# VOLTUS PY 2024 (FY 2025) LOAD IMPACT PROTOCOL EX POST AND EX ANTE IMPACTS

## CALMAC STUDY ID: VLT0001

## PUBLIC REPORT

Submitted to:
Voltus and the California Public Utilities Commission

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PUBLIC – Confidential Information Removed and Redacted

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# 1 EXECUTIVE SUMMARY

This report summarizes analysis conducted by Verdant Associates (Verdant) to estimate ex post load impacts of Voltus's 2024 participation in demand response (DR) programs within PG&E's and SCE's service territory and forecast ex ante load impacts for the same Voltus portfolio for 2025 through 2028. The purpose of these estimated load impacts is to satisfy the California Public Utilities Commission (CPUC) requirements for a Load Impact Protocol (LIP) to determine the contributions to Resource Adequacy (RA) for the Voltus programs.

The ex post analysis uses participation in the Demand Response Auction Mechanism (DRAM), Capacity Bidding Program (CBP), Demand Side Grid Support Option 2 (DSGS), and CCA RA contracts to demonstrate the capabilities of Voltus DR resources and inform the ex ante impacts associated with Voltus's full portfolio and incremental RA contributions awarded through the LIP process. The ex ante presents the total PG&E and SCE service territory portfolio of DR capacity and contributions to RA based on customer migration. [redacted].

Per guidelines that require the presentation of specific information on the first page of the Executive Summary, Table 1-1 provides a summary of the participant counts and impacts for 2026 RA based on a 1-in-2 utility weather scenario.Table 1-2 Table 1-2 presents key metrics underlying the estimated impacts.[1] These summary tables are followed by a description of key program attributes for DR contracts with non-IOU LSE's , Voltus's portfolio of program participation and customers, and the methods employed to estimate the ex post impacts and generate the ex ante forecast. The requested qualifying capacity (QC) of 34.2 MW is considering [redacted].

### TABLE 1-1: TOTAL 2026 RA YEAR PARTICIPANTS UNDER 1-IN-2 UTILITY WEATHER SCENARIO IN AUGUST

| | Scenario 1 | | Scenario 2 | | Scenario 3 | |
|---|---|---|---|---|---|---|
| **Local or System?** | **Number of Customers** | **MW** | **Number of Customers** | **MW** | **Number of Customers** | **MW** |
| PG&E | 409 | 23.8 | 367 | 22.5 | 326 | 19.5 |
| SCE | 243 | 10.3 | 183 | 7.5 | 123 | 5.5 |
| **Total** | **652** | **34.1** | **550** | **30** | **449** | **25** |

1 For the specific requirements for these tables, see page 5, item # 7 and page 6, item # 10 in the guidelines provided in the LIP Filing Guide (https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/demand-response/lip-filing-guide-and-related-materials/lip-filing-guide-v51.pdf)

**TABLE 1-2: EX ANTE SUMMARY INFORMATION**

| Item Num. | DRP (below) = Third-party | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
|---|---|---|---|---|---|---|---|
| 1 | Total August capacity awarded to DRP by the IOUs under DRAM | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 2 | Total August DRAM capacity shown by the DRP on month-ahead supply plans | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 3 | Total August customer (meter) enrollment (related to #2 above) estimated by the DRP in the month ahead supply plans | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 4 | How much of the August DRAM capacity in #2 above was invoiced by the DRP as Demonstrated Capacity (%) | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 5 | Total August customer (meter) enrollment (related to #4 above) estimated by the DRP in the year ahead supply plans (submitted in October of the prior year) | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 6 | Total August DR capacity contracted by the DPR with non-IOU LSEs | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 7 | Total August capacity (related to #6 above) shown by the DRP on month-ahead supply plans*** | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 8 | Total August customer (meter) enrollment (related to #6 above) estimated by the DRP in month-ahead supply plans*** | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 9 | Total August capacity nominated (or to be nominated) by the DRP into the IOU CBP | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 10 | Total August capacity enrolled (or to be enrolled) by the DRP into IOU BIP | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 11 | Total DR August capacity contracted by the DRP under other IOU procurement programs (as of April of the filing year) | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |

***For 2025, reported with April supply plan.

### Summary of Key Program Attributes for DR Contracts with Non-IOU LSE's

Per the LIP Filing Guide v5.1, the executive summary must include a section with a summary of key program attributes of DR contracts with non-IOU LSEs related to resource availability, performance obligations, energy and capacity invoicing and payment terms, and penalties for under performance or not meeting commitments. These details include:

[redacted]

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[redacted]

[redacted]

[redacted]

### Voltus DR Programs

Voltus participated in five DR programs/resources covered by this LIP evaluation. These include PG&E's Capacity Bidding Program (PG&E CBP), PG&E's Demand Response Auction Mechanism (PG&E DRAM), SCE's Demand Response Auction Mechanism (SCE DRAM), CCA RA contracts, and CEC DSGS Option 2.

PG&E CBP is an aggregator-managed day-ahead DR program that operates from May 1st through October 31st. Each aggregator, including Voltus, is responsible for submitting monthly capacity nominations for curtailment commitment levels from their enrolled customer fleets. PG&E is responsible for triggering events for one or more of its Sub-Load Aggregation Points (SubLAP).

Both PG&E and SCE DRAM programs are pay-as-bid auctions of system DR Resource Adequacy (RA) that allow sellers, like Voltus and other third-party aggregators and platforms, to bid directly into the CAISO day-ahead market. Sellers of aggregated DR bid directly into the CAISO market as a proxy demand resource (PDR) and PG&E and SCE acquire the capacity from awarded bidders. However, neither utility has any claim to any revenues generated from the award of DRAM participants. This LIP evaluation only looks to determine ex post impacts from the PG&E and SCE DRAM participants that enrolled with Voltus. All ex post impacts are intended to inform the RA potential from like resources.

The CPUC's RA program has two goals as defined by the CPUC. These goals are: 1) To ensure the safe and reliable operation of the grid in real-time providing sufficient resources to the CAISO when and where needed; and 2) to incentivize the siting and construction of new resources needed for future grid reliability.

The California Energy Commission's (CEC) offers the Demand Side Grid Support (DSGS) program through the California Strategic Reliability Reserve. DSGS provides incentive payments to customers that provide load reduction and backup generation during events from May to October, with the goal of reducing the risk of rotating power outages. The program offers three incentive tracks for participation: 1) Standby and energy payment, 2) Incremental Market-Integrated DR, and 3) Market-Aware behind-the-meter battery storage. For purposes of this LIP Evaluation, Voltus resource participation occurs under Option 2.

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### Voltus Participants

Across the programs in Voltus's CAISO DR portfolio that are included in the LIP analysis, there were 621 facilities that participated in DR events in 2024. For purposes of this evaluation, these participating facilities are referred to as enrolled participants. PG&E participants were dispatched for RA, DSGS, DRAM and CBP events and SCE participants participated in both DRAM and DSGS.

### Voltus 2024 Event Information

Over the course of the 2024 RA year, there were three event days for PG&E CBP, 34 event days (including 52 distinct dispatches) for PG&E DRAM and 26 event days for SCE DRAM. For the new DSGS program, PG&E customers had 15 events and SCE customers had 8. Finally, resources in the Voltus portfolio responded to 16 Resource Adequacy events in PG&E for PY 2024. In general, there are two event types for which Voltus participants receive payments for their participation: test events and market dispatch events. Test events are called to test load reduction capabilities and system functions. Market dispatch events are called when Voltus energy bids clear market prices.  Voltus also conducts voluntary dispatch events where Voltus participants are asked to curtail their load; there were two voluntary events in 2024 for Voltus customers.

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# 2 INTRODUCTION

This report summarizes analysis conducted by Verdant Associates (Verdant) to estimate ex post load impacts of Voltus's 2024 participation in demand response (DR) programs in PG&E's and SCE's service territory and forecast ex ante load impacts for the full Voltus portfolio for 2025 through 2028 and for resource adequacy (RA) contributions for 2025 through 2028. The intention is to demonstrate the full PG&E and SCE service territory portfolio potential and demonstrate the ability of the portfolio [redacted]. More pertinently, the purpose of these estimated load impacts is to satisfy the California Public Utilities Commission (CPUC) requirements for a Load Impact Protocol (LIP) to determine the contributions to RA for the Voltus programs. This document further describes the DR programs in Voltus's CAISO portfolio, the characteristics of program participants, and the methodologies and data used to estimate ex post impacts and produce a forecast of ex ante impacts.

CPUC Decision D.19-06-026 exempts the Demand Response Auction Mechanism (DRAM) from the requirement of a LIP evaluation for future and current solicitations. However, this study estimates demand reductions for Voltus's participation in the DRAM for Pacific Gas and Electric (PG&E) and Southern California Edison (SCE) service territories for demonstrated RA capabilities. [redacted].

## 2.1 VOLTUS DR PROGRAMS

Voltus participated in five DR programs/RA options covered by this LIP evaluation. These include PG&E's Capacity Bidding Program (PG&E CBP), PG&E's Demand Response Auction Mechanism (PG&E DRAM), CCA RA contracts within the PG&E service territory, CEC DSGS Option 2, and SCE's Demand Response Auction Mechanism (SCE DRAM). The descriptions of these programs are detailed below.

### PG&E CBP

The CBP, under PG&E direction, operates fully as an aggregator managed program. The PG&E CBP is a day-ahead program that operates from May 1st through October 31st. Each aggregator, including Voltus, is responsible for submitting monthly capacity nominations for curtailment commitment levels from their enrolled customer fleets. PG&E is responsible for triggering events and events may be called for one or more Sub-Load Aggregation Points (SubLAP) if one of several criteria are met. These criteria include: the California Independent System Operator (CAISO) day-ahead market clearing price exceeds a specified offer price, PGE&E receives a market award or dispatch instruction from the CAISO, PG&E forecasts that generation resources or system capacity is not adequate, or forecasted temperatures exceed temperature thresholds. Note that Voltus does not control the duration or frequency of dispatches. This LIP evaluation only looks to determine impacts from the CBP participants that enrolled with Voltus.

### PG&E DRAM

The DRAM is a pay-as-bid auction of system for DR that allows sellers, like Voltus and other third-party aggregators and platforms, to bid directly into the CAISO day-ahead market. Sellers of aggregated DR bid directly into the CAISO market as a proxy demand resource (PDR) and PG&E acquires the capacity from awarded bidders. However, PG&E does not have claim to any revenues generated from the award of DRAM participants. To participate in the PG&E DRAM market, resources must be located within a PG&E Local Capacity Area (LCA). Additionally, PG&E customers that are enrolled in another DR program are not eligible for DRAM participation. This LIP evaluation only looks to determine impacts from the DRAM participants that enrolled with Voltus.

### CA RA Program Contracts in PG&E Service Territory

The CPUC's RA program has two goals as defined by the CPUC. These goals are: 1) To ensure the safe and reliable operation of the grid in real-time providing sufficient resources to the CAISO when and where needed; and 2) to incentivize the siting and construction of new resources needed for future grid reliability. [redacted].

### SCE DRAM

The SCE DRAM has the same participation mechanisms and requirements as the PG&E DRAM. To participate in the SCE DRAM market, resources must be located within an SCE LCA. This LIP evaluation only looks to determine impacts from the DRAM participants that enrolled with Voltus.

### CEC DSGS (Option 2)

The California Energy Commission's (CEC) offers the DSGS program through the California Strategic Reliability Reserve. DSGS provides incentive payments to customers that provide load reduction and backup generation during events from May to October, with the goal of reducing the risk of rotating power outages. The program offers three incentive tracks for participation: 1) Standby and energy payment, 2) Incremental Market-Integrated DR, and 3) Market-Aware behind-the-meter battery storage. For purposes of this LIP Evaluation, Voltus resource participation occurs under Option 2.

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## 2.2 PARTICIPANT CHARACTERISTICS

Across the programs in Voltus's CAISO DR portfolio that are included in the LIP analysis, there were 621 facilities that participated in DR events in 2024.[2] For purposes of this evaluation, these participating facilities are referred to as enrolled participants. PG&E participants were dispatched for DRAM, CBP, DSGS, or CCA RA events. While SCE participants were enrolled in DRAM and DSGS. In total there were 389 Voltus participants in PG&E's service territory and 232 in SCE's service territory.

Voltus utilizes a variety of mechanisms to initiate load curtailment, for which the LIP evaluation will seek to estimate impacts separately. As shown in Table 2-1, a total of 92 Voltus participants use engineering integration, which is the term applied to those that have a fully automated curtailment ability. There are 162 Voltus participants that use a scripted response, which refers to those participants where the curtailment is mostly automated but still requires an explicit initiation by the facility. The remaining 367 participants use manual curtailment, which represent those facilities that need to follow a specific course of action to produce the desired curtailment.

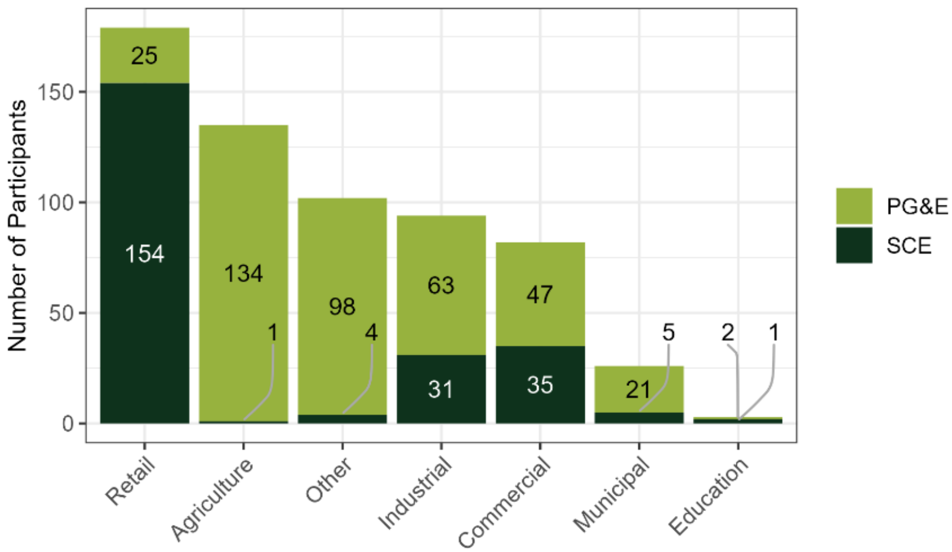
**TABLE 2-1: COUNT OF ENROLLED PARTICIPANTS BY RESPONSE TYPES AND IOU**

| Curtailment Mechanism | PG&E | SCE | Total |
|---|---|---|---|
| | PG&E CBP, PG&E DRAM, CCA RA Contracts, DSGS | SCE DRAM, DSGS | |
| Engineering Integration | 23 | 69 | 92 |
| Scripted | 42 | 120 | 162 |
| Manual | 324 | 43 | 367 |
| **Total** | **389** | **232** | **621** |

Voltus participants represent a diverse set of industry types. Overall, Voltus participants represent 22 distinct industry types falling under seven industry groups. The counts of unique facilities are listed by the industry groups and types in Figure 2-1 below.

[2] A facility is equivalent to a premise meter, the level of analysis required for reporting of impacts.

**FIGURE 2-1: NUMBER OF PARTICIPANTS BY IOU SERVICE TERRITORY AND INDUSTRY TYPE**

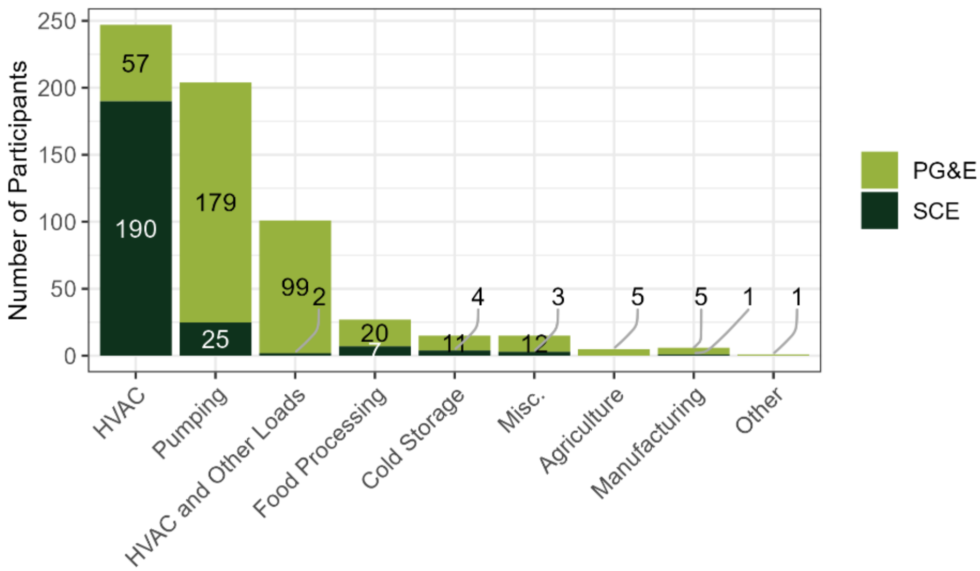



While the figure above presents the participant counts by industry type, there are a number of industry classifications that are embedded within each group. These sub classifications are as follows.

- **Retail**: Includes Big Box Retail; Grocer/Market and Retail (non-Big Box, non-Mall)
- **Industrial**: Includes Asphalt, Concrete, Sand, Aggregates; Chemical Processing; Consumer Products Manufacturing; Food & Beverage Processing; Machinery Manufacturing; Metals Product Manufacturing; Oil & Gas Refinery/Supply; Waste & Water Treatment/Recycling; and Plastic Manufacturing
- **Commercial**: Includes Entertainment Center; Hotels & Hospitality; Real Estate and Bank/Financial Services
- **Agriculture:** Includes Agriculture; Lumber and Wood Products
- **Other:** Includes Unknown; Cold Storage; Hospitals/Healthcare Centers; and Other
- **Education:** Includes College/University and K-12 School/School District
- **Municipal**: Includes City/Municipal Government

The participant population is further broken into load type categories (See Figure 2-2). This category represents the types of loads that are curtailed during DR event participation. This is of particular interest for this analysis because the ex ante impacts and forecasts are largely driven by the average weather adjusted impacts for the various load types and the participant forecasts are based on growth for load types in the respective PG&E and SCE service territory.

**FIGURE 2-2: NUMBER OF PARTICIPANTS BY IOU SERVICE TERRITORY AND LOAD TYPE**




The programs for which Voltus aggregates DR resources in California can call events for one or more SubLAP when DR resources are needed in a specific location on the grid. For this reason, it is especially important to identify participants based on their geographic locations, particularly by SubLAP. Table 2-2 presents the number of participants by SubLAP. As requested under LIP guidelines, Verdant estimated ex post and ex ante impacts by these groups.

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**TABLE 2-2: PARTICIPANT ENROLLMENT BY SUBLAP**

| IOU | SubLAP | Enrolled Participants |
|---|---|---|
| PG&E | PGCC | 17 |
| | PGEB | 29 |
| | PGF1 | 32 |
| | [redacted] | [redacted] |
| | [redacted] | [redacted] |
| | [redacted] | [redacted] |
| | [redacted] | [redacted] |
| | PGNP | 74 |
| | PGP2 | 32 |
| | PGSB | 75 |
| | PGSF | 16 |
| | PGSI | 50 |
| | [redacted] | [redacted] |
| | PGZP | 35 |
| SCE | SCEC | 82 |
| | SCEN | 24 |
| | SCEW | 96 |
| | [redacted] | [redacted] |
| | [redacted] | [redacted] |
| **Total** | **Total** | **621** |

## 2.3 2024 EVENT INFORMATION

Over the course of the 2024 RA year, there were three event days for PG&E CBP (including 4 distinct dispatches), 34 event days (including 52 distinct dispatches) for PG&E DRAM and 26 event days for SCE DRAM. Additionally, there were 16 RA dispatches for CCA RA in in PG&E's Territory. For the new DSGS program, PG&E and SCE customers responded to 15 and 8 events respectively. Table 2-3 through Table 2-8Table 2-7 below present the 2024 event dates, day of week, event type, event times, durations, and participant counts for each program. Given the volume of dispatches for DRAM, only event dates, day of week, event type and the number of participants dispatched on those days are included.

### TABLE 2-3: PG&E CBP EVENT INFORMATION

| Event Date | Day of Week | Event Type | Event Times (Local Time) | Event Duration (Hours) | Num. of Parts |
|---|---|---|---|---|---|
| 7/5/2024 | Friday | Market Dispatch | 5:00 pm to 7:00 pm | 2 | [redacted] |
| 7/11/2024 | Thursday | Market Dispatch | 7:00 pm to 8:00 pm | 1 | [redacted] |
| 8/28/2024 | Wednesday | Market Dispatch | 6:00 pm to 8:00 pm | 2 | 17 |
| 8/28/2024 | Wednesday | Market Dispatch | 7:00 pm to 8:00 pm | 1 | [redacted] |

### TABLE 2-4: PG&E DRAM EVENT INFORMATION

| Event Date | Day of Week | Event Type | Num. of Parts | Event Date | Day of Week | Event Type | Num. of Parts |
|---|---|---|---|---|---|---|---|
| 1/17/2024 | Wednesday | Market Dispatch | 60 | 8/7/2024 | Wednesday | Market Dispatch | 50 |
| 1/25/2024 | Thursday | Market Dispatch | [redacted] | 8/7/2024 | Wednesday | Market Dispatch | 17 |
| 2/7/2024 | Wednesday | Market Dispatch | 58 | 8/7/2024 | Wednesday | Market Dispatch | [redacted] |
| 2/22/2024 | Thursday | Market Dispatch | [redacted] | 8/29/2024 | Thursday | Market Dispatch | [redacted] |
| 3/6/2024 | Wednesday | Market Dispatch | 66 | 9/4/2024 | Wednesday | Market Dispatch | [redacted] |
| 3/28/2024 | Thursday | Market Dispatch | [redacted] | 9/4/2024 | Wednesday | Market Dispatch | 62 |
| 4/3/2024 | Wednesday | Market Dispatch | 66 | 9/4/2024 | Wednesday | Market Dispatch | [redacted] |
| 4/25/2024 | Thursday | Market Dispatch | [redacted] | 9/5/2024 | Thursday | Market Dispatch | [redacted] |
| 4/30/2024 | Tuesday | Market Dispatch | [redacted] | 9/26/2024 | Thursday | Market Dispatch | [redacted] |
| 5/1/2024 | Wednesday | Market Dispatch | 77 | 10/2/2024 | Wednesday | Market Dispatch | [redacted] |
| 5/22/2024 | Wednesday | Market Dispatch | [redacted] | 10/2/2024 | Wednesday | Market Dispatch | 64 |
| 5/23/2024 | Thursday | Market Dispatch | [redacted] | 10/2/2024 | Wednesday | Market Dispatch | [redacted] |
| 6/5/2024 | Wednesday | Market Dispatch | [redacted] | 10/24/2024 | Thursday | Market Dispatch | [redacted] |
| 6/5/2024 | Wednesday | Market Dispatch | 68 | 11/6/2024 | Wednesday | Market Dispatch | [redacted] |
| 6/5/2024 | Wednesday | Market Dispatch | [redacted] | 11/6/2024 | Wednesday | Market Dispatch | 64 |
| 6/27/2024 | Thursday | Market Dispatch | [redacted] | 11/6/2024 | Wednesday | Market Dispatch | [redacted] |
| 6/27/2024 | Thursday | Market Dispatch | [redacted] | 11/7/2024 | Thursday | Market Dispatch | [redacted] |
| 7/3/2024 | Wednesday | Market Dispatch | [redacted] | 11/21/2024 | Thursday | Market Dispatch | [redacted] |
| 7/3/2024 | Wednesday | Market Dispatch | 67 | 12/4/2024 | Wednesday | Market Dispatch | [redacted] |
| 7/3/2024 | Wednesday | Market Dispatch | [redacted] | 12/4/2024 | Wednesday | Market Dispatch | 65 |
| 7/5/2024 | Friday | Market Dispatch | [redacted] | 12/4/2024 | Wednesday | Market Dispatch | [redacted] |
| 7/10/2024 | Wednesday | Market Dispatch | [redacted] | 12/11/2024 | Wednesday | Market Dispatch | [redacted] |
| 7/11/2024 | Thursday | Market Dispatch | [redacted] | | | | |
| 7/11/2024 | Thursday | Market Dispatch | 23 | | | | |
| 7/12/2024 | Friday | Market Dispatch | [redacted] | | | | |
| 7/23/2024 | Tuesday | Market Dispatch | [redacted] | | | | |
| 7/24/2024 | Wednesday | Market Dispatch | [redacted] | | | | |
| 7/25/2024 | Thursday | Market Dispatch | [redacted] | | | | |
| 7/25/2024 | Thursday | Market Dispatch | [redacted] | | | | |
| 8/7/2024 | Wednesday | Market Dispatch | [redacted] | | | | |

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### TABLE 2-5: CCA RA CONTRACTS IN PG&E SERVICE TERRITORY

| Event Date | Day of Week | Event Type | Event Times (Local Time) | Event Duration (Hours) | Num. of Parts |
|---|---|---|---|---|---|
| 5/1/2024 | Wednesday | Market Dispatch | 5:00 pm to 6:00 pm | 1 | 151 |
| 5/23/2024 | Thursday | Market Dispatch | 5:00 pm to 9:00 pm | 4 | [redacted] |
| 6/5/2024 | Wednesday | Market Dispatch | 4:00 pm to 8:00 pm | 4 | 177 |
| 7/3/2024 | Wednesday | Market Dispatch | 4:00 pm to 5:00 pm | 1 | 199 |
| 7/10/2024 | Wednesday | Market Dispatch | 6:00 pm to 8:00 pm | 2 | 36 |
| 7/11/2024 | Thursday | Market Dispatch | 5:00 pm to 8:00 pm | 3 | 29 |
| 7/11/2024 | Thursday | Market Dispatch | 6:00 pm to 8:00 pm | 2 | 36 |
| 7/11/2024 | Thursday | Market Dispatch | 7:00 pm to 8:00 pm | 1 | 65 |
| 7/12/2024 | Friday | Market Dispatch | 7:00 pm to 8:00 pm | 1 | 36 |
| 7/23/2024 | Tuesday | Market Dispatch | 7:00 pm to 8:00 pm | 1 | 36 |
| 7/24/2024 | Wednesday | Market Dispatch | 7:00 pm to 8:00 pm | 1 | 36 |
| 7/25/2024 | Thursday | Market Dispatch | 7:00 pm to 9:00 pm | 2 | 36 |
| 8/6/2024 | Tuesday | Market Dispatch | 7:00 pm to 8:00 pm | 1 | 85 |
| 8/7/2024 | Wednesday | Market Dispatch | 4:00 pm to 8:00 pm | 4 | 201 |
| 9/4/2024 | Wednesday | Market Dispatch | 4:00 pm to 5:00 pm | 1 | 211 |
| 10/2/2024 | Wednesday | Market Dispatch | 4:00 pm to 8:00 pm | 4 | 225 |

### TABLE 2-6: DSGS EVENTS IN PG&E SERVICE TERRITORY

| Event Date | Day of Week | Event Type | Event Times (Local Time) | Event Duration (Hours) | Num. of Parts |
|---|---|---|---|---|---|
| 5/1/2024 | Wednesday | Market Dispatch | 5:00 pm to 6:00 pm | 1 | [redacted] |
| 6/5/2024 | Wednesday | Market Dispatch | 4:00 pm to 5:00 pm | 1 | [redacted] |
| 7/3/2024 | Wednesday | Market Dispatch | 4:00 pm to 5:00 pm | 1 | 15 |
| 7/10/2024 | Wednesday | Market Dispatch | 4:00 pm to 5:00 pm | 1 | [redacted] |
| 7/10/2024 | Wednesday | Market Dispatch | 6:00 pm to 8:00 pm | 2 | [redacted] |
| 7/11/2024 | Thursday | Market Dispatch | 5:00 pm to 6:00 pm | 1 | [redacted] |
| 7/11/2024 | Thursday | Market Dispatch | 6:00 pm to 7:00 pm | 1 | [redacted] |
| 7/11/2024 | Thursday | Market Dispatch | 7:00 pm to 8:00 pm | 1 | [redacted] |
| 7/12/2024 | Friday | Market Dispatch | 7:00 pm to 8:00 pm | 1 | [redacted] |
| 7/23/2024 | Tuesday | Market Dispatch | 7:00 pm to 8:00 pm | 1 | [redacted] |
| 7/24/2024 | Wednesday | Market Dispatch | 7:00 pm to 8:00 pm | 1 | [redacted] |
| 7/25/2024 | Thursday | Market Dispatch | 7:00 pm to 9:00 pm | 2 | [redacted] |
| 8/7/2024 | Wednesday | Market Dispatch | 4:00 pm to 5:00 pm | 1 | [redacted] |
| 9/4/2024 | Wednesday | Market Dispatch | 4:00 pm to 5:00 pm | 1 | 15 |
| 10/2/2024 | Wednesday | Market Dispatch | 4:00 pm to 5:00 pm | 1 | 15 |

### TABLE 2-7: SCE DRAM EVENT INFORMATION

| Event Date | Day of Week | Event Type | Num. of Parts | Event Date | Day of Week | Event Type | Num. of Parts |
|---|---|---|---|---|---|---|---|
| 4/25/2024 | Thursday | Voluntary Dispatch | 142 | 7/25/2024 | Thursday | Market Dispatch | 34 |
| 4/25/2024 | Thursday | Voluntary Dispatch | 69 | 8/2/2024 | Friday | Market Dispatch | 34 |
| 5/24/2024 | Friday | Market Dispatch | 135 | 8/5/2024 | Monday | Market Dispatch | 34 |
| 5/24/2024 | Friday | Market Dispatch | 68 | 8/6/2024 | Tuesday | Market Dispatch | 34 |
| 5/30/2024 | Thursday | Market Dispatch | 135 | 8/22/2024 | Thursday | Market Dispatch | [redacted] |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5/30/2024 | Thursday | Market Dispatch | [redacted] | 8/22/2024 | Thursday | Market Dispatch | 34 |
| 5/30/2024 | Thursday | Market Dispatch | 68 | 8/29/2024 | Thursday | Market Dispatch | 128 |
| 6/13/2024 | Thursday | Market Dispatch | 135 | 8/29/2024 | Thursday | Market Dispatch | [redacted] |
| 6/13/2024 | Thursday | Market Dispatch | [redacted] | 8/29/2024 | Thursday | Market Dispatch | 34 |
| 6/13/2024 | Thursday | Market Dispatch | 34 | 9/4/2024 | Wednesday | Market Dispatch | 33 |
| 6/27/2024 | Thursday | Market Dispatch | 135 | 9/5/2024 | Thursday | Market Dispatch | 33 |
| 6/27/2024 | Thursday | Market Dispatch | 34 | 9/6/2024 | Friday | Market Dispatch | 33 |
| 7/9/2024 | Tuesday | Market Dispatch | 34 | 9/19/2024 | Thursday | Market Dispatch | [redacted] |
| 7/10/2024 | Wednesday | Market Dispatch | 34 | 9/26/2024 | Thursday | Market Dispatch | 128 |
| 7/11/2024 | Thursday | Market Dispatch | 34 | 9/26/2024 | Thursday | Market Dispatch | 33 |
| 7/11/2024 | Thursday | Market Dispatch | 38 | 9/30/2024 | Monday | Market Dispatch | 114 |
| 7/12/2024 | Friday | Market Dispatch | 34 | 9/30/2024 | Monday | Market Dispatch | [redacted] |
| 7/18/2024 | Thursday | Market Dispatch | 131 | 9/30/2024 | Monday | Market Dispatch | 33 |
| 7/18/2024 | Thursday | Market Dispatch | [redacted] | 10/24/2024 | Thursday | Market Dispatch | 128 |
| 7/18/2024 | Thursday | Market Dispatch | 34 | 10/24/2024 | Thursday | Market Dispatch | [redacted] |
| 7/23/2024 | Tuesday | Market Dispatch | 34 | 10/24/2024 | Thursday | Market Dispatch | 33 |
| 7/24/2024 | Wednesday | Market Dispatch | 34 | 10/31/2024 | Thursday | Market Dispatch | 128 |
| 7/25/2024 | Thursday | Market Dispatch | 131 | 10/31/2024 | Thursday | Market Dispatch | 33 |

### TABLE 2-8: DSGS EVENTS IN SCE SERVICE TERRITORY

| Event Date | Day of Week | Event Type | Event Times (Local Time) | Event Duration (Hours) | Num. of Parts |
|---|---|---|---|---|---|
| 5/1/2024 | Wednesday | Market Dispatch | 5:00 pm to 6:00 pm | 1 | [redacted] |
| 6/5/2024 | Wednesday | Market Dispatch | 4:00 pm to 5:00 pm | 1 | 47 |
| 7/3/2024 | Wednesday | Market Dispatch | 4:00 pm to 5:00 pm | 1 | 49 |
| 7/11/2024 | Thursday | Market Dispatch | 7:00 pm to 8:00 pm | 1 | 35 |
| 7/11/2024 | Thursday | Market Dispatch | 7:00 pm to 8:00 pm | 1 | 52 |
| 8/7/2024 | Wednesday | Market Dispatch | 4:00 pm to 5:00 pm | 1 | 52 |
| 9/4/2024 | Wednesday | Market Dispatch | 4:00 pm to 5:00 pm | 1 | 52 |
| 9/5/2024 | Thursday | Market Dispatch | 6:00 pm to 8:00 pm | 2 | 52 |
| 10/2/2024 | Wednesday | Market Dispatch | 4:00 pm to 5:00 pm | 1 | 54 |

# 3 METHODS AND RESULTS

This section describes the methods used for estimating ex post load impacts and the ex ante forecast and summarizes the results of the analysis.

## 3.1 DATA SOURCES

The analysis conducted for ex ante impact estimation and ex post forecasts relied on data from multiple sources. These are summarized in Table 3-1, followed by a discussion of important details about their use in the analysis.

**TABLE 3-1: DATA SOURCE SUMMARY**

| Data Type | Source | Key Fields | Notes |
|---|---|---|---|
| **Interval load data** | Voltus | Facility ID, date and time stamp, interval energy readings. | |
| **Historical weather data** | Iowa State University, Iowa Environmental Mesonet | Weather station ID, weather station coordinates (latitude and longitude), date and time stamp, temperature, and relative humidity readings. | https://mesonet.agron.iastate.edu/request/download.phtml?network=CA_ASOS# |
| **Participant information** | Voltus | Facility ID, facility coordinates, program, industry type, curtailment type, enrollment, and expiration dates | |
| **Event data** | Voltus | Event ID, event start and end date and time stamps, program. | |
| **Participant event enrollment** | Voltus | Facility ID and event ID | |
| **Participant forecast** | Voltus | Ten-year forecast of projected program enrollment by program and industry type. | |
| **Alternate weather scenarios** | PG&E and SCE | Monthly series of hourly weather for alternate day types (typical event day vs. worst day) and weather years (1-2 vs. 1-10) by utility and climate zone. | These data include both utility and CAISO versions of the weather scenarios. |

Interval Data

Voltus provided the interval data used for the estimation of impacts. While the general structure of the data was consistent, the raw data included different interval lengths and multiple meters per facility. Given these characteristics, the preparation of these data for analysis required a careful application of several steps to ensure their consistency and reliability for use in the analysis, including:

- Review of the timestamps to detect any effects of daylight savings time and to ensure documented time zone was correct.

- Setting timestamps to a consistent local time of Pacific Standard Time and Pacific Daylight time (given the time of year) in a time-zone aware field in R (the software used for data processing and analysis) to ensure correct merging.
- Determining the interval definition associated with the raw data (either interval beginning or interval ending), and then setting all time stamps to a consistent period beginning.
- Aggregation of various interval lengths to a common hourly level.
- Aggregation of individual meters to the facility level and ensuring that each aggregated interval contained the full set of readings from the constituent meters.
- To remove any ambiguity in the model data, Verdant created separate "hour starting" and "hour ending" columns to ensure proper interpretation of the data.

Where applicable, the steps relating to timestamps also applied to several other data sources used for this analysis, including weather and event start and end times.

### Historical Weather Data

Weather data for 2024 were extracted from more than 150 different weather stations in California. In some cases, the readings were sparse for stations. After an analysis to determine which weather stations had sufficiently complete series for use in the modeling, facilities were then mapped to weather stations. The mapping of facilities to weather stations was based on using latitude and longitude data to calculate the distances between them. In rare cases, however, the station with the closest proximity might be at a markedly different elevation, which can result in a less apt match relative to a station that is somewhat farther in distance. To remedy this, Verdant pulled data from the USGS Elevation Point Query Service (https://nationalmap.gov/epqs/pqs.php) to get the elevation for all weather stations and facilities. These data were used to exclude any weather stations that were more than 600 meters different in elevation, which Verdant selected after examining the distribution of altitude differences. After excluding the stations with large altitude differences, the remaining weather stations closest to the facilities were retained as the primary weather stations for each facility. Overall, the median distance from each facility to its weather station was 30 miles, primarily due to the more rural facilities being farther from their weather stations than facilities in non-rural areas. The counts of facilities by weather station are presented in Table 3-2.

**TABLE 3-2: COUNT OF FACILITIES BY WEATHER STATION WITH GEOGRAPHIC LOCATION**

| Station ID | Station Name | Facilities | Percent | Station ID | Station Name | Facilities | Percent |
|---|---|---|---|---|---|---|---|
| BAB | Beale AFB/Marysville | 39 | 6.3% | NJK | El Centro NAF | [redacted] | [redacted] |
| BYS | Bicycle Lake | [redacted] | [redacted] | NLC | Lemoore NAS/Reeves | [redacted] | [redacted] |
| CCB | Cable | 35 | 5.7% | NTD | PT Mugu Naws | 19 | 3.1% |
| CVH | Hollister | [redacted] | [redacted] | NUQ | Moffett NAS | 107 | 17.3% |
| DLO | Delano | 24 | 3.9% | NXP | Twentynine Palms | [redacted] | [redacted] |
| DVO | Novato | [redacted] | [redacted] | O05 | Chester | [redacted] | [redacted] |
| E16 | San Martin | [redacted] | [redacted] | O22 | Columbia | [redacted] | [redacted] |
| EDU | University | 61 | 9.9% | O32 | Reedley | [redacted] | [redacted] |
| EDW | EDWARDS AFB | [redacted] | [redacted] | O69 | Petaluma | [redacted] | [redacted] |
| F70 | Murrieta | [redacted] | [redacted] | OAR | Fort Ord Fritzsche AAF | 16 | 2.6% |
| FCH | Fresno - Chandler | 26 | 4.2% | RIV | March AFB/Riverside | 21 | 3.4% |
| HAF | Half Moon Bay | 19 | 3.1% | SLI | Los Alimitos AAF | 99 | 16.0% |
| HMT | Hemet | [redacted] | [redacted] | SUU | Travis AFB/Fairfield | [redacted] | [redacted] |
| JAQ | Jackson | [redacted] | [redacted] | TCY | Tracy | 22 | 3.6% |
| L08 | Borrego Springs | [redacted] | [redacted] | TSP | Tehachapi | [redacted] | [redacted] |
| LHM | Lincoln | [redacted] | [redacted] | VCV | Victorville | [redacted] | [redacted] |
| MCC | Sacramento McClellan | [redacted] | [redacted] | VGN | Vandenberg Space Force North | 26 | 4.2% |
| NID | China Lake (NAF) | [redacted] | [redacted] | | | | |

## Participant and Event Data

Voltus also provided the data to identify and classify the facilities in the 2024 participant population and their participation in the various program events. In addition to the program associated with each facility ID, key information included the facility industry type, load type, method of curtailment, the associated SubLAP, and the geographic coordinates. The event information included associated program, the start and end time, and the type of the event (test or market dispatch).

## Participant Forecast and Alternate Weather Scenarios

The participant forecast and alternate weather scenarios are the inputs for the generation of the ex ante impact forecast. Voltus provided one forecast representing their incremental RA part forecasts for PG&E and SCE. [redacted]. The forecasts of customers provided by Voltus contained the total counts of customers by year, load type, and service territory. [redacted]. Because these customer forecasts do not include SubLAP, the proportions from the 2024 participant population have been assumed to be constant and were applied to the forecast to create a more granular breakdown of future participation. Table 3-3 and Table 3-4 shows the RA participant forecast by year, load type, and [redacted] scenario for PG&E's and SCE's service territories (respectively). [redacted].

**TABLE 3-3: VOLTUS EX ANTE PG&E TERRITORY RA PARTICIPANT FORECAST BY YEAR, LOAD TYPE AND SCENARIO**

| Scenario | Year | Ag. | Cold Storage | Food Proces. | HVAC | HVAC and Other Loads | Manuf-acturing | Misc. | Pumping | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Scenario 3 | 2025 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | **241** |
| | 2026 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | **326** |
| | 2027 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | **336** |
| | 2028 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | **347** |
| | 2029 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | **351** |
| Scenario 2 | 2025 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | **241** |
| | 2026 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | **367** |
| | 2027 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | **384** |
| | 2028 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | **400** |
| | 2029 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | **406** |
| Scenario 1 | 2025 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | **241** |
| | 2026 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | **409** |
| | 2027 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | **429** |
| | 2028 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | **451** |
| | 2029 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | **459** |

**TABLE 3-4: VOLTUS EX ANTE SCE TERRITORY RA PARTICIPANT FORECAST BY YEAR, LOAD TYPE AND SCENARIO**

| Scenario | Year | Cold Storage | Food Processing | HVAC | HVAC and Other Loads | Manufac-turing | Misc. | Pumping | Total |
|---|---|---|---|---|---|---|---|---|---|
| Scenario 3 | 2025 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | 0 |
| | 2026 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | 123 |
| | 2027 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | 129 |
| | 2028 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | 135 |
| | 2029 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | 139 |
| Scenario 2 | 2025 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | 0 |
| | 2026 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | 183 |
| | 2027 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | 191 |
| | 2028 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | 199 |
| | 2029 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | 204 |
| Scenario 1 | 2025 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | 0 |
| | 2026 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | 243 |
| | 2027 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | 254 |
| | 2028 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | 266 |
| | 2029 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | 272 |

Verdant collected the ex ante weather scenarios for each relevant IOU. The weather scenarios provided by the two utilities represent 24-hour load profiles for each month under a variety of different system and weather conditions. These scenarios are used to create the weather adjusted impacts for the ex ante forecasts. However, requirements for ex ante forecasts noted in the *LIP Filing Guide v5.1*[3] (filing guide) only necessitate 1-in-2 worst day (monthly system peak day) conditions for ex ante modeling. As a result, only 1-in-2 worst day conditions were used to produce ex ante MW forecasts of RA.

## 3.2 PARTICIPANT ASSESSMENT

After the initial processing of the data, Verdant conducted a thorough assessment of the data through both summary statistics and visualization to better understand the nature of the participants in the Voltus programs. The first part of this analysis was to identify any issues with overall data quality. Verdant and Voltus had conversations to better understand the data and address potential data quality issues, which resulted in a high-quality dataset used for modeling. Equally important is to get a sense of the challenges that the analysis is likely to provide. Verdant's experience with evaluating DR programs has been that non-

[3] *LIP Filing Guide v5.1* distributed December 31st, 2024. https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/demand-response/lip-filing-guide-and-related-materials/final-lip-filing-guide-v51.pdf

residential participants not only have far more varied and volatile load, but their response to events can be similarly unpredictable. For this reason, a large part of this assessment is the review of a variety of data visualizations to look at participants' load on both event and non-event days. As a rule, if there is not a clearly discernible curtailment when examining a facility's load profile on an event day, it will be challenging or impossible to reliably model its impacts. But even what might seem to be response to an event might be less clear when seen in the context of usage on other days, so it is valuable to have a more complete perspective of usage patterns.

### Weather Sensitivity Modeling

The facilities in Voltus's portfolio represent a wide variety of non-residential industry and load types. The loads of industrial facilities are frequently found to have no relationship to outdoor air temperatures. To determine the facility level weather sensitivity, Verdant applied a simple analysis to assess the relationship between load and outdoor temperature. The results were used to determine whether the candidate models for estimating impacts came from a group with various weather variables or from a group based on variables unassociated with weather.

Using the interval load and weather data for non-winter months (April through October), the analysis estimated regression models of consumption on different thresholds of cooling-degree hours for each facility by day type. If any of these models resulted in a parameter estimate with a probability ("p value") less than .05, the facility was deemed to be weather sensitive for that day type.

Overall, the results associated with this analysis are intuitive. As shown in Table 3-5, Commercial, Retail, and Education demonstrate the greatest share of weather sensitive facilities.

**TABLE 3-5: PERCENTAGE OF FACILITIES BY INDUSTRY EXHIBITING SUMMER WEATHER SENSITIVITY**

| IOU | Industrial | Retail | Agriculture | Commercial | Education | Municipal | Other |
|---|---|---|---|---|---|---|---|
| PG&E | 54% | 88% | 28% | 68% | 100% | 5% | 87% |
| SCE | 23% | 95% | 100% | 97% | 100% | 40% | 75% |

For winter events, Verdant conducted a similar analysis using data from January, February, March, November, and December that looked at both heating and cooling. As shown Table 3-6, only a small number of facilities appear to have weather sensitive heating load. And while the cooling in these winter months might seem counter-intuitive, for many of the facilities outside of coastal regions, there can be relatively warm temperatures in the winter months.

**TABLE 3-6: PERCENTAGE OF FACILITIES BY INDUSTRY EXHIBITING WINTER WEATHER SENSITIVITY**

| IOU | Sensitivity Type | Industrial | Retail | Agriculture | Commercial | Education | Municipal | Other |
|---|---|---|---|---|---|---|---|---|
| PG&E | Cooling | 10% | 16% | 7% | 34% | 0% | 0% | 33% |
| | Heating | 8% | 4% | 22% | 11% | 0% | 5% | 5% |
| SCE | Cooling | 16% | 25% | 0% | 60% | 100% | 20% | 0% |
| | Heating | 6% | 12% | 0% | 3% | 0% | 0% | 0% |

### Data Attrition

The estimation of load impacts requires having a minimum amount of data to reliably model the relationship between a participant's load and the independent variables used to predict it. Furthermore, these data need to be of sufficient quality for reliable results. In cases where the quantity and/or quality of the data was not sufficient, facilities were removed from the analysis.

Table 3-7 presents the facility level data attrition in PY 2024 analysis. Overall, there was little data attrition. The facility attrition from the 621 facilities with interval data to the 619 modeled is due to insufficient or poor-quality data. In all other cases, the remaining facilities with data were deemed to be modellable.

**TABLE 3-7: TOTAL VERSUS MODELED FACILITY COUNTS**

| Industry | Total Facilities | Facilities with Data | Facilities Modeled | % With Data Modeled |
|---|---|---|---|---|
| Industrial | 94 | 94 | 94 | 100% |
| Retail | 179 | 179 | 179 | 100% |
| Agriculture | 135 | 134 | 134 | 100% |
| Commercial | 82 | 81 | 81 | 100% |
| Education | 3 | 3 | 3 | 100% |
| Municipal | 26 | 26 | 26 | 100% |
| Other | 102 | 94 | 94 | 100% |
| Total | 621 | 619 | 619 | 100% |

## 3.3 EX POST IMPACT ESTIMATION METHODOLOGY

Verdant estimated ex post load impacts using hourly facility-specific regression models. While Verdant explored the use of aggregate and panel data models, there were a few key considerations that made models for individual facilities more practical. The first consideration was the sparseness of interval data. Not all sites had the same amount of data available for analysis, therefore aggregate models would have required excluding a substantial amount of data to ensure that the aggregated load was inclusive of all relevant accounts. The second consideration was the variation in event participation. Unless every participant participates in the same events, aggregate models will require the creation of multiple data sets to account for the various participant-event permutations. Finally, individual models were the most practical way to provide the desired granularity of results. The ability to show impacts at different levels of aggregation including utility, program type, industry, load type, and event response type would have made the development of data sets with the correct aggregation of accounts overly complicated.

### 3.3.1 Candidate Model Specifications

In 2024, Voltus dispatched resources for at least one event in all months of the year. As a result, seasonal models were considered to account for variations in seasonal operations of facilities and businesses. For example, a model designed to capture summer cooling loads will not be appropriate for winter months where HVAC cooling is likely to be non-existent. As a result, Verdant tested various sets of models across summer, winter, and shoulder seasons.

Overall, Verdant implemented 34 individual candidate model specifications to estimate ex post impacts. These varied by season and type of weather sensitivity (Table 3-8). Heating sensitive models were only included for winter months. Cooling sensitive and non-weather sensitive specifications were identical between seasons. The selected model specification, however, was allowed to differ between seasons. In addition to the 34 models described above, 7 adjustments were used for facilities that required improved modeling in a specific season. These models used the same independent variables but in different combinations than the initial candidate models tested.

**TABLE 3-8: COUNT OF CANDIDATE MODEL SPECIFICATIONS FOR IMPACT ESTIMATION**

| Season | Weather-Sensitive Cooling | Weather-Sensitive Heating | Non-Weather Sensitive |
|---|---|---|---|
| Summer Day | 14 | -- | 10 |
| Winter Day | | 10 | |

Despite the large number of models, they all follow a similar form, with only a few minor differences in the independent variables. This general form is presented in Equation 1.

**EQUATION 1: GENERAL MODEL SPECIFICATION**

$$kWh_{d,h} = \beta_{0,h} + \beta_{1d,h} EventDay_d EventID_d + \beta_{2,h} Weather_h + \sum_m \beta_{5,h,m} Month_m + \sum_w \beta_{6,h,w} Wday_w + \beta_{6,h,d} AvgLoad_d + \beta_{7,h} OtherEventHour_h + \varepsilon_{d,h}$$

Where:

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| | |
|---|---|
| $kWh_{d,h}$ | The hourly delivered kWh usage on event day *d* during hour *h*. |
| $\beta_{0,\mathrm{h}}$ | The intercept of the regression model during hour *h.* |
| $EventDay_d EventID_d$ | The interaction between the event day dummy and an event ID that corresponds to a specific event day. Its coefficient $\beta_{1\mathrm{d,h}}$ yields the impact of an event on usage on day *d* during hour *h.* |
| $Weather_{\mathrm{h}}$ | A temperature-based weather variable in hour *h*[4]. |
| $Month_m$ | A dummy variable for each month *m.* |
| $Wday_d$ | A dummy variable indicating the day of the week *d.* |
| $AvgLoad_d$ | The average daily load during a specific period (e.g., the afternoon) of day *d*. |
| $\varepsilon_{d,h}$ | The error term |

The interaction between $EventDay_d EventID_d$ results in a set of 24 $\beta_{1d,h}$ estimates (one from each hourly model) that capture event-specific impacts. The set of 24 estimates are used to estimate program impacts during the event window and capture any other event day effects, such as snapback, for hours outside of the event window. In essence, $\beta_{1d,h}$captures the difference between actual event day load for a given hour and the estimated baseline. For the ex-post analysis, $\beta_{1d,h}$ estimates over the event window provide the impact estimates for each event day.

The estimated impacts for each participant are then aggregated to multiple domains of interest for each facility including but not limited to, industry type, load type, and geographical location.

A comprehensive list of the model specifications (excluding the impact coefficients) along with definitions of each variable is provided in Appendix A.

## Model Selection

The selection of the final model for each facility was based on an assessment of model performance using a set of non-event days with event-like weather as a holdout sample. While the model $R^2$ or adjusted $R^2$ are valuable as a measure of how much variability is explained by the model, they are influenced by model overspecification and can be misleading. The ability of the models to predict load out of sample is a far better way to assess how well a model works at estimating a baseline.

Verdant selected for each facility a set of days with event-like weather (based on the max temperature) for use as a holdout sample. Different sets of proxy event days were selected four each relevant quarter where the given facility had an event participation. In the first stage of model estimation, we removed these days from the data and then used the remaining data to estimate the candidate models. Verdant then used the parameter estimates from candidate models to predict load on the holdout days. Based on the predicted and actual load, Verdant calculated both mean absolute percent error (MAPE) and root

4 Weather terms are only included for weather sensitive customers.

mean square error metrics on the daytime hours to determine which models predicted load most accurately during the relevant periods. The model with the best out-of-sample predictions for each facility was set aside as the final model. Verdant then applied these final model specifications to the full set of seasonal data – with the holdout days restored – to estimate the final set of ex post program impacts. It should be noted that that a sperate model was selected for each quarter where a given facility had event participation. As a result, a facility could have up to four different models selected to estimate impacts throughout the year.

## 3.4 EX POST RESULTS

A detailed set of results with impacts by IOU, industry type, and load type for all event days is available in the load impact protocol ex post table generator submitted with this report. The table generator provides event-specific results by utility and program as well as more detailed breakdowns by numerous facility characteristics. Given the sheer quantity of results, this section presents only the aggregate impact estimates by event.

The ex post results are presented by program and event day in Table 3-9 through Table 3-14 with the following columns:

- Event Times: Local time (prevailing time) of the event. Event impacts in UTC-8 time are presented in the ex post table generator in addition to prevailing time.
- Number of Facilities: The total number of facilities that were notified for the event.
- Mean Reference Load (kWh/h): The average hourly reference load per participant. This is the counterfactual, or the model estimate of what load would have been without the event.
- Mean Facility Impact (kWh/h): The average hourly kWh/h impact resulting from curtailment.
- Percent Load Reduction Average (%): The impact as a percentage of the reference load.
- Average Total Reduction (MWh/h): The average MWh/h load reduction during the event period calculated as the number of facilities multiplied by mean facility impact.
- Average Event Temperature (F): The average temperature during the event period.

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### TABLE 3-9: EX POST IMPACT ESTIMATES FOR PG&E CBP EVENTS

| Event Date | Event Times (Local Time) | Number of Facilities | Mean Reference Load (kWh/h) | Mean Facility Impact (kWh/h) | Percent Load Reduction (%) | Average Total Reduction (MWh/h) | Average Event Temp (F) |
|---|---|---|---|---|---|---|---|
| 7/5/2024 | 5:00 pm to 7:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 7/11/2024 | 7:00 pm to 8:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 8/28/2024 | 6:00 pm to 8:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 8/28/2024 | 7:00 pm to 8:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 7/5/2024 | 5:00 pm to 7:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |

### TABLE 3-10: EX POST IMPACT ESTIMATES FOR PG&E DRAM EVENTS

| Event Date | Event Times (Local Time) | Number of Facilities | Mean Reference Load (kWh/h) | Mean Facility Impact (kWh/h) | Percent Load Reduction (%) | Average Total Reduction (MWh/h) | Average Event Temp (F) |
|---|---|---|---|---|---|---|---|
| 1/17/2024 | 4:00 pm to 6:00 pm | 58 | 432.9 | 74.1 | 17% | 4.4 | 54.1 |
| 1/25/2024 | 4:00 pm to 6:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 2/7/2024 | 4:00 pm to 6:00 pm | 56 | 396.1 | 73.2 | 19% | 4.2 | 48.1 |
| 2/22/2024 | 4:00 pm to 6:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 3/6/2024 | 5:00 pm to 7:00 pm | 64 | 398.5 | 28.3 | 7% | 1.9 | 52.6 |
| 3/28/2024 | 5:00 pm to 7:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 4/3/2024 | 5:00 pm to 7:00 pm | 64 | 408.2 | 72.9 | 18% | 4.8 | 56.6 |
| 4/25/2024 | 5:00 pm to 7:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 4/30/2024 | 5:00 pm to 7:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 5/1/2024 | 5:00 pm to 7:00 pm | 76 | 398.5 | 35.8 | 9% | 2.8 | 65.8 |
| 5/22/2024 | 5:00 pm to 6:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 5/23/2024 | 5:00 pm to 7:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 6/5/2024 | 4:00 pm to 5:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 6/5/2024 | 4:00 pm to 6:00 pm | 66 | 397.7 | 44.3 | 11% | 3.0 | 79.3 |
| 6/5/2024 | 5:00 pm to 7:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 6/27/2024 | 4:00 pm to 5:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 6/27/2024 | 4:00 pm to 6:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 7/3/2024 | 4:00 pm to 5:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 7/3/2024 | 4:00 pm to 6:00 pm | 65 | 462.7 | 71.9 | 16% | 4.8 | 84.5 |
| 7/3/2024 | 7:00 pm to 9:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 7/5/2024 | 5:00 pm to 7:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 7/10/2024 | 6:00 pm to 8:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 7/11/2024 | 6:00 pm to 8:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 7/11/2024 | 7:00 pm to 8:00 pm | 22 | 384.5 | 63.6 | 17% | 1.5 | 68.8 |
| 7/12/2024 | 7:00 pm to 8:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 7/23/2024 | 7:00 pm to 8:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 7/24/2024 | 7:00 pm to 8:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 7/25/2024 | 4:00 pm to 6:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 7/25/2024 | 7:00 pm to 9:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 8/7/2024 | 4:00 pm to 5:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 8/7/2024 | 4:00 pm to 6:00 pm | 49 | 472.1 | 87.4 | 19% | 4.4 | 75.2 |
| 8/7/2024 | 5:00 pm to 7:00 pm | 17 | 112.3 | 25.4 | 23% | 0.4 | 70.7 |
| 8/7/2024 | 7:00 pm to 9:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 8/29/2024 | 4:00 pm to 6:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 9/4/2024 | 4:00 pm to 5:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 9/4/2024 | 4:00 pm to 6:00 pm | 62 | 370.8 | 69.8 | 19% | 4.3 | 75.3 |
| 9/4/2024 | 7:00 pm to 9:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 9/5/2024 | 5:00 pm to 6:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 9/26/2024 | 4:00 pm to 6:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 10/2/2024 | 4:00 pm to 5:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 10/2/2024 | 4:00 pm to 6:00 pm | 64 | 356.2 | 49.6 | 14% | 3.2 | 84.3 |
| 10/2/2024 | 7:00 pm to 9:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 10/24/2024 | 4:00 pm to 5:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 11/6/2024 | 4:00 pm to 5:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 11/6/2024 | 4:00 pm to 6:00 pm | 64 | 362.2 | 43.1 | 12% | 2.8 | 60.8 |
| 11/6/2024 | 7:00 pm to 9:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 11/7/2024 | 4:00 pm to 6:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 11/21/2024 | 4:00 pm to 5:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 12/4/2024 | 4:00 pm to 5:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 12/4/2024 | 4:00 pm to 6:00 pm | 64 | 340.8 | 47.2 | 14% | 3.1 | 53.0 |
| 12/4/2024 | 7:00 pm to 9:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 12/11/2024 | 4:00 pm to 5:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |

**TABLE 3-11: EX POST IMPACT ESTIMATES FOR PG&E CCA RA EVENTS**

| Event Date | Event Times (Local Time) | Number of Facilities | Mean Reference Load (kWh/h) | Mean Facility Impact (kWh/h) | Percent Load Reduction (%) | Average Total Reduction (MWh/h) | Average Event Temp (F) |
|---|---|---|---|---|---|---|---|
| 5/1/2024 | 5:00 pm to 6:00 pm | 134 | 82.4 | 18.9 | 23% | 2.8 | 73.0 |
| 5/23/2024 | 5:00 pm to 9:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 6/5/2024 | 4:00 pm to 8:00 pm | 167 | 270.0 | 29.3 | 11% | 5.2 | 84.9 |
| 7/3/2024 | 4:00 pm to 5:00 pm | 188 | 211.6 | 41.9 | 20% | 8.3 | 92.2 |
| 7/10/2024 | 6:00 pm to 8:00 pm | 31 | 41.5 | 12.0 | 29% | 0.4 | 92.2 |
| 7/11/2024 | 5:00 pm to 8:00 pm | 29 | 113.8 | 9.7 | 9% | 0.3 | 77.4 |
| 7/11/2024 | 6:00 pm to 8:00 pm | 31 | 41.7 | 12.0 | 29% | 0.4 | 97.2 |
| 7/11/2024 | 7:00 pm to 8:00 pm | 64 | 216.3 | 7.3 | 3% | 0.5 | 74.4 |
| 7/12/2024 | 7:00 pm to 8:00 pm | 31 | 40.2 | 14.3 | 36% | 0.5 | 86.8 |
| 7/23/2024 | 7:00 pm to 8:00 pm | 31 | 30.2 | 6.2 | 21% | 0.2 | 91.9 |
| 7/24/2024 | 7:00 pm to 8:00 pm | 31 | 36.2 | 15.8 | 44% | 0.6 | 86.2 |
| 7/25/2024 | 7:00 pm to 9:00 pm | 31 | 40.5 | 3.9 | 10% | 0.1 | 81.6 |
| 8/6/2024 | 7:00 pm to 8:00 pm | 84 | 127.7 | 9.1 | 7% | 0.8 | 68.0 |
| 8/7/2024 | 4:00 pm to 8:00 pm | 190 | 186.0 | 39.2 | 21% | 7.9 | 78.5 |
| 9/4/2024 | 4:00 pm to 5:00 pm | 200 | 228.5 | 39.6 | 17% | 8.3 | 87.7 |
| 10/2/2024 | 4:00 pm to 8:00 pm | 213 | 222.2 | 27.2 | 12% | 6.1 | 86.6 |

**TABLE 3-12: EX POST IMPACT ESTIMATES FOR SCE DRAM EVENTS**

| Event Date | Event Times (Local Time) | Number of Facilities | Mean Reference Load (kWh/h) | Mean Facility Impact (kWh/h) | Percent Load Reduction (%) | Average Total Reduction (MWh/h) | Average Event Temp (F) |
|---|---|---|---|---|---|---|---|
| 4/25/2024 | 5:00 pm to 7:00 pm | 140 | 212.7 | 17.9 | 8% | 2.5 | 58.4 |
| 4/25/2024 | 6:00 pm to 8:00 pm | 68 | 139.4 | 17.1 | 12% | 1.2 | 57.1 |
| 5/24/2024 | 5:00 pm to 7:00 pm | 134 | 227.8 | 26.9 | 12% | 3.6 | 63.8 |
| 5/24/2024 | 6:00 pm to 8:00 pm | 68 | 147.0 | 26.5 | 18% | 1.8 | 61.8 |
| 5/30/2024 | 5:00 pm to 7:00 pm | 134 | 250.1 | 26.1 | 10% | 3.5 | 69.9 |
| 5/30/2024 | 5:00 pm to 9:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 5/30/2024 | 6:00 pm to 8:00 pm | 68 | 150.2 | 22.9 | 15% | 1.6 | 61.2 |
| 6/13/2024 | 4:00 pm to 6:00 pm | 134 | 269.1 | 45.6 | 17% | 6.2 | 78.5 |
| 6/13/2024 | 4:00 pm to 8:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 6/13/2024 | 6:00 pm to 8:00 pm | 34 | 89.5 | 12.7 | 14% | 0.4 | 66.1 |
| 6/27/2024 | 4:00 pm to 6:00 pm | 134 | 285.1 | 12.3 | 4% | 1.7 | 82.2 |
| 6/27/2024 | 6:00 pm to 8:00 pm | 34 | 100.2 | 13.1 | 13% | 0.4 | 72.4 |
| 7/9/2024 | 7:00 pm to 8:00 pm | 34 | 103.7 | 1.0 | 1% | 0.0 | 72.4 |
| 7/10/2024 | 6:00 pm to 8:00 pm | 34 | 110.0 | 3.7 | 3% | 0.1 | 74.6 |
| 7/11/2024 | 6:00 pm to 8:00 pm | 34 | 105.8 | 4.3 | 4% | 0.1 | 73.1 |
| 7/11/2024 | 7:00 pm to 8:00 pm | 38 | 258.8 | 29.8 | 12% | 1.1 | 68.7 |
| 7/12/2024 | 7:00 pm to 8:00 pm | 34 | 97.8 | 26.1 | 27% | 0.9 | 70.6 |
| 7/18/2024 | 4:00 pm to 6:00 pm | 130 | 314.3 | 42.4 | 14% | 5.6 | 83.7 |
| 7/18/2024 | 4:00 pm to 8:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 7/18/2024 | 6:00 pm to 8:00 pm | 34 | 105.3 | 18.6 | 18% | 0.6 | 71.4 |
| 7/23/2024 | 7:00 pm to 8:00 pm | 34 | 106.8 | 5.7 | 5% | 0.2 | 72.2 |
| 7/24/2024 | 7:00 pm to 8:00 pm | 34 | 110.1 | 8.3 | 8% | 0.3 | 76.0 |
| 7/25/2024 | 4:00 pm to 6:00 pm | 130 | 341.1 | 9.4 | 3% | 1.2 | 91.0 |
| 7/25/2024 | 6:00 pm to 8:00 pm | 34 | 113.9 | 23.0 | 20% | 0.8 | 75.5 |
| 8/2/2024 | 7:00 pm to 8:00 pm | 33 | 110.3 | 31.4 | 29% | 1.1 | 76.6 |
| 8/5/2024 | 6:00 pm to 8:00 pm | 33 | 118.6 | 3.8 | 3% | 0.1 | 78.6 |
| 8/6/2024 | 7:00 pm to 8:00 pm | 33 | 108.0 | 21.7 | 20% | 0.7 | 73.2 |
| 8/22/2024 | 4:00 pm to 6:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 8/22/2024 | 6:00 pm to 8:00 pm | 33 | 103.7 | 19.1 | 18% | 0.6 | 70.5 |
| 8/29/2024 | 4:00 pm to 6:00 pm | 128 | 292.4 | 10.9 | 4% | 1.4 | 80.6 |
| 8/29/2024 | 4:00 pm to 8:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 8/29/2024 | 6:00 pm to 8:00 pm | 33 | 96.1 | 15.9 | 17% | 0.5 | 68.9 |
| 9/4/2024 | 6:00 pm to 8:00 pm | 33 | 118.6 | 4.0 | 3% | 0.1 | 79.8 |

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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 9/5/2024 | 6:00 pm to 8:00 pm | 33 | 126.4 | 7.5 | 6% | 0.2 | 82.8 |
| 9/6/2024 | 6:00 pm to 8:00 pm | 33 | 130.1 | 35.8 | 28% | 1.2 | 80.8 |
| 9/19/2024 | 4:00 pm to 6:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 9/26/2024 | 4:00 pm to 6:00 pm | 126 | 278.6 | 9.8 | 4% | 1.3 | 77.7 |
| 9/26/2024 | 6:00 pm to 8:00 pm | 33 | 88.9 | 11.7 | 13% | 0.4 | 66.4 |
| 9/30/2024 | 4:00 pm to 6:00 pm | 112 | 292.4 | -4.8 | -2% | -0.5 | 79.8 |
| 9/30/2024 | 4:00 pm to 8:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 9/30/2024 | 6:00 pm to 8:00 pm | 33 | 93.8 | 14.5 | 15% | 0.5 | 67.7 |
| 10/24/2024 | 4:00 pm to 6:00 pm | 126 | 262.6 | 13.3 | 5% | 1.7 | 71.0 |
| 10/24/2024 | 4:00 pm to 8:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 10/24/2024 | 6:00 pm to 8:00 pm | 33 | 79.4 | 8.5 | 11% | 0.3 | 63.0 |
| 10/31/2024 | 4:00 pm to 6:00 pm | 126 | 231.2 | 18.5 | 8% | 2.4 | 62.5 |

### TABLE 3-13: EX POST IMPACTS FOR ESTIMATES FOR DSGS (OPTION2) EVENTS IN PG&E SERVICE TERRITORY

| Event Date | Event Times (Local Time) | Number of Facilities | Mean Reference Load (kWh/h) | Mean Facility Impact (kWh/h) | Percent Load Reduction (%) | Average Total Reduction (MWh/h) | Average Event Temp (F) |
|---|---|---|---|---|---|---|---|
| 5/1/2024 | 5:00 pm to 6:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 6/5/2024 | 4:00 pm to 5:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 7/3/2024 | 4:00 pm to 5:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 7/10/2024 | 4:00 pm to 5:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 7/10/2024 | 6:00 pm to 8:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 7/11/2024 | 5:00 pm to 8:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 7/11/2024 | 6:00 pm to 8:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 7/11/2024 | 7:00 pm to 8:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 7/12/2024 | 7:00 pm to 8:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 7/23/2024 | 7:00 pm to 8:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 7/24/2024 | 7:00 pm to 8:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 7/25/2024 | 7:00 pm to 9:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 8/7/2024 | 4:00 pm to 5:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 9/4/2024 | 4:00 pm to 5:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 10/2/2024 | 4:00 pm to 5:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |

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**TABLE 3-14: EX POST IMPACTS ESTIMATES FOR DSGS (OPTION2) EVENTS IN SCE SERVICE TERRITORY**

| Event Date | Event Times (Local Time) | Number of Facilities | Mean Reference Load (kWh/h) | Mean Facility Impact (kWh/h) | Percent Load Reduction (%) | Average Total Reduction (MWh/h) | Average Event Temp (F) |
|---|---|---|---|---|---|---|---|
| 5/1/2024 | 5:00 pm to 6:00 pm | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| 6/5/2024 | 4:00 pm to 5:00 pm | 47 | 186.5 | 37.8 | 20% | 1.78 | 73.9 |
| 7/3/2024 | 4:00 pm to 5:00 pm | 49 | 179.5 | 70.6 | 39% | 3.46 | 85.2 |
| 7/11/2024 | 7:00 pm to 8:00 pm | 35 | 344.1 | 89.1 | 26% | 3.12 | 68.7 |
| 8/7/2024 | 4:00 pm to 5:00 pm | 52 | 233.4 | 81.3 | 35% | 4.23 | 79 |
| 9/4/2024 | 4:00 pm to 5:00 pm | 52 | 273.1 | 122.4 | 45% | 6.37 | 92.8 |
| 9/5/2024 | 6:00 pm to 8:00 pm | 52 | 343.7 | 87.5 | 26% | 4.55 | 81.7 |
| 10/2/2024 | 4:00 pm to 5:00 pm | 54 | 294.4 | 97.2 | 33% | 5.25 | 84.6 |

## 3.4.1 Event Impacts by Load Types

Table 3-15 and Table 3-16 below present the participation-weighted per capita ex post impacts for PG&E and SCE participants respectively by month and load type. The intent is to inform the reader of average event per-capita impacts by varying load types. Participant counts represent the monthly event average participant counts where an event is a single dispatch. Note that more than one dispatch can occur on a given day.

### TABLE 3-15: PG&E SERVICE TERRITORY PARTICIPANT WEIGHTED AVERAGE EVENT HOURLY IMPACTS BY MONTH AND LOAD TYPE

| | Agricultural Equipment | | Cold Storage | | Food Processing | | HVAC | |
|---|---|---|---|---|---|---|---|---|
| Month | Num. of Monthly Parts | Avg. Hourly Impact (kwh/h) | Num. of Monthly Parts | Avg. Hourly Impact (kwh/h) | Num. of Monthly Parts | Avg. Hourly Impact (kwh/h) | Num. of Monthly Parts | Avg. Hourly Impact (kwh/h) |
| Jan. | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | 24.0 | 18.9 |
| Feb. | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | 24.0 | 23.1 |
| Mar. | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | 34.0 | 4.7 |
| April | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | 18.0 | 25.5 |
| May | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| June | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| July | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| Aug. | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| Sep. | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| Oct. | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| Nov. | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | 24.0 | 14.2 |
| Dec. | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | 24.0 | 6.7 |

| | HVAC Plus Other Loads | | Manufacturing Equipment | | Miscellaneous Machinery | | Pumping | |
|---|---|---|---|---|---|---|---|---|
| Month | Num. of Monthly Parts | Avg. Hourly Impact (kwh/h) | Num. of Monthly Parts | Avg. Hourly Impact (kwh/h) | Num. of Monthly Parts | Avg. Hourly Impact (kwh/h) | Num. of Monthly Parts | Avg. Hourly Impact (kwh/h) |
| Jan. | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| Feb. | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| Mar. | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| April | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| May | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | 37.3 | 17.1 |
| June | 47.0 | 25.7 | [redacted] | [redacted] | [redacted] | [redacted] | 44.3 | 15.9 |
| July | 24.4 | 34.2 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| Aug. | 64.9 | 25.8 | [redacted] | [redacted] | [redacted] | [redacted] | 30.4 | 29.9 |
| Sep. | 30.0 | 25.2 | [redacted] | [redacted] | [redacted] | [redacted] | 18.1 | 31.2 |
| Oct. | 50.7 | 15.5 | [redacted] | [redacted] | [redacted] | [redacted] | 53.4 | 22.3 |
| Nov. | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| Dec. | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |

**TABLE 3-16: SCE SERVICE TERRITORY EVENT WEIGHTED AVERAGE EVENT HOURLY IMPACTS BY MONTH AND LOAD TYPE**

| | Agricultural Equipment | | Cold Storage | | Food Processing | | HVAC | |
|---|---|---|---|---|---|---|---|---|
| Month | Num. of Monthly Parts | Avg. Hourly Impact (kwh/h) | Num. of Monthly Parts | Avg. Hourly Impact (kwh/h) | Num. of Monthly Parts | Avg. Hourly Impact (kwh/h) | Num. of Monthly Parts | Avg. Hourly Impact (kwh/h) |
| April | -- | -- | [redacted] | [redacted] | [redacted] | [redacted] | 93.5 | 10.9 |
| May | -- | -- | [redacted] | [redacted] | [redacted] | [redacted] | 93.5 | 19.9 |
| June | -- | -- | [redacted] | [redacted] | [redacted] | [redacted] | 71.8 | 18.1 |
| July | -- | -- | [redacted] | [redacted] | [redacted] | [redacted] | 51.3 | 19.0 |
| Aug. | -- | -- | [redacted] | [redacted] | [redacted] | [redacted] | 42.7 | 11.0 |
| Sep. | -- | -- | [redacted] | [redacted] | [redacted] | [redacted] | 46.5 | 11.9 |
| Oct. | -- | -- | [redacted] | [redacted] | [redacted] | [redacted] | 68.7 | 8.7 |

| | HVAC Plus Other Loads | | Manufacturing Equipment | | Miscellaneous Machinery | | Pumping | |
|---|---|---|---|---|---|---|---|---|
| Month | Num. of Monthly Parts | Avg. Hourly Impact (kwh/h) | Num. of Monthly Parts | Avg. Hourly Impact (kwh/h) | Num. of Monthly Parts | Avg. Hourly Impact (kwh/h) | Num. of Monthly Parts | Avg. Hourly Impact (kwh/h) |
| April | [redacted] | [redacted] | [redacted] | [redacted] | -- | -- | [redacted] | [redacted] |
| May | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| June | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| July | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| Aug. | -- | -- | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| Sep. | -- | -- | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| Oct. | -- | -- | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |

### 3.4.2 Average Event Day Impacts

During 2024, there were more than 10,000 participant event hours for customers with available data. Table 3-17 presents the number of participant event hours by program and hour ending (HE). As seen in the event day information presented in Section 2, the number of participants and event windows greatly differ across dispatches. This is especially true for PG&E DRAM resources, where participants are strategically dispatched by geographic regions.

**TABLE 3-17: TOTAL PARTICIPANT EVENT HOURS BY PROGRAM AND HOUR**

| Program | HE 17 | HE 18 | HE 19 | HE 20 | HE 21 |
|---|---|---|---|---|---|
| PG&E CBP | -- | 3 | 20 | 23 | -- |
| PG&E DRAM | 642 | 830 | 255 | 80 | 28 |
| PG&E CA RA | 1,009 | 775 | 703 | 995 | 37 |
| PG&E DSGS | 67 | 8 | 3 | 8 | 1 |
| SCE DRAM | 1,187 | 1,599 | 1,164 | 997 | 4 |
| SCE DSGS | 254 | 13 | 52 | 87 | -- |

While dispatching resources in this way is effective from a program resource perspective, it is problematic when estimating average event day impacts. Establishing average event day load profiles where the entire participant population is not dispatched for a consistent set of event hours can create misleading interpretations of event performance. The exclusion of event hours where resources were not fully dispatched or the dilution of program impacts, as a result of blending partial population participation for a given hour, can contribute to misleading interpretations. To remedy this, the average event day impacts reported in Table 3-18 represent the average hourly impact across all event hours.

**TABLE 3-18: AVERAGE EVENT EX POST IMPACT ESTIMATES BY PROGRAM**

| Program | Mean Number of Facilities | Mean Reference Load (kWh/h) | Mean Facility Impact (kWh/h) | Percent Load Reduction (%) | Average Total Reduction (MWh/h) | Average Event Temp (F) |
|---|---|---|---|---|---|---|
| PG&E CBP | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| PG&E DRAM | 21.2 | 500.55 | 82.5 | 16% | 1.75 | 68.2 |
| PG&E CA RA | 107.2 | 227.92 | 33.8 | 15% | 3.62 | 83.5 |
| PG&E DSGS | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| SCE DRAM | 51.4 | 215.90 | 18.5 | 9% | 0.95 | 72.7 |
| SCE DSGS | 45.1 | 274.97 | 86.4 | 31% | 3.90 | 80.8 |

This way of presenting event day averages provides a more accurate representation of average hourly event impacts. However, it differs from the method used in the ex post table generators, which requires representations of an average event day across a 24-hour period. As a result, the average event day for PG&E CBP and SCE DRAM utilize dispatches where HE 19 and HE 20 are event hours. PG&E DRAM and both utility DSGS programs utilize dispatches where HE 17 and HE 18 are event hours. This minimizes the effect of “non-participant dilution” on average event day impacts. PG&E CA RA does not exclude events based on hours of participation.

Figure 3-1 through Table 3-6 present the average event day load profiles as presented in the ex post table generators. Given that events occurred on varying hours across event days, the density of the shaded areas relates to the amount of event hours on a given event day. The darker (opaquer) an event hour, the more frequent that hour was an event hour. HE 20 for PG&E CBP and PG&E DRAM has larger load reductions on average compared to the preceding hour despite having less frequent event participation. Additionally, the hourly impacts appear noticeably lower than average impacts presented in Table 3-18. This highlights how the ex post table generator's average event day impacts can present misleading interpretations of average event performance when participants are not dispatched for a uniform set of hours. However, it is still valuable to understand the average event day load shape as it provides context for the average dispatched load shape and curtailment.

**FIGURE 3-1: PG&E CBP AVERAGE EVENT DAY**

**FIGURE 3-2: PG&E DRAM AVERAGE EVENT DAY**

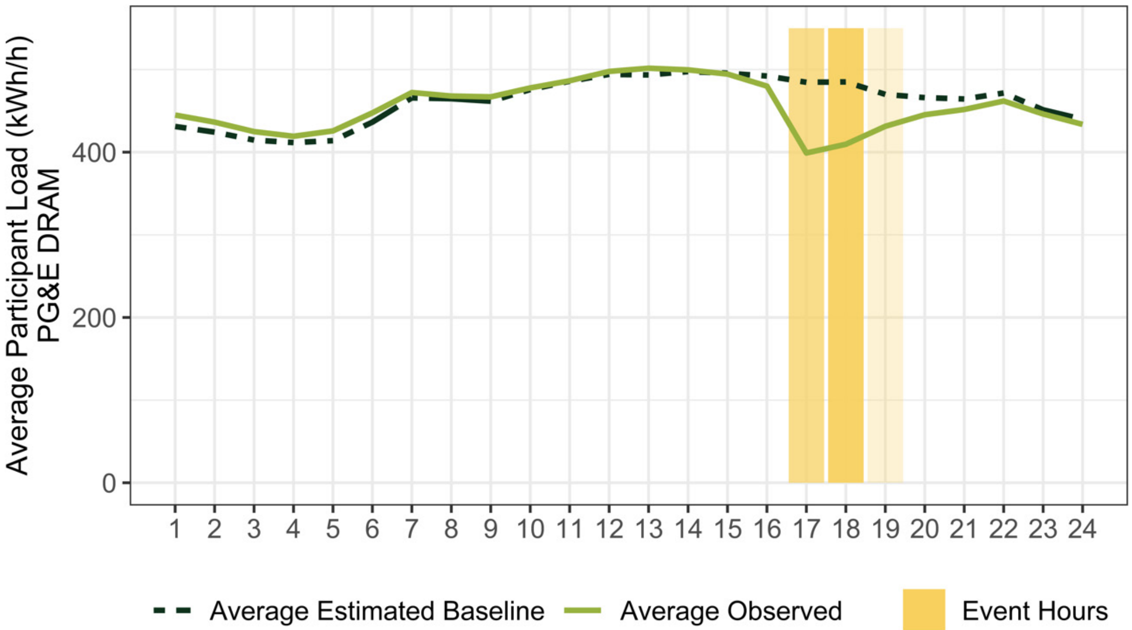



**FIGURE 3-3: PG&E CCA RA AVERAGE EVENT DAY**

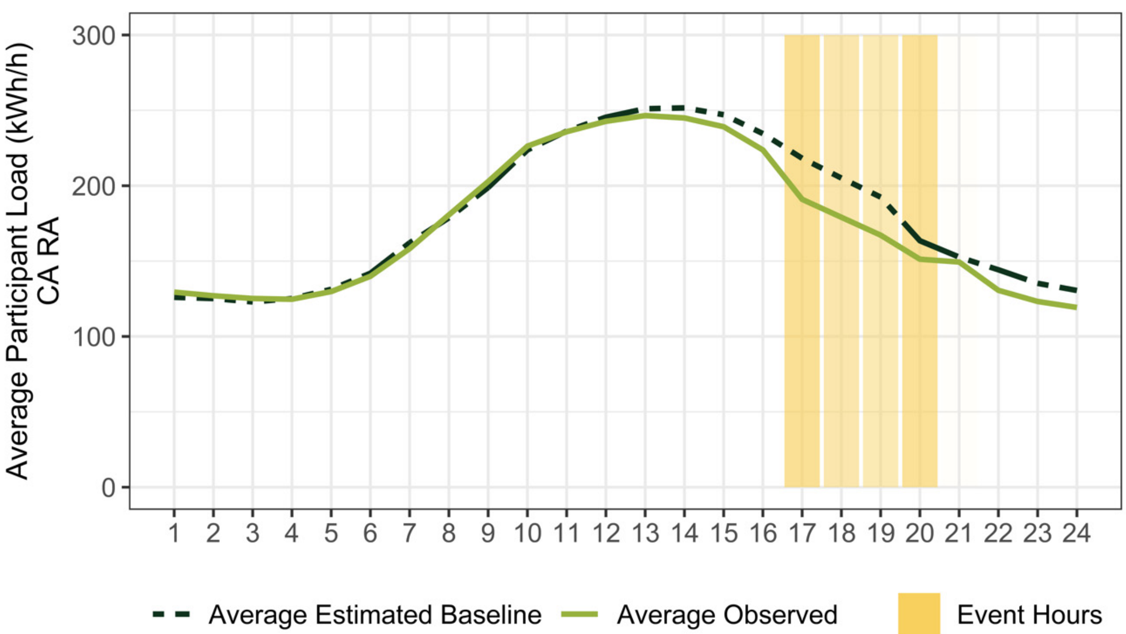


**FIGURE 3-4: PG&E DSGS AVERAGE EVENT DAY**

**FIGURE 3-5: SCE DRAM AVERAGE EVENT DAY**

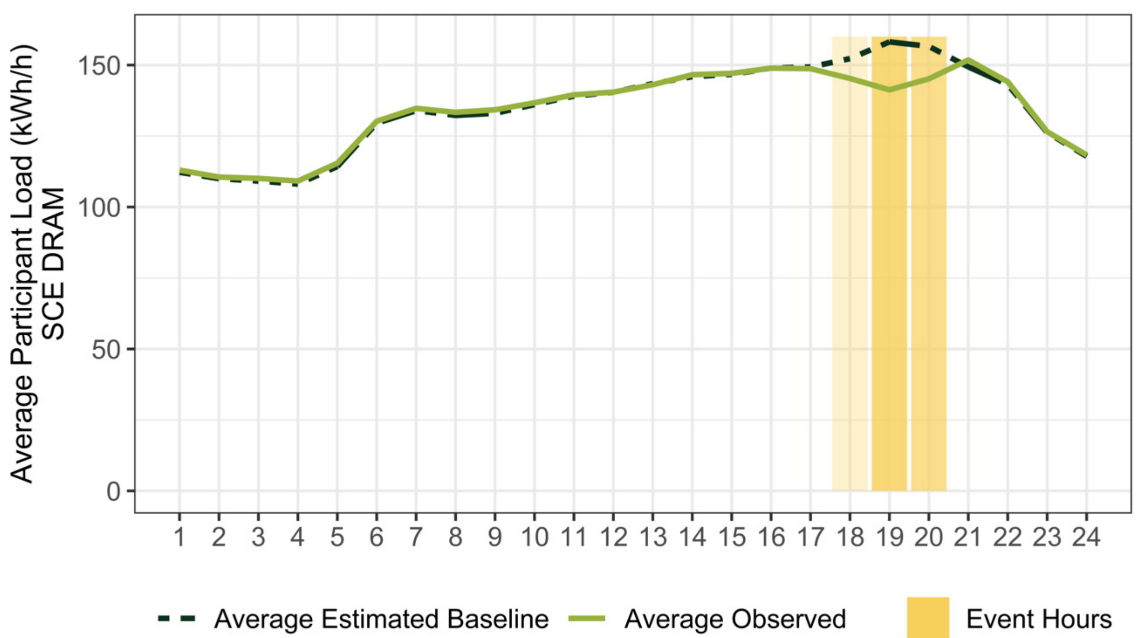
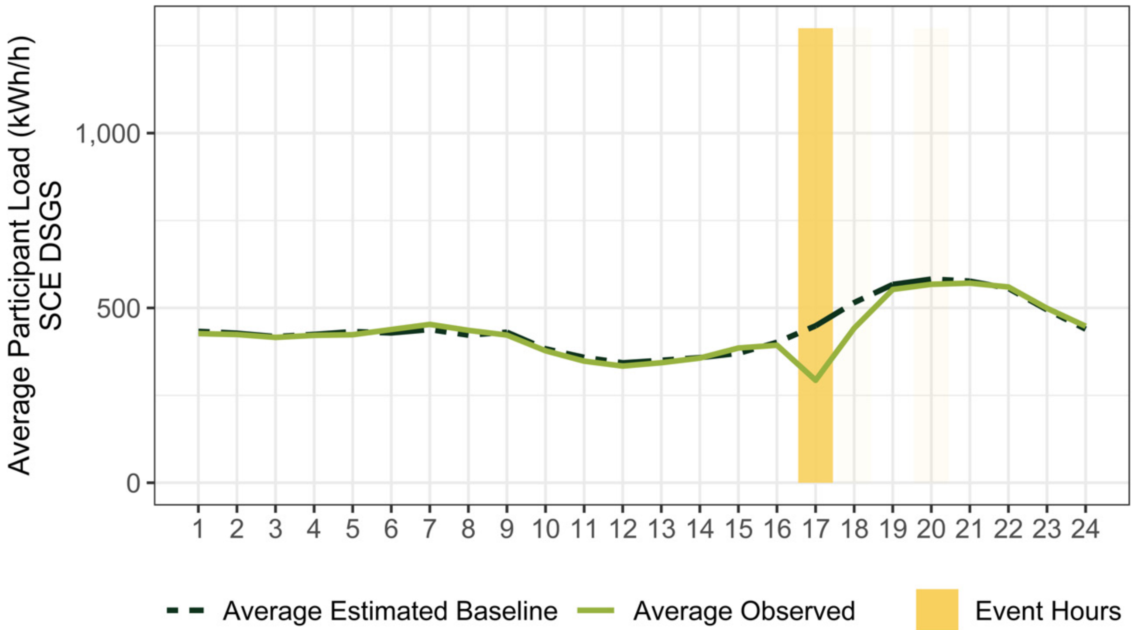


**FIGURE 3-6: SCE DSGS AVERAGE EVENT DAY**




## 3.5 EX ANTE FORECAST ESTIMATION METHODOLOGY

Verdant's approach to the estimation of ex ante load impacts for Voltus' participants is largely informed by the ex post methodology and impact estimates. There are four generalized steps for estimating ex ante impacts. These are detailed below.

1. **Develop Ex Ante Drivers.** Prior to ex ante modeling, Verdant developed the ex ante drivers dataset. The dataset contains assumptions about ex ante event day characteristics for each month and each ex ante weather scenarios required to predict the ex ante reference loads for each customer. Whereas the ex post impacts reflect actual event day conditions, the ex ante impacts are based on different planning assumptions, primarily the different scenarios that reflect typical or extreme weather conditions. While the weather scenarios are the most obvious element of the ex ante drivers, the models used to estimate reference loads often require the development of other variables related to load characteristics. Examples of this include average morning loads or days of the week, which often include several model specifications to help ensure that the baseline more reliably reflects event day conditions prior to dispatch. For the ex ante drivers, these variables were based on conditions seen in PY 2024. As for weekday dummy variables, the ex ante drivers assume a value of 0.2 (1 divided by 5) to represent each weekday with equal weight.
2. **Estimate Reference Loads.** Using the customer-specific ex post models with the ex ante driver data as predictive inputs, Verdant estimated ex ante reference loads for each customer.

3. **Estimate Ex Ante Impacts.** Ex ante impacts were developed as a percent load reduction for each group of participants in a given load type and SubLAP combination. Impacts were estimated as a percent load reduction to normalize impacts across customers that can vary substantially in size (energy consumption). Percent load reductions were developed for each $n^{th}$ hour of dispatch (i.e. the first hour of dispatch, second hour of dispatch, etc.). For customer segments that did not have more than two or three hours of dispatch, the prior hour's percent load reduction estimate was applied to missing hours and along with a degradation rate representing the typical hourly degradation of impacts seen in the ex post analysis. Percent load reductions were then applied to the ex ante reference loads to develop the load impacts (kwh/h) for each customer segment (load type and SubLAP). Equation 2 presents the ex ante percent load reduction generalized model specification. Where the typical percent load reduction for a given season is a function of the ex post percent load reduction in the $n^{th}$ hour of dispatch and, for HVAC loads, temperature.

**EQUATION 2: EX ANTE IMPACT GENERAL MODEL SPECIFICATION**

$$SeasonPercentLoadReduction_{s,n} = \beta_n ExPostPercentLoadReduction_n + \beta_{s,n} Temp_{e,n} + \varepsilon$$

Where:

| | |
|---|---|
| $SeasonPercentLoadReduction_{s,n}$ | The season s percent load reduction in nth hour *n.* |
| $ExPostPercentLoadReduction_n$ | $n^{th}$ hour of dispatch *n* ex post percent load reduction. |
| $Hour_h$ | A dummy variable indicating hour *h.* |
| $Temp_{s,h}$ | The temperature for ex ante scenario *s* during hour *h.* |

4. **Apply Participant Forecasts.** After producing ex ante reference loads and load impacts, each customer is grouped into the lowest level domain (groups of SubLAP and load type) of the participant forecast. Reference loads and impacts in each domain are then averaged to represent the typical customer of a given domain. This is then multiplied by the share of participants in the enrollment forecasts to produce the MW forecast for each month and year by the lowest level of aggregation. Each group's MW forecast is then summed at each respective level of reporting.

As with the ex post impacts, ex ante impacts were modeled separately for summer and winter months. The RA window used for ex ante impacts is California's peak period of 4:00 pm to 8:00 pm in all months except March through May, which is from 5:00pm to 9:00pm. For purposes of the ex ante analysis, it is assumed that dispatch occurs in the first four hours of the RA window. The hours after the four hour window includes expected snapback effects (although not all load types were seen have measurable snapback).

### 3.5.1 Resource Adequacy Window Adjustments

Voltus selected the first four hours of the RA window, starting at 4:00 PM and ending at 8:00 PM (5:00 pm to 9:00pm in March through May) to represent events for the ex ante impacts because they represent the window for RA. These are the hours of most interest, so it is important to have estimates of impacts during this window. Table 3-19 summarizes the total number of participant event hours for events in 2024 by CA IOU. The majority of 2024 PG&E and SCE event hours occurred in the first four hours of the RA window (HE 17 to HE 20).

**TABLE 3-19: TOTAL PARTICIPANT EVENT HOURS BY IOU AND HOUR**

| IOU | HE 17 | HE 18 | HE 19 | HE 20 | HE 21 |
|---|---|---|---|---|---|
| PG&E | 642 | 833 | 275 | 103 | 28 |
| SCE | 1,187 | 1,599 | 1,164 | 997 | 4 |

## 3.6 EX ANTE RESULTS

As with the ex post impacts, a detailed set of results with impacts by IOU, load type, and SubLAP type for all weather scenarios is available in the load impact protocol ex ante table generators submitted with this report. Given the different weather sources, weather years, day types, and months, the number of permutations associated with the results are far too many to present here. Consequently, this section presents only a high-level overview of the ex ante impacts associated with Voltus's DR programs.

The 2025 through 2028 ex ante MWh/h forecasts and participants under CAISO and Utility August 1-in-2 worst day scenarios are presented in Table 3-20 for PG&E and SCE.

**TABLE 3-20: VOLTUS 2025 THROUGH 2028 1-IN-2 AUGUST MONTHLY WORST DAY EX ANTE MW FORECAST**

| Utility and Year | Scenario 3 | | | Scenario 2 | | | Scenario 1 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Part. Forecast | CAISO 1-in-2 (MWh/h) | Utility 1-in-2 (MWh/h) | Part. Forecast | CAISO 1-in-2 (MWh/h) | Utility 1-in-2 (MWh/h) | Part. Forecast | CAISO 1-in-2 (MWh/h) | Utility 1-in-2 (MWh/h) |
| ***PG&E*** | | | | | | | | | |
| 2025 | 241 | 8.3 | 8.9 | 241 | 8.3 | 8.9 | 241 | 8.3 | 8.9 |
| **2026** | 326 | 18.9 | 19.5 | 367 | 22.0 | 22.5 | 409 | 23.3 | 23.8 |
| 2027 | 336 | 19.0 | 19.6 | 384 | 21.7 | 22.3 | 429 | 24.4 | 24.9 |
| 2028 | 347 | 20.6 | 21.2 | 400 | 23.0 | 23.6 | 451 | 25.1 | 25.6 |
| ***SCE*** | | | | | | | | | |
| 2025 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| **2026** | 123 | 4.8 | 5.5 | 183 | 6.5 | 7.5 | 243 | 9.0 | 10.3 |
| 2027 | 129 | 4.9 | 5.6 | 191 | 6.6 | 7.6 | 254 | 9.2 | 10.5 |
| 2028 | 135 | 4.9 | 5.7 | 199 | 7.1 | 8.1 | 266 | 9.4 | 10.8 |

To accommodate the slice of day reporting requirements, ex ante modeling assumes a four-hour dispatch over the availability assessment hours (AAH) between 4:00pm and 8:00pm where snapback occurs between 8:00pm and 9:00pm. For March through May, 5:00pm to 9:00pm are the assumed event hours with snapback occurring between 9:00 and 10:00 pm. Table 3-21 presents the August slice of day hourly load reductions (MW) over the AAH window (hour ending 17 through hour ending 20), including snapback in hour ending 21 and hour ending 22 under the Scenario 2. Notably, Verdant does not anticipate snapback in the last hour of the RA window and anticipates impacts persisting into the 5$^{th}$ hour of the RA window, with some snap back in the first hour following the RA window.

**TABLE 3-21: VOLTUS 2026 SLICE OF DAY OVER AAH WINDOW – UTILITY AUGUST 1-IN-2 MONTHLY WORST DAY**

| IOU | Enrollment Type | Availability Assessment Hour (AAH) – MW of Curtailment | | | | | |
|---|---|---|---|---|---|---|---|
| | | Hour Ending 17 | Hour Ending 18 | Hour Ending 19 | Hour Ending 20 | Hour Ending 21 (Snapback) | Hour Ending 22 (Snapback) |
| PG&E | CAISO | 17.8 | 20.8 | 25.2 | 24.1 | 2.6 | -1.7 |
| | Utility | 18.9 | 21.5 | 25.9 | 23.6 | 3.0 | -1.5 |
| SCE | CAISO | 5.5 | 6.1 | 6.8 | 7.6 | 2.4 | 2.4 |
| | Utility | 7.0 | 7.2 | 8.3 | 7.5 | 2.8 | 2.7 |

Voltus has events throughout the year; Table 3-22 shows the total MW by enrollment scenario for 2026. There are a few caveats to the monthly estimates. Not all resources hosted events every month of the year. To address this, Verdant adjusted the participation forecasts in the anticipated estimates by considering only the portion of the current Voltus portfolio that engaged in non-summer events. For instance, if in 2024, 60% of the Voltus portfolio participated in at least one non-summer event, the participant forecast for monthly anticipated estimates would be adjusted to 60% of the total participant forecast during the non-summer months. These proportions are calculated at the SubLAP and load type levels to accommodate load types that exhibit varying participation rates based on season and location. Summer months are assumed to have full participation. This year there were no SCE events in January, February, March, November and December. Thus, there are no estimates for SCE resources in that time frame.

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**TABLE 3-22: VOLTUS 2026 EX ANTE MW BY MONTH AND RA SCENARIO, UTILITY 1-IN-2 WEATHER**

| | Scenario 3 | | Scenario 2 | | Scenario 1 | |
|---|---|---|---|---|---|---|
| Month | PG&E | SCE | PG&E | SCE | PG&E | SCE |
| Jan. | 4.5 | - | 4.8 | - | 5.6 | - |
| Feb. | 4.9 | - | 5.7 | - | 6.9 | - |
| Mar. | 6.0 | - | 6.6 | - | 7.7 | - |
| Apr. | 15.0 | 3.6 | 19.0 | 4.5 | 20.4 | 6.1 |
| May | 13.6 | 2.9 | 15.9 | 3.3 | 17.6 | 4.4 |
| Jun. | 20.4 | 5.4 | 24.1 | 7.1 | 26.6 | 9.4 |
| Jul. | 21.7 | 5.7 | 25.2 | 6.6 | 27.0 | 9.5 |
| Aug. | 19.5 | 5.5 | 22.5 | 7.5 | 23.8 | 10.3 |
| Sep. | 18.3 | 3.1 | 22.0 | 4.0 | 23.2 | 5.6 |
| Oct. | 20.1 | 4.7 | 24.0 | 6.6 | 25.4 | 8.3 |
| Nov. | 3.4 | - | 3.8 | - | 4.1 | - |
| Dec. | 2.7 | - | 3.1 | - | 3.5 | - |

### 3.6.1 2026 Ex Ante MW Forecasts - PY 2024 vs. PY 2023 Reporting Estimates

Verdant explored how ex ante MW forecasts for 2026 changed between estimates produced for in this year's ex ante forecast (PY 2024) and the previous year's forecast (PY 2023). Both years use a similar set of programs, PG&E DRAM, PG&E CBP, PG&E CCA RA, and SCE DRAM with the new addition of DSGS in 2025. Table 3-23 and Table 3-24 presents the PY 2025 aggregate impact estimates produced for PY 2024 (FY 2025) LIP and PY 2023 (FY 2024) LIP ex ante impact analysis for PG&E and SCE (respectively) under the 1-in-2 August worst day weather scenarios.

Most notably, there is an increase in the PG&E participant forecast and a decrease in SCE. The estimated ex ante MW values have remained steady in PG&E with a slight increase in SCE. [redacted].

**TABLE 3-23: PG&E 2026 FORECAST OF AGGREGATE IMPACTS – PY 2023 VS. PY 2024 ESTIMATES**

| | | | CAISO Monthly Worst Day (Month of August) | Utility Monthly Worst Day (Month of August) |
|---|---|---|---|---|
| IOU | Report Year | Participants | 1-in-2 | 1-in-2 |
| PG&E | PY 2024 (FY 2025) | 409 | 23.3 | 23.8 |
| PG&E | PY 2023 (FY 2024) | 296 | 26.8 | 25.8 |

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**TABLE 3-24: SCE 2026 FORECAST OF AGGREGATE IMPACTS – PY 2023 VS. PY 2024 ESTIMATES**

| IOU | Report Year | Participants | CAISO Monthly Worst Day (Month of August) | Utility Monthly Worst Day (Month of August) |
|---|---|---|---|---|
| | | | 1-in-2 | 1-in-2 |
| SCE | PY 2024 (FY 2025) | 243 | 9.0 | 10.3 |
| SCE | PY 2023 (FY 2024) | 287 | 8.8 | 8.3 |

# 4 FINDINGS AND RECOMMENDATIONS

Key findings and recommendations in this study include:

## Findings

Voltus's DR portfolio is anticipated to be able to provide 23.8 MW of curtailment in PG&E and 10.4 MW of curtailment in SCE for a total 34.1 MW of curtailment under the August utility worst day 1-in-2 weather scenario in 2026 under Scenario 1. Under Scenario 2 the expected curtailment under the same day and weather scenarios are 22.5 MW in PG&E and 7.5 MW in SCE, or 30 MW total. Finally, under Scenario 3 the estimated curtailment is 19.5 MW in PG&E and 5.5 MW in SCE for a total of 25 MW.

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# APPENDIX A LIST OF MODEL SPECIFICATIONS

This appendix lists the base model specifications for the full set of models that were estimated as candidate models for the estimation of ex post impacts and ex ante analysis. The appropriate event day, event hour and weather interactions were attached to each respective base model as detailed in the main body of the report. The models are presented in Table A-1 and Table A-2 using R syntax, which is the software used for the analysis. The definitions for the unique list of variables referenced in the formulas are provided below the model specifications.

### TABLE A-1: GENERAL FORM MODEL SPECIFICIATIONS BY SEASON/DAY TYPE AND WEATHER SENSITIVITY TYPE

| Weather Sensitivity Type | Model Number | R Code Specification |
|---|---|---|
| Weather-Sensitive: Cooling | 1 | kwh ~ cdh65 + factor(month) |
| | 2 | kwh ~ cdh60 + factor(month) |
| | 3 | kwh ~ cdh65 + factor(month) + dtype |
| | 4 | kwh ~ cdh60 + factor(month) + dtype |
| | 5 | kwh ~ cdd65 + factor(month) |
| | 6 | kwh ~ cdd60 + factor(month) |
| | 7 | kwh ~ cdh65 + cdd65 + factor(month) |
| | 8 | kwh ~ cdh65 + cdd65 + factor(month) |
| | 9 | kwh ~ cdh65 + factor(month) + morning_load |
| | 10 | kwh ~ cdh65 + factor(month) + afternoon_load |
| | 11 | kwh ~ I(cdh65^2) + factor(month) + dtype |
| | 12 | kwh ~ I(cdh60^2) + factor(month) + dtype |
| | 13 | kwh ~ cdh65 + I(cdh65^2) + factor(month) + dtype |
| | 14 | kwh ~ cdh60 + factor(month) + I(cdh60^2) + dtype |
| Weather-Sensitive: Heating | 1 | kwh~cdh65+hdh60+factor(month) |
| | 2 | kwh~cdh60+hdh60+factor(month) |
| | 3 | kwh~cdh65+hdh60+factor(month)+dtype |
| | 4 | kwh~cdh60+hdh60+factor(month)+dtype |
| | 5 | kwh~cdd65+hdh60+factor(month) |
| | 6 | kwh~cdd60+hdh60+factor(month) |
| | 7 | kwh~cdh65+hdh60+cdd65+factor(month) |
| | 8 | kwh~cdh60+hdh60+factor(month) |
| | 9 | kwh~cdh65+hdh60+factor(month)+ morning_load |
| | 10 | kwh~cdh65+hdh60+factor(month)+ afternoon_load |
| | 11 | kwh~I(cdh65^2)+hdh60+factor(month)+dtype |
| | 12 | kwh~I(cdh60^2)+hdh60+factor(month)+dtype |
| | 13 | kwh~cdh65+hdh60+I(cdh65^2)+factor(month)+dtype |
| | 14 | kwh~cdh60+hdh60+factor(month)+I(cdh60^2)+dtype |
| Non-Weather Sensitive | 1 | kwh ~ factor(month) + factor(dtype) |
| | 2 | kwh ~ factor(month) + factor(dtype) + morning_load |
| | 3 | kwh ~ factor(month) + factor(dtype) + morning_load + evening_load |
| | 4 | kwh ~ factor(month) + factor(dtype) + afternoon_load |
| | 5 | kwh ~ factor(month) + factor(dtype) + morning_load + afternoon_load |
| | 6 | kwh ~ factor(month) + factor(dtype) + morning_load + afternoon_load + evening_load |
| | 7 | kwh ~ factor(month) + factor(dtype) + monday + friday |
| | 8 | kwh ~ factor(month) + factor(dtype) + monday + friday + morning_load |
| | 9 | kwh ~ factor(month) + factor(dtype) + monday + friday + afternoon_load |
| | 10 | kwh ~ factor(month) + factor(dtype) + monday + friday + morning_load + evening_load |

### TABLE A-2: DEFINITION OF VARIABLES IN MODEL SPECIFICATIONS

| Variables | Definition |
|---|---|
| kwh | Hourly kWh values |
| Morning_load | Average morning load on a given day |
| Afternoon_load | Average afternoon load on a given day |
| Evening_load | Average evening load on a given day |
| cdd65 | Cooling degree days using as base of 65 degrees |
| Friday | Binary variable indicating Friday interacted with the hour of the day. |
| Monday | Binary variable indicating Monday interacted with the hour of the day |
| dtype | Categorical variable indicating the day of the week (Monday through Friday) |
| as.factor(month) | Series of binary indicators for the months in the model estimation data. |

# APPENDIX B EVALUATION PLAN COMMENT RESPONSES

In total Verdant received one comment from CPUC Energy Division on the *Voltus PY 2024 (FY 2025) LIP Draft Evaluation Plan*[1]. This comment and Verdant's response are as follows:

**Comment Received from the CPUC Energy Division:** "*In section 2.5 of Voltus' evaluation plan, Voltus states that free ridership will not be examined and is out of scope for this evaluation. Can you explain how this has been determined?*"

**Verdant Response:** Free riders in the DR context refers to the concept of structural benefiters. Per the Load Impact Protocols (LIP)[2], the evaluation plan should determine if the understanding structural benefiters is necessary for the LIP evaluation. Additionally, the LIP states that "*When assessing the need to determine the number of structural benefiters that might be participating in a DR program or tariff, it is important to keep a number of things in mind**. First and foremost, the methods discussed in sections 4 through 6 are all designed to produce unbiased estimates of demand response. It is not necessary to estimate the number of structural benefiters in order to achieve this goal**.*" (Section 3.2.9, p.27).

Given the goal of Voltus's LIP filing is to produce unbiased ex post results and an ex ante forecast for qualifying RA capacity, an exploration of free riders is not relevant for determining unbiased results of qualifying capacity from a third party DR provider. Further, in all previous Voltus LIP filings this has not been explored and was also determined to be unnecessary for Voltus's LIP filings.

[1] Summitted as *Voltus PY 2024 (FY 2025) LIP Draft Evaluation Plan – Confidential.pdf*

[2] https://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/81979.PDF

# APPENDIX C EX ANTE AND EX POST TABLE GENERATORS

Ex ante and Ex Post works are presented in documents outside of this report. The files are entitled:

- PY 2024 (FY 2025) Voltus Ex Post Table Generators - Final – PUBLIC.xlsx
- PY 2024 (FY 2025) Voltus Ex Ante Table Generators - Final – PUBLIC.xlsx