2022 Load Impact Evaluation of San Diego Gas & Electric's AC Saver Day Of Program

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Contents

1. Executive Summary

San Diego Gas & Electric Company's (SDG&E) AC Saver Day Of program is a demand response resource based on central air conditioner (CAC) load control that is implemented through an agreement between SDG&E and Itron, Inc. AC Saver Day Of was previously marketed to SDG&E customers as the Summer Saver program – the program name changed to AC Saver Day Of in 2018. This report provides ex post load impact estimates for the 2022 AC Saver Day Of program and ex ante load impact forecasts for 2023–2033.

The AC Saver Day Of program is available to residential and commercial customers in the SDG&E territory. There are two enrollment options for both residential and commercial customers. Residential customers can choose between 50% or 100% cycling and commercial customers can choose between 30% and 50% cycling. The incentive paid for each option varies and is based on the number of CAC tons under control at each premise. Load control is enabled through devices installed on enrolled CAC units that receive dispatch signals from the program's control system, delivered through a public paging network. The AC Saver Day Of season runs from April 1 through October 31. An AC Saver Day Of event may be triggered by temperature or system load conditions and customers are not automatically notified when an event occurs; however, customers can sign up to receive event notification.

At the end of 2022, there were 10,463 customers enrolled in the program with a total cooling capacity of 53,715 tons. These counts represent all the customers that were enrolled at some point during the 2022 season. For the 2022 program year, there were 8,106 residential customers, representing approximately 77% of AC Saver Day Of participants, and 32,456 cooling tons, accounting for about 60% of the program's total tonnage. In the commercial customer class, there were 2,357 participants and 21,259 cooling tons enrolled. Among residential participants, 30% selected the highest cycling option (100% cycling); among commercial participants, 77% selected the 50% cycling option over the 30% option.

Due to the COVID-19 pandemic, reference loads and load impacts for the residential and commercial segments have varied more in the past three years than in prior years. In 2020, increased home occupancy because of stay-at-home orders resulted in higher residential reference loads and subsequently higher load impacts. Similarly, the pandemic caused commercial customer reference loads and load impact estimates to be lower because of decreased occupancy and operations. In 2021, residential reference loads decreased compared to 2020, but remained higher than 2019. On the other hand, commercial reference loads returned to 2019 levels. Both residential and commercial absolute kW impacts were more similar to those observed in 2019 than in 2020. In 2022, reference loads and load impacts for the residential and commercial segments increased due to higher temperatures this season.

A total of eleven regular program events were called in 2022 with event hours ranging between 5 PM and 9 PM. There were two events called on weekend days and one event called on the Labor Day holiday (September 5, 2022). Event hours varied but the most common event period was 6 to 8 PM, which comprised 5 of the 11 events. The event period from 6 to 8 PM is used for reporting Average

Event Day load impacts. Load impacts were estimated using a statistically matched control group for both the residential and commercial customers. Table 1-1 shows the overall 2022 AC Saver Day Of residential ex post load impacts and maximum event window temperatures. The rows colored light blue indicate events that occurred on weekdays from 6-8 PM and were used to estimate the average event impacts. The rows colored dark blue indicate events that occurred on weekends and holidays. The average aggregate demand reduction for residential customers totaled 1.68 MW, or 0.20 kW per premise. All individual event impacts were statistically significant. The largest aggregate load reduction was 2.46 MW on the event on September 3, 2022. This day also had one of the highest maximum event window temperatures of the season at 93 °F.

Table 1-1: 2022 AC Saver Day Of Average Residential Ex Post Load Impacts

Date	Impact				Max Event Window Temperature (°F)
	Per Ton (kW)	Per Device (kW)	Per Premise (kW)	Aggregate (MW)	
8/16/2022	0.04	0.16	0.18	1.48	80
8/30/2022	0.04	0.12	0.14	1.18	82
8/31/2022	0.07	0.25	0.29	2.37	86
9/1/2022	0.05	0.18	0.21	1.71	86
9/3/2022	0.07	0.26	0.30	2.46	93
9/4/2022	0.07	0.23	0.27	2.19	87
9/5/2022	0.07	0.24	0.28	2.26	90
9/7/2022	0.07	0.26	0.30	2.44	93
9/8/2022	0.04	0.13	0.15	1.25	88
9/9/2022	0.01	0.04	0.05	0.38	74
9/26/2022	0.04	0.14	0.16	1.33	83
Average*	**0.05**	**0.18**	**0.20**	**1.68**	**86**

Note: All load impact metrics for individual and average event days were statistically significant.
* Reflects the average 6 PM to 8 PM weekday 2022 AC Saver Day Of event

Table 1-2 shows the 2022 AC Saver Day Of ex post load impacts for the commercial segment. The aggregate load reduction for commercial customers was roughly 0.23 MW, or 0.10 kW per premise. Individual impacts for four of the events were statistically significant. The largest load reduction for commercial customers totaled approximately 0.88 MW, which occurred on the first event of the season on August 16.

Table 1-2: 2022 AC Saver Day Of Average Commercial Ex Post Load Impacts

Date	Impact				Max Event Window Temperature (°F)
	Per Ton (kW)	Per Device (kW)	Per Premise (kW)	Aggregate (MW)	
8/16/2022	0.04*	0.15*	0.36*	0.88*	79
8/30/2022	0.00	0.01	0.02	0.04	81
8/31/2022	-0.01	-0.04	-0.09	-0.23	85
9/1/2022	0.01	0.03	0.08	0.20	84
9/3/2022	-0.01	-0.02	-0.05	-0.12	93
9/4/2022	0.03*	0.10*	0.23*	0.56*	86
9/5/2022	0.03*	0.10*	0.24*	0.60*	89
9/7/2022	0.00	0.00	-0.01	-0.02	91
9/8/2022	-0.01	-0.02	-0.05	-0.12	88
9/9/2022	0.00	0.00	0.01	0.02	73
9/26/2022	0.02*	0.06*	0.15*	0.37*	82
Average**	**0.01***	**0.04***	**0.10***	**0.23***	**85**

* Indicates statistically significant impacts
** Reflects the average 6 PM to 8 PM weekday 2022 AC Saver Day of event

Ex ante load impacts are intended to represent weather conditions under normal (1-in-2 year) and extreme (1-in-10 year) conditions, defined for two scenarios: one representing weather conditions expected when the SDG&E system peaks and another representing weather conditions when the California Independent System Operator (CAISO) system peaks. Based on ex post results, it is established that AC Saver Day Of load impacts increase with temperature. In the ex ante forecasts, the largest impacts are observed on the September monthly system peak days when the temperature scenarios are the hottest.

As shown in Table 1-3, on a typical event day in 2023 under 1-in-2 year SDG&E-specific peaking conditions, aggregate load impacts are forecasted to equal 1.2 MW for residential customers and 0.2 MW for commercial customers, for a total program load reduction of 1.4 MW. In 2023, under 1-in-10 year SDG&E-specific peaking conditions, estimated impacts on the typical event day are forecasted to equal 1.6 MW and 0.2 MW for residential and commercial customers, respectively, or 1.8 MW in total. This is about 50% greater than on a typical event day under 1-in-2 year weather conditions.

Table 1-3: 2023 AC Saver Day Of Typical Event Day Aggregate Ex Ante Impacts

Customer Type	Day Type	Aggregate Impact (MW)	
		SDGE 1-in-2	SDGE 1-in-10
Residential	Typical Event Day	1.2	1.6
Commercial	Typical Event Day	0.2	0.2
Total	**Typical Event Day**	**1.4**	**1.8**

In the case of the residential segment, August 2023 enrollments are forecasted to be 7,001 participants. In the case of the commercial segments, August 2023 enrollments are forecasted to be 2,160 participants. Over the next five years, the residential population is projected to decrease by 13.1% per year while the commercial population is projected to decrease by 7.8% per year.

2. Introduction and Program Summary

San Diego Gas & Electric Company's (SDG&E) AC Saver Day Of program is a demand response resource based on central air conditioner (CAC) load control that is implemented through an agreement between SDG&E and Itron, Inc.[1] This report provides 2022 ex post load impact estimates and ex ante load impact estimates for an 11-year forecast horizon (2023–2033) as required by the California Public Utilities Commission (CPUC) Load Impact Protocols.[2]

The AC Saver Day Of program is classified as a day-of demand response program and is available to both residential and commercial customers. AC Saver Day Of events may only be called during the months of April through October. Under the current program framework, events can be triggered up to 80 hours per year, 24 hours per month, and three consecutive days at maximum with a total of no more than 20 events per year. Load control events can occur on weekends but not on holidays and cannot be called more than three days in any calendar week. These program rules apply to both residential and commercial customers alike.

Under program design changes that took place in 2017, event triggers vary by month. During the program operational season, an AC Saver Day Of event can be triggered by any of the following criteria:

- Generator heat rates reaching or exceeding 35,000 Btu[3] per kWh in April, May, June, or October; or 25,000 Btu per kWh in July, August, or September;
- Imminent statewide or local emergencies, extreme conditions, and/or local distribution needs; or
- Upon the award of a bid into the California Independent System Operator (CAISO) wholesale market.

AC Saver Day Of events may be called between 12 PM and 9 PM, and each event may last from a minimum of two to a maximum of four hours in duration. Prior to 2017, an AC Saver Day Of event could be called between 12 PM and 8 PM, and each event could last one to four hours.

There are two enrollment options for both residential and commercial participants. Residential customers can choose to have their CAC units cycled 50% or 100% of the time during an event. The incentive paid for each option varies: the 50% cycling option pays $10.35 per ton per year of CAC capacity and the 100% cycling option pays $27 per ton per year.

[1] AC Saver Day Of was previously marketed to SDG&E customers as the Summer Saver program. The program name changed to AC Saver Day Of in 2018.

[2] See CPUC Rulemaking 07-01-041 Decision (D.) 08-04-050, "Adopting Protocols for Estimating Demand Response Load Impacts" and Attachment A, "Protocols."

[3] British thermal unit, defined as the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit.

For example, a residential customer with a four-ton CAC unit would be paid the following in the form of an annual credit on their SDG&E bill:

- $41.40 for 50% cycling; or
- $108 for 100% cycling.

Commercial customers have the option of choosing 30% or 50% cycling. The incentive payment for 30% cycling is $4.50 per ton per year and $7.50 per ton per year for the 50% cycling option.

For instance, a commercial customer with five tons of air conditioning would be paid the following in the form of an annual credit on their SDG&E bill:

- $22.50 for 30% cycling; or
- $37.50 for 50% cycling.

Customer enrollment in the AC Saver Day Of program is summarized in Table 2-1. The table includes all customers who were enrolled at the end of the 2022 season. There were 10,463 customers enrolled in the program, representing 53,715 tons of CAC capacity in aggregate. For the 2022 program year, residential customers represented approximately 77% of AC Saver Day Of participants and accounted for about 60% of the program's total cooling tons. About 70% of residential customers selected the 50% cycling option and approximately 77% of commercial customers chose the 50% cycling option, which represents the higher of the two cycling strategies offered to those customer segments. Total enrollment—as measured by number of customers, number of devices, and CAC capacity (in tons)—has generally decreased for residential and commercial customers since 2017 due to minimal marketing to attract new participants to the program.

Table 2-1: 2022 AC Saver Day Of Enrollment

Customer Type	Cycling Option	Enrolled Customers	Enrolled Control Devices	Enrolled Tons
Residential	50%	5,652	6,411	22,073
	100%	2,454	2,901	10,383
	Total	8,106	9,312	32,456
Commercial	30%	547	1,643	5,915
	50%	1,810	4,087	15,344
	Total	2,357	5,730	21,259
Grand Total		**10,463**	**15,042**	**53,715**

2.1. Evaluation Objectives

The primary objectives of the 2022 AC Saver Day Of load impact evaluation are to:

- Estimate hourly ex post load impacts for the residential and small/medium business (SMB) program segments, for each cycling strategy, climate zone, NEM status, and dual-enrollment status in other DR programs;
- Estimate hourly ex post load impacts and average daily load impacts for the SMB program segment for each industry group and demand category; and
- Forecast 2023-2033 hourly ex ante load impacts for 1-in-2 and 1-in-10 year weather conditions weather conditions by month – in the aggregate and per customer – for utility-specific and CAISO peak conditions.

2.2. Report Structure

The remainder of this report is organized as follows: Section 3 summarizes the data and methods that were used to develop ex post and ex ante load impact estimates and the validation tests that were applied to assess their accuracy. Section 4 contains the 2022 ex post load impact estimates. Section 5 presents the ex ante estimates and provides details concerning the differences between the 2022 and the 2021 ex ante load impacts—in addition to differences between ex post and ex ante load impacts. Section 6 presents the key findings from this evaluation and recommendations for future program years.

3. Data and Methodology

This section describes the datasets and analysis methods used to estimate load impacts for each event in 2022 and for ex ante weather and event conditions. The residential and commercial ex post load impacts were estimated using a matched control group research design. For residential customers, the ex post load impact estimates from 2019, 2021, and 2022 were used to estimate models relating temperature to load reductions that were then used in conjunction with ex ante weather data to predict ex ante load impacts. Only certain events with particular event hours were used to estimate the relationship between temperature and load reductions. Similarly, for commercial customers, the average load impacts from 2019, 2021, and 2022 were used to estimate models relating temperature to load reductions that were then used in conjunction with ex ante weather data to predict ex ante load impacts. A more detailed discussion is provided in Section 3.2.3.

3.1. Data

A total of eleven AC Saver Day Of events were called in 2022. Table 3-1 shows the date, day of week, start time, end time, and temperature metrics for each event. The key temperature metrics of interest for each event include mean17 (the average temperature during the event day from midnight to 5 PM, and the maximum temperature during the event window. The event hours varied from 5 PM to 9 PM across the events in 2022. There were two events called on weekend days and one event called on the Labor Day Holiday (September 5). This event was considered a weekend event for reporting purposes.

Table 3-1: Summary of 2022 AC Saver Day Of Events

Date	Day of Week	Start Time	End Time	Mean17 Temperature (°F)	Max. Event Window Temperature (°F)
8/16/2022	Tuesday	6:00 PM	8:00 PM	75	80
8/30/2022	Tuesday	6:00 PM	8:00 PM	75	82
8/31/2022	Wednesday	6:00 PM	8:00 PM	79	86
9/1/2022	Thursday	6:00 PM	9:00 PM	80	86
9/3/2022	Saturday	6:00 PM	8:00 PM	85	93
9/4/2022	Sunday	6:00 PM	8:00 PM	87	87
9/5/2022	Monday	5:00 PM	9:00 PM	81	90
9/7/2022	Wednesday	5:00 PM	9:00 PM	83	93
9/8/2022	Thursday	5:00 PM	9:00 PM	81	88
9/9/2022	Friday	5:00 PM	7:00 PM	82	74
9/26/2022	Monday	5:00 PM	7:00 PM	74	83

Table 3-2 shows the distribution of CAC tonnage by cycling option and climate zone for the residential participant population as of October 2022. Due to the small populations of participants in the Mountain and Desert Climate Zones, they are combined into the Coastal and Inland Climate Zones, respectively, in the ex post and ex ante analyses.

Table 3-2: Distribution of CAC Tonnage by Program Option and Climate Zone

Group	Cycling Option	Group	Climate Zone				Total
			Coastal	Inland	Desert	Mountain	
Residential	50%	Population	9.2%	58.9%	0.1%	0.9%	70.8%
	100%	Population	8.1%	22.5%	0.0%	0.2%	29.2%
	Total	**Population**	**17.3%**	**81.5%**	**0.1%**	**1.1%**	**100.0%**
Commercial	30%	Population	12.9%	13.4%	0.0%	0.2%	25.3%
	50%	Population	36.0%	37.5%	0.0%	0.1%	74.7%
	Total	**Population**	**48.9%**	**50.8%**	**0.0%**	**0.3%**	**100.0%**

3.2. Methodology

The primary task in developing ex post load impacts is to estimate the reference load for each event. The reference load represents the counterfactual—a measure of what participant demand would have been in the absence of CAC cycling during an event. The primary task in estimating ex ante load impact forecasts—which is often of more practical concern—is to make the best use of historical data on loads and load impacts to predict future program performance. The data and models used to estimate ex post impacts are typically the key inputs to the ex ante analysis.

In previous years, a randomized controlled trial (RCT) framework was utilized to estimate ex post reference loads for the residential segment. However, the implementation of this framework was associated with technical challenges and sampling error due to changes in customer load between the two control groups from one season to the next. Further, the RCT framework requires a fraction of the enrolled residential population be held back during events to serve as a control group, reducing the total load impacts of the program. In the 2021 evaluation, Resource Innovations recommended utilizing a statistical matching framework for the residential sector, which was implemented for the 2022 program year.

3.2.1. Ex Post Methodology

3.2.1.1. Statistical Matching Framework

For the 2022 AC Saver Day Of load impact evaluation, a matched control group framework was used for both the residential and commercial segments. In this framework, one nonparticipant was selected as a match for each participant on each event. Interval data for approximately 200,000 randomly selected residential non-participants, and the entire SDG&E small and medium business (SMB) non-participant population (approximately 121,000 customers) were made available for the statistical matching analysis.[4] From these candidate customers, one match was selected for each treatment customer. Each matched customer was chosen because they most closely resembled their matched participant in terms of the dissimilarity statistic described in Equation 3-1. The dissimilarity statistic measures how similar each match candidate is to any given participant customer based on how well (or not) their energy usage characteristics match those of the participant on both the event day and other hot non-event days in 2022, called proxy days. The characteristics used in the dissimilarity statistic are:

- Average demand during the event window hours on the average proxy day;
- Average demand from midnight to 10 AM on the event day; and
- Average demand from 10 AM to the start of the event for each event day.

Equation 3-1: Dissimilarity Statistic for Customer Matching

$$Dissimilarity_i = \left(PeakProxy_i - PeakProxy_j\right)^2 + \left(EventMorn_i - EventMorn_j\right)^2 + \left(EventMidday_i - EventMidday_j\right)^2$$

Variable	Definition
$\boldsymbol{PeakProxy}$	Average demand across the 2022 proxy days during the event window hours
$\boldsymbol{EventMorn}$	Average demand on the event day from midnight to 10 AM
$\boldsymbol{EventMidday}$	Average demand on the event day from 10 AM to the start of the event
$\boldsymbol{j}$	AC Saver Day Of participant to be matched
$\boldsymbol{i}$	Index of the pool of control customers

This dissimilarity statistic was chosen as the optimal metric for matching among four alternately specified metrics and following an out-of-sample testing exercise with many alternative matching models. The best metric was chosen based on pre-treatment balance measures.

Matches were chosen such that only customers in the same industry (for commercial customers) and climate zone would be matched to one another. Likewise, NEM customers were only matched to other NEM customers. This approach minimizes the differences between participants and matched nonparticipants while allowing for good estimates for program subsegments of interest.

[4] A random sample of the residential segment was provided as candidate matches as SDG&E was only able to provide interval data for a maximum of 350,000 customers.

The matching process proceeds, one participant at a time, by selecting the non-participant within the same industry (commercial only), climate zone, and NEM status with the smallest dissimilarity statistic. Individual non-participants may be selected more than once as a matched control customer.

3.2.1.2. Load Impact Estimation

Ex post event impacts were estimated for a broad collection of program segments including customer class, cycling strategy, NEM status, climate zone, industry, and status of dual-enrollment in other pricing and demand response programs at SDG&E.

In previous years, a lagged dependent variable (LDV) regression model was used to estimate load impacts in both the residential and non-residential segments. Since a statistical matching framework was used for both segments in this evaluation, a difference-in-differences (DiD) regression methodology was employed to better control for inherent differences that likely exist between the treatment and control customers. This methodology assumes that the program impact is equal to the difference in usage between the treatment and the control groups during the event window period, minus any pre-existing difference between the two groups. When using a DiD methodology, the matched control group does not need to perfectly match the treatment group on non-event days. Subtracting any difference between treatment and control customers on non-event days adjusts for any difference between the two groups that might occur due to random chance. Therefore, any further change between the groups in the post-treatment period can be measured as the impact of treatment.

The regression specification for estimating load impacts is shown in Equation 3-2.

Equation 3-2: Difference-in-Differences Model for Estimating Impacts

$$kWh_{i,t} = \alpha_i + \delta \text{treat}_i + \gamma \text{post}_t + \beta (\text{treat*post})_{i,t} + u_t + v_i + \varepsilon_{i,t}$$

Variable	Definition
i, t	Indicate observations for each individual *i*, date *t*, and event number *n*
α	The model constant
δ	Pre-existing difference between treatment and control customers
γ	The difference between event and proxy days common to both treatment and control group members[5]
β	The net difference between treatment and control group customers during event days– this parameter represents the difference-in-differences
u	Time effects for each date that control for unobserved factors that are common to all treatment and control customers but unique to the date
v	Customer fixed effects that control for unobserved factors that are time-invariant and unique to each customer
ε	The error for each individual customer and time period
treat	A binary indicator or whether or not the customer is part of the treatment or control group (in practice this is absorbed by the individual customer fixed effects)
post	A binary indicator that equals 0 in the pre-treatment period and 1 in the post-treatment period (in practice this is absorbed by the individual date fixed effects)
*treat*post*	A binary indicator of whether an event occurred that day–impacts are only observed if the customer is on PTS (*Treatment* = 1) and it was an event day

Hourly impact estimates for the entire residential AC Saver Day Of population were calculated by taking a weighted average of the impact estimates for each cycling option, with weights determined by the number of tons enrolled on each cycling option and enrolled within each climate zone for each cycling option.

3.2.2. Ex Post Validation Analysis

Even though statistical matching should produce research groups with similar characteristics, it is still important to compare the treatment groups to the matched control groups based on electricity consumption when AC Saver Day Of events are not in effect. Specifically, it is necessary to ensure that the treatment and matched control groups follow similar usage patterns on proxy days, days similar to events in weather where an event was not called.

[5] In practice, this term is absorbed by the time effects, but it is useful for representing the model logic.

Figure 3-1 compares the average load profile of residential treatment customers to their matched control counterparts during 2022 proxy days. This figure indicates similar usage behavior among residential participants and their matched control counterparts. Figure 3-2 and Figure 3-3 compare residential treatment and matched control customers for the 50% and 100% cycling options, respectively. Visually, we can see that the treatment and matched control customers are very similar in usage.

Figure 3-1: Residential Matched Control and Treatment Group Comparison Average Load across All 2022 Proxy Days- All Customers

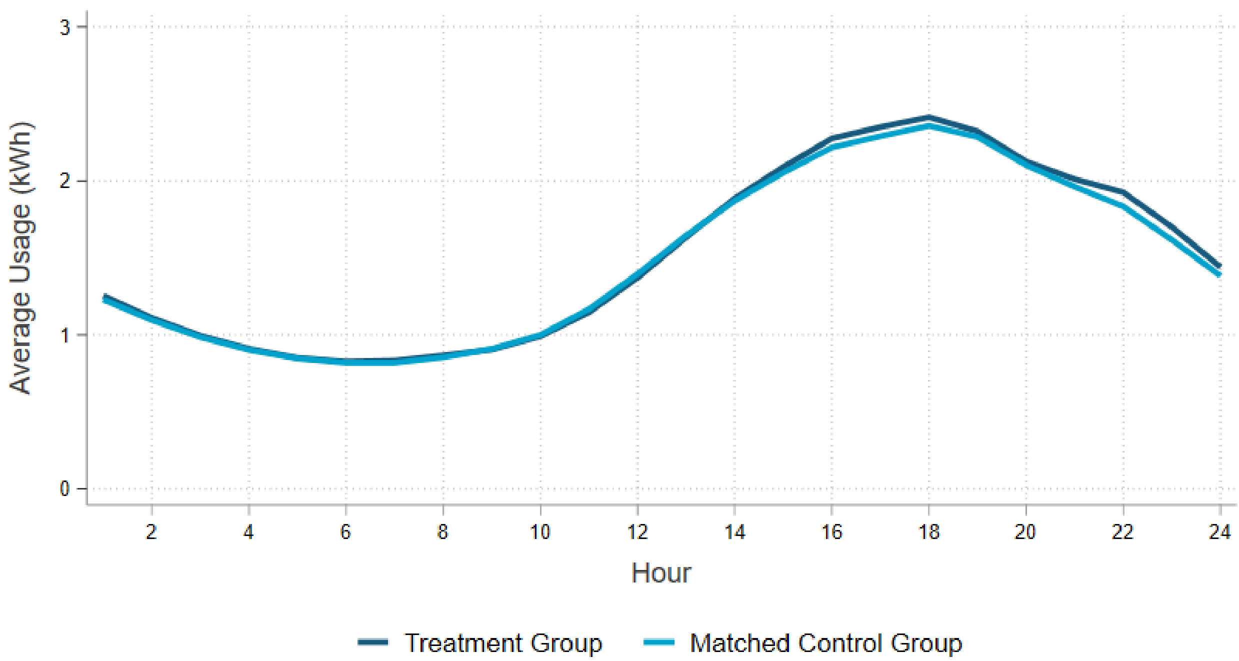


Figure 3-2: Residential Matched Control and Treatment Group Comparison Average Load across All 2022 Proxy Days, 50% Cycling Option

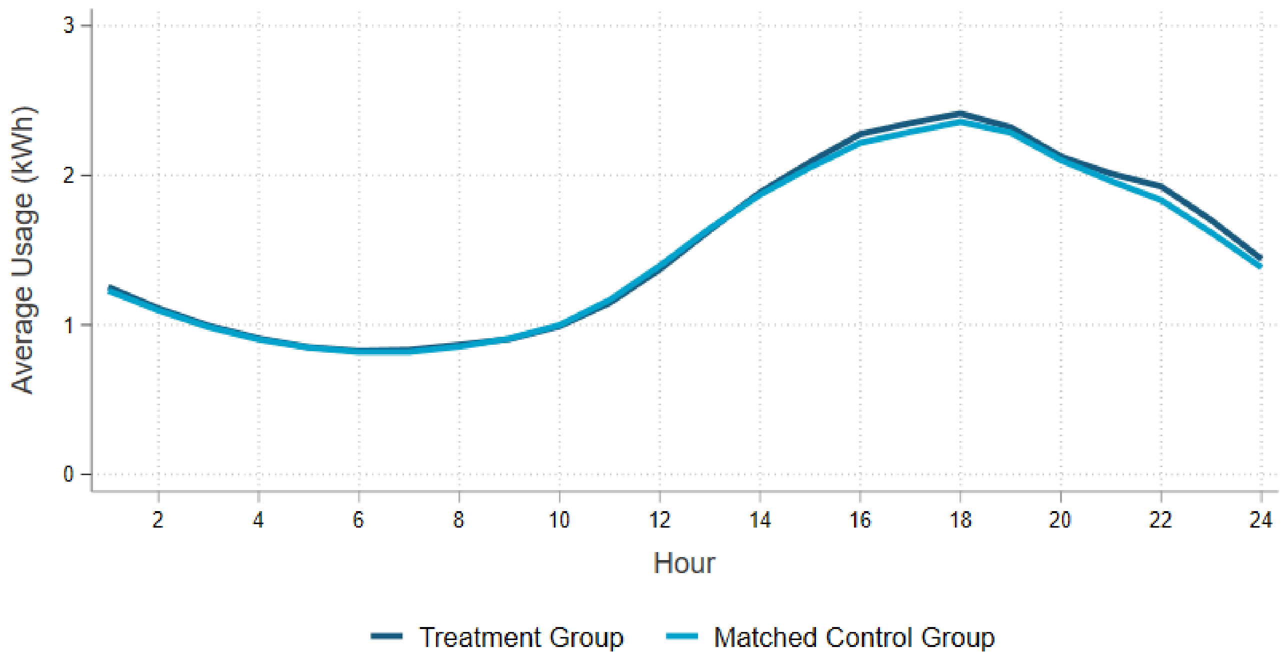


Figure 3-3: Residential Matched Control and Treatment Group Comparison Average Load across All 2022 Proxy Days, 100% Cycling Option

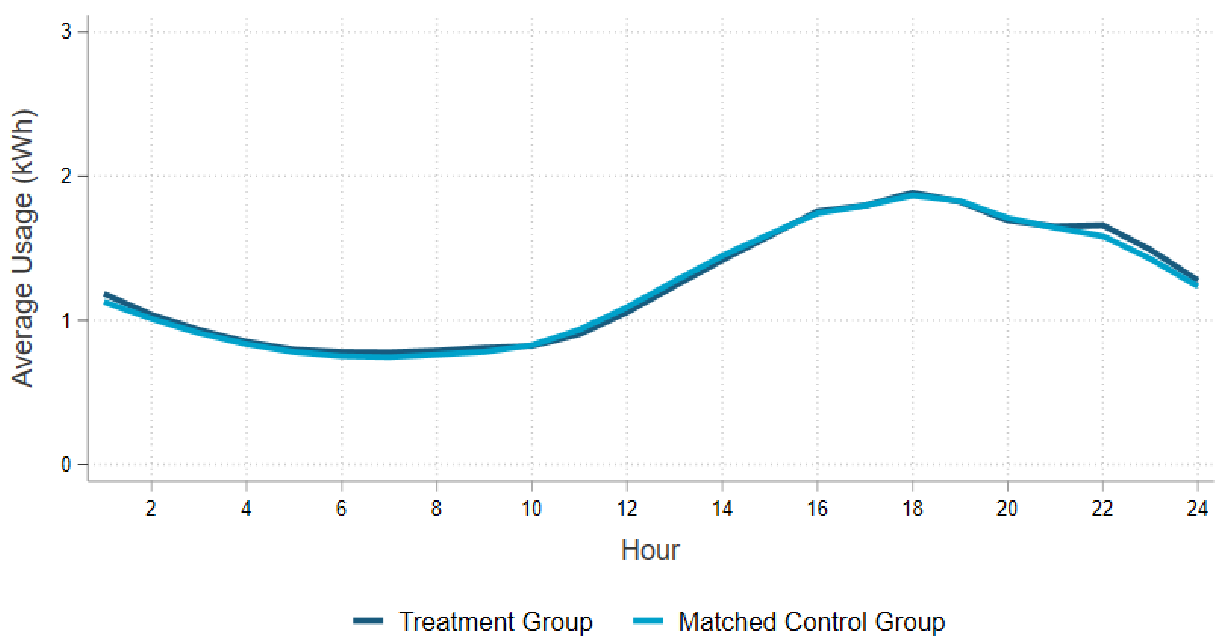


Figure 3-4 compares the average load profile of commercial treatment customers to their matched control counterparts during 2022 proxy days. Like the residential segment, commercial treatment customers exhibit very similar usage patterns to their matched control counterparts during proxy days. Figure 3-5 and Figure 3-6 compare commercial treatment and matched control customers for the 30% and 50% cycling options, respectively.

Figure 3-4: Commercial Matched Control and Treatment Group Comparison Average Load across All 2022 Proxy Days

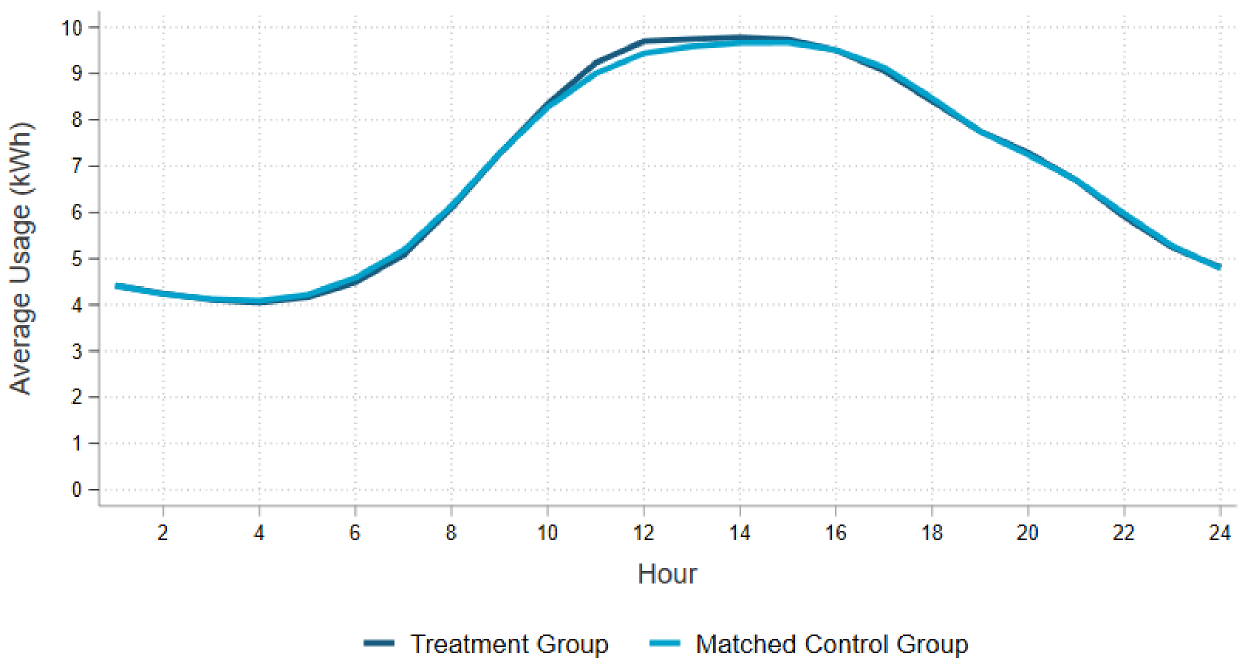


Figure 3-5: Commercial Matched Control and Treatment Group Comparison Average Load Across All 2022 Proxy Days, 30% Cycling Option

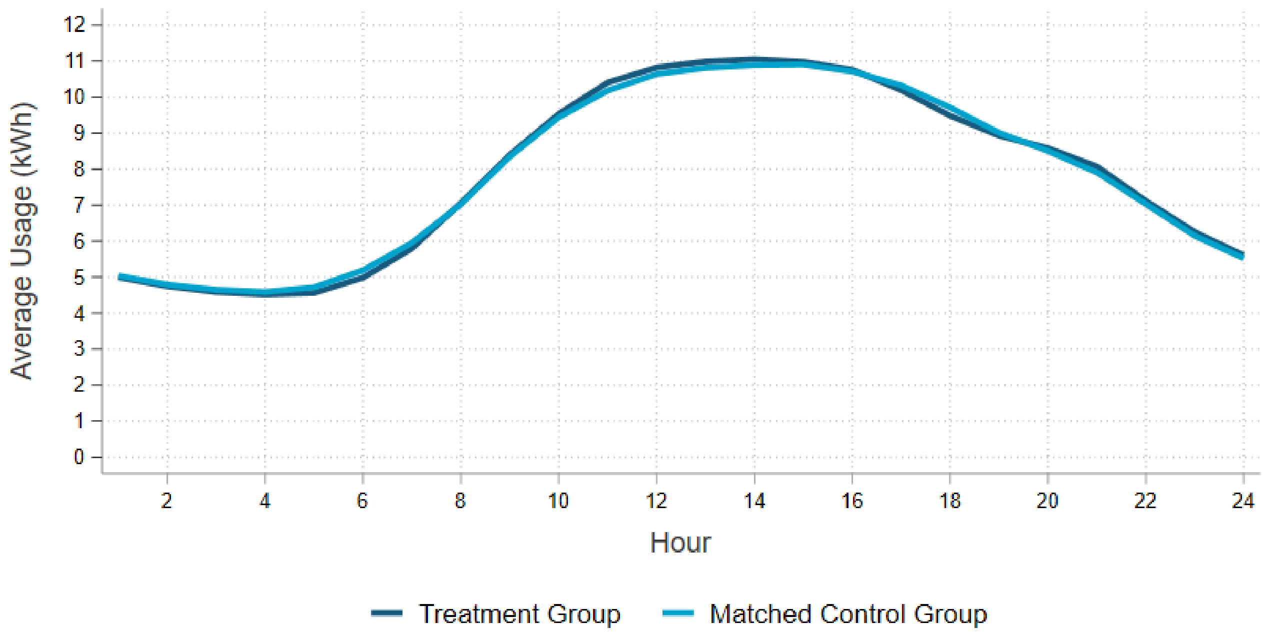
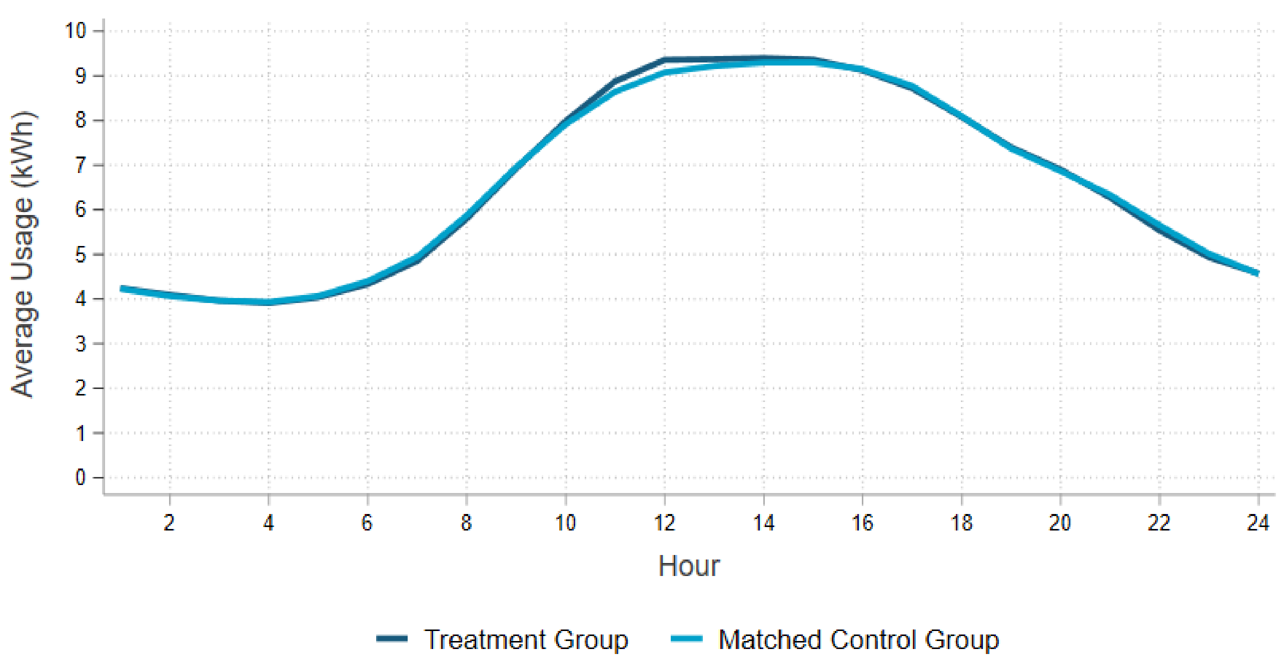


Figure 3-6: Commercial Matched Control and Treatment Group Comparison Average Load Across All 2022 Proxy Days, 50% Cycling Option



3.2.3. Ex Ante Impact Estimation Methodology

The ex ante load impacts were developed using recent ex post load impacts. While reliably estimated load impacts are available going back ten years, the older load impact estimates are not likely to be as relevant as the most recent ones because the program's device fleet has been aging over the past ten years without any significant program efforts to refresh older equipment in the field. Ex ante impacts have traditionally been developed using two years of historical ex post load impacts, where ex post results from the current evaluation (2022) and prior evaluation (2021) are used to model reference loads and kW impacts. However, for the 2021 and 2022 evaluations, ex post load impacts for 2020 were not included because the COVID-19 pandemic caused the residential and commercial reference loads and impacts to shift considerably compared to other years. To account for this, ex post load impacts from 2019, 2021, and 2022 were used as the foundational data for developing the ex ante model that estimates the weather response of AC Saver Day Of load impacts.

In estimating ex ante load impacts, we fit a single model that estimates the weather responsiveness of average ex post load impacts. To ensure that similar events were used from 2019, 2021, and 2022, the average load impacts are defined as the average load impact across the window of 6 to 8 PM, for all weekday events with the event window spanning this two-hour range. The benefit of this selection is that it results in the greatest amount of data points available for estimating the model – 3 of the 11 events in 2022 fit these criteria, as well as 4 of 7 events in 2021 and 12 of 20 events in 2019. In the remainder of this section, we refer to this set of average load impacts (the 6 to 8 PM average ex post impacts from 2019, 2021, and 2022) as the core ex post impacts.

The methodology for estimating ex ante impacts in 2022 is the same for residential and commercial participants. The core ex post load impacts are modeled as a function of the average temperature over the first 17 hours of each event day—midnight to 5 PM (mean17). This 17-hour average is used to capture the impact of heat buildup leading up to and including the event hours. Per-ton load impacts have historically been used in the AC Saver Day Of load impact evaluation so that the load impacts would be scalable to ex ante scenarios where the tonnage and number of devices per premise may be different.

The regressions only include one explanatory variable; more complicated models were found to not perform better in prior AC Saver Day Of evaluations owing mostly to the relatively limited dataset of ex post load impacts that is available for ex ante estimation. Additionally, this model offers the added benefit of being easily interpretable and understandable. Equation 3-3 presents the model that is used to predict average ex post impacts as a function of weather. This model is estimated separately by customer class (residential and commercial) and cycling strategy. The estimated parameters from the models are used to predict load impacts under 1-in-2 and 1-in-10-year ex ante weather conditions.

Equation 3-3: Ex Ante Model for Predicting Ex Post Load Impacts' Weather Response

$$impact_d = b_0 + b_1 \cdot mean17_{\mathrm{d}} + \varepsilon_d$$

Variable	Definition
$impact_d$	Core 2019, 2021 and 2022 ex post load impacts
b_0	Estimated constant
b_1	Estimated parameter coefficient
$mean17_d$	Average temperature over the first 17 hours of the day for each event day
ε_d	The error term for each day d

Figure 3-7 and Figure 3-8 show residential core ex post impacts from 2019, 2021, and 2022 (by cycling strategy) graphed against mean17. The figures also show two lines, where the light blue line represents the current ex ante estimate of the weather responsiveness of the ex post load impacts, as estimated by the model in Equation 3-3, and the orange line represents the ex ante model developed in the 2021 evaluation, which used ex post estimates from 2018, 2019, and 2021. The lines in both figures shows a strong weather response – the hotter it is, the higher the average AC Saver Day Of load impacts. Including three years' worth of data allows for the model to predict impacts at a wide range of temperatures. The impacts at lower temperatures serve as a lower bound for load impacts at cool temperatures. AC Saver Day Of load impacts will eventually become zero at cooler temperatures. With load impacts available at these temperatures from 2021 and impacts at hotter temperatures from 2019 and 2022, a clear weather response signature is seen for both cycling strategies for both evaluations. However, the relationship between mean17 temperatures and load impacts (i.e., the steepness of the slope of the regression line) is estimated to be less in the 2022 model relative to the 2021 model.

Figure 3-7: Average 2019, 2021, and 2022 Ex Post Load Impacts and Ex Ante Predictions for Residential 50% Cycling Participants

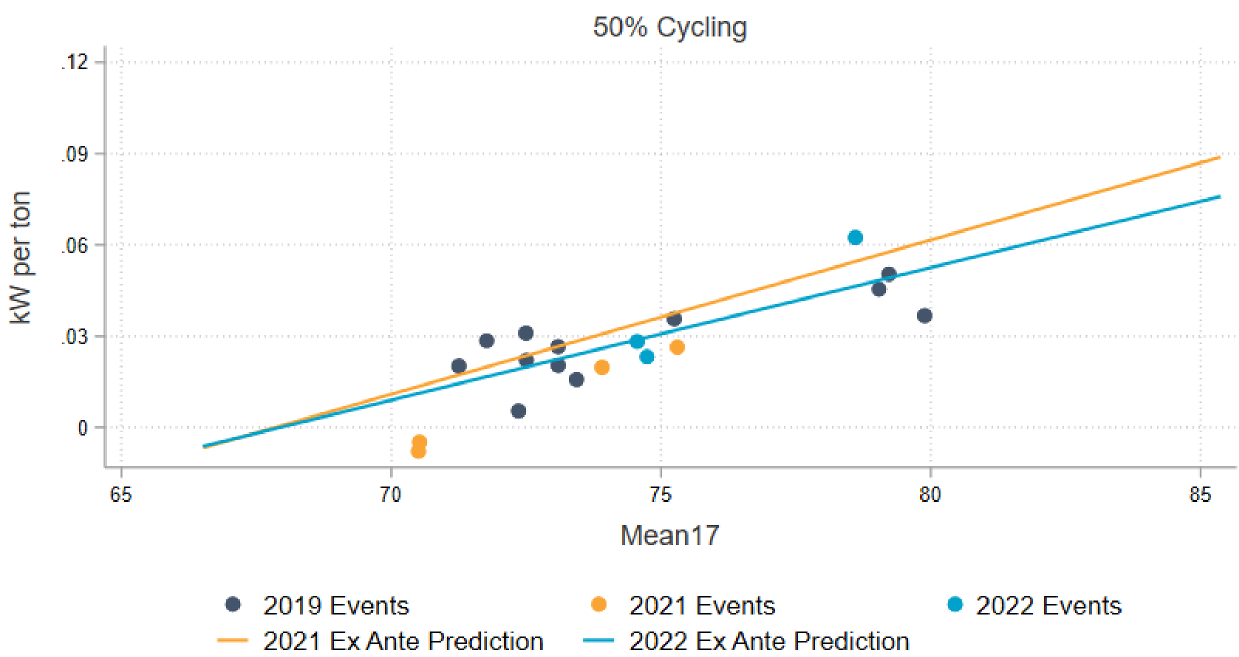


Figure 3-8: Average 2019, 2021, and 2022 Ex Post Load Impacts and Ex Ante Predictions for Residential 100% Cycling Participants

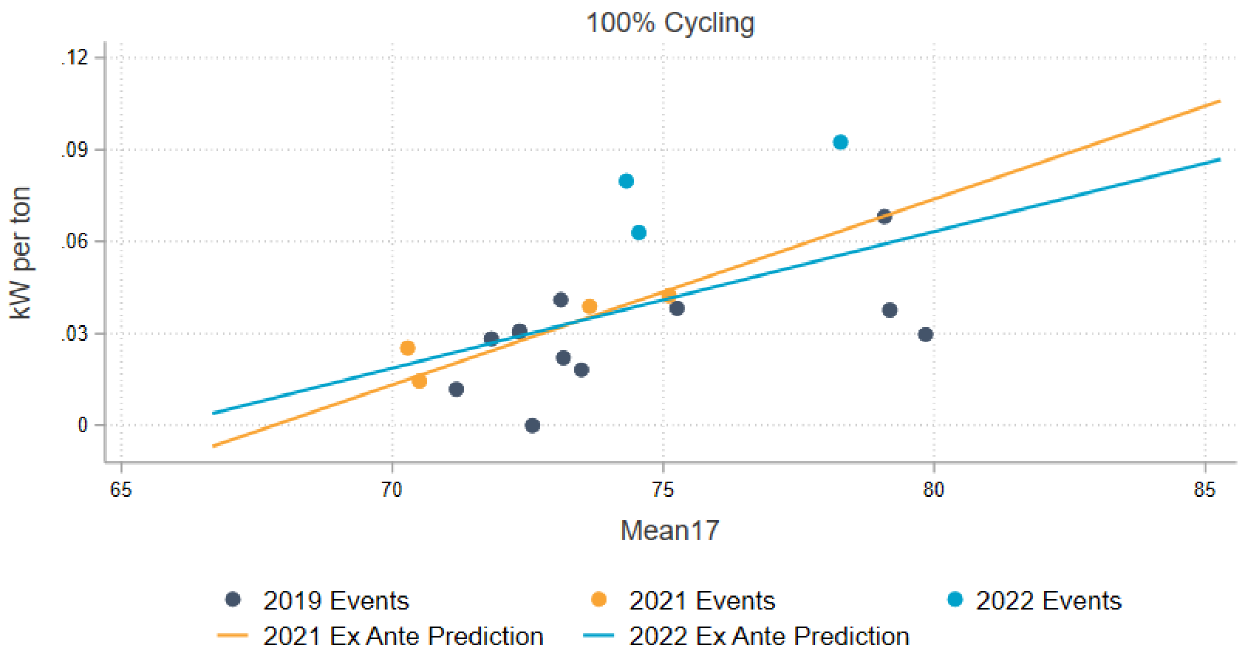


Figure 3-9 and Figure 3-10 show the commercial ex post impacts from 2019, 2021, and 2022 (by cycling strategy) as a function of mean17. Here again, the light blue line represents the relationship of ex post load impacts to mean17 as estimated in the current evaluation and the orange line represents the ex ante relationship estimated for the 2021 load impact evaluation, which used ex post impacts from 2018, 2019, and 2021. As compared to the residential results, the weather response for the commercial participants is less sensitive. The 2022 ex ante relationship for the commercial 30% cycling group is slightly negative due to the negative impacts observed on August 31, 2022, shown in Figure 3-9 as the light blue dot between 75 and 80 degrees F. The load impacts for that event, however, are not statistically significant. The 2022 ex ante relationship for the commercial 50% cycling group is flatter than in 2021, but still positive. It should be noted that while the weather response for commercial participants is less sensitive than in previous years, the forecasted impacts for commercial customers for both the 1-in-2 and 1-in-10 weather scenarios are still positive, which are provided in Section 5.

Figure 3-9: Average 2019, 2021, and 2022 Ex Post Load Impacts and Ex Ante Predictions for Commercial 30% Cycling Participants

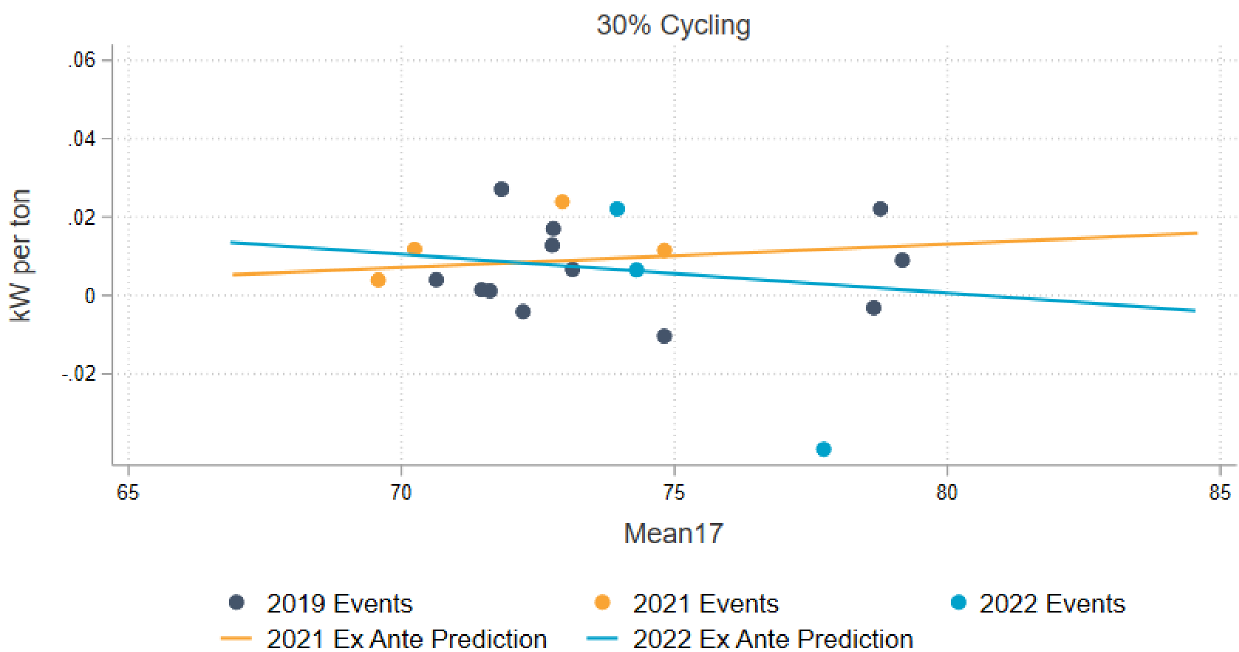
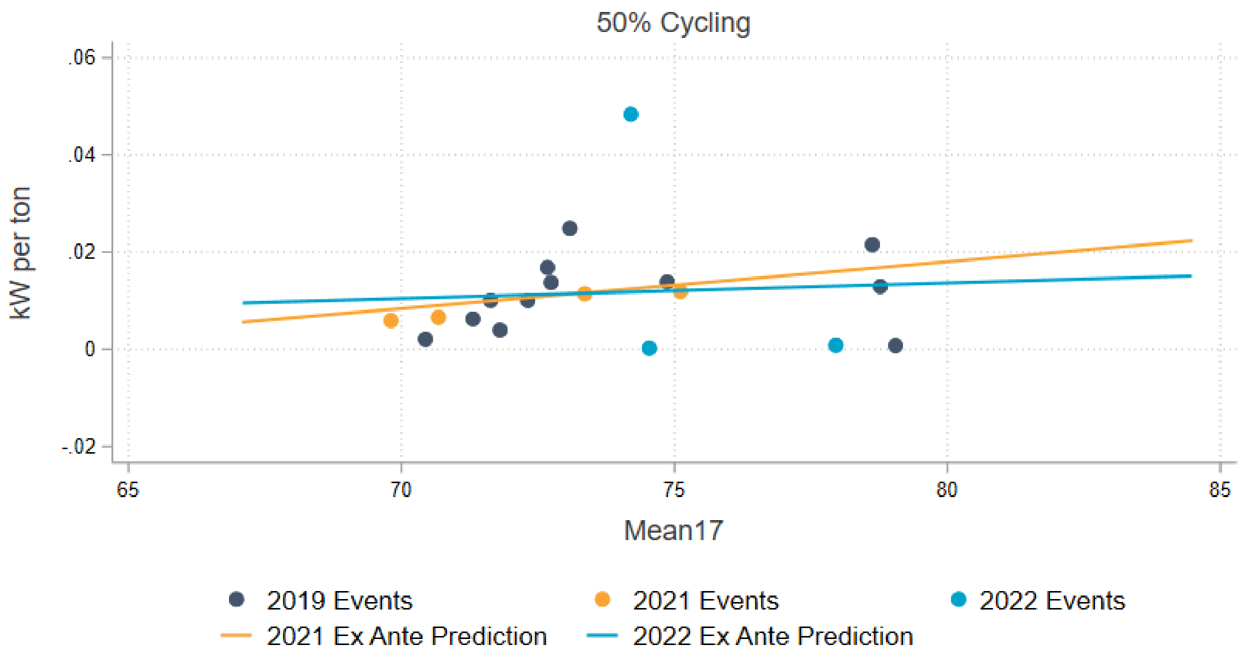


Figure 3-10: Average 2019, 2021, and 2022 Ex Post Load Impacts and Ex Ante Predictions for Commercial 50% Cycling Participants



After the ex ante impacts have been estimated based on the average ex post load impacts, the next step is to predict impacts for each of the hours covered by the CPUC resource adequacy window, which is 5 hours in duration.[6]

To estimate hourly ex ante load impacts, we use the load impacts from 4-hour events from 2018 and 2022 – to estimate the ratio of first hour, second hour, third hour, and fourth hour load impacts to the average load impacts in the middle two hours. These ratios are calculated separately for residential and commercial segments and for each cycling option. When applied to the predicted ex ante average load impact, they provide a consistent hourly shape to ex ante load impacts. Since there are no 5-hour AC Saver Day Of events, an additional hour is created between the second and third hours that is a linear interpolation of the ratios of the two surrounding hours.

This method constrains the relative size of event impacts across different hours to be the same for all ex ante estimates. The magnitude of event impacts varies with weather, but with this approach the ratio of the impact at 4 PM to the impact at 5 PM, for example, is always the same. The ratios for each customer type and cycling option are shown in Table 3-3.

[6] In 2022, the RA adequacy window was adjusted from 4-9 PM to 5-10 PM for the months of March and April. To accommodate this change, RI estimated ex ante impacts using both the old and new RA windows.

Table 3-3: Ex Ante Shaping Ratios for Each Customer Type and Cycling Option

Hour of the Event (April)	Hour of the Event (May-October)	Ratio: Hourly Impact / Core Impact			
		Residential 50%	Residential 100%	Commercial 30%	Commercial 50%
5-6 PM	4-5 PM	0.88	0.73	2.44	1.64
6-7 PM	5-6 PM	1.16	1.08	1.37	1.05
7-8 PM	6-7 PM	1.00	1.00	1.00	1.00
8-9 PM	7-8 PM	0.84	0.92	0.63	0.95
9-10 PM	8-9 PM	0.64	0.89	0.92	0.08

An alternative method could be to use a separate ex ante model for each event hour. Such a strategy would have the virtue of independently identifying the effect of weather on event impacts at different times of day. However, when there are only a moderate number of events and, for some hours, many fewer events than for other hours, that strategy risks fitting spurious trends to individual hours or trends across hours that conflict with one another. Given the highly auto-correlated nature of the data, the differential impact of weather on different event hours is likely to be difficult to measure as compared to the primary effect of temperature on average event impacts.

Table 3-4 illustrates how the ratio approach for estimating the hourly shape of average load impacts works in estimating the ex ante load impacts for the RA window. For the case of residential 100% cycling, the load impacts for the 1-in-10 scenario are higher than those for 1-in-2, reflecting the model's prediction for higher average load impacts under hotter weather conditions, but the relationship between the hourly load impacts and the average load impacts are constant across the 1-in-2 and 1-in-10 load impacts.

Table 3-4: Hourly Load Impacts Compared to Average Impacts for Residential 100% Cycling

Hour of Event (April)	Hour of Event (May-October)	Ratio: Hourly Impact / Core Impact	Hourly Impact for Typical SDG&E Event Day, 1-in-2 Weather (kW/ton)	Hourly Impact for Typical SDG&E Event Day, 1-in-10 Weather (kW/Ton)
5-6 PM	4-5 PM	0.73	0.03	0.05
6-7 PM	5-6 PM	1.08	0.05	0.07
7-8 PM	6-7 PM	1.00	0.05	0.07
8-9 PM	7-8 PM	0.92	0.04	0.06
9-10 PM	8-9 PM	0.89	0.04	0.06

As discussed previously, average ex ante load impacts were estimated directly based on ex post impacts. However, the CPUC Load Impact Protocols require that reference loads also be estimated to accompany ex ante load impacts even though they may not always be necessary for load impact estimation, as is true here. To meet this requirement, reference loads were estimated in a manner similar to the approach used for ex ante load impacts; models for estimating reference loads are estimated separately by customer type and cycling strategy. The following steps are taken to estimate reference loads:

- Model the average control group usage during the 6 to 8 PM time period for 2019, 2021, and 2022 weekday event days with event windows of 6 to 8 PM as a function of mean17;
- Predict average control group usage for the period of 6 to 8 PM under ex ante weather conditions using the parameters from this regression;
- Calculate a ratio of the average control group load for each hour of the 4-hour events in 2018 and 2022 to the average control group load for the middle two event hours on those days; and
- Derive the control group load (i.e., reference load) profiles by applying the hourly ratios to the predicted average 6 to 8 PM loads under all the ex ante weather conditions.

Finally, estimates of the ex ante snapback effect were developed in a similar manner. Snapback refers to the increase in load following termination of a load control event as a result of the increased temperature that occurs in buildings when air conditioning is cycled. As with load impacts and reference loads, snapback for residential customers was calculated by cycling strategy. The calculation consisted of the following steps:

- Average the snapback values across the three hours after each ex post event;
- Develop a ratio between snapback in each hour and snapback in the first hour after the event;
- Multiply the snapback value in the first hour after the event by the ratio used to scale the ex post impact to ex ante weather conditions; and
- Multiply the adjusted snapback values for each set of ex ante weather conditions by the snapback ratios to get snapback values for the three hours after each ex ante event.

Commercial snapback is assumed to be zero as there is little prior evidence of CAC snapback after AC Saver Day Of events for commercial participants.

4. Ex Post Load Impact Estimates

This section contains the ex post load impact estimates for program year 2022. Residential load impacts are presented first, followed by commercial load impacts.

4.1. Residential Ex Post Load Impact Estimates

A total of eleven AC Saver Day Of events were called in 2022 with event hours ranging between 5 PM and 9 PM. There were two events called on weekend days and one event called during the Labor Day holiday. Table 4-1 presents ex post load impacts for the residential program segment for each event in program year 2022. The rows highlighted in blue represent events from 6 to 8 PM that are used in the calculation of the Average Event Day. All impacts were statistically significant.

Aggregate residential load impacts ranged from a low of 0.37 MW on September 9, 2022 to a high of 2.45 MW on September 3, 2022. This low result on September 9 can be explained by the unusual weather patterns occurring during that day. Temperatures during the early morning of September 9 were very high with a mean17 temperature of 82 °F, but the highest temperature during the event period, 5-7 PM, was only 74 °F. This cooler temperature during the event hours likely lead to lower cooling loads and thereby load impacts, relative to other event days. The highest event impacts occurred during the event on September 3. In contrast, this day had the highest maximum event window temperature at 93 °F and one of the highest mean17 temperatures at 85 °F.

For this ex post evaluation, "Average Event Day" load impacts are calculated using only events with the same event duration, at the same time of day, and only for weekday events. These criteria were selected because load impacts for the direct load control of residential CAC units may be sensitive to the hour in which the event was dispatched, so events with different event times should not be directly compared. In this case, the average event day load impacts are calculated using the events August 16, August 30, and August 31. All three of these events were dispatched from 6 to 8 PM. The three 2022 AC Saver Day Of events included in the Average Event Day estimate yield an average aggregate load reduction of 1.68 MW.

Table 4-1: AC Saver Day Of 2022 Residential Ex Post Load Impact Estimates

Event Date	Impact		Mean17 (°F)	Max Event Window Temperature (°F)	Event Hours	Statistically Significant at 90% Level
	Per Site (kW)	Aggregate (MW)				
8/16/2022	0.18	1.48	75	80	6pm - 8pm	Yes
8/30/2022	0.14	1.18	75	82	6pm - 8pm	Yes
8/31/2022	0.29	2.37	79	86	6pm - 8pm	Yes
9/1/2022	0.21	1.71	80	86	6pm - 9pm	Yes
9/3/2022	0.30	2.46	85	93	6pm - 8pm	Yes
9/4/2022	0.27	2.19	87	87	6pm - 8pm	Yes
9/5/2022	0.28	2.26	81	90	5pm - 9pm	Yes
9/7/2022	0.30	2.44	83	93	5pm - 9pm	Yes
9/8/2022	0.15	1.25	81	88	5pm - 9pm	Yes
9/9/2022	0.05	0.38	82	74	5pm - 7pm	Yes
9/26/2022	0.16	1.33	74	83	5pm - 7pm	Yes
Average**	**0.20**	**1.68**	**76**	**86**	**6pm - 8pm**	**Yes**

**Light blue rows indicate the weekday 6-8 PM events used in the average event calculation
*** Dark blue rows indicate weekend and holiday events

The residential Average Event Day load impacts per premise in 2019, 2020, 2021 and 2022 were 0.11 kW, 0.13 kW, 0.06 kW, and 0.20 kW, respectively. These averages were calculated using events with similarly timed event windows (6 to 8 PM), but with varying average mean17 temperatures (74 °F in 2019, 73 °F in 2020 and 2021, and 76 °F in 2022) and average event window temperatures (82 °F in 2018, 80 °F in 2019 and 2020, 81 °F in 2021, and 86 °F in 2022). Figure 4-1 shows the relationship between mean17 and impact for all events in 2019, 2020, 2021, and 2022. As noted in the 2021 evaluation, impacts in 2020 were likely impacted by the COVID-19 pandemic. Despite lower mean17 temperatures in 2020 compared to 2019, residential respondents had larger impacts, likely driven by increased occupancy due to stay-at-home orders.

Figure 4-1: 2019, 2020, 2021 and 2022 Ex Post Load Impacts vs. Temperature

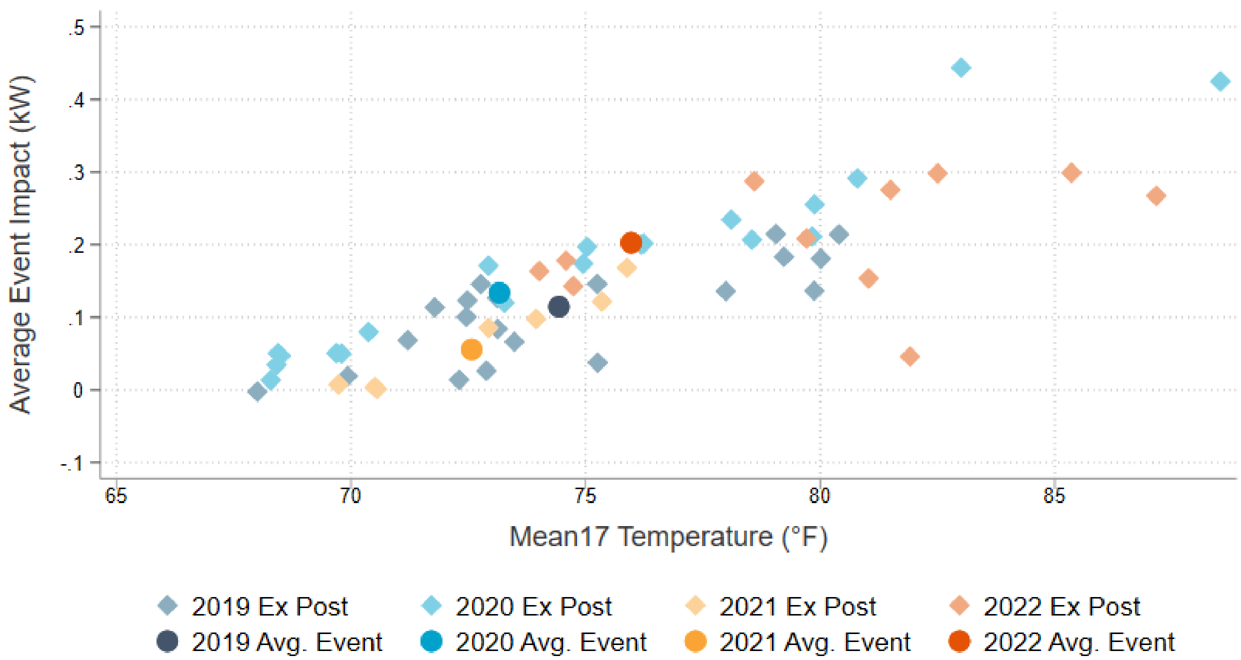


Table 4-2 shows the average per-premise reference loads, load impacts, and percent impacts for residential customers by cycling option. On the average event day, the reference load for the 50% cycling group was approximately 26% higher than the reference load for the 100% cycling group, with reference loads of 2.29 and 1.82 kW per premise, respectively. When comparing average percent impacts across event days, the 100% cycling customers provide larger percentage impacts, with average percentage impacts of 18% for the 100% cycling group and 6% for the 50% cycling group.

Table 4-2: AC Saver Day Of 2022 Residential Average Per-Premise Reference Load, Impacts, and Percent Impacts by Cycling Option

Event Date	Average Reference Load per Site (kW)		Average Load Impact per Site (kW)		Average Percent Impact	
	50%	100%	50%	100%	50%	100%
8/16/2022	2.16	1.73	0.11	0.34	5%	19%
8/30/2022	2.10	1.69	0.09	0.27	4%	16%
8/31/2022	2.60	2.04	0.24	0.39	9%	19%
9/1/2022	2.60	2.10	0.10	0.46	4%	22%
9/3/2022	3.08	2.63	0.15	0.64	5%	24%
9/4/2022	2.79	2.47	0.17	0.49	6%	20%
9/5/2022	2.84	2.43	0.14	0.59	5%	24%
9/7/2022	2.87	2.41	0.19	0.56	7%	23%
9/8/2022	2.26	1.92	0.08	0.34	3%	18%
9/9/2022	1.42	1.22	0.02	0.11	1%	9%
9/26/2022	2.04	1.60	0.13	0.25	6%	15%
Average*	**2.29**	**1.82**	**0.15**	**0.33**	**6%**	**18%**

*Reflects the average 6 to 8 PM weekday 2022 AC Saver Day Of event

Aggregate ex post load impacts for the residential portion of AC Saver Day Of are presented in Table 4-3 for each event day, segmented by cycling option. The 100% cycling option contributes roughly 49% of the total residential load impacts. On the average event day, the 50% cycling participants deliver an estimated 0.85 MW of load reduction while the 100% cycling participants contribute approximately 0.83 MW.

Table 4-3: AC Saver Day Of 2022 Residential Average Per-Premise and Aggregate Load Impacts by Cycling Option

Event Date	Average Load Impact per Site (kW)		Aggregate Load Impact (MW)	
	50%	100%	50%	100%
8/16/2022	0.11	0.34	0.64	0.85
8/30/2022	0.09	0.27	0.52	0.67
8/31/2022	0.24	0.39	1.39	0.98
9/1/2022	0.10	0.46	0.58	1.13
9/3/2022	0.15	0.64	0.89	1.59
9/4/2022	0.17	0.49	0.97	1.23
9/5/2022	0.14	0.59	0.80	1.47
9/7/2022	0.19	0.56	1.07	1.38
9/8/2022	0.08	0.34	0.43	0.83
9/9/2022	0.02	0.11	0.11	0.28
9/26/2022	0.13	0.25	0.72	0.61
***Average**	**0.15**	**0.33**	**0.85**	**0.83**

*Reflects the average 6 to 8 PM weekday 2022 AC Saver Day Of event

Table 4-4 shows estimated event impacts for residential customers segmented by usage quintiles, and

Table 4-5 shows the same but segmented by usage deciles. Each customer was placed into 1 of 5 quintiles (or 1 of 10 deciles, in the case of

Table 4-5), based on their average usage during the peak hours from 11 AM to 6 PM on all proxy event days in 2022. Impact estimates were calculated separately for each quintile and decile for the average event hour of the 2022 Average Event Day to determine reference loads and load impacts. Load impacts by quintile largely increase with electricity usage, however given the smaller sample sizes associated with each individual quintile, there are relatively large standard errors, as compared to the impacts, associated with these estimates. In the case of the largest quintiles, per-premise load impacts top out at 0.33 kW for 50% cycling and 0.83 kW for 100% cycling – both more than double the overall average impacts for all customers enrolled in these cycling options of 0.03 kW and 0.13 kW, respectively. For the largest decile, 50% cycling load impacts peak at 0.38 kW and 100% cycling load impacts peak at 1.01 kW.

Table 4-4: Residential Average Per-Premise Load Impacts by Usage Quintile and Cycling Option

Quintile	50% Cycling		100% Cycling	
	Average* Per Premise Load Impact (kW)	Load Impact Standard Error (kW)	Average* Per Premise Load Impact (kW)	Load Impact Standard Error (kW)
1	0.00	0.01	0.21	0.02
2	0.02	0.01	0.14	0.01
3	0.09	0.01	0.31	0.02
4	0.15	0.02	0.48	0.02
5	0.33	0.02	0.83	0.03

*Reflects the average 6 to 8 PM weekday 2022 AC Saver Day Of event

Table 4-5: Residential Average Per-Premise Load Impacts by Usage Decile and Cycling Option

Decile	50% Cycling		100% Cycling	
	Average* Per Premise Load Impact (kW)	Load Impact Standard Error (kW)	Average* Per Premise Load Impact (kW)	Load Impact Standard Error (kW)
1	-0.02	0.02	0.32	0.03
2	0.03	0.01	0.10	0.02
3	0.03	0.02	0.15	0.02
4	0.01	0.02	0.14	0.02
5	0.08	0.02	0.21	0.02
6	0.11	0.02	0.42	0.03
7	0.16	0.02	0.47	0.03
8	0.14	0.02	0.49	0.03
9	0.27	0.02	0.66	0.04
10	0.38	0.03	1.01	0.05

*Reflects the average 6 to 8 PM weekday 2022 AC Saver Day Of event

4.2. Commercial Ex Post Load Impact Estimates

Table 4-6 presents the ex post load impact estimates for commercial customers for each 2022 event day and the Average Event Day. Here again, the Average Event Day load impacts are calculated using August 16, August 30, and August 31. These rows highlighted in blue represent weekday events from 6 to 8 PM that are used in the calculation of the Average Event Day.

Weekday commercial aggregate impact estimates vary from a low of -0.22 MW on August 31 to a high of 0.86 MW on August 17. Event day temperature was generally not correlated with higher load impacts for commercial customers. The event which yielded the largest load impacts, August 16, had one of the lower mean17 and max event window temperatures. This is likely due to the fact that commercial customers in general are less responsive to changes in weather than residential customers. Note that four of the individual event impacts are negative, however these impacts are not statistically significant. These negative impacts are likely due to statistical uncertainty rather than actual load increases for treatment customers.

Table 4-6: AC Saver Day Of 2022 Commercial Ex Post Load Impact Estimates

Event Date	Impact		Mean17 (°F)	Max Event Window Temperature (°F)	Event Hours	Statistically Significant at 90% Level
	Per Site (kW)	Aggregate (MW)				
8/16/2022	0.36	0.88	74	79	6pm - 8pm	Yes
8/30/2022	0.02	0.04	75	81	6pm - 8pm	No
8/31/2022	-0.09	-0.23	78	85	6pm - 8pm	No
9/1/2022	0.08	0.20	79	84	6pm - 9pm	No
9/3/2022	-0.05	-0.12	84	93	6pm - 8pm	No
9/4/2022	0.23	0.56	87	86	6pm - 8pm	Yes
9/5/2022	0.24	0.60	81	89	5pm - 9pm	Yes
9/7/2022	-0.01	-0.02	82	91	5pm - 9pm	No
9/8/2022	-0.05	-0.12	81	88	5pm - 9pm	No
9/9/2022	0.01	0.02	82	73	5pm - 7pm	No
9/26/2022	0.15	0.37	74	82	5pm - 7pm	Yes
Average**	**0.10**	0.23	**76**	**85**	**6pm - 8pm**	**Yes**

**Light blue rows indicate the weekday 6-8 PM events used in the average event calculation
*** Dark blue rows indicate weekend and holiday events

Figure 4-2 shows the relationship between mean17 and impact for all commercial events in 2019, 2020, 2021 and 2022. The dark circles show the average event mean17 between the three program years. The commercial Average Event Day (6 to 8 PM events) load impacts per premise in 2019, 2020, 2021 and 2022 were 0.14 kW, 0.09 kW, 0.09 kW, and 0.10 kW, respectively. As displayed in Figure 4-2, the mean17 temperature was higher in 2022 than the earlier three years. However, as mentioned previously, commercial impacts remain relatively consistent regardless of the temperature, especially when the mean17 is lower than 75 °F. The smallest impacts for the commercial segment occurred in 2020 during the COVID-19 pandemic. During this time, many commercial customers were shut down or experienced reduced hours or operations due to the pandemic. Impacts in 2021 and 2022 were more similar to 2019 levels, indicating that the impact of COVID-19 was diminished following 2020.

Figure 4-2: Commercial 2019-2022 Ex Post Load Impacts vs. Temperature

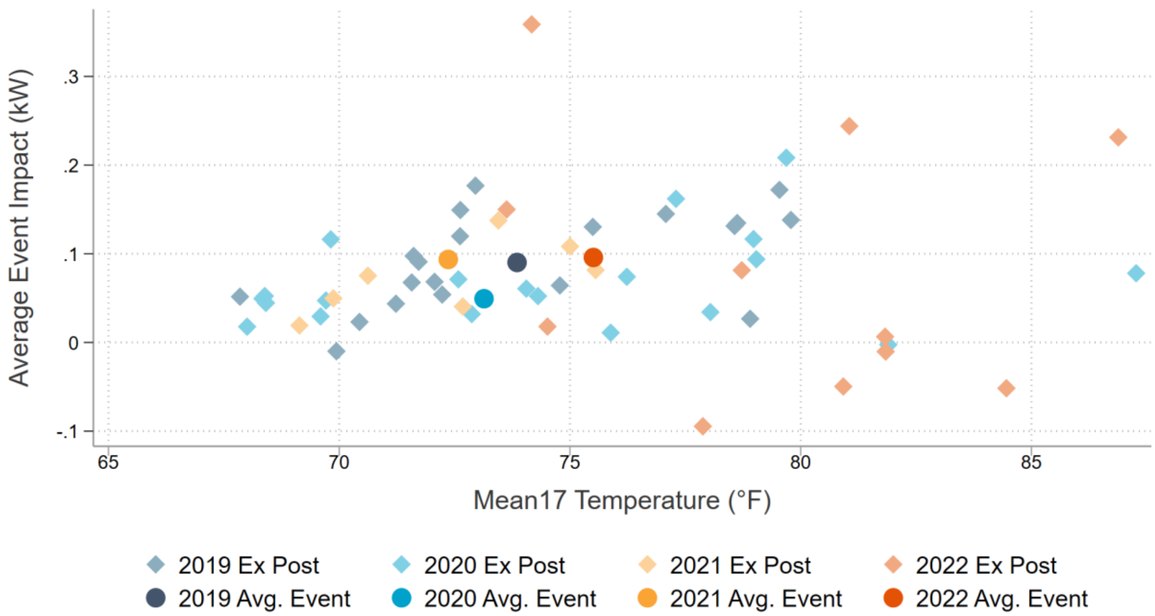


Table 4-7 presents the per-premise and aggregate load impacts for commercial participants on each event day, segmented by cycling strategy. On a per-premise basis, load impacts for the 50% cycling option range from -0.02 kW on September 9 to 0.40 kW on August 16. Per-premise load impacts for the 30% cycling option are more broadly distributed, ranging from -0.43 kW to 0.38 kW. Although the distributions of impacts vary between the groups, on the Average Event Day, load impacts for the 50% cycling group are 0.14 kW, while the 30% group has an average -0.04 kW. The difference in aggregate impacts reflects the differences in customer enrollment between the two cycling strategies. There were 547 premises in the 30% cycling group and 1,810 in the 50% cycling group at the end of the 2022 event season.

Table 4-7: Commercial Average Per-Premise and Aggregate Load Impacts by Cycling Option

Event Date	Average Load Impact per Site (kW)		Aggregate Load Impact (MW)	
	50%	100%	50%	100%
8/16/2022	0.24	0.40	0.13	0.75
8/30/2022	0.07	0.00	0.04	0.00
8/31/2022	-0.43	0.01	-0.23	0.01
9/1/2022	-0.19	0.16	-0.10	0.31
9/3/2022	0.34	-0.17	0.18	-0.32
9/4/2022	0.41	0.18	0.22	0.34
9/5/2022	0.38	0.20	0.21	0.39
9/7/2022	-0.24	0.06	-0.13	0.11
9/8/2022	-0.03	-0.06	-0.02	-0.10
9/9/2022	0.09	-0.02	0.05	-0.03
9/26/2022	0.18	0.14	0.10	0.26
***Average**	**-0.04**	**0.14**	**-0.02**	**0.26**

*Reflects the average 6 to 8 PM weekday 2022 AC Saver Day Of event

Table 4-8 shows estimated event impacts for commercial customers segmented by usage quintiles, and

Quintile	30% Cycling		50% Cycling	
	Average* Per Premise Load Impact (kW)	Load Impact Standard Error (kW)	Average* Per Premise Load Impact (kW)	Load Impact Standard Error (kW)
1	-0.16	0.18	-0.10	0.08
2	-0.01	0.05	0.00	0.03
3	-0.09	0.10	0.07	0.04
4	0.17	0.10	0.11	0.05
5	0.25	0.26	0.37	0.14

*Reflects the average 6 to 8 PM 2022 AC Saver Day Of Weekday event

Table 4-9 shows the same but segmented by usage deciles. Each customer was placed into 1 of 5 quintiles (or 1 of 10 deciles, in the case of

Quintile	30% Cycling		50% Cycling	
	Average* Per Premise Load Impact (kW)	Load Impact Standard Error (kW)	Average* Per Premise Load Impact (kW)	Load Impact Standard Error (kW)
1	-0.16	0.18	-0.10	0.08
2	-0.01	0.05	0.00	0.03
3	-0.09	0.10	0.07	0.04
4	0.17	0.10	0.11	0.05
5	0.25	0.26	0.37	0.14

*Reflects the average 6 to 8 PM 2022 AC Saver Day Of Weekday event

Table 4-9), based on their average usage during the peak hours from 11 AM to 6 PM on all proxy event days in 2022. Impact estimates were calculated separately for each quintile and decile for the average event hour of the Average Event Day to determine reference loads and load impacts.

Load impacts by quintile and decile largely increase with electricity usage for 30% and 50% cycling customers. However, these impacts come with a significant amount of statistical uncertainty. There were approximately 560 commercial 30% cycling customers in total and dividing this group further produces a limited amount of data to evaluate. Given the smaller sample sizes associated with each individual decile for 30% cycling, there are relatively large standard errors associated with these estimates. For example, in the 1st decile of usage for 30% cycling there is a per-premise load impact of -0.36 kW with standard error of 0.34.

Table 4-8: Commercial Average Per-Premise Load Impacts by Usage Quintile and Cycle Option

Quintile	30% Cycling		50% Cycling	
	Average* Per Premise Load Impact (kW)	Load Impact Standard Error (kW)	Average* Per Premise Load Impact (kW)	Load Impact Standard Error (kW)
1	-0.16	0.18	-0.10	0.08
2	-0.01	0.05	0.00	0.03
3	-0.09	0.10	0.07	0.04
4	0.17	0.10	0.11	0.05
5	0.25	0.26	0.37	0.14

*Reflects the average 6 to 8 PM 2022 AC Saver Day Of Weekday event

Table 4-9: Commercial Average Per-Premise Load Impacts by Usage Decile and Cycle Option

Decile	30% Cycling	50% Cycling

	Average* Per Premise Load Impact (kW)	Load Impact Standard Error (kW)	Average* Per Premise Load Impact (kW)	Load Impact Standard Error (kW)
1	-0.36	0.34	-0.12	0.13
2	0.04	0.03	-0.08	0.07
3	0.03	0.06	-0.01	0.05
4	-0.05	0.08	0.00	0.04
5	0.18	0.10	0.04	0.06
6	-0.35	0.16	0.10	0.06
7	0.19	0.11	0.18	0.06
8	0.15	0.16	0.03	0.08
9	0.43	0.21	0.19	0.11
10	0.08	0.46	0.55	0.26

*Reflects the average 6 to 8 PM 2022 AC Saver Day Of Weekday event

4.3. Ex Post Load Impact Comparison to 2020 and 2021

In 2020, the COVID-19 pandemic had a large effect on impacts for both residential and commercial customers. This section illustrates the differences in impacts between 2020, 2021, and 2022. It also provides context for why 2020 impacts were excluded from ex ante calculations.

Varying weather conditions in 2020, 2021 and 2022 and the COVID-19 pandemic contributed to a change in load impacts across program years. Figure 4-3, Figure 4-4 and Figure 4-5 show the daily mean17 temperature (average daily temperature between midnight and 5 PM) from May 1 through October 31 for 2020, 2021 and 2022, respectively. Each graph has a horizontal line at 75 °F and red circles to represent each event day that season. In 2020, 9 of the 20 events called were on days with a mean17 over 75 °F. There was also a significant heat wave in September 2020 with mean17 temperatures exceeding 80 °F. Comparatively, in 2021, only 2 of 7 events were called with a mean17 over 75 °F. In 2022, 8 of the 11 events were called with a mean17 over 75 °F.

Figure 4-3: 2020 AC Saver Day Of Event Days and Mean17 Temperatures

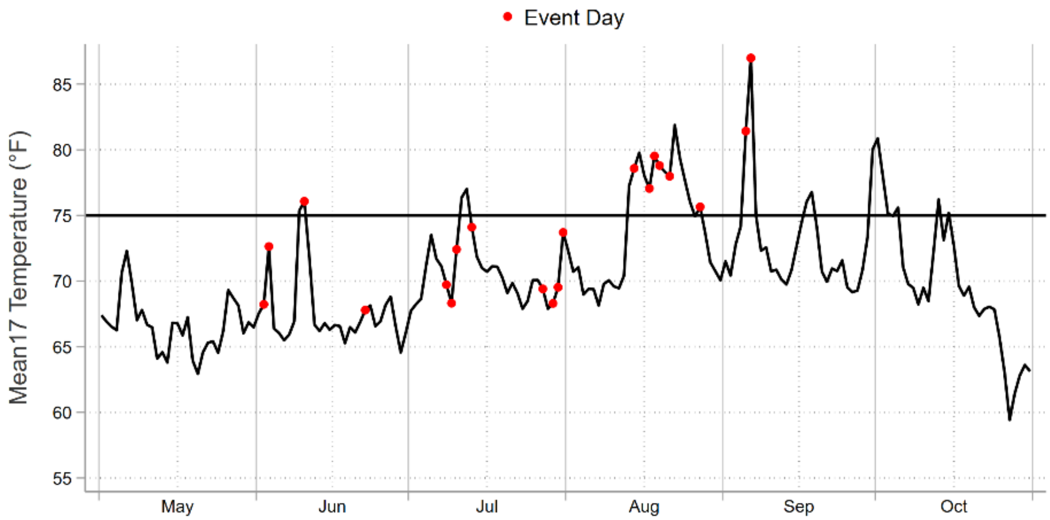


Figure 4-4: 2021 AC Saver Day Of Event Days and Mean17 Temperatures

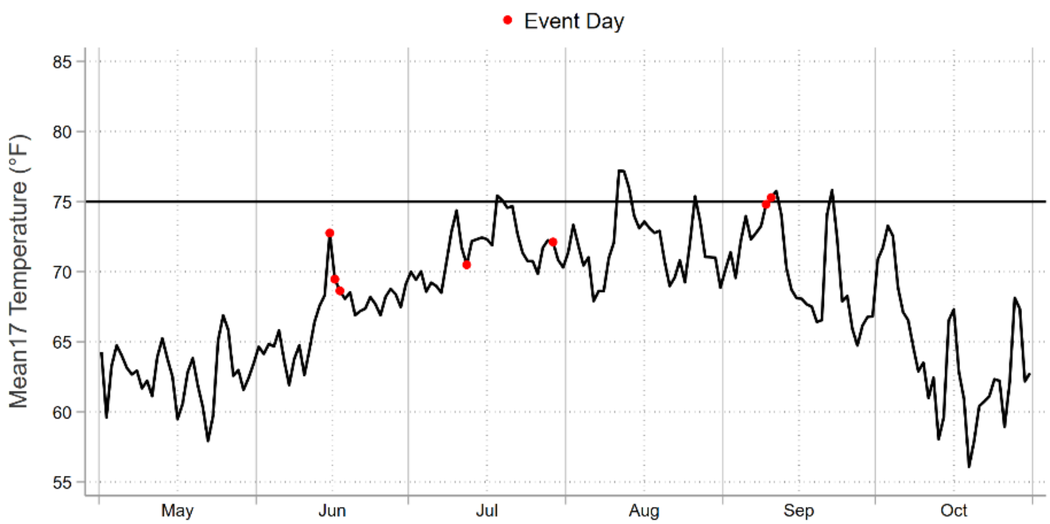


Figure 4-5: 2022 AC Saver Day Of Event Days and Mean17 Temperatures

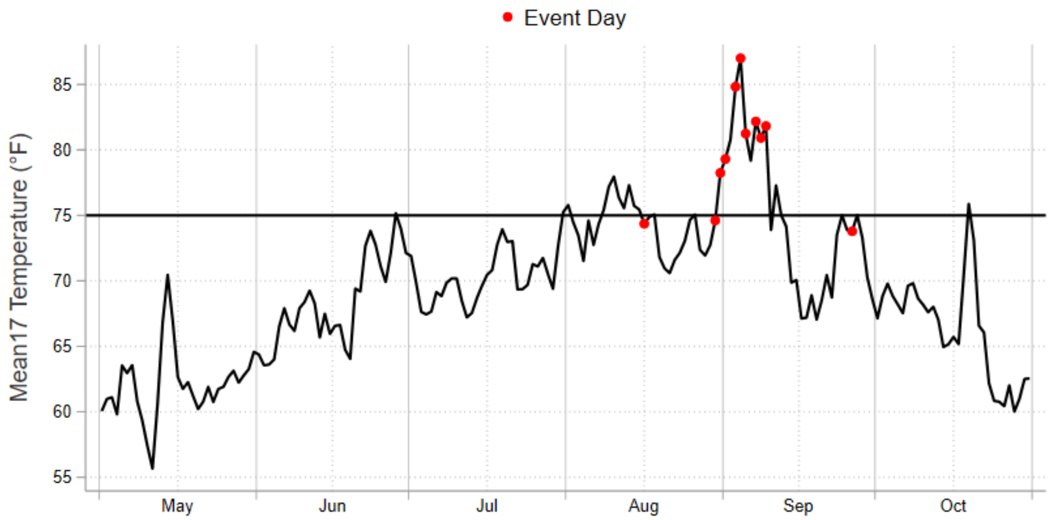


Table 4-10 shows the residential Average Event Day (6 to 8 PM) impacts for 2020, 2021 and 2022. Impacts were lower in 2021 in both absolute and percentage terms compared to the other two years. In 2020 reference loads for residential customers were higher, presumably because residential customers were spending more time at home, increasing electricity use, due to stay-at-home orders. In contrast, in 2022, reference loads were higher due to higher temperatures. Generally, customers with higher reference loads will produce larger kW impacts because they have more load to shed.

Table 4-10: Residential 2020, 2021, and 2022 Ex Post Impacts

Year	Avg. Event Hours	Customers Called	Mean17 Avg. Temp. (°F)	Avg. Reference Load (kW)	Avg. Load w/DR (kW)	Impact (kW)	Impact (%)	Snapback (kW)	Aggregate Impact (MW)
2020 Average Event Day	6PM - 8PM	6,975	73	1.44	1.31	0.13	9.3%	-0.04	0.94
2021 Average Event Day	6PM - 8PM	7,798	73	1.37	1.31	0.06	4.1%	-0.04	0.44
2022 Average Event Day	6PM - 8PM	8,241	76	2.15	1.95	0.20	9.4%	-0.07	1.68

Table 4-11 shows the commercial Average Event Day (6 to 8 PM) impacts for 2020, 2021, and 2022. The effects of the COVID-19 pandemic on commercial customers were opposite of what was seen with the residential customers. In 2020, commercial customers had smaller reference loads and thereby load impacts because many businesses were shut down or running partial operations. In 2021, both reference loads and impacts increased relative to 2020. In 2022, higher temperatures led to greater reference loads in the commercial segment, but not significantly higher impacts. Generally, impacts in the commercial segment are not as sensitive to changes in temperature as the residential segment.

Table 4-11: Commercial 2020, 2021, and 2022 Ex Post Impacts

Year	Avg. Event Hours	Customers Called	Mean17 Avg. Temp. (°F)	Avg. Reference Load (kW)	Avg. Load w/DR (kW)	Impact (kW)	Impact (%)	Snapback (kW)	Aggregate Impact (MW)
2020 Average Event Day	6PM - 8PM	3,124	73	4.98	4.93	0.05	1.0%	0.01	0.15
2021 Average Event Day	6PM - 8PM	2,312	72	5.85	5.75	0.09	1.6%	0.03	0.22
2022 Average Event Day	6PM - 8PM	2,377	76	7.83	7.76	0.10	1.2%	0.07	0.23

As shown in the tables above, temperature during events has a major influence on the impacts observed during a given year. Additionally, COVID-19 had a major influence on the results of the program in 2020. Accordingly, the results in 2020 are viewed more as an anomaly than the norm. The ex ante methodology reflects this by not including 2020 results in the analysis, but using 2019, 2021, and 2022 results instead, representing years in which the effects of the pandemic on electricity usage are either nonexistent or diminished.

5. Ex Ante Load Impact Estimates

This section presents ex ante load impact estimates for SDG&E's AC Saver Day Of program. Residential ex ante estimates are provided first, followed by estimates for commercial customers. These estimates are then compared to the ex ante estimates produced in the 2021 load impact evaluation and the relationship between the 2022 ex post impacts and the ex ante estimates is explained.

5.1. Ex Ante Estimates

The models described in Section 3 were used to estimate load impacts based on ex ante event weather conditions and enrollment projections for the years 2023–2033. Recent AC Saver Day Of evaluations have shown a steady decrease in enrollment forecasts because the program is no longer actively marketed. This trend continues in 2022 with predicted enrollments decreasing about 13% per year for residential and 8% per year for commercial customers.

The Load Impact Protocols require that ex ante load impacts are estimated assuming weather conditions associated with both normal and extreme utility operating conditions. Normal conditions are defined as those that would be expected to occur once every 2 years (1-in-2 conditions) and extreme conditions are defined as those that would be expected to occur once every 10 years (1-in-10 conditions). From 2008 to 2014, the California IOUs based their ex ante weather conditions on system operating conditions specific to each individual utility for estimating demand response load impacts. However, an alternative is to use ex ante weather conditions that reflect 1-in-2 and 1-in-10 year operating conditions for the CAISO rather than the operating conditions for each IOU. While the Protocols do not address this issue, a letter from the CPUC Energy Division to the IOUs dated October 21, 2014 directed the utilities to provide impact estimates under two sets of operating conditions starting with the April 1, 2015 filings: one reflecting operating conditions for each IOU and one reflecting operating conditions for the CAISO system.

In order to meet this requirement, California's IOUs contracted with Resource Innovations (formerly Nexant) in 2014 to develop ex ante weather conditions based on the peaking conditions for each utility and for the CAISO system. Resource Innovations subsequently updated these weather conditions for SDG&E in 2017 and 2022[7]. The new ex ante weather dataset utilizes a more recent historical window of weather conditions from 2012 to 2021 that better reflect recent warming trends.

Ex ante weather conditions for CAISO peaking conditions and SDG&E peaking conditions may differ, and the extent to which that can happen largely depends on the correlation between individual utility and CAISO peak loads. Based on CAISO and SDG&E system peak loads for the top 200 CAISO system load days from 2014 to 2021, the correlation coefficient for SDG&E is 0.52, indicating that there are many days on which the CAISO system loads are high while SDG&E loads are more modest, and vice-

[7] The original ex ante weather conditions used in DR load impact evaluations were developed in 2009.

versa. This correlation for SDG&E tends to be weakest when CAISO loads are below 44,000 MW. CAISO loads often reach 43,000 MW when loads in the Los Angeles area temperatures are extreme but San Diego loads are moderate. However, whenever CAISO loads have exceeded 44,000 MW, loads typically have been high across all three IOUs, leading to a stronger correlation for SDG&E in these cases.

Table 5-1 and Table 5-2 show the AC Saver Day Of residential and commercial enrollment-weighted average mean17 (temperature buildup from midnight to 5 PM) for the typical event day and the monthly system peak days under the four sets of weather conditions for which load impacts are estimated. The differences in mean17 values based on SDG&E peak conditions and CAISO peak conditions, and also differences between normal and extreme weather conditions, can be significant. For example, the residential AC Saver Day Of enrollment-weighted temperature on a 1-in-10 CAISO July peak day is 77 °F, while on a SDG&E 1-in-10 peak July day it is 81 °F. There are also large differences across months. As seen in later tables in this section, even small differences in the value of mean17 can have large impacts on aggregate load impacts.

Table 5-1: Residential Enrollment-Weighted Ex Ante Weather Conditions

Customer Type	Cycle	Day Type	CAISO System Mean17 Temperature (°F)		SDG&E System Mean17 Temperature (°F)	
			1-in-2	1-in-10	1-in-2	1-in-10
Residential	50%	Typical Event Day	76	80	78	82
		April Peak Day	69	75	71	74
		May Peak Day	68	75	69	79
		June Peak Day	72	77	72	80
		July Peak Day	76	77	78	81
		August Peak Day	78	82	80	83
		September Peak Day	78	85	83	84
		October Peak Day	76	82	76	83
	100%	Typical Event Day	76	80	78	82
		April Peak Day	69	75	71	75
		May Peak Day	68	75	69	79
		June Peak Day	72	77	71	79
		July Peak Day	76	77	78	81
		August Peak Day	78	82	80	83
		September Peak Day	78	85	83	84
		October Peak Day	77	82	76	83

Table 5-2: Commercial Enrollment-Weighted Ex Ante Weather Conditions

Customer Type	Cycle	Day Type	CAISO System Mean17 Temperature (°F)		SDG&E System Mean17 Temperature (°F)	
			1-in-2	1-in-10	1-in-2	1-in-10
Commercial	30%	Typical Event Day	76	79	78	81
		April Peak Day	69	75	71	75
		May Peak Day	67	75	69	79
		June Peak Day	72	76	71	78
		July Peak Day	76	77	78	80
		August Peak Day	78	81	79	82
		September Peak Day	78	85	82	84
		October Peak Day	76	81	75	83
	50%	Typical Event Day	76	79	77	81
		April Peak Day	69	75	71	75
		May Peak Day	67	75	69	79
		June Peak Day	72	75	71	78
		July Peak Day	75	76	78	79
		August Peak Day	77	81	79	82
		September Peak Day	78	84	82	84
		October Peak Day	76	82	75	83

AC Saver Day Of enrollment is assumed to decrease over the forecast horizon. Table 5-3 shows the enrollment forecast for the two customer groups for the summer months of each year from 2023 to 2033. The forecast reflects an annual enrollment change from 2022-2027 of an approximately 13% decrease for residential customers and 8% decrease for commercial customers.

Table 5-3: AC Saver Day Of Enrollment Forecast

Customer Type	Forecast Year	Forecast Month						
		April	May	June	July	August	Sept.	October
Residential	2023	7,001	7,001	7,001	7,001	7,001	7,001	7,001
	2024	6,083	6,083	6,083	6,083	6,083	6,083	6,083
	2025	5,294	5,294	5,294	5,294	5,294	5,294	5,294
	2026	4,614	4,614	4,614	4,614	4,614	4,614	4,614
	2027-2033	4,027	4,027	4,027	4,027	4,027	4,027	4,027
Commercial	2023	2,160	2,160	2,160	2,160	2,160	2,160	2,160
	2024	1,991	1,991	1,991	1,991	1,991	1,991	1,991
	2025	1,835	1,835	1,835	1,835	1,835	1,835	1,835
	2026	1,691	1,691	1,691	1,691	1,691	1,691	1,691
	2027-2033	1,559	1,559	1,559	1,559	1,559	1,559	1,559

While AC Saver Day Of events can be called any time between noon and 9 PM, ex ante load impacts reported here represent the average load impact across the hours defined by the CPUC for determining resource adequacy (RA) requirements.

Previously, these RA hours were defined as the hours from 4-9 PM for all 12 months of the year. In 2022, CPUC adjusted the RA hours to 5-10 PM for the months of March and April. To reflect this change, the results for the month of April are presented for both the new and old RA hours.

Table 5-4 and Table 5-5 summarize the average and aggregate load impact estimates per premise under SDG&E-specific peaking conditions and CAISO peaking conditions for 2023. The per-premise load impacts are highest for the September monthly peak for both CAISO and SDG&E system conditions, for both residential and commercial, and for both 1-in-2 and 1-in-10 weather conditions. Similarly, the per-premise impacts are generally lowest for the April monthly peak for all scenarios and customer types. Those scenarios that have a predicted value of zero represented cooler weather months where the program is not expected to provide noticeable impacts.

For a typical event day under SDG&E-specific weather conditions, the impact per premise in a 1-in-2 year is 0.17 kW for residential customers and 0.24 kW in a 1-in-10 year. The hottest weather conditions are expected in the month of September, where per-premise load impacts peak at 0.25 kW under the SDG&E-specific 1-in-2 conditions and at 0.27 kW under 1-in-10 conditions. Differences between 1-in-2 and 1-in-10 load impacts are driven by differences in mean17, which vary by as much as 13 degrees for some months; a 13-degree temperature difference on average over 17 hours represents a very large difference in temperature conditions and air conditioning requirements.

Load impacts for commercial customers follow similar patterns. Under the SDG&E peaking scenarios, the typical event day per-premise load impact is 0.08 kW under the 1-in-2 assumption and

0.08 kW under the 1-in-10 assumption. In September, commercial per-premise load impacts peak at 0.08 kW under 1-in-2 conditions and 0.09 kW under 1-in-10 conditions. While the commercial load impacts are very similar to residential impacts, they on one hand reflect lower cycling strategies (30% and 50% compared to 50% and 100%) and on the other reflect more CAC units enrolled in the program per premise. The net effect is that commercial load impacts are similar, but somewhat lower, than residential. The lower cycling strategies also yield less weather-sensitive load impacts for commercial participants as compared to residential participants.

The aggregate program load reduction potential for residential customers is 1.2 MW and 0.2 MW for commercial customers for a typical event day in 2023 under SDG&E-specific 1-in-2 year weather conditions. Under SDG&E-specific 1-in-10 year weather conditions, the aggregate impacts for residential and commercial customers are 1.6 MW and 0.2 MW, respectively. The aggregate impacts for both segments under CAISO-wide 1-in-2 and 1-in-10 years weather conditions are similar to the impacts under the equivalent SDG&E conditions.

Table 5-4: 2023 Residential Ex Ante Load Impact Estimates by CAISO and SDG&E-specific Weather and Day Type

Customer Type	Day Type	Impact per Premise (kW)				Aggregate Impact (MW)			
		CAISO 1-in-2	SDGE 1-in-2	CAISO 1-in-10	SDGE 1-in-10	CAISO 1-in-2	SDGE 1-in-2	CAISO 1-in-10	SDGE 1-in-10
Residential	Typical Event Day	0.14	0.17	0.21	0.24	1.0	1.2	1.5	1.6
	April Monthly Peak	0.02	0.05	0.11	0.11	0.1	0.4	0.8	0.8
	May Monthly Peak	0.01	0.02	0.12	0.19	0.1	0.1	0.8	1.3
	June Monthly Peak	0.08	0.06	0.15	0.20	0.5	0.4	1.1	1.4
	July Monthly Peak	0.14	0.17	0.16	0.22	1.0	1.2	1.1	1.5
	August Monthly Peak	0.18	0.21	0.24	0.25	1.2	1.5	1.6	1.8
	Sept. Monthly Peak	0.18	0.25	0.30	0.27	1.3	1.7	2.1	1.9
	October Monthly Peak	0.15	0.13	0.24	0.26	1.0	0.9	1.7	1.8

Table 5-5: 2023 Commercial Ex Ante Load Impact Estimates by CAISO and SDG&E-specific Weather and Day Type

Customer Type	Day Type	Impact per Premise (kW)				Aggregate Impact (MW)			
		CAISO 1-in-2	SDGE 1-in-2	CAISO 1-in-10	SDGE 1-in-10	CAISO 1-in-2	SDGE 1-in-2	CAISO 1-in-10	SDGE 1-in-10
Commercial	Typical Event Day	0.09	0.08	0.08	0.08	0.2	0.2	0.2	0.2
	April Monthly Peak	0.10	0.10	0.09	0.09	0.2	0.2	0.2	0.2
	May Monthly Peak	0.10	0.10	0.09	0.08	0.2	0.2	0.2	0.2
	June Monthly Peak	0.09	0.09	0.09	0.08	0.2	0.2	0.2	0.2
	July Monthly Peak	0.09	0.08	0.08	0.08	0.2	0.2	0.2	0.2
	August Monthly Peak	0.08	0.08	0.08	0.08	0.2	0.2	0.2	0.2
	Sept. Monthly Peak	0.08	0.08	0.09	0.09	0.2	0.2	0.2	0.2
	October Monthly Peak	0.09	0.09	0.08	0.09	0.2	0.2	0.2	0.2

5.1.1. Comparison of Ex Ante Load Impacts by Month

Table 5-6 and Table 5-7 provide ex ante impact estimates on an hourly basis for residential and commercial customers, respectively. The hours presented reflect the peak period as defined by the CPUC resource adequacy requirements.[8] Residential impacts peak in the second hour of this peak period, and commercial impacts peak in the first hour.

September ex ante conditions are much hotter than typical event day conditions and therefore have the highest impacts. In 2023, the residential program is estimated to provide an average impact of 1.9 MW over the 5-hour event window from 4 to 9 PM on a 1-in-10 September monthly system peak day and 1.7 MW on the September monthly system peak day under 1-in-2 year weather conditions for SDG&E-specific peaking conditions.

There is significant variation in load impacts across months and weather conditions for residential and commercial customers. Based on 1-in-2 year weather, the low temperatures in April, May, and June typically experienced in San Diego result in the smallest average and aggregate load impacts. The April 1-in-2 year impacts for residential customers are 0.4 MW while impacts in May and June are 0.1 MW and 0.4 MW respectively. As shown in Table 5-1, May has a slightly higher mean17 under SDG&E 1-in-2 weather conditions than April and June. For commercial customers, the estimates are much more stable given the lack of weather sensitivity for these customers. The average aggregate impacts range from 0.1-0.4 MW regardless of month or weather.

[8] In previous years, this period was defined as the hours of 4-9 PM for all months. In 2022, these hours were adjusted from 4-9 PM to 5-10 PM for the months of March and April. To accommodate this adjustment, we present impacts for the month of April with both the old and new RA adequacy hours.

Table 5-6: 2023 Residential AC Saver Day Of Ex Ante Load Impact Estimates by Weather Year, Day Type and Hour, SDG&E Peaking Conditions

Weather Year	Day Type	Hour of Day						Average (MW)
		4 to 5 PM (MW)	5 to 6 PM (MW)	6 to 7 PM (MW)	7 to 8 PM (MW)	8 to 9 PM (MW)	9 to 10 PM (MW)	
1-in-2	Typical Event Day	1.1	1.5	1.3	1.2	1.0	-	1.2
	April Monthly Peak (New Hours)	-	0.3	0.4	0.4	0.3	0.3	0.4
	April Monthly Peak (Old Hours)	0.3	0.4	0.4	0.3	0.3	-	0.4
	May Monthly Peak	0.1	0.2	0.1	0.1	0.1	-	0.1
	June Monthly Peak	0.4	0.5	0.5	0.4	0.4	-	0.4
	July Monthly Peak	1.1	1.5	1.3	1.2	1.0	-	1.2
	August Monthly Peak	1.3	1.8	1.6	1.4	1.2	-	1.5
	September Monthly Peak	1.6	2.2	1.9	1.7	1.4	-	1.7
	October Monthly Peak	0.8	1.1	1.0	0.9	0.7	-	0.9
1-in-10	Typical Event Day	1.5	2.0	1.8	1.6	1.3	-	1.6
	April Monthly Peak (New Hours)	-	0.7	1.0	0.9	0.8	0.6	0.6
	April Monthly Peak (Old Hours)	0.7	1.0	0.9	0.8	0.6	-	0.8
	May Monthly Peak	1.2	1.7	1.5	1.3	1.1	-	1.3
	June Monthly Peak	1.2	1.7	1.5	1.3	1.1	-	1.4
	July Monthly Peak	1.4	1.9	1.7	1.5	1.2	-	1.5
	August Monthly Peak	1.6	2.2	1.9	1.7	1.4	-	1.8
	September Monthly Peak	1.7	2.4	2.1	1.8	1.5	-	1.9
	October Monthly Peak	1.7	2.3	2.0	1.8	1.5	-	1.8

Table 5-7: 2023 Commercial AC Saver Day Of Ex Ante Load Impact Estimates by Weather Year, Day Type and Hour, SDG&E Peaking Conditions

Weather Year	Day Type	Hour of Day						Average (MW)
		4 to 5 PM (MW)	5 to 6 PM (MW)	6 to 7 PM (MW)	7 to 8 PM (MW)	8 to 9 PM (MW)	9 to 10 PM (MW)	
1-in-2	Typical Event Day	0.3	0.2	0.2	0.2	0.0	-	0.2
	April Monthly Peak (New Hours)	-	0.4	0.2	0.2	0.2	0.1	0.2
	April Monthly Peak (Old Hours)	0.4	0.2	0.2	0.2	0.1	-	0.2
	May Monthly Peak	0.4	0.2	0.2	0.2	0.1	-	0.2
	June Monthly Peak	0.4	0.2	0.2	0.2	0.1	-	0.2
	July Monthly Peak	0.3	0.2	0.2	0.2	0.0	-	0.2
	August Monthly Peak	0.3	0.2	0.2	0.2	0.0	-	0.2
	September Monthly Peak	0.3	0.2	0.2	0.2	0.0	-	0.2
	October Monthly Peak	0.3	0.2	0.2	0.2	0.0	-	0.2
1-in-10	Typical Event Day	0.3	0.2	0.2	0.2	0.0	-	0.2
	April Monthly Peak (New Hours)	-	0.3	0.2	0.2	0.2	0.0	0.2
	April Monthly Peak (Old Hours)	0.3	0.2	0.2	0.2	0.0	-	0.2
	May Monthly Peak	0.3	0.2	0.2	0.2	0.0	-	0.2
	June Monthly Peak	0.3	0.2	0.2	0.2	0.0	-	0.2
	July Monthly Peak	0.3	0.2	0.2	0.2	0.0	-	0.2
	August Monthly Peak	0.3	0.2	0.2	0.2	0.0	-	0.2
	September Monthly Peak	0.3	0.2	0.2	0.2	0.0	-	0.2
	October Monthly Peak	0.3	0.2	0.2	0.2	0.0	-	0.2

Table 5-8 provides program-level ex ante aggregate estimates for each hour. In 2023, the program is expected to provide its highest impact under 1-in-10 conditions in September. Under those conditions, the average impact over the event window is expected to be 2.1 MW, with an hourly peak of 2.6 MW between the hours of 5 and 6 PM.

Table 5-8: 2023 AC Saver Day Of Ex Ante Load Impact Estimates by Weather Year, Day Type and Hour – All Customers – SDG&E Peaking Conditions

Weather Year	Day Type	Hour of Day						Average (MW)
		4 to 5 PM (MW)	5 to 6 PM (MW)	6 to 7 PM (MW)	7 to 8 PM (MW)	8 to 9 PM (MW)	9 to 10 PM (MW)	
1-in-2	Typical Event Day	1.4	1.7	1.5	1.3	1.0	-	1.4
	April Monthly Peak (New Hours)	-	0.7	0.7	0.6	0.5	0.4	0.6
	April Monthly Peak (Old Hours)	0.7	0.7	0.6	0.5	0.4	-	0.6
	May Monthly Peak	0.5	0.4	0.4	0.3	0.2	-	0.4
	June Monthly Peak	0.8	0.8	0.7	0.6	0.4	-	0.6
	July Monthly Peak	1.4	1.7	1.5	1.3	1.0	-	1.4
	August Monthly Peak	1.6	2.0	1.8	1.6	1.2	-	1.6
	September Monthly Peak	1.9	2.4	2.1	1.9	1.4	-	1.9
	October Monthly Peak	1.2	1.3	1.2	1.1	0.8	-	1.1
1-in-10	Typical Event Day	1.8	2.2	2.0	1.8	1.3	-	1.8
	April Monthly Peak (New Hours)	-	1.0	1.2	1.1	0.9	0.7	1.1
	April Monthly Peak (Old Hours)	1.0	1.2	1.1	0.9	0.7	-	1.0
	May Monthly Peak	1.5	1.9	1.7	1.5	1.1	-	1.5
	June Monthly Peak	1.6	1.9	1.7	1.5	1.1	-	1.6
	July Monthly Peak	1.7	2.1	1.9	1.6	1.2	-	1.7
	August Monthly Peak	1.9	2.4	2.1	1.9	1.4	-	1.9
	September Monthly Peak	2.1	2.6	2.3	2.0	1.6	-	2.1
	October Monthly Peak	2.0	2.5	2.2	1.9	1.5	-	2.0

5.2. Comparison of 2022 Ex Ante Load Impacts to 2021 Ex Ante Load Impacts

The following section compares ex ante impacts for a common year, 2023, between this year's evaluation and the 2021 evaluation. The 2021 AC Saver Day Of load impact evaluation estimated that the program's 2023 capacity load reduction is reached under September SDG&E-specific 1-in-10 weather conditions with a combined load impact peak of 2.6 MW. This current year's evaluation yields a lower estimate of program capacity for the residential segment under these conditions – 2.3 MW. A full comparison of the 2021 estimates of the 2023 program year under different weather years and day types can be found in Table 5-9.

Table 5-9: 2023 AC Saver Day Of Estimates by Weather Year and Day Type – 2021 to 2022 Comparison – All Customers – SDG&E Peaking Conditions

Weather Year	Day Type	2021 Average Estimate for 2023 (MW)	2022 Average Estimate for 2023 (MW)
1-in-2	Typical Event Day	1.3	1.4
	April Monthly Peak	0.1	0.6
	May Monthly Peak	0.3	0.4
	June Monthly Peak	0.1	0.6
	July Monthly Peak	1.2	1.4
	August Monthly Peak	1.7	1.6
	September Monthly Peak	2.2	1.9
	October Monthly Peak	1.2	1.1
1-in-10	Typical Event Day	2.0	1.8
	April Monthly Peak	1.2	1.0
	May Monthly Peak	1.4	1.5
	June Monthly Peak	1.6	1.6
	July Monthly Peak	1.5	1.7
	August Monthly Peak	2.1	1.9
	September Monthly Peak	2.6	2.1
	October Monthly Peak	1.7	2.0

In most months and during the typical event day, the ex ante impacts forecasted using the 2022 model are larger than those forecasted using the 2021 model. This is likely due to greater enrollment forecasts in 2022 from not having to hold back a fraction of the residential participant population to serve as a control group in the RCT framework. However, in some months, despite these greater enrollment forecasts, the aggregate forecasted impacts are smaller. This is especially prevalent during 1-in-10 weather conditions. This is likely because the relationship between mean17 and load impacts was weaker in the 2022 model, as seen in Figure 3-7 through Figure 3-10. In other words, a higher mean17 yields a smaller increase in impacts based on the 2022 model relative to the 2021 model. It is also important to note that the ex ante weather used to estimate these impacts was also updated this year. These three factors explain the discrepancy in impact estimates between the two years.

5.3. Relationship between Ex Post and Ex Ante Load Impact Estimates

Table 5-10 facilitates a comparison of the ex post load impact estimates between each event and the ex ante estimates for 1-in-2 and 1-in-10 SDG&E weather conditions. Although ex ante estimates were created using only weekday 6 to 8 PM events, all events are included in this table for completeness.

The purpose of this table is to demonstrate the four important changes that are made to go from ex post results to ex ante predictions: enrollment numbers, predictions using a weather-dependent model, the event window, and weather. We will now step through the table to explain each of these changes, using the first event as an example:

1. First, 2.35 MW (Column D) was delivered by AC Saver Day Of on August 16, 2022 when the heat build-up (as measured by mean17) was 74 °F (Column B). This load impact was generated by 10,650 total AC Saver Day Of participants (Column C).

2. Given the mean17 observed on this date (Column B), the observed enrollment numbers (Column C), and the hours of the event (Column A), our ex ante model predicts that we would expect AC Saver Day Of to deliver 1.16 MW of load reduction (Column E). The impact scaling in this model is based on the impacts from 6 to 8 PM weekday events from 2019, 2021, and 2022, and because our model is linear, this difference between ex post (Column D) and ex ante (Column E) implies that the load impact observed on August 16, 2022 was larger than average as would be predicted by the mean17.

3. The next step is to perform the same ex ante model calculation as in Step 2, but to use the total predicted 2023 enrollment between residential and commercial (Column F) in place of the observed enrollment numbers (Column C). Note that as the total enrollment number changes, there may also be changes in the proportions of residential and commercial customers, and in the enrollments in different cycling options within each customer type, all of which is captured by the model. Using these new enrollment figures, our ex ante model predicts that we would expect AC Saver Day Of to deliver 1.00 MW of load reduction (Column G) on a day with a similar temperature profile (Column B) as August 16, 2022.

4. Another key difference in going from ex post to ex ante results is that ex ante results are designed to cover the RA window of 4 PM to 9 PM, which is longer than any AC Saver Day Of events. This is resolved by creating an approximate load shape that covers the RA window, which is used to convert the ex ante model output to an ex ante impact. Here, we take the observed ex post load impact (Column D), apply the predicted enrollment numbers from ex ante (Column F), and stretch the hourly impacts to fit the approximate RA window load shape. This gives an adjusted ex post load impact of 1.94 MW (Column H). Depending on the proportions of different groups of customers and the hours of the event, this new estimate may increase, decrease, or stay the same.

5. We may now compare this adjusted ex post impact "apples-to-apples" with ex ante load impacts since they now use the same enrollment (Column F) and RA window load shape. We find that the adjusted ex post impact for this event (1.94 MW) is very similar to the 1-in-10 ex ante estimates for an August event day (1.94 MW), which would be expected to occur under higher temperatures than the actual event (83 °F on the 1-in-10 event day vs 74 °F

during the actual event). All in all, these results indicate that this event (August 16) saw higher impacts than would be predicted given the temperature, but within the range of expected event impacts for an August event.

Table 5-10: Ex Post to Ex Ante Walk Example

Ex Post									SDG&E 1-in-2		SDG&E 1-in-10	
Date and Event Time		Mean17 (°F)	Ex Post Enrollment	Ex Post Estimate (MW)	Ex Ante Estimate Using 2022 Enrollment (MW)	Ex Ante Enrollment	Ex Ante Estimate Using 2023 Enrollment (MW)	Ex Post Estimate Using 2023 Enrollment and Adjusted to RA Window (MW)	Mean17 (°F)	Ex Ante Estimate Using 2023 Enrollment and Adjusted to RA Window (MW)	Mean17 (°F)	Ex Ante Estimate Using 2023 Enrollment and Adjusted to RA Window (MW)
A		B	C	D	E	F	G	H	I	J	K	L
8/16/2022	6pm - 8pm	74	10,650	2.35	1.16	9,161	1.00	1.94	80	1.65	83	1.94
8/30/2022	6pm - 8pm	75	10,610	1.23	1.17		1.02	0.99				
8/31/2022	6pm - 8pm	78	10,593	2.14	1.72		1.48	1.87				
9/1/2022	6pm - 9pm	79	10,574	1.91	1.69	9,161	1.46	1.63	82	1.93	84	2.11
9/3/2022	6pm - 8pm	85	10,561	2.33	2.70		2.33	2.20				
9/4/2022	6pm - 8pm	87	10,559	2.75	2.97		2.56	2.29				
9/5/2022	5pm - 9pm	81	10,558	2.86	2.08		1.80	2.39				
9/7/2022	5pm - 9pm	82	10,530	2.41	2.22		1.92	2.05				
9/8/2022	5pm - 9pm	81	10,508	1.13	2.01		1.74	1.02				
9/9/2022	5pm - 7pm	82	10,501	0.39	2.47		2.14	0.37				
9/26/2022	5pm - 7pm	74	10,463	1.70	1.19		1.05	1.40				

6. Findings and Recommendations

This section presents findings and recommendations from the 2022 AC Saver Day Of load impact evaluation.

Finding 1

The 2022 ex post load impacts were estimated using a statistical matching framework for both customer segments (residential and commercial), unlike previous years in which a randomized control trial (RCT) design was utilized for the residential segment. This matched control process allowed for consistency across both customer segments and yielded control customers which were similar in proxy (non-event) day usage to treatment customers. The matched control methodology in the residential segment yielded results with similar levels of precision as those estimated using an RCT without the technical challenges and sampling error seen in recent years.

Recommendation 1

Continue to implement the matched control methodology for both the residential and non-residential segments in future years. The matched control approach yielded statistically-robust load impact estimates for the residential customer segment and allowed all residential program participants to provide load impacts without the need to hold back a fraction of the customers to serve as a control group.

Finding 2

The 2022 program events were consistently called during the hottest days of the season, with 8 of the 11 events dispatched on days with a mean[17] temperature over 75 °F. This led to a lack of similar proxy days to evaluate ex post impacts. This, combined with the transition to a matched control framework, led to implementing a difference-in-differences (DiD) framework to estimate ex post load impacts in contrast to the lagged dependent variable (LDV) framework employed in previous evaluations. The DiD methodology is commonly employed in demand response load impact evaluations as it accounts for inherent differences between proxy and event days and between treatment and control customers.

Recommendation 2

Continue to employ a difference-in-differences framework to estimate ex post impacts in future AC Saver Day Of evaluations. This methodology has the advantage of being robust to large-scale differences in weather between event and proxy days and time-invariant differences in consumption between treatment and control customers.

Finding 3

Commercial customers produced inconsistent impacts in 2022 when compared to residential customers. Of the 11 events called in 2022, impacts for only four events were statistically significant. Further, the commercial load impacts in 2022 were less correlated with the timing of events or the temperature during the event day. However, impacts during some events were both statistically significant and large, indicating that the program does have the potential to yield meaningful savings in the commercial segment. This inconsistency in commercial responsiveness to the program may be due to device operability issues, as some of the installed devices are over 15 years old. Devices that have been installed for a long period of time could be nonfunctional or have been inadvertently disconnected during CAC upgrades or maintenance.

Recommendation 3

To ensure that the program's direct load control devices are dispatching during events and producing load reductions, a field study should be conducted that examines the fleet of devices for functionality, prioritizing devices for commercial customers. Alternatively, a data-based analysis could be designed that uses clustering or similar techniques to identify specific devices that do not exhibit evidence of cycling during program events.

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