694	104.2	1.15	0.60			3.40	0.88	26%	0.03	34.84
Device brand	ecobee	3,222	104.3	1.32	0.71			3.55	1.01	29%	0.04	26.66
Device brand	Emerson	164	103.9	1.07	0.99			3.44	1.03	30%	0.18	5.86
Device brand	Nest	4,255	104.2	1.03	0.51			3.28	0.77	23%	0.03	22.37
Device brand	Honeywell	21	104.3	0.73	0.24			4.51	0.48	11%	0.53	0.91
Number of thermostats	1	6,705	104.2	1.06	0.55			3.29	0.81	24%	0.03	31.37
Number of thermostats	2	844	104.3	1.70	0.91			4.03	1.30	32%	0.10	13.70
Number of thermostats	3+ thermostats	145	104.4	2.12	1.11			4.58	1.62	35%	0.24	6.62
Low income	N	4,366	104.2	1.28	0.68			3.42	0.98	29%	0.04	27.51
Low income	Y	3,328	104.2	0.98	0.50			3.37	0.74	22%	0.03	21.52
Solar	No solar	4,722	104.2	1.04	0.53			3.39	0.78	23%	0.03	25.54
Solar	Solar	2,972	104.3	1.33	0.72			3.41	1.02	30%	0.04	23.76
Sublap	Other	0										
Sublap	SLAP_PGCC	0										
Sublap	SLAP_PGEB	0										
Sublap	SLAP_PGF1	7,694	104.2	1.15	0.60			3.40	0.88	26%	0.03	34.84
Sublap	SLAP_PGFG	0										
Sublap	SLAP_PGHB	0										
Sublap	SLAP_PGKN	0										
Sublap	SLAP_PGNB	0										
Sublap	SLAP_PGNC	0										
Sublap	SLAP_PGNP	0										
Sublap	SLAP_PGP2	0										
Sublap	SLAP_PGSB	0										
Sublap	SLAP_PGSF	0										
Sublap	SLAP_PGSI	0										
Sublap	SLAP_PGST	0										
Sublap	SLAP_PGZP	0										
AC Propensity	Highest	2,297	104.3	1.57	0.75			4.68	1.16	25%	0.06	20.85
AC Propensity	High	2,006	104.3	1.19	0.57			3.39	0.88	26%	0.05	19.16
AC Propensity	Medium	1,596	104.2	0.98	0.61			2.91	0.79	27%	0.05	16.37
AC Propensity	Low	1,042	104.2	0.85	0.52			2.42	0.69	28%	0.06	11.69
AC Propensity	Lowest	470	104.1	0.57	0.43			1.94	0.50	26%	0.08	6.10
AC Propensity	None	282	104.0	0.40	0.07			1.76	0.24	14%	0.10	2.49
Electric Vehicle	EV	691	104.5	1.61	0.77			4.02	1.19	30%	0.11	11.01
Electric Vehicle	No EV	7,003	104.2	1.11	0.58			3.34	0.85	25%	0.03	33.18
TOU Automation	Y	1,533	104.3	1.40	0.77			3.49	1.09	31%	0.06	19.54
TOU Automation	N	6,161	104.2	1.09	0.56			3.37	0.82	24%	0.03	29.25

Table A- 28: 08/16/2023 16:00-20:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts				Average Performance				
				Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	5,615	98.8	0.96	0.59	0.39	0.29	2.94	0.56	19%	0.03	19.97
Device brand	ecobee	1,716	98.8	1.04	0.70	0.40	0.34	2.97	0.62	21%	0.05	12.49
Device brand	Emerson	177	99.0	0.86	0.62	0.61	0.47	2.84	0.64	22%	0.14	4.54
Device brand	Nest	3,664	98.8	0.93	0.54	0.37	0.26	2.93	0.52	18%	0.04	14.90
Device brand	Honeywell	29	99.4	1.60	1.15	0.27	0.59	2.61	0.90	35%	0.35	2.58
Number of thermostats	1	4,800	98.9	0.91	0.54	0.35	0.27	2.89	0.52	18%	0.03	17.78
Number of thermostats	2	773	98.4	1.20	0.87	0.59	0.38	3.15	0.76	24%	0.09	8.52
Number of thermostats	3+ thermostats	42	97.9	1.49	0.85	0.56	0.91	3.92	0.95	24%	0.41	2.33
Low income	N	4,099	98.8	1.01	0.68	0.43	0.32	2.89	0.61	21%	0.03	18.36
Low income	Y	1,516	99.1	0.82	0.33	0.27	0.22	3.05	0.41	13%	0.05	8.00
Solar	No solar	3,390	98.6	1.02	0.59	0.33	0.28	2.95	0.55	19%	0.03	16.14
Solar	Solar	2,225	99.1	0.86	0.59	0.48	0.32	2.92	0.57	19%	0.05	11.95
Sublap	Other	0										
Sublap	SLAP_PGCC	0										
Sublap	SLAP_PGEB	0										
Sublap	SLAP_PGF1	0										
Sublap	SLAP_PGFG	0										
Sublap	SLAP_PGHB	0										
Sublap	SLAP_PGKN	0										
Sublap	SLAP_PGNB	0										
Sublap	SLAP_PGNC	0										
Sublap	SLAP_PGNP	5,615	98.8	0.96	0.59	0.39	0.29	2.94	0.56	19%	0.03	19.97
Sublap	SLAP_PGP2	0										
Sublap	SLAP_PGSB	0										
Sublap	SLAP_PGSF	0										
Sublap	SLAP_PGSI	0										
Sublap	SLAP_PGST	0										
Sublap	SLAP_PGZP	0										
AC Propensity	Highest	1,291	99.1	1.26	0.69	0.42	0.26	4.23	0.66	16%	0.07	9.27
AC Propensity	High	1,368	98.9	1.22	0.70	0.31	0.31	3.25	0.64	20%	0.06	10.71
AC Propensity	Medium	1,211	99.0	0.88	0.65	0.56	0.35	2.71	0.61	22%	0.06	11.03
AC Propensity	Low	883	98.7	0.82	0.49	0.41	0.35	2.22	0.52	23%	0.06	8.29
AC Propensity	Lowest	479	98.4	0.47	0.33	0.27	0.12	1.69	0.30	18%	0.07	4.32
AC Propensity	None	383	97.8	0.31	0.29	0.27	0.26	1.42	0.28	20%	0.08	3.67
Electric Vehicle	EV	977	96.1	0.90	0.81	0.72	0.47	2.78	0.72	26%	0.08	9.44
Electric Vehicle	No EV	4,638	99.4	0.97	0.55	0.32	0.26	2.97	0.52	18%	0.03	17.62
TOU Automation	Y	949	98.7	1.00	0.68	0.44	0.32	2.94	0.61	21%	0.07	9.19
TOU Automation	N	4,666	98.9	0.95	0.57	0.38	0.29	2.93	0.55	19%	0.03	17.78

Table A- 29: 08/16/2023 17:00-20:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Average Performance: Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	13,878	100.7	1.24	0.79	0.43		3.30	0.82	25%	0.02	41.23
Device brand	ecobee	5,208	101.2	1.34	0.85	0.47		3.35	0.89	26%	0.03	28.29
Device brand	Emerson	342	100.1	1.17	0.93	0.87		3.34	0.99	30%	0.12	8.07
Device brand	Nest	8,212	100.5	1.17	0.73	0.38		3.26	0.76	23%	0.03	28.89
Device brand	Honeywell	57	99.9	1.95	0.90	0.75		3.71	1.20	32%	0.28	4.24
Number of thermostats	1	11,257	101.0	1.10	0.67	0.34		3.10	0.70	23%	0.02	33.71
Number of thermostats	2	2,298	99.4	1.83	1.26	0.74		3.99	1.28	32%	0.06	22.73
Number of thermostats	3+ thermostats	324	99.9	2.06	1.52	1.23		5.19	1.60	31%	0.19	8.58
Low income	N	9,605	100.1	1.31	0.85	0.48		3.33	0.88	26%	0.02	35.41
Low income	Y	4,273	102.2	1.08	0.65	0.31		3.21	0.68	21%	0.03	21.14
Solar	No solar	7,974	100.9	1.13	0.67	0.36		3.09	0.72	23%	0.02	29.22
Solar	Solar	5,904	100.5	1.38	0.95	0.52		3.58	0.95	26%	0.03	29.21
Sublap	Other	0										
Sublap	SLAP_PGCC	0										
Sublap	SLAP_PGEB	0										
Sublap	SLAP_PGF1	7,551	103.7	1.13	0.71	0.34		3.08	0.73	24%	0.03	29.01
Sublap	SLAP_PGFG	0										
Sublap	SLAP_PGHB	0										
Sublap	SLAP_PGKN	0										
Sublap	SLAP_PGNB	0										
Sublap	SLAP_PGNC	0										
Sublap	SLAP_PGNP	0										
Sublap	SLAP_PGP2	0										
Sublap	SLAP_PGSB	0										
Sublap	SLAP_PGSF	0										
Sublap	SLAP_PGSI	6,327	97.2	1.37	0.88	0.53		3.56	0.93	26%	0.03	30.20
Sublap	SLAP_PGST	0										
Sublap	SLAP_PGZP	0										
AC Propensity	Highest	3,979	101.0	1.72	1.03	0.51		4.58	1.08	24%	0.04	24.39
AC Propensity	High	3,432	101.0	1.25	0.83	0.40		3.35	0.83	25%	0.04	22.57
AC Propensity	Medium	2,836	100.8	1.17	0.79	0.43		2.91	0.80	27%	0.04	19.50
AC Propensity	Low	1,987	100.4	0.92	0.63	0.45		2.44	0.67	27%	0.04	15.29
AC Propensity	Lowest	992	100.2	0.62	0.49	0.37		1.85	0.50	27%	0.06	8.42
AC Propensity	None	652	99.5	0.42	0.15	0.20		1.77	0.26	14%	0.07	3.45
Electric Vehicle	EV	2,977	98.4	1.58	1.09	0.69		4.03	1.12	28%	0.05	21.54
Electric Vehicle	No EV	10,901	101.4	1.15	0.70	0.36		3.10	0.74	24%	0.02	35.35
TOU Automation	Y	2,698	100.9	1.37	0.87	0.45		3.32	0.90	27%	0.04	19.91
TOU Automation	N	11,180	100.7	1.21	0.77	0.42		3.29	0.80	24%	0.02	36.16

Table A- 30: 08/16/2023 18:00-20:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Average Performance: Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	54,248	80.5	0.67	0.37			2.13	0.52	24%	0.01	57.95
Device brand	ecobee	11,681	81.2	0.76	0.43			2.24	0.59	26%	0.02	31.56
Device brand	Emerson	840	81.8	0.59	0.40			1.95	0.49	25%	0.06	7.81
Device brand	Nest	41,288	80.3	0.64	0.36			2.11	0.50	24%	0.01	48.09
Device brand	Honeywell	221	81.7	0.85	0.45			2.02	0.65	32%	0.14	4.69
Number of thermostats	1	42,767	80.5	0.58	0.32			2.00	0.45	22%	0.01	47.17
Number of thermostats	2	9,961	80.6	0.97	0.60			2.57	0.78	30%	0.02	31.81
Number of thermostats	3+ thermostats	1,519	79.4	1.15	0.59			3.12	0.87	28%	0.07	12.00
Low income	N	49,413	80.2	0.67	0.37			2.10	0.52	25%	0.01	54.39
Low income	Y	4,835	82.8	0.65	0.40			2.45	0.52	21%	0.03	19.58
Solar	No solar	37,487	80.2	0.57	0.30			1.97	0.43	22%	0.01	44.34
Solar	Solar	16,761	81.3	0.88	0.55			2.50	0.71	29%	0.02	37.43
Sublap	Other	0										
Sublap	SLAP_PGCC	972	71.4	0.07	(0.08)			1.13	-0.01	-1%	0.06	-0.12
Sublap	SLAP_PGEB	19,532	81.8	0.77	0.41			2.39	0.59	25%	0.02	36.70
Sublap	SLAP_PGF1	0										
Sublap	SLAP_PGFG	1,968	79.2	0.62	0.33			1.88	0.47	25%	0.04	10.70
Sublap	SLAP_PGHB	0										
Sublap	SLAP_PGKN	0										
Sublap	SLAP_PGNB	2,426	80.2	0.46	0.41			1.93	0.43	23%	0.04	10.45
Sublap	SLAP_PGNC	0										
Sublap	SLAP_PGNP	0										
Sublap	SLAP_PGP2	8,495	76.2	0.62	0.34			2.07	0.48	23%	0.02	21.35
Sublap	SLAP_PGSB	16,498	79.0	0.59	0.35			1.83	0.47	26%	0.01	32.09
Sublap	SLAP_PGSF	0										
Sublap	SLAP_PGSI	0										
Sublap	SLAP_PGST	2,528	96.0	0.99	0.50			3.03	0.75	25%	0.05	16.51
Sublap	SLAP_PGZP	1,828	84.9	0.67	0.44			2.37	0.55	23%	0.05	10.71
AC Propensity	Highest	7,891	82.6	1.35	0.74			4.02	1.05	26%	0.03	31.54
AC Propensity	High	8,328	81.8	0.99	0.57			2.83	0.78	27%	0.03	30.88
AC Propensity	Medium	9,250	81.1	0.78	0.44			2.28	0.61	27%	0.02	27.41
AC Propensity	Low	9,526	80.1	0.56	0.29			1.78	0.43	24%	0.02	22.50
AC Propensity	Lowest	7,949	79.5	0.29	0.16			1.31	0.22	17%	0.02	13.04
AC Propensity	None	11,304	78.5	0.18	0.11			1.03	0.15	14%	0.01	11.28
Electric Vehicle	EV	35,301	79.4	0.73	0.41			2.25	0.57	25%	0.01	47.97
Electric Vehicle	No EV	18,947	82.5	0.55	0.31			1.92	0.43	22%	0.01	32.77
TOU Automation	Y	7,307	80.8	0.79	0.45			2.18	0.62	28%	0.02	25.86
TOU Automation	N	46,941	80.5	0.65	0.36			2.13	0.51	24%	0.01	52.15

Table A- 31: 08/16/2023 19:00 – 20:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Average Performance: Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	2,936	102.0	1.11				3.23	1.11	34%	0.04	29.56
Device brand	ecobee	1,034	102.0	1.09				3.26	1.09	33%	0.06	18.68
Device brand	Emerson	67	102.0	1.16				3.10	1.16	37%	0.23	4.98
Device brand	Nest	1,818	102.0	1.12				3.21	1.12	35%	0.05	22.40
Device brand	Honeywell	0										
Number of thermostats	1	2,615	102.0	0.95				3.04	0.95	31%	0.04	25.61
Number of thermostats	2	275	102.0	2.15				4.45	2.15	48%	0.15	14.35
Number of thermostats	3+ thermostats	46	102.0	3.08				6.37	3.08	48%	0.41	7.55
Low income	N	1,368	102.0	1.24				3.38	1.24	37%	0.06	21.45
Low income	Y	1,568	102.0	1.00				3.11	1.00	32%	0.05	20.61
Solar	No solar	1,625	102.0	0.93				2.83	0.93	33%	0.05	19.95
Solar	Solar	1,311	102.0	1.32				3.72	1.32	35%	0.06	22.00
Sublap	Other	0										
Sublap	SLAP_PGCC	0										
Sublap	SLAP_PGEB	0										
Sublap	SLAP_PGF1	0										
Sublap	SLAP_PGFG	0										
Sublap	SLAP_PGHB	0										
Sublap	SLAP_PGKN	2,936	102.0	1.11				3.23	1.11	34%	0.04	29.56
Sublap	SLAP_PGNB	0										
Sublap	SLAP_PGNC	0										
Sublap	SLAP_PGNP	0										
Sublap	SLAP_PGP2	0										
Sublap	SLAP_PGSB	0										
Sublap	SLAP_PGSF	0										
Sublap	SLAP_PGSI	0										
Sublap	SLAP_PGST	0										
Sublap	SLAP_PGZP	0										
AC Propensity	Highest	919	102.0	1.45				4.32	1.45	33%	0.08	18.24
AC Propensity	High	868	102.0	1.22				3.26	1.22	37%	0.06	20.09
AC Propensity	Medium	627	102.0	0.84				2.60	0.84	32%	0.07	11.98
AC Propensity	Low	309	102.0	0.74				2.15	0.74	34%	0.08	9.19
AC Propensity	Lowest	129	102.0	0.58				1.97	0.58	30%	0.15	3.84
AC Propensity	None	84	102.0	0.74				1.98	0.74	37%	0.22	3.37
Electric Vehicle	EV	130	102.0	1.32				3.90	1.32	34%	0.23	5.64
Electric Vehicle	No EV	2,806	102.0	1.10				3.20	1.10	34%	0.04	29.15
TOU Automation	Y	465	102.0	1.03				3.25	1.03	32%	0.09	11.60
TOU Automation	N	2,471	102.0	1.12				3.23	1.12	35%	0.04	27.19

Table A- 32: 08/23/2023 17:00 – 19:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Average Performance: Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	2,326	91.6	0.59	0.29			2.27	0.44	19%	0.05	9.62
Device brand	ecobee	497	91.4	0.55	0.41			2.16	0.48	22%	0.09	5.10
Device brand	Emerson	33	92.4	0.33	0.37			1.78	0.35	20%	0.27	1.29
Device brand	Nest	1,796	91.7	0.61	0.26			2.31	0.44	19%	0.05	8.15
Device brand	Honeywell	0										
Number of thermostats	1	1,757	91.3	0.58	0.29			2.20	0.43	20%	0.05	8.67
Number of thermostats	2	485	92.5	0.68	0.35			2.49	0.51	21%	0.11	4.52
Number of thermostats	3+ thermostats	84	94.1	0.43	(0.08)			2.39	0.18	7%	0.30	0.59
Low income	N	2,169	91.7	0.62	0.29			2.28	0.46	20%	0.05	9.46
Low income	Y	157	91.2	0.26	0.17			2.14	0.22	10%	0.14	1.61
Solar	No solar	1,646	91.6	0.56	0.26			2.38	0.41	17%	0.05	8.38
Solar	Solar	680	91.7	0.67	0.35			2.00	0.51	25%	0.10	5.01
Sublap	Other	0										
Sublap	SLAP_PGCC	0										
Sublap	SLAP_PGEB	0										
Sublap	SLAP_PGF1	0										
Sublap	SLAP_PGFG	0										
Sublap	SLAP_PGHB	0										
Sublap	SLAP_PGKN	0										
Sublap	SLAP_PGNB	2,326	91.6	0.59	0.29			2.27	0.44	19%	0.05	9.62
Sublap	SLAP_PGNC	0										
Sublap	SLAP_PGNP	0										
Sublap	SLAP_PGP2	0										
Sublap	SLAP_PGSB	0										
Sublap	SLAP_PGSF	0										
Sublap	SLAP_PGSI	0										
Sublap	SLAP_PGST	0										
Sublap	SLAP_PGZP	0										
AC Propensity	Highest	208	92.3	0.85	0.11			3.76	0.48	13%	0.20	2.34
AC Propensity	High	293	92.0	0.86	0.36			3.12	0.61	20%	0.14	4.38
AC Propensity	Medium	409	91.6	0.88	0.62			2.76	0.75	27%	0.11	6.72
AC Propensity	Low	462	90.8	0.62	0.36			2.20	0.49	22%	0.10	5.05
AC Propensity	Lowest	344	91.5	0.33	0.25			1.92	0.29	15%	0.10	2.84
AC Propensity	None	610	91.8	0.27	0.10			1.27	0.18	15%	0.07	2.64
Electric Vehicle	EV	1,572	92.3	0.65	0.26			2.40	0.46	19%	0.06	7.68
Electric Vehicle	No EV	754	90.3	0.48	0.34			2.00	0.41	20%	0.07	6.01
TOU Automation	Y	270	91.4	0.42	0.42			2.03	0.42	21%	0.13	3.17
TOU Automation	N	2,056	91.7	0.62	0.27			2.30	0.44	19%	0.05	9.08

Table A- 33: 10/05/2023 17:00 – 19:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts				Average Performance				
				Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	32,035	81.5	0.45	0.28			1.52	0.36	24%	0.01	34.27
Device brand	ecobee	5,988	81.4	0.45	0.27			1.54	0.36	23%	0.02	15.50
Device brand	Emerson	396	81.0	0.44	0.33			1.28	0.39	30%	0.07	5.14
Device brand	Nest	25,435	81.5	0.46	0.27			1.52	0.36	24%	0.01	30.05
Device brand	Honeywell	114	81.4	0.52	0.31			1.41	0.42	30%	0.16	2.57
Number of thermostats	1	25,515	81.4	0.45	0.27			1.44	0.36	25%	0.01	30.88
Number of thermostats	2	5,533	81.6	0.48	0.33			1.75	0.41	23%	0.03	14.49
Number of thermostats	3+ thermostats	987	81.6	0.51	0.17			2.20	0.34	16%	0.08	4.50
Low income	N	30,250	81.5	0.47	0.29			1.53	0.38	25%	0.01	33.44
Low income	Y	1,785	81.4	0.33	0.17			1.50	0.25	17%	0.03	7.55
Solar	No solar	23,552	81.4	0.42	0.27			1.46	0.35	24%	0.01	31.72
Solar	Solar	8,483	81.6	0.55	0.29			1.70	0.42	25%	0.03	15.82
Sublap	Other	0										
Sublap	SLAP_PGCC	1,024	78.9	0.12	0.03			1.33	0.08	6%	0.05	1.40
Sublap	SLAP_PGEB	0										
Sublap	SLAP_PGF1	0										
Sublap	SLAP_PGFG	0										
Sublap	SLAP_PGHB	0										
Sublap	SLAP_PGKN	0										
Sublap	SLAP_PGNB	2,599	80.6	0.53	0.19			1.76	0.36	20%	0.04	8.82
Sublap	SLAP_PGNC	0										
Sublap	SLAP_PGNP	0										
Sublap	SLAP_PGP2	8,976	82.1	0.51	0.25			1.68	0.38	23%	0.02	16.37
Sublap	SLAP_PGSB	17,382	81.9	0.47	0.35			1.47	0.41	28%	0.01	30.33
Sublap	SLAP_PGSF	2,053	77.7	0.17	0.01			1.05	0.09	8%	0.03	3.04
Sublap	SLAP_PGSI	0										
Sublap	SLAP_PGST	0										
Sublap	SLAP_PGZP	0										
AC Propensity	Highest	2,987	81.9	1.21	0.72			3.06	0.96	31%	0.05	19.08
AC Propensity	High	3,770	81.8	0.76	0.51			2.17	0.63	29%	0.04	17.61
AC Propensity	Medium	4,854	81.8	0.62	0.36			1.79	0.49	27%	0.03	18.56
AC Propensity	Low	5,809	81.8	0.42	0.31			1.43	0.36	25%	0.02	17.50
AC Propensity	Lowest	5,354	81.6	0.20	0.06			1.07	0.13	12%	0.03	4.75
AC Propensity	None	9,261	80.7	0.05	(0.01)			0.82	0.02	2%	0.01	1.34
Electric Vehicle	EV	23,154	81.5	0.48	0.30			1.64	0.39	24%	0.01	30.67
Electric Vehicle	No EV	8,881	81.3	0.38	0.21			1.20	0.30	25%	0.02	15.45
TOU Automation	Y	3,976	81.4	0.45	0.28			1.49	0.37	25%	0.03	12.94
TOU Automation	N	28,059	81.5	0.45	0.27			1.53	0.36	24%	0.01	31.78

Table A- 34: 10/06/2023 17:00 – 19:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts				Average Performance				
				Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
All	All	29,747	81.7	0.55	0.36			1.73	0.46	26%	0.01	38.41
Device brand	ecobee	5,552	81.7	0.56	0.38			1.73	0.47	27%	0.03	18.24
Device brand	Emerson	359	81.5	0.40	0.39			1.57	0.40	25%	0.09	4.58
Device brand	Nest	23,635	81.8	0.55	0.36			1.74	0.45	26%	0.01	33.42
Device brand	Honeywell	106	81.8	0.55	0.56			1.58	0.55	35%	0.17	3.27
Number of thermostats	1	23,653	81.7	0.51	0.34			1.64	0.43	26%	0.01	33.56
Number of thermostats	2	5,200	81.8	0.67	0.46			2.03	0.57	28%	0.03	17.55
Number of thermostats	3+ thermostats	894	81.9	0.81	0.45			2.61	0.63	24%	0.09	6.72
Low income	N	28,070	81.8	0.58	0.39			1.75	0.48	28%	0.01	38.40
Low income	Y	1,677	81.6	0.28	0.10			1.64	0.19	11%	0.04	4.79
Solar	No solar	21,630	81.7	0.48	0.31			1.62	0.39	24%	0.01	31.07
Solar	Solar	8,117	81.8	0.75	0.52			2.02	0.63	31%	0.03	22.79
Sublap	Other	0										
Sublap	SLAP_PGCC	1,019	79.3	0.21	0.12			1.62	0.17	10%	0.06	2.72
Sublap	SLAP_PGEB	0										
Sublap	SLAP_PGF1	0										
Sublap	SLAP_PGFG	0										
Sublap	SLAP_PGHB	0										
Sublap	SLAP_PGKN	0										
Sublap	SLAP_PGNB	2,580	80.8	0.47	0.23			1.90	0.35	18%	0.05	7.53
Sublap	SLAP_PGNC	0										
Sublap	SLAP_PGNP	0										
Sublap	SLAP_PGP2	8,912	82.1	0.66	0.40			1.90	0.53	28%	0.02	23.05
Sublap	SLAP_PGSB	17,235	81.8	0.52	0.38			1.62	0.45	28%	0.01	30.60
Sublap	SLAP_PGSF	0										
Sublap	SLAP_PGSI	0										
Sublap	SLAP_PGST	0										
Sublap	SLAP_PGZP	0										
AC Propensity	Highest	2,956	81.9	1.50	0.88			3.50	1.19	34%	0.06	21.03
AC Propensity	High	3,722	81.8	0.81	0.52			2.34	0.66	28%	0.04	17.81
AC Propensity	Medium	4,780	81.8	0.68	0.52			2.01	0.60	30%	0.03	19.56
AC Propensity	Low	5,679	81.8	0.50	0.35			1.59	0.43	27%	0.02	18.37
AC Propensity	Lowest	5,149	81.7	0.26	0.13			1.20	0.19	16%	0.02	8.49
AC Propensity	None	7,462	81.5	0.03	0.01			0.87	0.02	2%	0.02	1.37
Electric Vehicle	EV	21,870	81.8	0.61	0.40			1.88	0.50	27%	0.01	34.33
Electric Vehicle	No EV	7,877	81.6	0.40	0.26			1.33	0.33	24%	0.02	17.40
TOU Automation	Y	3,670	81.7	0.60	0.42			1.70	0.51	30%	0.03	16.24
TOU Automation	N	26,077	81.8	0.54	0.36			1.74	0.45	26%	0.01	35.04

Table A- 35: 10/19/2023 17:00 to 19:00

Category	Subcategory	Total sites dispatched	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hourly Impacts: Hour 2 Impact (kW)	Hourly Impacts: Hour 3 Impact (kW)	Hourly Impacts: Hour 4 Impact (kW)	Average Performance: Reference Load (kW)	Average Performance: Impact (kW)	Average Performance: % Load reduction	Average Performance: Std. error	Average Performance: t-stat
All	All	30,420	78.0	0.36	0.25			1.36	0.30	22%	0.01	32.64
Device brand	ecobee	5,635	77.8	0.35	0.27			1.39	0.31	22%	0.02	14.70
Device brand	Emerson	383	77.4	0.26	0.15			1.17	0.21	18%	0.07	2.91
Device brand	Nest	24,193	78.1	0.36	0.25			1.36	0.30	22%	0.01	28.91
Device brand	Honeywell	113	78.2	0.33	0.28			1.17	0.30	26%	0.12	2.51
Number of thermostats	1	24,207	78.0	0.34	0.22			1.28	0.28	22%	0.01	28.16
Number of thermostats	2	5,293	78.2	0.43	0.35			1.61	0.39	24%	0.03	15.51
Number of thermostats	3+ thermostats	920	78.2	0.52	0.31			2.14	0.41	19%	0.07	5.75
Low income	N	28,688	78.1	0.37	0.26			1.37	0.31	23%	0.01	32.26
Low income	Y	1,732	77.8	0.25	0.09			1.36	0.17	12%	0.03	5.21
Solar	No solar	22,147	78.0	0.32	0.21			1.27	0.26	21%	0.01	26.33
Solar	Solar	8,273	78.1	0.46	0.35			1.61	0.41	25%	0.02	19.38
Sublap	Other	0										
Sublap	SLAP_PGCC	1,043	71.3	0.33	0.28			1.30	0.31	24%	0.04	7.42
Sublap	SLAP_PGEB	0										
Sublap	SLAP_PGF1	0										
Sublap	SLAP_PGFG	0										
Sublap	SLAP_PGHB	47	60.0	0.06	0.14			1.11	0.10	9%	0.16	0.62
Sublap	SLAP_PGKN	0										
Sublap	SLAP_PGNB	2,634	78.3	0.41	0.24			1.59	0.32	20%	0.04	9.18
Sublap	SLAP_PGNC	0										
Sublap	SLAP_PGNP	0										
Sublap	SLAP_PGP2	9,119	78.5	0.34	0.17			1.43	0.26	18%	0.02	14.44
Sublap	SLAP_PGSB	17,577	78.2	0.36	0.29			1.30	0.32	25%	0.01	27.54
Sublap	SLAP_PGSF	0										
Sublap	SLAP_PGSI	0										
Sublap	SLAP_PGST	0										
Sublap	SLAP_PGZP	0										
AC Propensity	Highest	3,031	78.4	0.79	0.52			2.55	0.66	26%	0.04	15.00
AC Propensity	High	3,814	78.3	0.61	0.53			1.95	0.57	29%	0.03	18.44
AC Propensity	Medium	4,866	78.2	0.43	0.25			1.49	0.34	23%	0.02	14.50
AC Propensity	Low	5,764	78.2	0.30	0.23			1.23	0.27	22%	0.02	14.93
AC Propensity	Lowest	5,248	78.1	0.19	0.06			0.96	0.12	13%	0.02	7.22
AC Propensity	None	7,697	77.5	0.08	0.05			0.81	0.07	9%	0.01	4.91
Electric Vehicle	EV	22,336	78.1	0.39	0.28			1.48	0.33	22%	0.01	28.72
Electric Vehicle	No EV	8,084	77.8	0.28	0.17			1.04	0.22	22%	0.01	15.79
TOU Automation	Y	3,674	77.9	0.35	0.29			1.35	0.32	23%	0.03	12.24
TOU Automation	N	26,746	78.1	0.36	0.24			1.37	0.30	22%	0.01	30.29

APPENDIX B: EVENT IMPACTS MATCHED CONTROL GROUP TOURNAMENT RESULTS

The evaluation of the 2023 DR impacts was estimated using a matched control group that was selected each event. There are different techniques – Euclidian distance, propensity score matching, stratified matching - that can be used to identify a matched control group. This section documents how the matched control group was selected and the quality of the matched control group (before the differences-in-differences estimation).

Rather than pre-determine the method and model used to select the matched control group, we held a tournament to identify the most accurate matched control group approach. This model was then used to pick a matched control group for each event's participants. Table B- 1: 2023 DR Matched Control Group Selection summarizes the key elements of this process.

Table B- 1: 2023 DR Matched Control Group Selection

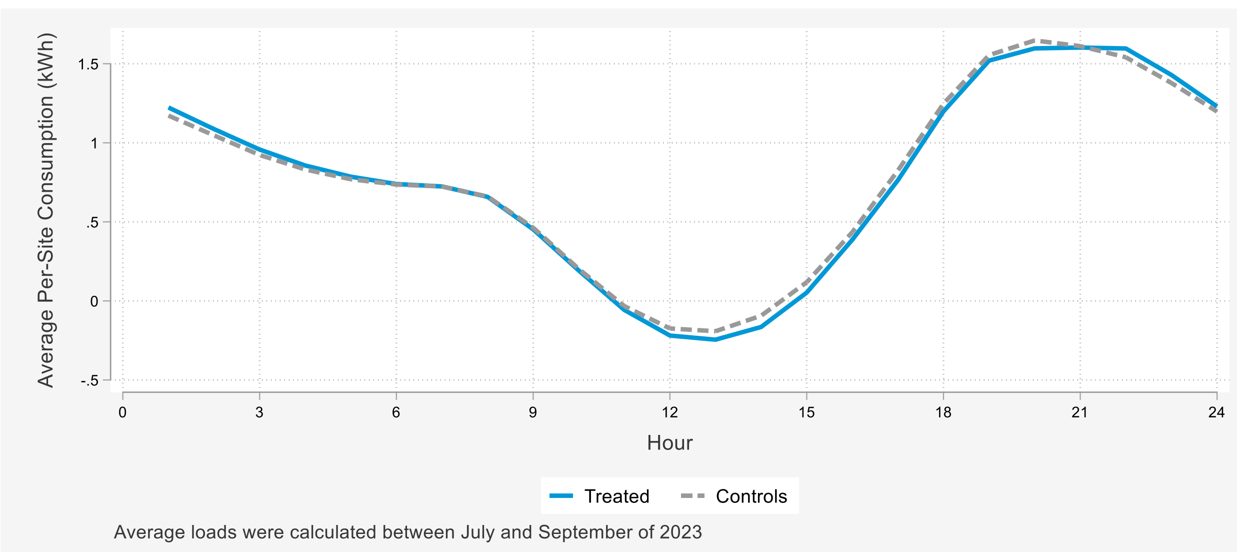
COMPONENT	ANSWER
What population was used a control group? And how many sites did it include?	The control pool was comprised of 25,000 PG&E customers who were pre-selected as a representative control pool for participants in this Pilot. From this pool, one match for each participant was selected. Members from the control pool could be selected more than once.
Was matching done with or without replacement?	Matching was done with replacement, meaning that the same control pool candidate could be matched to more than one DR (treatment) participant if they were the best match.
What characteristics were included in the matching?	The matching was selected based a tournament of six different combinations of methods and models. The final model used propensity score matching and included the following characteristics: ▪ Sub-LAP ▪ Solar Flag ▪ Solar Capacity (kW) ▪ Weather Sensitivity Coefficient ▪ Average Consumption on the top 10 hottest days prior to an event in three-hour intervals ▪ The propensity the premise had an EV on site

COMPONENT	ANSWER
The matching included customer loads. What time frame was included in the matching?	The top 10 hottest days prior to an event were included when assessing the closeness of matches
How was the best matching method and model identified?	The best method and model combination was identified by comparing the loads for the treatment and matched control group out-of-sample, during the period prior to the event, excluding prior event days. We selected the matched control group that best mirrored the participant group (in aggregate) during summer peak hours, as measured by % Bias and RRMSE, in the out-of-sample test. The below table shows how well TOU automation and matched control group characteristics compared to each other using t-tests.

Table B- 2: Performance Metrics for Peak Hours – End of 2023 Season Matched Control Group

Treated		Control		MAE	MAPE	MSE	SSE	RMSE	% BIAS	RRMSE
Average Usage	Sites	Average Usage	Sites							
1.336	73,494	1.377	73,494	0.041	0.063	0.003	1.263	0.054	3.04%	4.03%

Figure B- 1: Average Control Versus Participant Consumption – End of 2023 Season



APPENDIX C: AUTOMATED DAILY LOAD SHIFTING MATCHED CONTROL GROUP TOURNAMENT

The analysis of the automated daily load shifting enabled by thermostats relied on a matched control groups. There are different techniques – Euclidian distance, propensity score matching, stratified matching - that can be used to identify a matched control group. In addition, the control pool used matters. This section documents how the matched control group was selected and the quality of the matched control group (before the differences-in-differences estimation). A fundamental characteristic of the algorithm is that once it was turned on, it was active on all days. Thus, the analysis had to rely on pre and post activations data.

Rather than pre-determine the method and model used to select the matched control group, we held a tournament to identify the most accurate matched control group approach. This model was then used to pick a matched control group for each event's participants.

Table C-1: Automated Daily Load Shifting Matched Control Group Selection

COMPONENT	ANSWER
What population was used a control group? And how many sites did it include?	The control pool included all ecobee thermostat customers who: 1. Enrolled in the event based (DR) program 2. Where were invited to participate in daily automated load shifting 3. Declined the offer to automate daily shifting for TOU rates 4. Had a full year of pre-treatment data 5. Had a full year (or more) or post-treatment data From this pool, one match for each participant was selected. Members from the control pool could be selected more than once.
Was matching done with or without replacement?	Matching was done with replacement, meaning that the same control pool candidate could be matched to more than one DR (treatment) participant if they were the best match.
What characteristics were included in the matching?	The matching was selected based a tournament of twenty (20) different combinations of methods and models.
The matching included customer loads. What time frame was included in the matching?	For sites, we included the summary load characteristics from the summer prior to enrollment.
How was the best matching method and model identified?	The best combination of method and model was selected using a two stage process. First, options had insufficient coverage (matches for less than 90% of sites) or had a bias in excess of +/-1% based on outsample testing were eliminated from consideration. Ten of the twenty options tested passed the first screen. Second, the best performaning model was selected based on out-of-sample root-mean-squared error (RMSE), as standard metric for model precision.

Figure C-1: Pre-treatment Comparison of Automated Daily Shifting Treatment Control Group

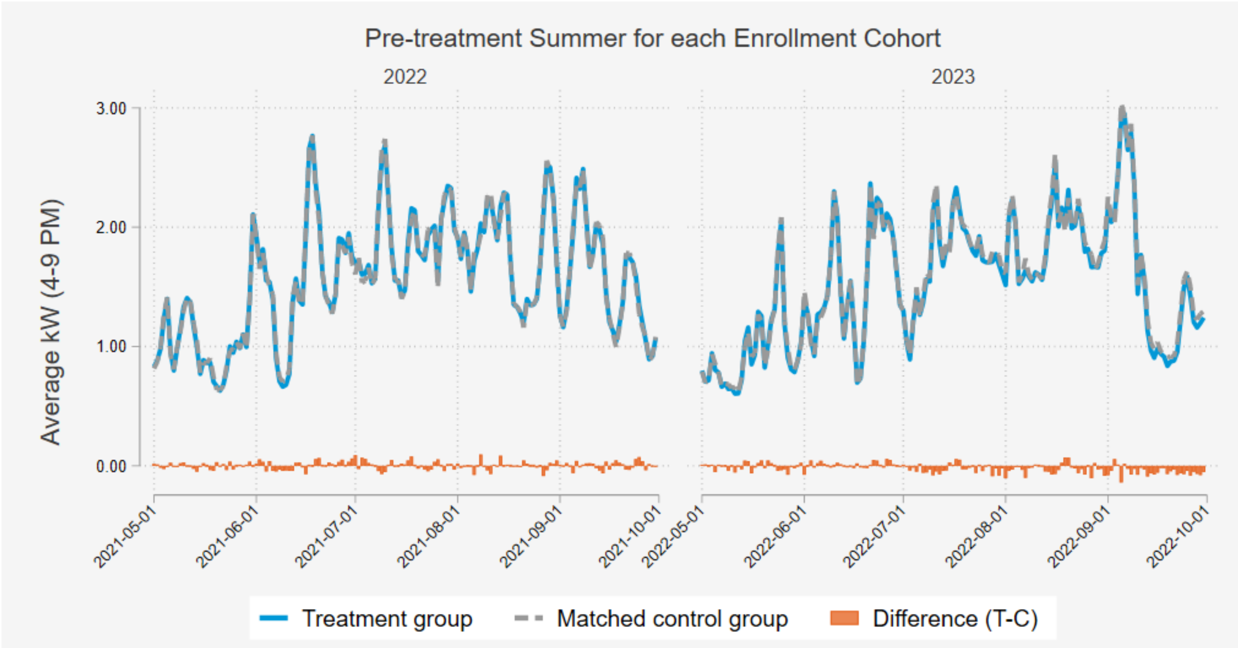


Table C- 2: Performance Metrics – Automated Daily Shifting Matched Control Group

Model	Treatment Avg. kW	Control Average kW	% Bias	MAPE	SSE	RMSE	CVRMSE
1	1.170	1.180	0.009	7.3%	92,464	0.064	0.054
2	1.163	1.167	0.004	6.5%	81,151	0.061	0.053
3	1.180	1.179	0.000	5.2%	99,762	0.069	0.059
4	1.150	1.134	-0.014	8.3%	111,346	0.069	0.060
5	1.152	1.124	-0.025	7.8%	148,340	0.081	0.070
6	1.161	1.152	-0.007	8.1%	116,580	0.072	0.062
7	1.157	1.174	0.015	20.4%	141,985	0.076	0.066
8	1.157	1.157	0.000	13.8%	93,958	0.062	0.054
9	1.155	1.158	0.002	7.5%	89,957	0.061	0.053
10	1.151	1.118	-0.028	9.0%	101,697	0.065	0.056
11	1.151	1.151	0.000	8.4%	92,433	0.062	0.054
12	1.151	1.145	-0.005	7.1%	78,844	0.057	0.050
13	1.187	1.187	0.000	7.3%	126,870	0.077	0.065
14	1.225	1.229	0.004	7.5%	114,264	0.082	0.067
15	1.211	1.211	-0.001	6.4%	103,247	0.072	0.059
16	1.153	1.144	-0.007	7.5%	84,734	0.059	0.051
17	1.154	1.152	-0.001	17.7%	96,908	0.063	0.055
18	1.153	1.144	-0.007	10.0%	123,634	0.072	0.062
19	1.237	1.245	0.006	4.7%	82,026	0.070	0.056
20	1.155	1.166	0.009	7.4%	87,119	0.060	0.052

Table C-3: Performance Metrics – Automated Daily Shifting Matched Control Group

		Matching Model																			
	Component	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Segmention (Hard Match)	Matching method PSM: Propensity Score Matching EDM: Euclidean Distance Matching	PSM	PSM	PSM	PSM	PSM	PSM	EDM	EDM	EDM	EDM	EDM	EDM	PSM	PSM	PSM	EDM	EDM	EDM	PSM	EDM
	Annual cohort (2)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Geographic region (2)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Size bins (5)	x	x	x				x	x	x				x	x	x	x	x	x	x	x
	Rate category (3)				x	x	x				x	x	x	x	x	x	x	x	x	x	x
	Solar (2)	x	x	x	x	x	x	x	x	x	x	x	x							x	x
Matching variables (Soft Match)	Avg kWh	x	x	x				x	x	x					x	x		x	x		
	Percentile load	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Load factor	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	EV score	x	x	x				x	x	x											
	Solar installed capacity	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Battery storage	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Hourly kW (24)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Weather sensitivity	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Monthly usage patterns		x	x					x	x											
	Detailed Rate		x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x
	Geographic area			x						x											
	Size bins (% of total demand)			x		x	x			x		x	x							x	x
	Low income				x	x	x				x	x	x	x	x	x	x	x	x	x	x
	Sub LAP						x						x			x			x	x	x

APPENDIX D: ANALYSIS WITH DELIVERED LOADS VERSUS NET LOADS

In 2023, PG&E opted to calculate impacts using delivered loads in order to meet with CAISO settlement requirements, which do not count load reductions if they lead to exports to the grid. The shift introduced a significant methodological shift. During the 2021 and 2022 seasons, net loads were utilized because they provide unbiased, accurate results.

Delivered loads, used in 2023, represent the energy supplied to a consumer's premise and do not include exports by the customers to the grid. This measurement does not account for behind-the-meter generation, such as solar or wind energy, which customers might generate and export back to the grid. Using only delivered loads, lead to censoring and produces downward bias int the results. Consequently, delivered loads often show a lower value than net loads.

In contrast, net loads, used in the previous years, reflect the full energy patterns at a site, and include both imports from and exports to the grid. This approach provides a more accurate reflection of actual load impacts to the grid, offering clearer insights into consumer behavior and the effectiveness of energy-saving measures.

Only using delivered load inherently leads to bias and incorrect results. The use of delivered loads only is a form of data censoring, which introduces bias. Two examples are useful for understanding the bias. The first is battery storage. Most sites will have zero energy use because the battery storage typically offsets home consumption during peak hours. A battery may be discharging 2kW normally (non-event conditions) but can, if called, dispatch up to 7 kW. Doing so leads to exports, however. If only delivered loads are counted, the estimated impacts would be zero per battery when, in fact, there is a 5kW change in loads. A similar, but more subtle, bias occurs with smart thermostat. For sites with solar, the thermostat can lead to a 1 kW drop in loads in afternoon hours. If the whole home load is 0.5 kW, the dispatch of the thermotats would lead to a -0.5kW load (1 kW reduction). However, if only delivered loads are used, only 0.5 kW of reductions are counts. Put directly, using only the delivered channel fails to estimate the load reduction accurately.

The bias gets bigger as more customers adopt solar and battery storage. The implications of the bias introduced by only counting delivered loads (versus both imports and exports) are substantial for a Pilot such as this where over one third of customers have rooftop solar. It also precludes participation of technologies such electric vehicles and behind the meter batteries in supply side DR programs that participate in the CAISO market. From an evaluation standpoint,the objective to accurately reflect the full impact on DR on the grid. Moever, accurate estimates are vital for effective grid management and planning.

Below, Table D- 1 and Table D- 2 display the results for 2023 events using delivered and net loads, respectively. The customer sites, control group, and methods used were identical. The only difference was that the results using delivered load do not include exports to grid – they use censored load. By contrast, the results using net load includes all the energy use at the sites regardless of whether the site was importing or exporting energy at the time. Impacts are greater when calculated using net loads and lower when using delivered loads only (due to the data censoring).

Table D- 1: 2023 DR Results using Delivered Loads

Date	Event window	Total sites dispatched	Total sites enrolled	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Event Average Performance: Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
6/30/2023	16:00 to 17:00	14,119	71,411	99.6	0.73				2.03	0.73	35.9%	0.018	40.96
6/30/2023	17:00 to 18:00	26,708	71,411	82.0	0.44				1.44	0.44	30.9%	0.012	37.28
6/30/2023	18:00 to 19:00	6,075	71,411	92.4	0.70				2.32	0.70	30.3%	0.032	21.85
6/30/2023	19:00 to 20:00	24,224	71,411	82.7	0.69				2.23	0.69	31.1%	0.016	43.21
7/15/2023	16:00 to 19:00	43,000	73,415	99.5	0.82	0.59	0.41		2.50	0.61	24.3%	0.011	53.21
7/17/2023	17:00 to 19:00	11,817	73,983	101.3	1.10	0.65			3.28	0.87	26.6%	0.022	39.51
8/15/2023	16:00 to 18:00	14,472	79,350	100.5	1.09	0.76			2.87	0.92	32.1%	0.019	48.84
8/15/2023	17:00 to 19:00	7,694	79,350	104.2	1.15	0.60			3.40	0.88	25.8%	0.025	34.84
8/16/2023	16:00 to 20:00	5,615	79,513	98.8	0.96	0.59	0.39	0.29	2.94	0.56	19.0%	0.028	19.97
8/16/2023	17:00 to 20:00	13,878	79,513	100.7	1.24	0.79	0.43		3.30	0.82	24.8%	0.020	41.23
8/16/2023	18:00 to 20:00	54,248	79,513	80.5	0.67	0.37			2.13	0.52	24.4%	0.009	57.95
8/16/2023	19:00 to 20:00	2,936	79,513	102.0	1.11				3.23	1.11	34.2%	0.037	29.56
8/23/2023	17:00 to 19:00	2,326	80,487	91.6	0.59	0.29			2.27	0.44	19.4%	0.046	9.62
10/5/2023	17:00 to 19:00	32,035	84,390	81.5	0.45	0.28			1.52	0.36	24.0%	0.011	34.27
10/6/2023	17:00 to 19:00	29,747	84,537	81.7	0.55	0.36			1.73	0.46	26.4%	0.012	38.41
10/19/2023	17:00 to 19:00	30,420	86,160	78.0	0.36	0.25			1.36	0.30	22.2%	0.009	32.64

Table D- 2: 2023 DR Results using Net Loads

Date	Event window	Total sites dispatched	Total sites enrolled	Avg temp (F, site weighted)	Hourly Impacts: Hour 1 Impact (kW)	Hour 2 Impact (kW)	Hour 3 Impact (kW)	Hour 4 Impact (kW)	Event Average Performance: Reference Load (kW)	Impact (kW)	% Load reduction	Std. error	t-stat
6/30/2023	16:00 to 17:00	14,119	71,411	99.6	0.95				1.56	0.95	60.6%	0.021	44.10
6/30/2023	17:00 to 18:00	26,708	71,411	82.0	0.50				1.15	0.50	43.6%	0.013	37.33
6/30/2023	18:00 to 19:00	6,075	71,411	92.4	0.73				2.20	0.73	33.4%	0.035	20.80
6/30/2023	19:00 to 20:00	24,224	71,411	82.7	0.73				2.22	0.73	32.6%	0.016	44.13
7/15/2023	16:00 to 19:00	43,000	73,415	99.5	1.06	0.66	0.42		2.23	0.72	32.1%	0.013	55.90
7/17/2023	17:00 to 19:00	11,817	73,983	101.3	1.30	0.70			3.22	1.00	31.1%	0.024	41.51
8/15/2023	16:00 to 18:00	14,472	79,350	100.5	1.36	0.86			2.70	1.11	41.1%	0.021	52.93
8/15/2023	17:00 to 19:00	7,694	79,350	104.2	1.33	0.63			3.35	0.98	29.2%	0.026	37.32
8/16/2023	16:00 to 20:00	5,615	79,513	98.8	1.21	0.68	0.42	0.27	2.85	0.65	22.7%	0.029	22.03
8/16/2023	17:00 to 20:00	13,878	79,513	100.7	1.35	0.80	0.43		3.27	0.86	26.3%	0.020	42.38
8/16/2023	18:00 to 20:00	54,248	79,513	80.5	0.69	0.39			2.12	0.54	25.4%	0.009	59.07
8/16/2023	19:00 to 20:00	2,936	79,513	102.0	1.10				3.21	1.10	34.3%	0.038	29.16
8/23/2023	17:00 to 19:00	2,326	80,487	91.6	0.58	0.28			2.12	0.43	20.2%	0.046	9.21
10/5/2023	17:00 to 19:00	32,035	84,390	81.5	0.46	0.26			1.47	0.36	24.4%	0.011	33.36
10/6/2023	17:00 to 19:00	29,747	84,537	81.7	0.56	0.36			1.69	0.46	27.2%	0.012	37.96
10/19/2023	17:00 to 19:00	30,420	86,160	78.0	0.37	0.26			1.35	0.31	23.2%	0.009	33.34

APPENDIX E: EX-ANTE REGRESSION OUTPUT

Figure E - 1: Regression Output used to Estimate Ex-Ante Impacts

```
HDFE Linear regression                            Number of obs   =        845
Absorbing 1 HDFE group                            F(  52,      15) =          .
Statistics robust to heteroskedasticity           Prob > F        =          .
                                                  R-squared       =     0.9149
                                                  Adj R-squared   =     0.9093
Number of clusters (date)    =         27         Within R-sq.    =     0.9149
Number of clusters (sublaps) =         16         Root MSE        =     0.1105

                                  (Std. err. adjusted for 16 clusters in date sublaps)
-------------------------------------------------------------------------------------
                     |               Robust
              impact | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
---------------------+---------------------------------------------------------------
             avgtemp |   .0599531   .0068267     8.78   0.000     .0454025    .0745038
             pct_tou |   .9696727     2.1001     0.46   0.651    -3.506584     5.44593
             avgtemp |          0   7.96e-13     0.00   1.000    -1.70e-12    1.70e-12
                     |
 c.pct_tou#c.avgtemp |    -.019654   .0245508   -0.80   0.436    -.0719827    .0326747
                     |
                hour |
                 18  |   .3666646   .3227749     1.14   0.274    -.3213138    1.054643
                 19  |    .963159   .4415741     2.18   0.045     .0219661    1.904352
                 20  |   1.199545   .5514284     2.18   0.046     .0242031    2.374887
                 21  |   .7009831   .5875584     1.19   0.251    -.5513679    1.953334
                     |
             avgtemp |          0   8.67e-11     0.00   1.000    -1.85e-10    1.85e-10
                     |
      hour#c.avgtemp |
                 17  |          0  (omitted)
                 18  |  -.0051524   .0041646    -1.24   0.235     -.014029    .0037243
                 19  |  -.0128064   .0057731    -2.22   0.042    -.0251115   -.0005014
                 20  |  -.0160917   .0072419    -2.22   0.042    -.0315275    -.000656
                 21  |   -.010519   .0074258    -1.42   0.177    -.0263467    .0053087
                     |
           1.weekday |  -.2211669   .2331196    -0.95   0.358    -.7180495    .2757157
             avgtemp |          0   2.24e-11     0.00   1.000    -4.78e-11    4.78e-11
                     |
   weekday#c.avgtemp |
                  0  |          0  (omitted)
                  1  |   .0028219   .0027414     1.03   0.320    -.0030214    .0086652
                     |
             sublaps |
          SLAP_PGCC  |  -3.438773   .7592499    -4.53   0.000    -5.057076    -1.82047
          SLAP_PGEB  |   .6681798   .3697041     1.81   0.091    -.1198258    1.456186
          SLAP_PGF1  |    3.04522   1.119339     2.72   0.016     .6594041    5.431035
          SLAP_PGFG  |  -2.754433   .6037354    -4.56   0.000    -4.041264   -1.467601
          SLAP_PGHB  |   .0871079    .087437     1.00   0.335    -.0992597    .2734756
          SLAP_PGKN  |   5.459768    1.20509     4.53   0.000      2.89118    8.028357
          SLAP_PGNB  |   1.709903   .2827524     6.05   0.000      1.10723    2.312575
          SLAP_PGNC  |   1.578068   .6332012     2.49   0.025     .2284313    2.927704
          SLAP_PGNP  |   1.618606   .7294128     2.22   0.042     .0638998    3.173313
          SLAP_PGP2  |   2.136552    .373383     5.72   0.000     1.340705    2.932399
          SLAP_PGSB  |   1.878082   .1849303    10.16   0.000     1.483912    2.272251
          SLAP_PGSF  |    5.86114   1.077016     5.44   0.000     3.565535    8.156746
          SLAP_PGSI  |   1.030339   .3826821     2.69   0.017     .2146717    1.846007
          SLAP_PGST  |   1.708899    .790129     2.16   0.047     .0247785    3.393019
          SLAP_PGZP  |  -.8722221   .5166107    -1.69   0.112    -1.973352    .2289076
```

avgtemp	0	9.31e-13	0.00	1.000	-1.99e-12	1.99e-12
sublaps#c.avgtemp						
None	0	(omitted)				
SLAP_PGCC	.0493487	.0107284	4.60	0.000	.0264817	.0722158
SLAP_PGEB	-.008193	.0050796	-1.61	0.128	-.01902	.0026339
SLAP_PGF1	-.036954	.012676	-2.92	0.011	-.0639722	-.0099357
SLAP_PGFG	.040365	.008691	4.64	0.000	.0218405	.0588894
SLAP_PGHB	0	3.50e-12	0.00	1.000	-7.45e-12	7.45e-12
SLAP_PGKN	-.0627901	.0133644	-4.70	0.000	-.0912757	-.0343045
SLAP_PGNB	-.0241916	.0039777	-6.08	0.000	-.0326698	-.0157133
SLAP_PGNC	-.0198967	.0079933	-2.49	0.025	-.036934	-.0028594
SLAP_PGNP	-.020748	.0088571	-2.34	0.033	-.0396264	-.0018696
SLAP_PGP2	-.0295236	.0052342	-5.64	0.000	-.04068	-.0183671
SLAP_PGSB	-.0262845	.0025209	-10.43	0.000	-.0316576	-.0209114
SLAP_PGSF	-.0884762	.0158288	-5.59	0.000	-.1222143	-.054738
SLAP_PGSI	-.0111476	.0046774	-2.38	0.031	-.0211173	-.0011779
SLAP_PGST	-.0214799	.0095721	-2.24	0.040	-.0418823	-.0010775
SLAP_PGZP	.0114101	.0061942	1.84	0.085	-.0017926	.0246128
event_hour						
2	.4472831	.1896901	2.36	0.032	.0429682	.851598
3	.5283277	.3261654	1.62	0.126	-.1668773	1.223533
4	.5827478	.5592092	1.04	0.314	-.6091785	1.774674
avgtemp	0	3.90e-13	0.00	1.000	-8.32e-13	8.32e-13
event_hour#c.avgtemp						
1	0	(omitted)				
2	-.0096875	.0023656	-4.10	0.001	-.0147296	-.0046454
3	-.0130369	.0039731	-3.28	0.005	-.0215053	-.0045684
4	-.014889	.0065618	-2.27	0.038	-.0288751	-.0009029
method						
0	0	(empty)				
1	.4885232	.3155764	1.55	0.142	-.1841121	1.161158
2	-.4289668	.5135532	-0.84	0.417	-1.52358	.6656459
3	0	6.34e-20	0.00	1.000	-1.35e-19	1.35e-19
avgtemp	0	1.61e-20	0.00	1.000	-3.43e-20	3.43e-20
method#c.avgtemp						
0	0	(empty)				
1	-.0068649	.003957	-1.73	0.103	-.015299	.0015693
2	.0045063	.0059354	0.76	0.459	-.0081447	.0171573
3	0	(omitted)				
_cons	-3.713275	.520141	-7.14	0.000	-4.821929	-2.604621

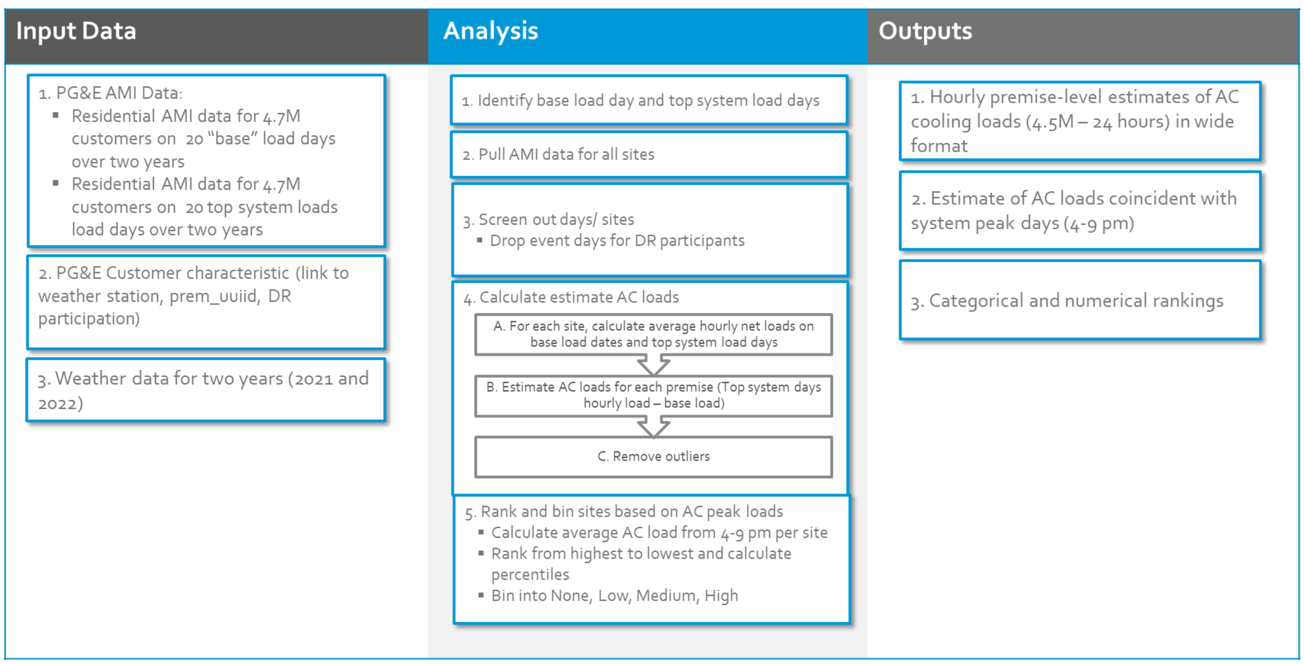
APPENDIX F: AIR CONDITIONER LOADS IN PG&E TERRITORY

PG&E is one of the largest utility companies in the United States and includes a diverse climate area, ranging from foggy coastal regions to inland areas where temperatures exceed 90°F for one hundred days or more. It provides natural gas and electric service to approximately 16 million people throughout a 70,000-square-mile service area in northern and central California. In addition to encompassing a wide range of climates, the housing stock varies by location. Newer homes are more likely to have air conditioning, while older pre-1950s housing often lacks the ducting needed for central air conditioning. As a result, the need for and use of cooling varies widely across the PG&E service territory.

For a thermostat program to be successful in PG&E territory, it is critical to understand how air conditioner loads vary geographically Thus, as part of the study, DSA used hourly smart meter data to estimate hourly air conditioner loads for each of over 4.5 million households. The objective was to define a scalable algorithm to identify customers with substantive air conditioner loads. Developing an algorithm that could be updated regularly and quickly was critical.

Figure F-1 describes the inputs, analysis, and outputs. At a simple level, we used whole home data on days when the PG&E system peaked and on when neither heating nor cooling is needed (nearly perfect days) to estimate hourly air conditioner loads for nearly all PG&E residential customers.

Figure F-1: Pre-treatment Comparison of Automated Daily Shifting Treatment Control Group



For individual sites, air conditioner loads are bi-modal, with air conditioners being on or off at any point in time. The smooth curved shape occurs after aggregating across time (or days) or aggregating across customers. Figure F-2 shows twenty randomly selected sites near San Ramon and Danville, an area in PG&E's territory with a mix of homes without and without air conditioning. The panel to the left shows the AC loads estimated using the simple algorithm. The panel to the right shows the same sites after aggregation. Even within compact portions of PG&E territory, there is wide variation in air conditioner use due to differences in schedules and in the age of homes. Figure F-3 shows the hourly air conditioner loads on peak days for the population of PG&E accounts. Over 75% of PG&E air conditioner loads are concentrated in 30% of the population, and roughly 40% of customers have little to no air conditioner use during peak days.

Figure F-2: Individual Air Conditioner Loads and Aggregation

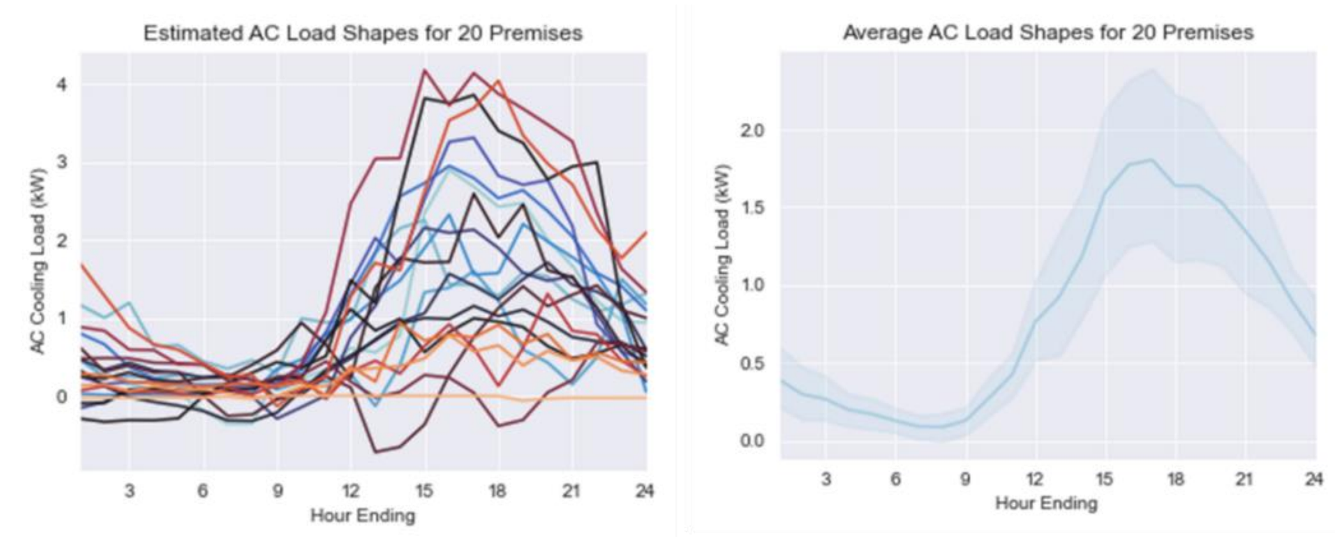


Figure F-3: PG&E Population Hourly Air Conditioner Peak Loads by Decile and Centile

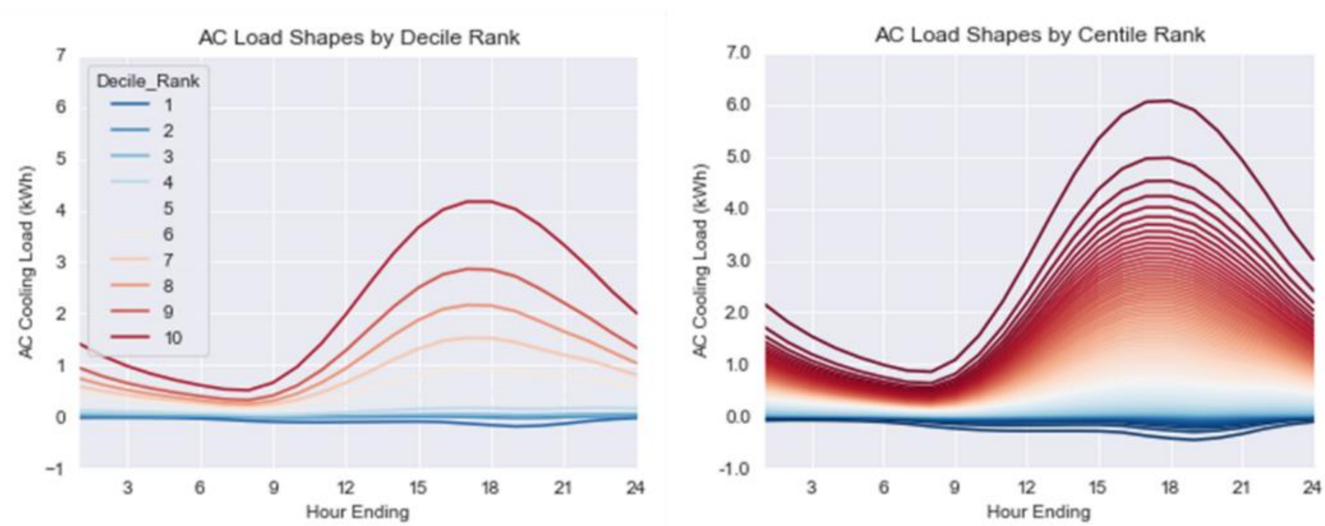
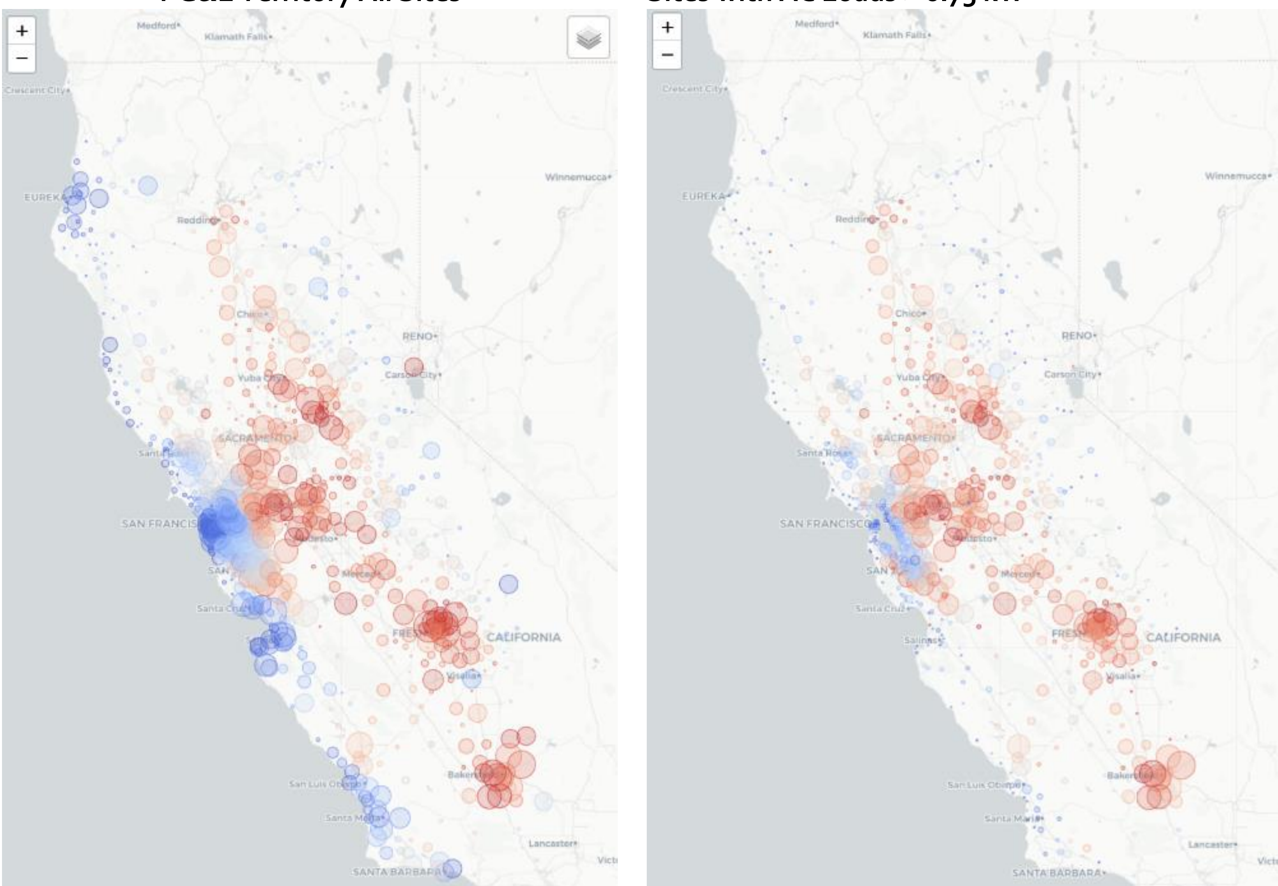


Figure F-4 visualizes AC loads across PG&E territory. Each bubble represents a zip code. The color represents the average 4-9 pm AC load in each zip code, with blue representing small AC loads and red representing large AC loads. The difference between the two plots is that bubbles on the left side are sized based on the total number of accounts in the zip code, while on the right panel, bubbles are sized based on the number of accounts with average peak day AC load (4-9 pm) above 0.75 kW. Figure F-5 shows the same map focusing on the Greater Bay Area, which has a large share of the PG&E accounts and a wide diversity of micro-climates and AC loads. Within substantive AC loads are largely limited to areas East of the East Bay Hills and the outer parts of the San Jose metro. The plots show that AC loads are geographically concentrated, and much of the Greater Bay Area has little to no AC loads on peak days, even if some homes have smart thermostats.

Figure F-4: PG&E Territory Map of AC Loads by Zip Code

PG&E Territory All Sites | **Sites with AC Loads > 0.75 kW**



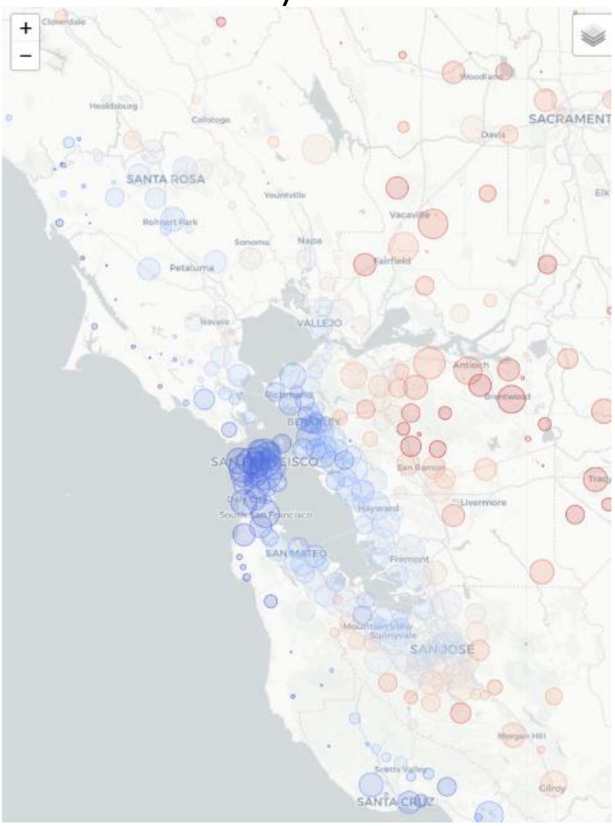
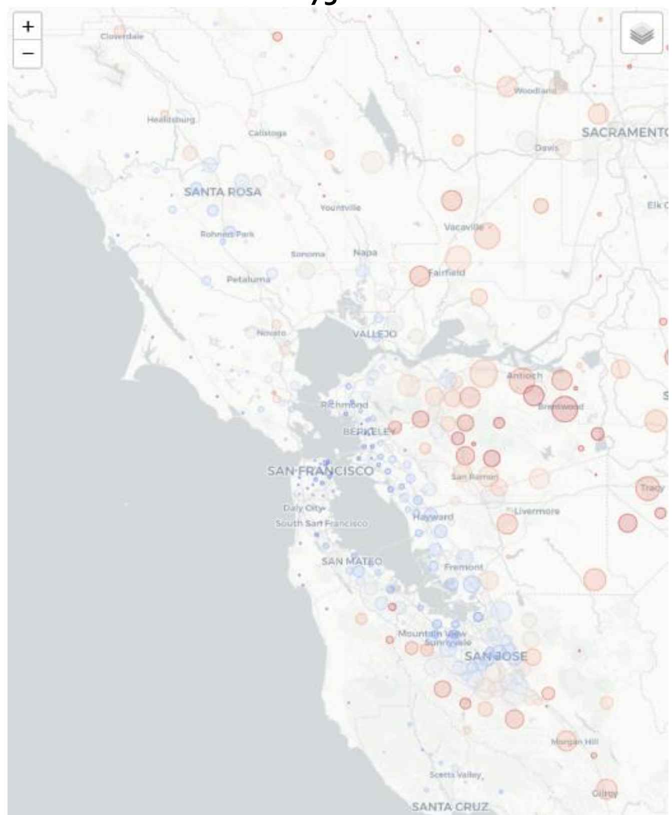
PG&E Territory All Sites:

- Bubbles represent zip codes.
- The size of the bubble is proportional to the number of residential accounts.
- The color represents the average 4-9 pm AC load for each zip code, with blue representing small AC load and red representing large AC loads

Sites with AC Loads > 0.75 kW:

- Bubbles represent zip codes.
- The size of the bubble is proportional to the number of residential accounts with AC loads above 0.75 kW
- The color represents the average 4-9 pm AC load for each zip code. The color represents the average 4-9 pm AC load for each zip code, with blue representing small AC load and red representing large AC loads

Figure F-5: Greater Bay Area Map of AC Loads by Zip Code

Greater Bay Area All Sites	Sites with AC Loads > 0.75 kW
	

Greater Bay Area All Sites:

- Bubbles represent zip codes.
- The size of the bubble is proportional to the number of residential accounts.
- The color represents the average 4-9 pm AC load for each zip code.

Sites with AC Loads > 0.75 kW:

- Bubbles represent zip codes.
- The size of the bubble is proportional to the number of residential accounts with AC loads above 0.75 kW
- The color represents the average 4-9 pm AC load for each zip code.

From a grid standpoint, resources are dispatched by grid areas known as sub-LAPs. Figure F-6 shows the distribution of 4-9 PM AC loads by grid areas. What is evident from the analysis is that PG&E can and has used smart meter data to identify cost-effective sites with air conditioner loads. However, most thermostat manufacturers prefer to control the recruitment of thermostat owners and to price access to thermostat management based on monthly fees per thermostat. The fees do not reflect the magnitude of the controllable air conditioner loads. Thus, while PG&E can identify cost-effective sites, limiting recruitment to cost-effective sites and making thermostat access fees proportional to the controllable air conditioner loads has been met with some opposition.

Figure F-6: Distribution of 4-9 pm AC loads by Grid Area (Sub-LAP)