Demand Side Analytics
DATA DRIVEN RESEARCH AND INSIGHTS

FINAL REPORT
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2024 Load Impact Evaluation of San Diego Gas and Electric's Electric Vehicles Time-of-Use (TOU) Rates

ACKNOWLEDGEMENTS

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ABSTRACT

This report summarizes the evaluation findings of San Diego Gas and Electric's (SDG&E) EV-TOU Rates. In total, over 2.9M light-duty vehicles (LDVs) are registered with the California DMV in SDG&E's service territory, which includes all of San Diego County and portions of Orange County. Electric vehicles (EVs) are growing as a share of LDVs and SDG&E has enrolled roughly 60,000 homes on EV rates. On the top 5 load days for CAISO gross loads, these customers curtailed demand during peak hours by 12% (MW) on average and increased energy use during the lower priced super off-peak hours. The change in load patterns coincides with the enrollment on TOU rates for electric vehicles and is sustained throughout the first year of participation. Moreover, customers delivered larger demand reductions on the highest system load days and when conditions were hotter.

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1 EXECUTIVE SUMMARY

This report summarizes the evaluation findings for San Diego Gas and Electric's (SDG&E) EV-TOU-2 and EV-TOU-5 whole-home time-of-use rates for residential electric vehicle (EV) drivers. Note that while SDG&E also has a small number of customers on an EV-only sub-metered rate called EV-TOU that are not included in this evaluation, we will refer to the TOU-2 and TOU-5 rates collectively as EV-TOU throughout this report. SDG&E's two whole home EV-TOU rates are voluntary Time of Use rate programs designed to offer electric bill saving for EV drivers, while also promoting charging during periods when the grid historically experiences lower demand and has excess capacity. These rates aim to encourage the electrification of the transportation sector, increase access to EV adoption, and reduce the impact of electric vehicles on peak grid conditions. This report aims to provide an overview of the program's history, methods, and impacts and a summary of the Program Year 2024 ex-post and ex-ante impacts for incremental customers on San Diego Gas and Electric's (SDG&E) TOU rates for electric vehicles.

1.1 KEY FINDINGS

SDG&E has two main residential time-of-use rates for electric vehicles: EV-TOU2 and EV-TOU5, both of which are whole-home rates. Moreover, SDG&E recently introduced a new pricing plan, TOU-ELEC, for customer who own an electric vehicle, energy storage, and/or an electric heat pump water heater[1]. In addition, SDG&E has a small number of homes on an electric vehicle rate (EV-TOU) with sub-metering for the charger, which is not included in the evaluation. On 2024 high load days, SDG&E had about 60,000 homes enrolled across their electric vehicle rates. Table 1 shows participants' aggregate and average load impact during the top 5, 10, and 20 load days for CAISO Gross Loads, CAISO Net Loads, and SDG&E Gross Loads. On the top 5 load days for CAISO Gross loads, participant loads peaked at 103 MW, and participants curtailed peak period demand by 12.4 MW in aggregate. For the top 5 load days for SDG&E Gross loads, participant loads peaked at 115 MW, and participants curtailed peak demand by 12.2 MW in aggregate.

[1] TOU-ELEC customers are included in the ex-post analysis but excluded from the ex-ante analysis, due to their small number and the lack of precision in their impacts used for forecasting. A separate report will be issued, focusing specifically on TOU-ELEC.

Table 1: Ex-post Demand Reductions on Highest System Load Days (4-9 PM)

System	Month	Sample[1]	New Accounts	Total Accounts	Daily avg. temp[2]	Avg. Customer (kW) Reference Load	Avg. Customer (kW) Load Impact	Avg. Customer (kW) % Change	New Load Impact (MW)	Total Load Impact (MW)
CAISO Gross Loads	Top 05 load day(s)	2,221	10,538	60,327	75.0	1.7	-0.2	-12.1%	-2.2	-12.4
	Top 10 load day(s)	2,221	10,538	60,327	74.3	1.6	-0.2	-11.7%	-2.0	-11.4
	Top 20 load day(s)	2,221	10,538	60,327	73.1	1.5	-0.2	-13.6%	-2.1	-11.9
CAISO Net Loads	Top 05 load day(s)	2,221	10,538	60,327	73.5	1.6	-0.2	-12.0%	-2.0	-11.5
	Top 10 load day(s)	2,221	10,538	60,327	73.8	1.6	-0.2	-11.6%	-1.9	-11.1
	Top 20 load day(s)	2,221	10,538	60,327	73.2	1.5	-0.2	-13.0%	-2.0	-11.6
SDG&E Gross Loads	Top 05 load day(s)	2,221	10,538	60,327	76.8	1.9	-0.2	-10.7%	-2.1	-12.2
	Top 10 load day(s)	2,221	10,538	60,327	75.8	1.8	-0.2	-10.1%	-1.9	-10.7
	Top 20 load day(s)	2,221	10,538	60,327	74.5	1.6	-0.2	-11.6%	-2.0	-11.3

[1] Estimating sample is lower than populations because it excludes sites that whose transition to EV TOU coincided with the arrival of the electric vehicle or with solar or battery installation.
[2] Participant weighted average temperature. SDG&E maps all customers to eight distinct weather stations.

2 INTRODUCTION AND BACKGROUND

This report presents the program year 2024 results for SDG&E's electric vehicle time-of-use rates (EV-TOU). The program is designed to encourage the electrification of the transportation sector, reduce barriers to EV adoption, reduce greenhouse gas (GHG) emissions, and encourage customers to reduce demand during peak hours and charge during hours when energy is more abundant and less costly. The report has two primary objectives: to estimate the demand reductions that were delivered in 2024 and to quantify the magnitude of incremental demand reductions during peaking conditions for use in planning.

Time of use rates are considered a passive form of load management. They encourage customers to shift their use from higher-priced periods to lower-cost periods but do not directly control the charging behavior of customers or vehicles. A feature that distinguished event-based resources such as DR programs, from non-event-based resources such as TOU rates, is the ability to dispatch the resource. The primary intervention – a dispatch or price signal – is introduced on some days and not on others, making it possible to observe energy use patterns with and without demand reductions. This, in turn, enables us to assess whether the outcome – electricity use – rises or falls with the presence or absence of demand response dispatch instructions. The exception is TOU rates, which are discussed in more detail below.

The evaluation includes three main interventions[2]:

- **Electric Vehicle Time of Use rates.** As explained in the Executive Summary above, SDG&E has two primary residential EV-TOU rates, the whole-home rates EV-TOU-2 and EV-TOU-5, and a small number of sub-meter homes on an EV-TOU rate that are not included in this evaluation. As of January 1, 2024, customers without an EV[3] were eligible to enroll on EV-TOU-5. Our main results are based on customers with a full year of data on the rate so any such customers will not be included in our main results. SDG&E also recently introduced a new pricing plan, TOU-ELEC, for customer who own an electric vehicle, energy storage, and/or an electric heat pump water heater. All the rates include a peak period from 4-9 PM, super off-peak rates from 12-6 AM, and off-peak rates in all other hours. The main differences between the whole premise rates are in the super off-peak rates, the monthly billing fee, and rates during holidays and weekends. Overall, the EV-TOU-5 rate has a lower super-off peak price, a higher monthly fixed charge, and the same rates for weekdays and weekends. On the other hand, the TOU-ELEC rate has the lowest price difference between the off-peak and super off-peak periods among the three rates. Nearly all new enrollments are on the EV-TOU-5 rate.

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[2] TOU-ELEC customers are included in the ex-post analysis but excluded from the ex-ante analysis, due to their small number and the lack of precision in their impacts used for forecasting. A separate report will be issued, focusing specifically on TOU-ELEC.

[3] It has always been the case that customers self-report EV ownership when they enroll, so it is possible that customers without EVs could be enrolled on these rates prior to January 1 2024.

The remainder of this section provides context and additional detail about the EV-TOU-5, EV-TOU-2, and TOU-ELEC rates. It details the key research questions, summarizes 2024 grid conditions, and discusses the electric vehicle TOU rates and historical participation.

2.1 RESEARCH QUESTIONS

While each program/rate at each utility has unique characteristics, the core research questions are similar:

- What were the demand reductions due to electric vehicle time of use rates?
- How do load impacts differ for different types of customers?
- How does weather influence the magnitude of demand response, if at all?
- How does price influence the magnitude of demand response?
- What is the ex-ante load reduction capability for 1-in-2 and 1-in-10 weather conditions? And how well do these reductions align with ex-post results and prior ex-ante forecasts?
- What concrete steps can be undertaken to improve program performance?

2.2 KEY FACTS ABOUT ELECTRIC VEHICLES IN SDG&E

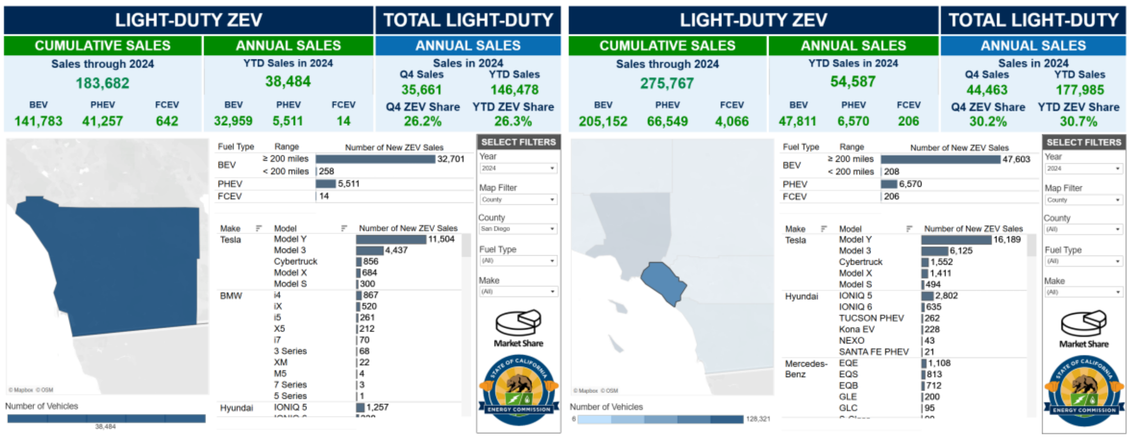
Electric vehicles have the potential to transform the electric grid fundamentally. As the residential electric vehicle market grows, it will impact all aspects of the electric grid. Therefore, in addition to the load impacts achieved by the electric vehicle programs, it is also essential to understand the population and distribution of electric vehicles in SDG&E's service territory.

As of December 2023, over 2.9M[4] vehicles were registered with the California DMV in SDG&E's service territory, which includes all of San Diego County and portions of South Orange County. Over 130,000 electric vehicles and 40,000 plug-in hybrid electric vehicles (PHEV) were registered in SDG&E territory. While the share of electric vehicles is small, the market share of electric vehicles grew exponentially until 2023, and stagnated in 2024, as shown in Figure 2. Focusing on San Diego County (Figure 1, left panel), 26% of new vehicle sold were either full electric vehicles or plug-in hybrid vehicles, a similar trend to 2023. The historical market share penetration data has matured enough that vehicle share adoption can be estimated using historical data, as shown in Figure 2. This estimation of future market share relies on simple methods and historical data. Recent macroeconomic factors, and potential changes in state and federal policy, present a significant headwind to EV adoption. Higher interest rates tend to affect EVs more than other vehicles because they have a high up front cost and lower operational cost. Tax credits for EVs were passed under the Inflation Reduction Act of 2022 (IRA) and vehicle emissions standards that benefit EVs are likely to be weakened. Though the preliminary effects

[4] Source: California Energy Commission (2024). Data last updated January 31, 2025. Retrieved February 15, 2025.

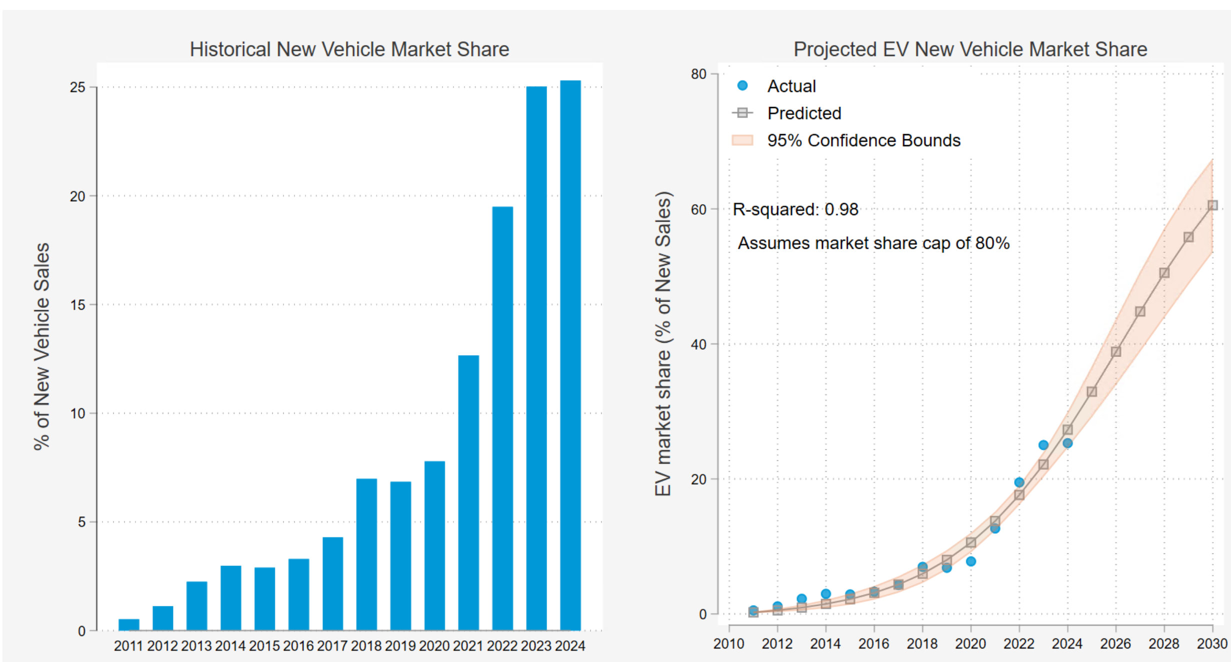
of some of these factors appears evident in the calendar year 2024 market share data, these factors are not fully incorporated into the forecast, which should be interpreted with caution.

Figure 1: Electric Vehicle Population in SDG&E Territory (2024)



Source: California Energy Commission (2024). New ZEV Sales in California. Data last updated January 31, 2025. Retrieved February 14, 2025, from https://www.energy.ca.gov/zevstats

Figure 2: Electric Vehicle Market Share of New Vehicle Sales in California



Data source: California Energy Commission (2024). New ZEV Sales in California. Retrieved February 18, 2025, from https://www.energy.ca.gov/zevstats Graphs and market share projection produced by DSA.

2.3 2024 GRID CONDITIONS

SDG&E delivers electricity to 3.7 million people in San Diego and southern Orange counties. It has 1.5 million residential and business accounts, a service area that spans 4,100 square miles, and a peak demand of over 5,000 MW[5]. SDG&E is responsible for ensuring that electricity supply remains reliable by projecting future demand and reinforcing the transmission and distribution network so that sufficient capacity is available to meet local needs as they grow over time. SDG&E is part of the California Independent System Operator (CAISO) electricity market.

The electric grid is unique in that supply and demand must be balanced nearly instantaneously because an imbalance can lead to cascading outages and compromise the reliability of the entire grid. The California System Operator has the critical role of balancing supply and demand, thus ensuring grid reliability. Historically, the electric grid infrastructure has been sized to meet the aggregate demand of end-users when it is forecasted to be at its highest—peak demand. With the introduction of large amounts of solar and wind power, the focus of planning has shifted to ensure enough flexible resources are in place to meet the demand that cannot be met by solar and wind alone – known as net loads.

Meeting peak demand requires procuring enough supply capacity to meet peak demand and maintaining sufficient operating reserves to absorb system shocks such as unscheduled generator outages, transmission outages, and large unforeseen swings in demand or supply. However, peak demand conditions occur infrequently – one or two times every ten years or so – and thus, planning for a small number of extreme conditions drives a significant share of infrastructure costs. An alternative to building additional peaking power plants is to reduce coincident demand by injecting power within the distribution grid (e.g., battery storage) or by reducing or shifting demand. The EV-TOU prices encourage customers to shift usage to lower-priced hours when the electric grid is not peaking.

Figure 3 shows the hourly load pattern for the ten highest load days for SDG&E, CAISO, and CAISO net loads. In 2024, peak demand at both SDG&E and CAISO was high compared to historical years: SDG&E peaked at 5,032 MW, CAISO peaked at 47,759 MW, and CAISO net loads peaked at 43,276 MW. Figure 4 shows the concentration of demand visualized with a normalized load duration curve. A load duration curve is a way to visualize "peakiness" or utilization of a system. It simply ranks each hour of the year based on demand from highest to lowest. The need for generation capacity resources is highly concentrated. If targeted precisely, shaving loads on the top 1% of hours at SDG&E would lead to an 26% reduction (1263 MW) in generation capacity needs at SDG&E. Likewise, a small number of hours drives peak planning and infrastructure costs for the California system. Shaving CAISO net loads on the top 1% of hours would lead to a 18% reduction (~7,950 MW) in need for generation capacity. Figure 5 shows the hourly electricity market prices for the SDG&E area from May to September 2024. The high price periods coincided with times when CAISO net loads were highest.

[5] SDG&E system load peaked at 5,032 MW on Sunday September 8 at 6:45 PM.

Figure 3: SDG&E and CAISO Top Ten Peak Load Days (Oct 2023-Sep 2024)

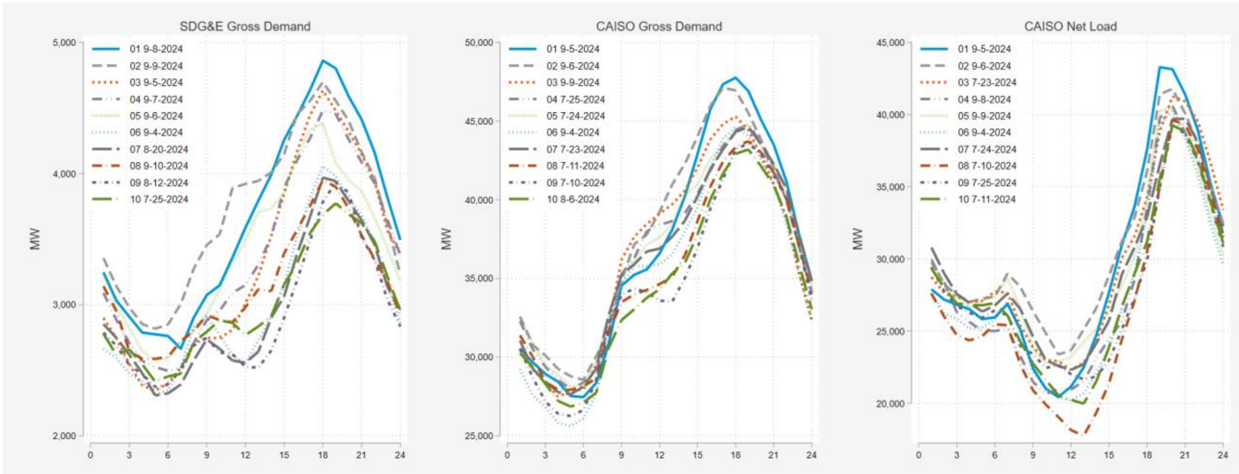


Figure 4: Normalized Load Duration Curves for Top 5% of Hours (Oct 2023-Sep 2024)

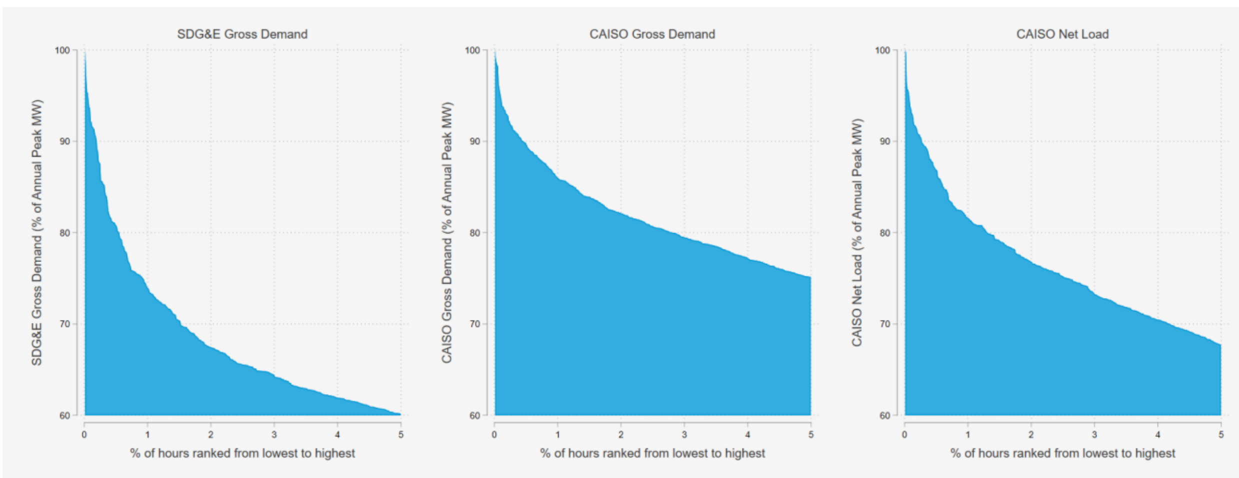
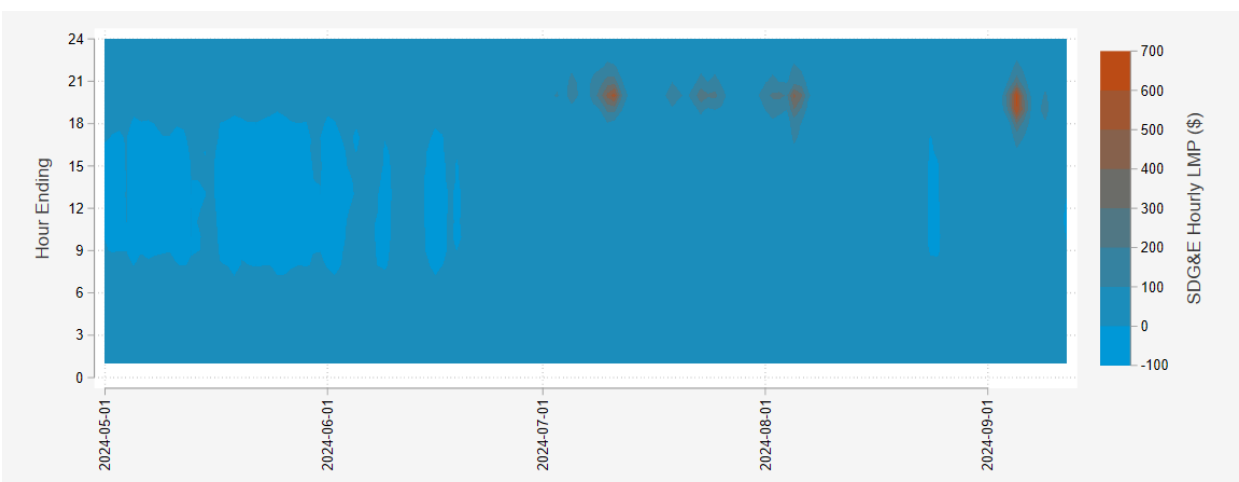


Figure 5: SDG&E Summer 2024 Hourly Electricity Market Prices



3 METHODOLOGY

This section first presents an overview of general issues in program evaluation. We then discuss the specific methodology we use in this analysis to estimate load impacts for EV-TOU rates. The primary challenge of impact evaluation is the need to accurately detect changes in energy consumption while systematically eliminating plausible alternative explanations for those changes, including random chance. Did the price signal cause a behavior change resulting in a load shift? Or can the differences be explained by other factors? To estimate changes in load, it is necessary to estimate what load would have been in the absence of the rate change – this is called the counterfactual or reference load. At a fundamental level, the ability to measure load changes accurately depends on four key components:

- The effect or signal size – The effect size is most easily understood as the percent change. It is easier to detect large changes than it is to detect small ones.
- Inherent data volatility or background noise – The more volatile the load, the more difficult it is to detect small changes. Energy use patterns of homes with air conditioners tend to be more predictable than industrial load patterns.
- The ability to filter out noise or control for volatility – At a fundamental level, statistical models, baseline techniques, and control groups – no matter how simple or complex – are tools to filter out noise (or explain variation) and allow the effect or impact to be more easily detected.
- Sample/population size – For most of the programs in question, sample sizes are not relevant because we plan to analyze data for the full population of participants either using AMI data or thermostat runtime. Sample size considerations aside, it is easier to precisely estimate average impacts for a large population than for a small population because individual customer behavior patterns smooth out and offset across large populations.

3.1 EV-TOU RATE METHODOLOGY

We estimate EV-TOU rate load impacts by difference-in-differences with a matched control group. To avoid confounding the effect of the rate with changes in load due to a newly registered EV, the analysis sample is a subsample of the population that we restrict to customers that did not acquire an EV in the analysis window. Furthermore, to estimate monthly load impacts that are not subject to composition effects, we require that the analysis sample have a full year of pre- and post-treatment data. We provide more detail below.

Like other TOU rates, once a customer is on an EV-TOU rate, the EV-TOU rate is in place every day, and it is no longer possible to observe their behavior absent new rates. Thus, estimating effects ideally requires a control group. Furthermore, to estimate monthly load reductions that are not subject to composition effects, we require a year of pre-treatment and post-treatment data for both the EV-TOU and control groups. The pre-treatment data is useful for assessing if energy consumption changed and allows the use of more powerful statistical techniques such as difference-in-difference models. When neither group is on EV-TOU rates, the energy use patterns should be nearly identical. If the EV-TOU rates lead to changes in energy use, we should observe a change in consumption for customers who went on the EV-TOU rate but no similar change for the control group. In addition, the timing of the change should coincide with the adoption of EV-TOU rates.

EX-POST EVALUATION APPROACH

Key issues that influenced the ex-post evaluation approach are:

- Identifying an appropriate control pool. The primary challenge in evaluating electric vehicle programs is finding appropriate control customers. The appropriate control pool is customers who have electric vehicles but have not signed onto the EV-TOU rate. However, SDG&E only has conclusive data about EV ownership for homes that sign onto TOU rates for electric vehicles. DSA used AMI data to develop electric vehicle propensity estimates and identify sites with electric vehicles that were not on TOU rates for electric vehicles. In developing the propensity models, we intentionally avoided variables that focus on hourly load patterns and overall consumption since both are influenced by the TOU rates for electric vehicles. Instead, the markers to identify electric vehicles were focused on max demand values on temperate days when air conditioning loads were not present.
- Electric vehicle adoption often coincides with enrollment in the TOU rate and solar or battery storage adoption. When multiple changes occur at once, it is more difficult to isolate the effect of the TOU rates. It is necessary to eliminate from the analysis both participants and control candidates that purchased their electric vehicle or had solar or battery installation near the time they enrolled on the EV-TOU rate. SDG&E provided access to their interconnection data, allowing us to remove sites with changes in solar or battery status over the analysis period.
- Rolling enrollments versus first-year patterns. Customers adopt and sign on to electric vehicle rates at different points in time. The pattern can create imbalanced time series and lead to spurious effects. We must estimate monthly load impacts, which requires observing load in the same calendar month pre- and post-enrollment. If we did not require a year of pre- and post-treatment data for all customers, the specific customers underlying each monthly load impacts estimate would differ across months. Thus, the primary analysis is based on sites with a full year before and after customers transitioned to the electric vehicle TOU rates. In PY2023, the analysis sample was based on sites with a full year before and a full summer after customers transitioned to the rate. Last year, we shortened duration of data required to be in the analysis sample due to data gaps in 2021 that occurred due to SDG&E's transition from one data storage system to another. This allowed us to obtain a larger pool of potential control customers.[6] However, for PY2024, we use a full year of pre- and post-treatment data.

6 The analysis sample for 2023 and 2024 was pulled at the premise-account level, to ensure that we examine data for a premise for the same individual and do not pick up spurious effects due to movers..

The above factors were taken into consideration in selecting our evaluation approach, which is summarized in Table 2.

Table 2: EV-TOU Ex-Post Evaluation Approach Summary

Methodology Component	Description
1. **Population or sample analyzed**	The evaluation focused only on incremental sites that enrolled between October 1, 2022 and September 30, 2023 thereby reaching their full first year of savings on October 1, 2024. It excluded sites who had a change in electric vehicle, solar, or battery status that coincided with the study period. The full population of incremental participants with a full year of data before and a full summer of data after electric vehicle TOU rate adoption. The evaluation included approximately 22% of the incremental enrollments as customers often enroll on TOU rates for electric vehicles shortly after getting their electric vehicle.
2. **Data included in the analysis**	The analysis included a full year of pre and post TOU data. The same data was included for participants and matched control. In all cases, we ensured that both the participant and control had pre and post TOU data for the same day of year.
3. **Use of control groups**	We relied on a control group of customers with electric vehicles but that were not on SDG&E's TOU rates for electric vehicles. The process to find this control group involves two steps. First, we build electric vehicle propensity using AMI data to identify unique load patterns that indicate the presence of electric vehicles (but avoiding variables about load shape and overall consumption). As part of the analysis we also identified the approximate date the electric vehicle(s) arrived at the household. Once control candidates with electric vehicles had been identified, we matched customers using pre-treatment hourly AMI data. The matching on pre-treatment loads used propensity score matching and Euclidian distance matching and matches were selected only from customers with similar electric vehicle scores. Participants were paired to the matched control site and the control site was assigned the same "treatment date" as the participant.
4. **Evaluation Method**	Simple difference-in-differences was used to isolate the load impact. The process involved the following steps: 1. Aggregate (or average) the data to the relevant time unit of analysis. This was done for both participants and control and for the year before and after the treatment. 2. The difference between the before and after period was calculated for the treatment group. 3. The difference between the before and after time period was calculated for the control group. 4. The difference observed in the control group was netted out of the participant difference to produce the difference-in-differences.
5. **Model selection**	The approach relies more heavily on selecting a comparable matched control group than the model specification. We conducted a tournament to identify the model that performed best (least percent bias and relative RMSE) at identifying the control pool.
6. **Segmentation of impact results**	The results were segmented by: ▪ Rate ▪ Region in SDG&E territory (based on 3-digit zip code) ▪ Solar status ▪ Low income

Ex-Ante Evaluation Approach

A key objective of evaluations is to quantify the relationship between changes in load, temperature, and hour-of-the-day. The purpose of doing so is to establish the load-shift capability under 1-in-2 and 1-in-10 weather conditions for planning purposes and, increasingly, for operations. When possible, we rely on the historical event performance to forecast ex-ante impacts for future years for different operating conditions.

At a fundamental level, the process of estimating ex-ante impacts is simple:

1. Decide on an adequate segmentation to reflect how the customer mix evolves over time.
2. Estimate the relationship between reference loads and weather.
3. Use the models to predict reference loads for different weather conditions (e.g., 1-in-2 and 1-in-10 weather year conditions).
4. Estimate the relationship between weather and impacts.
5. Predict load impacts for different weather conditions.
6. Combine the reference loads (#4) and impacts (#5) to produce per-customer impacts.
7. Multiply per-customer impacts by the enrollment forecast.

The process can be used to develop ex-ante estimates of demand reduction as a function of different temperatures and day types. It can be used to develop estimates for 1-in-2 and 1-in-10 weather year planning conditions, and it can be used to develop time-temperature matrices useful for estimating reduction capability for operations or a wider range of planning conditions.

Table 3: EV-TOU Ex-Ante Evaluation Approach Summary

Methodology Component	Demand Side Analytics Approach
1. Years of historical data	Data from the year prior to the adoption of EV-TOU rates for each customers was used to develop reference loads. The load reductions for a full year of EV-TOU participation were used to model ex-ante load impacts.
2. Process for producing ex-ante impacts	The key steps were: ▪ Segment customers by rate type (EV-TOU-5 and EV-TOU-2) and solar status. ▪ Estimate the relationship between reference loads and weather on a per household basis. ▪ Use the models to predict reference loads for 1-in-2 and 1-in-10 weather year conditions. ▪ Estimate the relationship between EV-TOU load impacts and weather. ▪ Predict the reductions for 1-in-2 and 1-in-10 weather year conditions. ▪ Combine per customer reference loads and load impacts with an incremental forecast of enrollment on EV-TOU rated developed by SDG&E.
3. Accounting for changes in the participant mix	The ex-ante load impacts account for changes in the participant mix across the two main rate types – EV-TOU-2 and EV-TOU-5 – and rooftop solar status.
4. Producing busbar level impacts	Granular results for distribution planning have been required for the last few years. A key consideration in the approach is that there is more data about customer loads than there is data on the percent reductions delivered during events. To develop ex-ante impacts at the busbar level, we use the load impacts by segment and the current mix of customers at the busbar level to estimate the granular impacts.

4 ELECTRIC VEHICLE TOU EX-POST RESULTS

This section focuses on the magnitude of demand reductions delivered by incremental EV-TOU participants for the time frame from October 1, 2023 to September 30, 2024. SDG&E has three primary whole premise time of use rates for electric vehicles, EV-TOU-2,EV-TOU-5 and TOU-ELEC. These rates encourage customers to shift their use from higher priced periods to lower cost periods, but do not directly control the charging behavior of customers or vehicles.

Overall, SDG&E has signed over 60,000 homes onto electric vehicle TOU rates. For context, SDG&E territory has roughly 130,000 full battery electric vehicles and 40,000 plug-in hybrid vehicles in its territory. Since mid-2018 most electric vehicles have signed onto the EV-TOU-5 rate rather than the EV-TOU-2 rate. The EV-TOU-5 rate has a higher fixed charge and substantially lower super-off-peak rates. When the EV-TOU-5 rate was first introduced, many EV-TOU-2 customers switched onto it. However, by PY2022, the rates were largely stable and the switching between electric vehicle rates was negligible.

Figure 6: Total Enrollments by EV-TOU Rate type

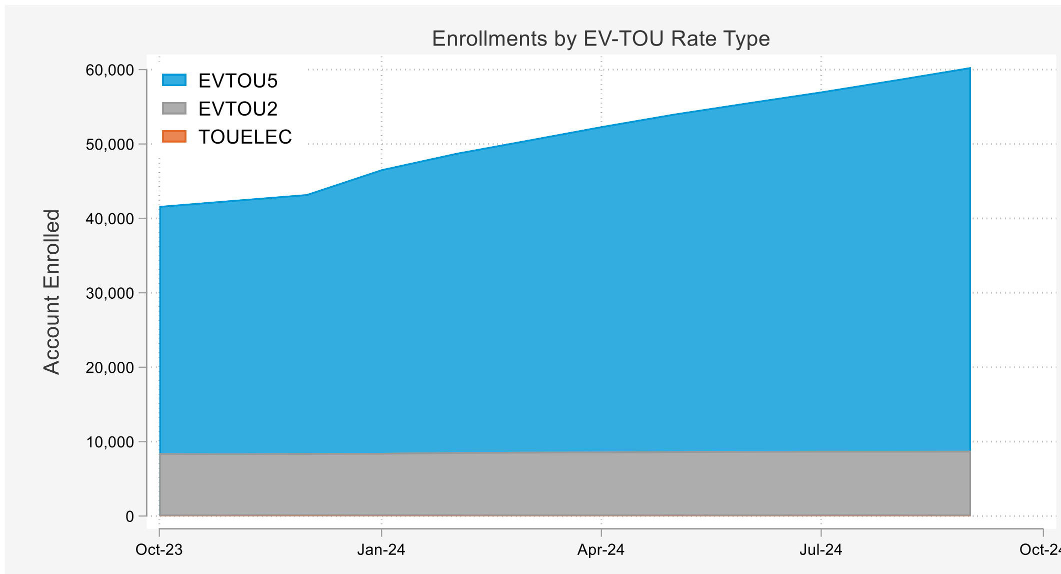
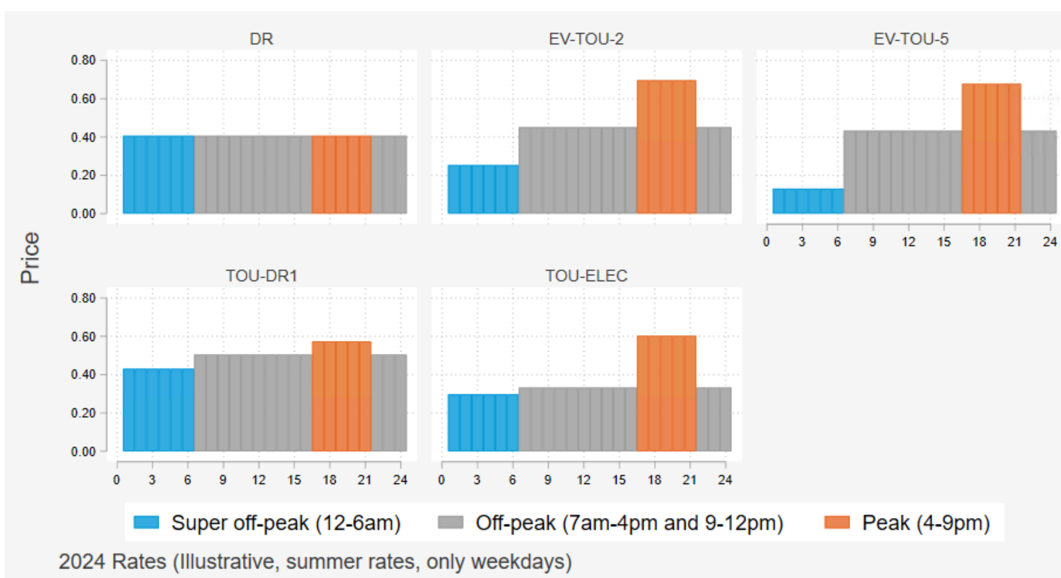
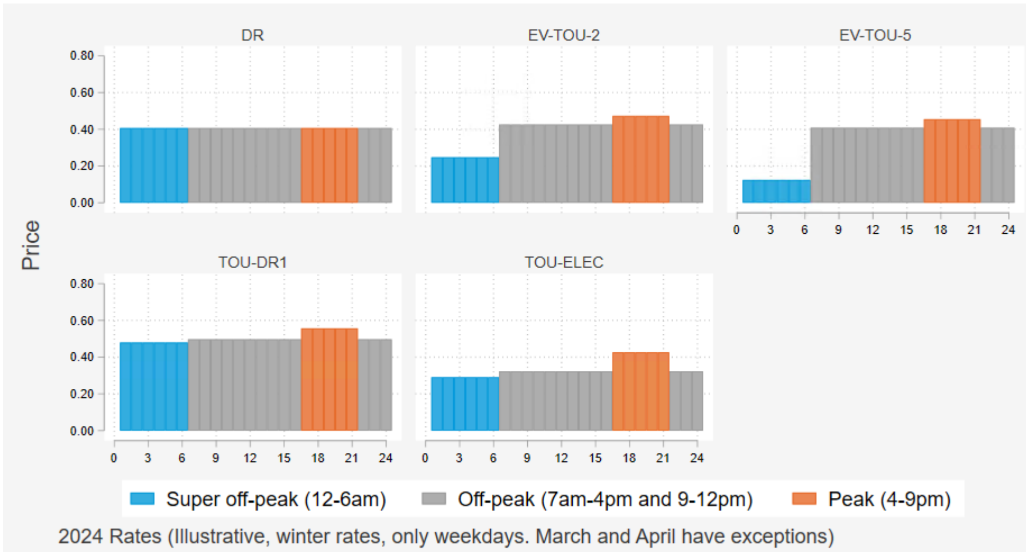


Figure 7: SDG&E Residential Rate Schedules for Summer 2024



Participation in EV-TOU rates is voluntary and customers selected the TOU rates for electric vehicles over the flat domestic rate (DR) and the default TOU rate (TOU-DR1) that applies to roughly 60% of SDG&E customers. Notably, the EV-TOU-2, EV-TOU-5, and TOU-ELEC rates have higher peak prices (4-9 PM) and lower super-off-peak peak prices (12-6 AM). Thus, the higher on peak price and lower super off peak price encourages customers to shift usage more than SDG&E's default time of use rate (TOU-DR1). As Figure 8 shows, the primary difference between summer and winter months is the significantly lower peak price during the winter months.

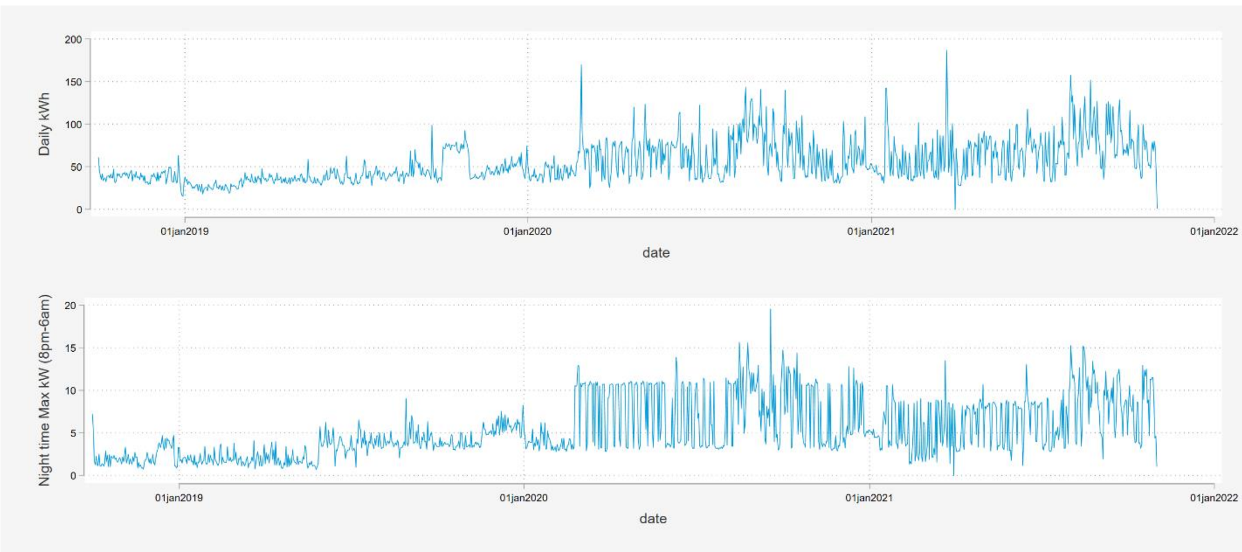
Figure 8: SDG&E Residential Rate Schedules for Winter 2024



4.1 CHARGING PATTERNS BEFORE AND AFTER TOU RATES FOR ELECTRIC VEHICLES

The early adopters of electric vehicles differ from the typical SDG&E customers. They are on average more likely to own solar and battery storage and are less likely to be on California Alternative Rates for Energy (CARE). When an electric vehicle is introduced, it fundamentally changes usage and max demand at a home. Figure 9 illustrates how the introduction of an electric vehicle leads to an increase in daily use, an increase in daily max demand, and increased volatility in energy use. The change is most obvious for customers with an electric vehicle Level 2 charger[7] and for the maximum daily demand between hours from 8 PM – 6 AM.

Figure 9: Example of How the Introduction of Electric Vehicle Change Household Energy Use



To isolate the effects of TOU we used the AMI data to identify customers with a similar electric vehicle footprint that were not on TOU rates for electric vehicles to serve as controls. In addition, we removed any participants and candidate controls where the change in electric vehicle ownership appeared to coincide with the adoption of TOU rates for electric vehicles. The participants were then matched to customers with similar electric vehicle footprints and a similar whole home load pattern during the time frame when neither participants nor the control candidates were on TOU rates.

Figure 10 show the hourly load patterns for the EV-TOU customers and the corresponding controls both before and after the participants enrolled on the rate. The plots reflect the raw data without any

[7] Level 2 charging enables the vehicle to charge at a higher rate, between 3.3 and 19.2 kW an hour depending on the amperage of the equipment, whereas a Level 1 charger cannot charge more than 1.32 kW an hour. It is very difficult to identify a Level 1 charger using hourly interval data as other appliances in the home can use a similar amount of energy as a central air conditioner, or a pool pump, or heat pump.

modeling. When neither group was on TOU rates, the electricity patterns mirrored each other, with small differences in the super off-peak period. Once participants go on TOU rates, the electric use patterns diverge. Customers on TOU rates for electric vehicles increased usage between 12-6 AM when prices were lowest, and decreased usage during the higher prices hours. Although the electric vehicle rates differ for 4-9 PM , participants reduced usage during both off-peak (6AM-4 PM and 10 PM-12 PM) and peak hours (4-9 PM). Table 4 shows the data underlying Figure 10, and shows the difference-in-difference calculation, which nets out pre-existing observed differences.

Figure 10: Hourly Load Patterns Before and After EV-TOU Rates (May-October)

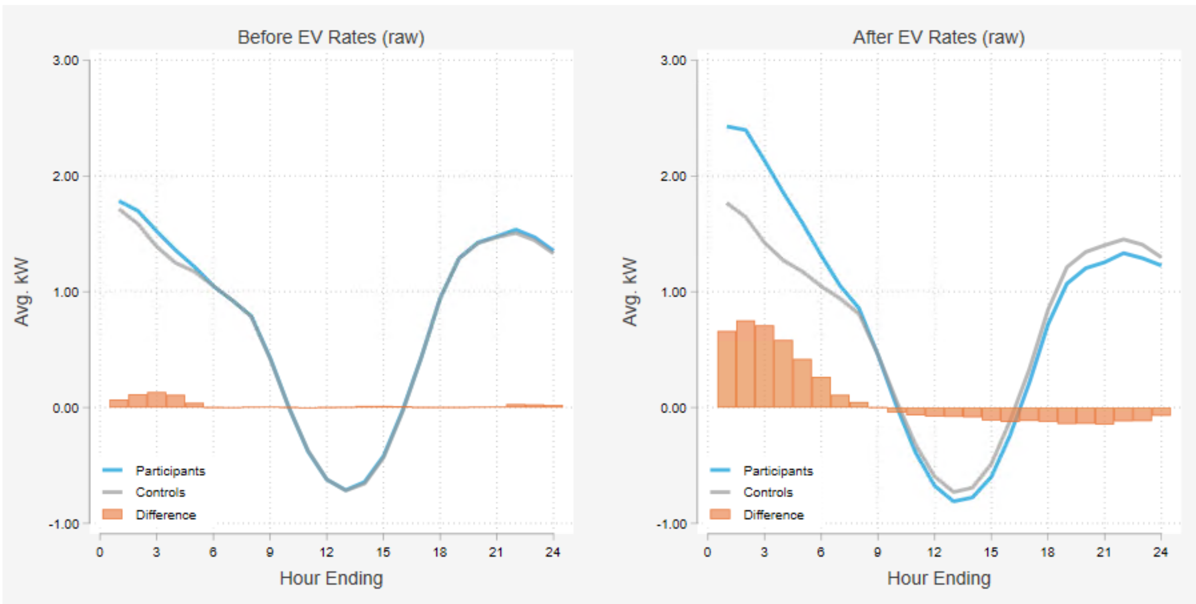


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Table 4: First Year Hourly Differences-in-Differences

	Treatment (n = 791)			Control (n=791)			Difference-in-Differences		
Hour Start	Before	After	Diff	Before	After	Diff	Diff-in-Diff	Std. Error	t-stat
0:00	1.78	2.43	0.64	1.71	1.77	0.05	0.59	0.029	20.28
1:00	1.70	2.40	0.70	1.59	1.65	0.06	0.64	0.028	22.96
2:00	1.52	2.13	0.61	1.39	1.42	0.03	0.58	0.024	24.01
3:00	1.36	1.85	0.50	1.25	1.27	0.02	0.47	0.021	22.33
4:00	1.22	1.59	0.38	1.17	1.18	0.00	0.38	0.019	19.39
5:00	1.05	1.31	0.26	1.05	1.05	0.00	0.27	0.015	17.22
6:00	0.93	1.05	0.13	0.93	0.94	0.01	0.11	0.011	10.66
7:00	0.79	0.86	0.07	0.79	0.81	0.02	0.04	0.010	4.11
8:00	0.43	0.46	0.03	0.42	0.46	0.03	-0.01	0.011	-0.82
9:00	0.00	0.01	0.01	0.00	0.05	0.05	-0.05	0.014	-3.42
10:00	-0.38	-0.39	-0.01	-0.37	-0.32	0.05	-0.06	0.016	-3.91
11:00	-0.62	-0.68	-0.05	-0.62	-0.60	0.03	-0.08	0.018	-4.46
12:00	-0.71	-0.81	-0.10	-0.72	-0.73	-0.01	-0.09	0.019	-4.54
13:00	-0.64	-0.78	-0.13	-0.66	-0.69	-0.04	-0.10	0.018	-5.42
14:00	-0.42	-0.60	-0.18	-0.43	-0.49	-0.05	-0.13	0.017	-7.59
15:00	-0.03	-0.24	-0.21	-0.04	-0.11	-0.07	-0.14	0.015	-9.38
16:00	0.43	0.21	-0.23	0.43	0.32	-0.11	-0.12	0.014	-8.31
17:00	0.95	0.72	-0.23	0.95	0.85	-0.10	-0.13	0.012	-10.33
18:00	1.29	1.07	-0.22	1.29	1.21	-0.08	-0.14	0.012	-12.07
19:00	1.43	1.20	-0.22	1.42	1.34	-0.08	-0.15	0.013	-11.32
20:00	1.48	1.26	-0.22	1.47	1.40	-0.07	-0.15	0.013	-11.50
21:00	1.54	1.33	-0.20	1.51	1.45	-0.05	-0.15	0.015	-9.71
22:00	1.47	1.29	-0.18	1.44	1.41	-0.04	-0.14	0.017	-8.41
23:00	1.35	1.23	-0.13	1.33	1.30	-0.03	-0.09	0.017	-5.38

Figure 11 shows average demand from 4-9 PM for each day for the full year before and after the introduction of the EV-TOU rates by day-of-year. The energy use patterns are similar for the treatment and control groups before the official adoption of the TOU rates for electric vehicles, but there are small differences. Those pre-existing differences are removed or netted out in the differences-in-differences technique.

Figure 11: Peak Period (4-9 PM) Daily Differences Before and After TOU Rates for Electric Vehicles

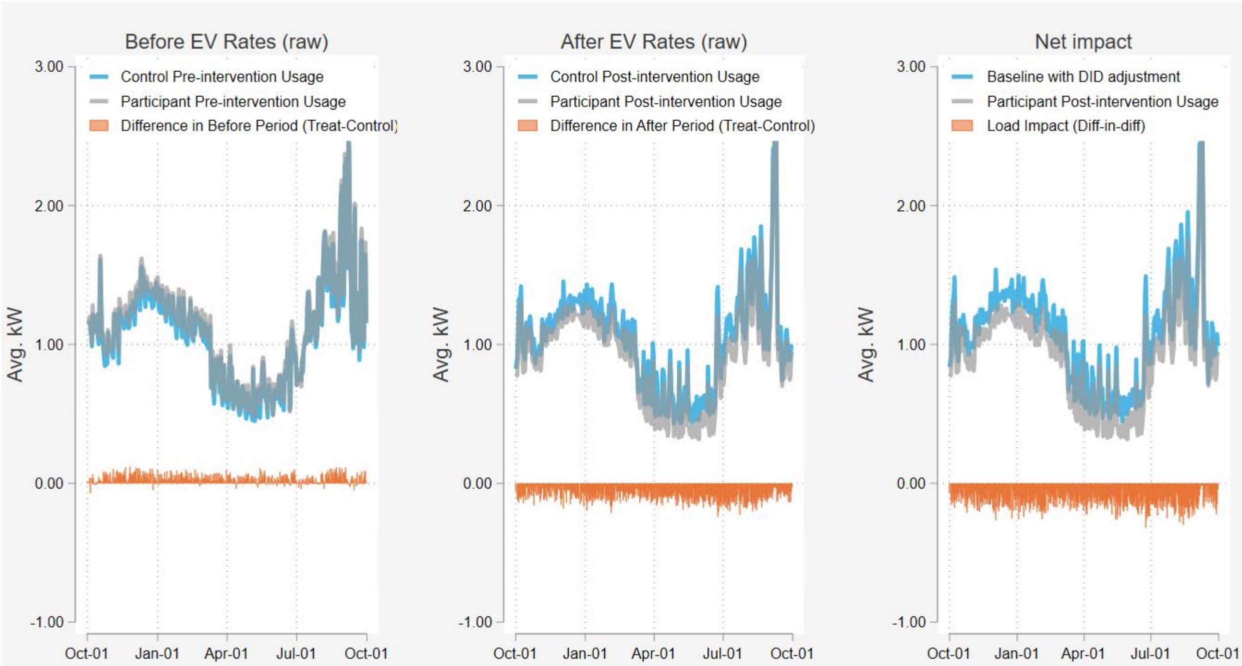
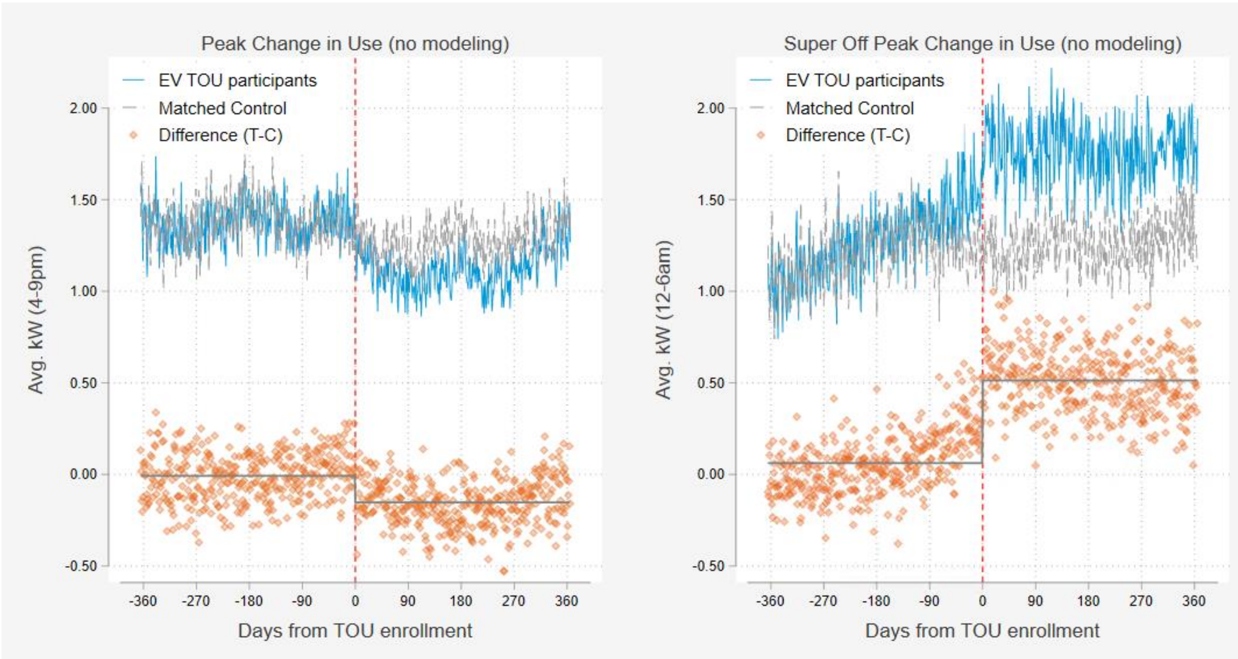


Figure 12 also shows the differences by day of year, but it compares the 365 days immediately before and after enrollment based on the days from enrollment. Thus, it normalizes the time dimensions allowing for direct comparison of sites that enrolled on different dates. As before, the energy use patterns are similar for the treatment and control groups before the official adoption of the TOU rates for electric vehicles, but there are small differences. The change in energy usage for participants roughly coincides with the adoption of the rates and the change in energy usage matches the expected price response. Participants decrease energy use when prices are higher and reduce demand when prices are lower. The shift in behavior does not coincide perfectly because billing periods differ by customer and customers may consider changes over multiple days and weeks in advance of the transition to electric vehicle rates.

Figure 12: Treatment and Control Group Differences by Days from Treatment



4.2 LOAD IMPACTS ON HIGHEST SYSTEM LOAD DAYS

Although EV-TOU customers have a daily incentive to shift load away from hours when prices are highest, peak hours, and charge when prices are lowest, it is critical to understand how the rates change load pattern when demand is highest. As noted earlier, many grid infrastructure components are sized to meet the aggregate peak demand levels that occur infrequently. When customers reduce demand coincident with the peaks that drive infrastructure needs – either by injecting power within the distribution grid (e.g., behind-the- meter generation) or by reducing demand – they often help avoid the costs associated with infrastructure expansion. Notably, different parts of the grid can peak at different times. As Figure 3 showed, the SDG&E system peaks on different days than CAISO demand, which, in turn, differs from the days when CAISO net loads are highest.

Figure 13 shows the average hourly demand reduction from EV-TOU participants in the 10 days when demand was highest for CAISO, CAISO net loads, and SDG&E. The change in peak and super-off-peak demand is similar for all three.

Table 5 provides additional detail about the load impacts for the top 5, 10, and 20 highest load days for CAISO, CAISO net loads, and SDG&E. The reductions were larger in magnitude on the top 5 highest system load days than on the top 10 and top 20 highest system load days. Simply put, customers on TOU rates for electric vehicles delivered larger demand reductions when resources were needed most.

Figure 13: Hourly Load Impacts on Top Highest Load Days by System

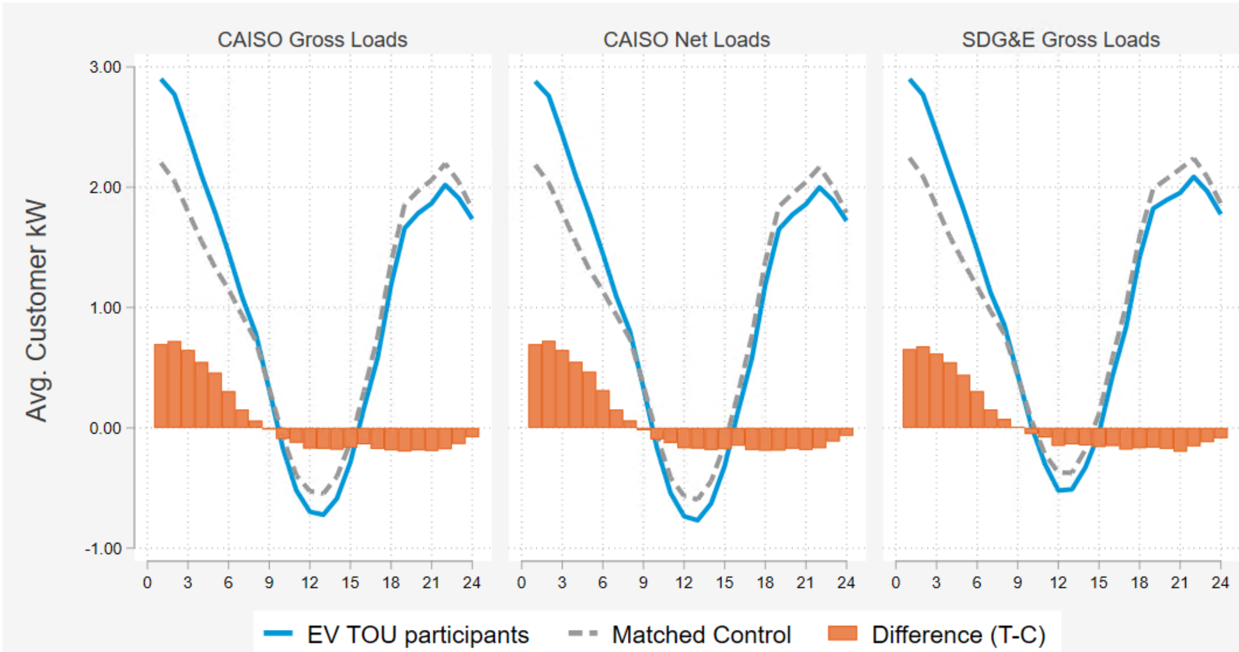


Table 5: Ex-post Demand Reductions on Highest System Load Days (4-9 PM)

System	Month	Sample[1]	New Accounts	Total Accounts	Daily avg. temp[2]	Avg. Customer (kW) Reference Load	Load Impact	% Change	New Load Impact (MW)	Aggregate Total Load Impact (MW)
CAISO Gross Loads	Top 05 load day(s)	2,221	10,538	60,327	75.0	1.7	-0.2	-12.1%	-2.2	-12.4
	Top 10 load day(s)	2,221	10,538	60,327	74.3	1.6	-0.2	-11.7%	-2.0	-11.4
	Top 20 load day(s)	2,221	10,538	60,327	73.1	1.5	-0.2	-13.6%	-2.1	-11.9
CAISO Net Loads	Top 05 load day(s)	2,221	10,538	60,327	73.5	1.6	-0.2	-12.0%	-2.0	-11.5
	Top 10 load day(s)	2,221	10,538	60,327	73.8	1.6	-0.2	-11.6%	-1.9	-11.1
	Top 20 load day(s)	2,221	10,538	60,327	73.2	1.5	-0.2	-13.0%	-2.0	-11.6
SDG&E Gross Loads	Top 05 load day(s)	2,221	10,538	60,327	76.8	1.9	-0.2	-10.7%	-2.1	-12.2
	Top 10 load day(s)	2,221	10,538	60,327	75.8	1.8	-0.2	-10.1%	-1.9	-10.7
	Top 20 load day(s)	2,221	10,538	60,327	74.5	1.6	-0.2	-11.6%	-2.0	-11.3

[1] Estimating sample is lower than populations because it excludes sites that whose transition to EV TOU coincided with the arrival of the electric vehicle or with solar or battery installation.
[2] Participant weighted average temperature. SDG&E maps all customers to eight distinct weather stations.

4.3 LOAD IMPACTS FOR MONTHLY WORST DAY

Figure 14 visualizes the hourly load impacts for the monthly worst day of each month. It shows the actual load for sites on EV-TOU and the reference load or counterfactual. The orange bar reflect the change in demand, or load impacts. A positive value indicates an increase in energy use and a negative value indicates a decrease in demand. In general use increased during the 12-6 AM period when prices were lowest and decreased during the peak window of 4-9 PM.

Figure 14: Ex-post Monthly Worst Day (SDG&E) Hourly Load Impacts

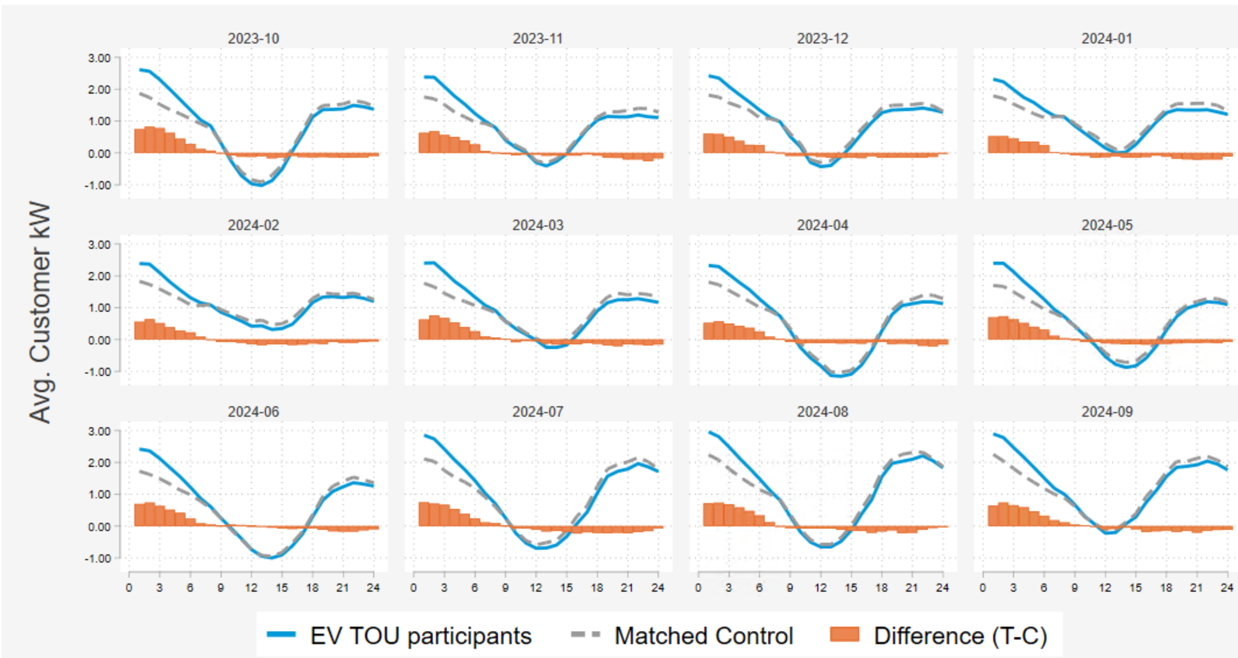


Table 6 summaries the hourly demand reductions for the worst days in each month. In general, estimating TOU impacts for a single hour is more difficult and noisier than estimating impacts for the average day of each month. Thus, we used to top 3 SDG&E load day for each month and also recommend a degree of caution in reviewing the monthly worst day impacts.

Table 6: Ex-post Monthly Worst Day (SDG&E) Hourly Demand Reductions per Site

Hour Ending	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
1	-0.52	-0.56	-0.63	-0.53	-0.70	-0.69	-0.75	-0.72	-0.65	-0.75	-0.63	-0.61
2	-0.52	-0.64	-0.76	-0.57	-0.73	-0.74	-0.70	-0.73	-0.74	-0.82	-0.68	-0.60
3	-0.45	-0.51	-0.67	-0.50	-0.63	-0.63	-0.67	-0.69	-0.66	-0.78	-0.56	-0.51
4	-0.36	-0.38	-0.53	-0.43	-0.52	-0.51	-0.54	-0.59	-0.59	-0.63	-0.50	-0.38
5	-0.35	-0.28	-0.40	-0.37	-0.40	-0.42	-0.39	-0.48	-0.47	-0.45	-0.40	-0.26
6	-0.24	-0.22	-0.26	-0.26	-0.31	-0.24	-0.24	-0.34	-0.33	-0.28	-0.27	-0.25
7	-0.03	-0.09	-0.10	-0.09	-0.11	-0.09	-0.12	-0.12	-0.19	-0.12	-0.07	-0.04
8	0.03	0.02	-0.06	-0.01	-0.04	-0.05	-0.09	0.02	-0.11	-0.07	0.01	0.01
9	0.07	0.08	-0.02	0.08	0.00	-0.01	-0.01	0.06	-0.05	0.02	0.05	0.09
10	0.09	0.08	0.08	0.13	0.08	-0.05	0.07	0.08	-0.02	0.08	0.07	0.09
11	0.16	0.11	0.05	0.12	0.07	-0.03	0.08	0.07	0.03	0.12	0.05	0.09
12	0.13	0.14	0.05	0.12	0.12	0.00	0.11	0.08	0.10	0.13	0.05	0.13
13	0.11	0.18	0.12	0.11	0.13	0.02	0.17	0.08	0.09	0.10	0.09	0.15
14	0.14	0.15	0.16	0.13	0.15	0.05	0.15	0.12	0.05	0.17	0.08	0.16
15	0.15	0.15	0.16	0.12	0.15	0.07	0.18	0.14	0.10	0.14	0.08	0.15
16	0.13	0.17	0.15	0.13	0.16	0.09	0.23	0.16	0.19	0.09	0.09	0.16
17	0.08	0.16	0.12	0.09	0.14	0.07	0.20	0.21	0.16	0.13	0.05	0.10
18	0.12	0.13	0.14	0.08	0.13	0.07	0.22	0.17	0.14	0.14	0.09	0.15
19	0.18	0.14	0.18	0.14	0.12	0.12	0.22	0.13	0.18	0.13	0.15	0.15
20	0.20	0.08	0.21	0.13	0.10	0.17	0.21	0.22	0.15	0.14	0.16	0.14
21	0.21	0.10	0.15	0.14	0.11	0.17	0.22	0.21	0.21	0.15	0.20	0.15
22	0.20	0.10	0.16	0.20	0.10	0.17	0.19	0.12	0.15	0.15	0.21	0.15
23	0.20	0.08	0.19	0.21	0.12	0.13	0.16	0.06	0.12	0.14	0.26	0.13
24	0.11	0.06	0.16	0.16	0.07	0.10	0.07	0.04	0.12	0.10	0.17	0.03

Table 7 shows the reference loads and load impacts by rate period for the monthly worst day of each month. The demand reductions are generally larger for hotter months. Customers reduced demand by 0.17 kW per site (9.2%) in September 2024, when SDG&E experienced its highest peak demand.

Table 7: Ex-post Monthly Worst Day (SDG&E) Demand Reductions by Rate Period

Rate Period	Month	New Accts	Daily avg. temp[1]	Avg. Customers (kW) Reference Load	Avg. Customers (kW) Load Impact	Aggregate Incremental (MW) Reference Load	Aggregate Incremental (MW) Load Impact	% Change
Peak (4-9 PM)	2023-Oct	41,658	71.4	1.30	0.14	54.20	5.76	-10.6%
	2023-Nov	42,476	62.0	1.17	0.13	49.56	5.47	-11.0%
	2023-Dec	43,251	57.6	1.40	0.14	60.60	6.01	-9.9%
	2024-Jan	46,589	53.8	1.42	0.16	66.07	7.44	-11.3%
	2024-Feb	48,793	52.9	1.32	0.12	64.22	5.95	-9.3%
	2024-Mar	50,516	53.1	1.17	0.16	59.27	8.06	-13.6%
	2024-Apr	52,380	59.7	0.70	0.12	36.77	6.04	-16.4%
	2024-May	54,055	60.6	0.70	0.12	37.83	6.53	-17.3%
	2024-Jun	55,593	66.7	0.76	0.12	42.25	6.63	-15.7%
	2024-Jul	57,046	74.6	1.53	0.21	87.07	12.17	-14.0%
	2024-Aug	58,665	76.2	1.89	0.19	110.73	11.02	-10.0%
	2024-Sep	60,327	76.7	1.84	0.17	110.78	10.18	-9.2%
Off-peak (6AM-4PM and 10PM-12AM)	2023-Oct	41,658	76.2	0.25	0.08	10.51	3.35	-31.8%
	2023-Nov	42,476	66.4	0.49	0.09	20.62	3.69	-17.9%
	2023-Dec	43,251	60.2	0.59	0.10	25.71	4.28	-16.6%
	2024-Jan	46,589	54.5	0.81	0.12	37.86	5.38	-14.2%
	2024-Feb	48,793	53.7	0.88	0.09	43.09	4.59	-10.7%
	2024-Mar	50,516	55.4	0.56	0.09	28.39	4.31	-15.2%
	2024-Apr	52,380	62.0	0.08	0.11	4.37	5.64	-128.9%
	2024-May	54,055	62.1	0.22	0.08	11.97	4.17	-34.8%
	2024-Jun	55,593	68.6	0.11	0.03	6.21	1.82	-29.3%
	2024-Jul	57,046	77.6	0.44	0.09	25.19	5.20	-20.6%
	2024-Aug	58,665	79.6	0.54	0.07	31.74	4.05	-12.8%
	2024-Sep	60,327	79.9	0.79	0.04	47.40	2.64	-5.6%
Super off-peak (12-6AM)	2023-Oct	41,658	60.7	1.47	-0.62	61.07	-25.73	42.1%
	2023-Nov	42,476	56.4	1.39	-0.51	59.14	-21.48	36.3%
	2023-Dec	43,251	51.3	1.51	-0.43	65.18	-18.71	28.7%
	2024-Jan	46,589	48.9	1.46	-0.41	68.02	-19.00	27.9%
	2024-Feb	48,793	52.6	1.49	-0.43	72.59	-21.10	29.1%
	2024-Mar	50,516	53.2	1.41	-0.54	71.08	-27.36	38.5%
	2024-Apr	52,380	53.0	1.44	-0.44	75.45	-23.15	30.7%
	2024-May	54,055	58.4	1.38	-0.55	74.48	-29.59	39.7%
	2024-Jun	55,593	61.9	1.38	-0.54	76.69	-29.97	39.1%
	2024-Jul	57,046	67.4	1.67	-0.55	95.08	-31.31	32.9%
	2024-Aug	58,665	67.2	1.69	-0.59	99.39	-34.63	34.8%
	2024-Sep	60,327	68.9	1.70	-0.57	102.86	-34.45	33.5%

[1] Participant weighted average temperature. SDG&E maps all customers to eight distinct weather stations.

[2] To reduce noise, the top 3 system load days were included in the analysis for each month

4.4 LOAD IMPACTS FOR MONTHLY AVERAGE DAY

Figure 15 visualizes the hourly load impacts for the monthly average day of each month. It shows the actual load for sites on electric vehicle rates and the reference load or counterfactual. The orange bar reflect the change in demand, or load impacts. A positive value indicates an increase in energy use and a negative value indicates a decrease in demand. In general use increased during the 12-6 AM period when prices were lowest and decreased during the peak window of 4-9 PM.

Table 8 summarizes the hourly demand reductions for the average days in each month.

Table 9 shows the reference loads and load impacts by rate period for the monthly average day of each month. The demand reductions are generally larger for hotter months. Customers reduced demand by 0.16 kW per site (13.8%) in September 2024, when SDG&E experienced its highest peak demand.

Figure 15: Ex-post Monthly Average Day Hourly Load Impacts

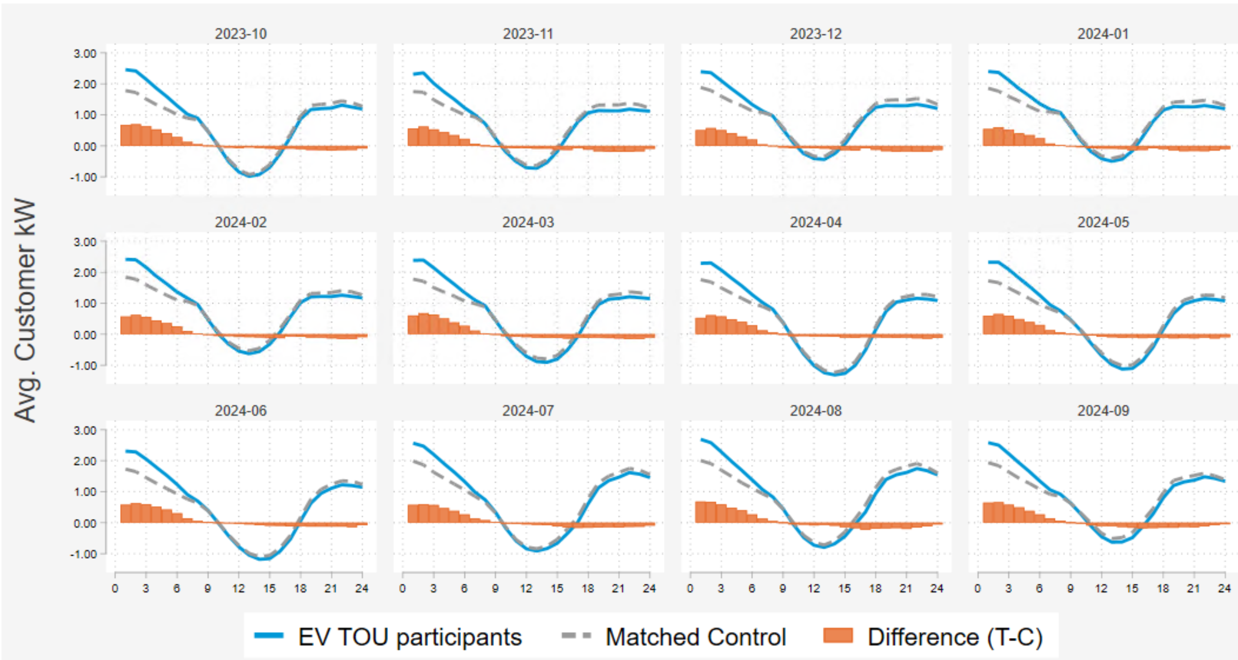


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Table 8: Ex-post Monthly Average Day Hourly Demand Reductions per Site

Hour Ending	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
1	-0.54	-0.57	-0.61	-0.53	-0.60	-0.58	-0.58	-0.68	-0.65	-0.68	-0.56	-0.51
2	-0.60	-0.63	-0.68	-0.61	-0.66	-0.64	-0.60	-0.68	-0.66	-0.70	-0.62	-0.57
3	-0.52	-0.56	-0.64	-0.58	-0.60	-0.60	-0.57	-0.59	-0.58	-0.64	-0.53	-0.51
4	-0.40	-0.45	-0.51	-0.49	-0.49	-0.51	-0.47	-0.48	-0.50	-0.53	-0.44	-0.41
5	-0.34	-0.37	-0.38	-0.40	-0.39	-0.42	-0.38	-0.40	-0.38	-0.41	-0.35	-0.30
6	-0.25	-0.26	-0.27	-0.29	-0.30	-0.31	-0.27	-0.27	-0.27	-0.29	-0.23	-0.20
7	-0.08	-0.10	-0.12	-0.12	-0.13	-0.14	-0.13	-0.14	-0.14	-0.13	-0.06	-0.05
8	-0.02	-0.03	-0.03	-0.06	-0.06	-0.06	-0.08	-0.06	-0.07	-0.05	0.00	0.01
9	0.02	0.03	0.01	0.00	-0.01	-0.01	-0.03	0.00	0.00	0.00	0.04	0.06
10	0.05	0.05	0.06	0.06	0.03	0.01	0.04	0.06	0.03	0.02	0.07	0.08
11	0.08	0.06	0.07	0.06	0.04	0.03	0.04	0.07	0.09	0.06	0.08	0.07
12	0.09	0.09	0.09	0.07	0.09	0.04	0.06	0.09	0.11	0.07	0.08	0.08
13	0.09	0.09	0.11	0.08	0.10	0.05	0.07	0.08	0.11	0.06	0.09	0.09
14	0.10	0.10	0.11	0.08	0.11	0.08	0.08	0.10	0.14	0.07	0.09	0.10
15	0.14	0.13	0.12	0.11	0.11	0.10	0.12	0.14	0.17	0.09	0.13	0.14
16	0.14	0.12	0.14	0.12	0.13	0.10	0.15	0.18	0.18	0.11	0.13	0.15
17	0.08	0.07	0.11	0.10	0.11	0.12	0.17	0.23	0.17	0.09	0.08	0.08
18	0.11	0.08	0.11	0.10	0.11	0.11	0.17	0.19	0.16	0.10	0.13	0.13
19	0.14	0.11	0.11	0.11	0.13	0.12	0.16	0.18	0.17	0.13	0.18	0.17
20	0.17	0.11	0.13	0.12	0.13	0.13	0.15	0.17	0.14	0.14	0.19	0.19
21	0.17	0.13	0.13	0.11	0.13	0.13	0.15	0.20	0.15	0.15	0.20	0.18
22	0.17	0.15	0.16	0.13	0.11	0.13	0.13	0.16	0.12	0.14	0.20	0.19
23	0.16	0.15	0.16	0.15	0.13	0.14	0.13	0.12	0.08	0.14	0.18	0.19
24	0.10	0.09	0.11	0.12	0.10	0.08	0.09	0.06	0.05	0.09	0.10	0.14

Demand Reductions are positive (Blue)
Load increases are negative (Orange)

Table 9: Ex-post Monthly Average Day Demand Reductions by Rate Period

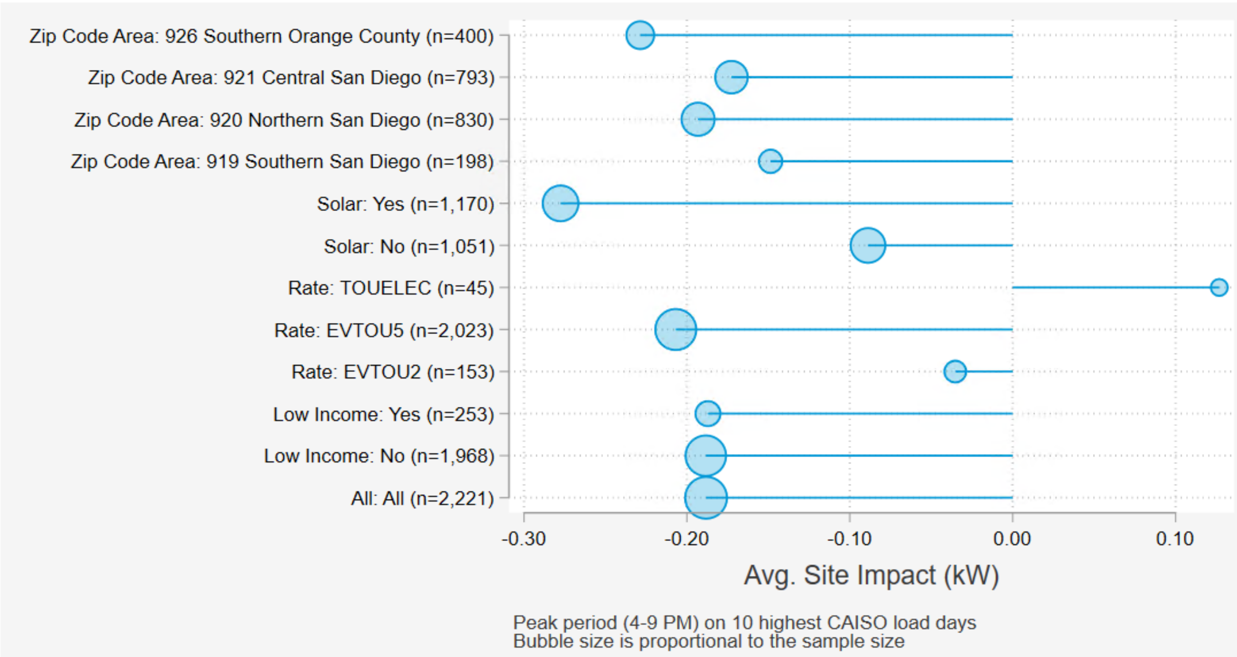
				Avg. Customers (kW)		Aggregate Incremental (MW)		
Rate Period	Month	New Accts	Daily avg. temp[1]	Reference Load	Load Impact	Reference Load	Load Impact	% Change
Peak (4-9 PM)	2023-Oct	11,322	66.6	1.07	0.12	12.15	1.41	-11.6%
	2023-Nov	11,244	60.0	1.20	0.15	13.53	1.73	-12.8%
	2023-Dec	11,180	56.1	1.37	0.15	15.29	1.69	-11.1%
	2024-Jan	11,122	54.7	1.28	0.13	14.25	1.50	-10.5%
	2024-Feb	11,066	55.0	1.15	0.10	12.70	1.10	-8.7%
	2024-Mar	10,994	55.6	0.86	0.12	9.48	1.32	-14.0%
	2024-Apr	10,959	58.3	0.62	0.11	6.75	1.19	-17.6%
	2024-May	10,883	60.3	0.62	0.12	6.71	1.32	-19.6%
	2024-Jun	10,819	64.1	0.57	0.12	6.16	1.33	-21.6%
	2024-Jul	10,711	70.6	1.08	0.16	11.57	1.71	-14.8%
	2024-Aug	10,630	71.8	1.37	0.20	14.54	2.08	-14.3%
	2024-Sep	10,538	68.7	1.16	0.16	12.19	1.68	-13.8%
Off-peak (6AM-4PM and 10PM-12AM)	2023-Oct	11,322	69.8	0.20	0.05	2.27	0.58	-25.5%
	2023-Nov	11,244	65.0	0.31	0.09	3.46	0.97	-28.0%
	2023-Dec	11,180	59.8	0.54	0.10	6.04	1.07	-17.8%
	2024-Jan	11,122	56.9	0.50	0.08	5.52	0.90	-16.3%
	2024-Feb	11,066	56.5	0.38	0.07	4.19	0.79	-18.9%
	2024-Mar	10,994	57.3	0.22	0.08	2.37	0.84	-35.5%
	2024-Apr	10,959	60.6	-0.02	0.06	-0.19	0.67	357.7%
	2024-May	10,883	62.1	0.10	0.06	1.13	0.62	-54.8%
	2024-Jun	10,819	66.0	0.05	0.04	0.53	0.47	-87.5%
	2024-Jul	10,711	73.3	0.23	0.05	2.51	0.56	-22.3%
	2024-Aug	10,630	74.5	0.38	0.06	4.05	0.69	-17.0%
	2024-Sep	10,538	71.2	0.43	0.07	4.55	0.71	-15.6%
Super off-peak (12-6AM)	2023-Oct	11,322	59.2	1.42	-0.54	16.11	-6.10	37.9%
	2023-Nov	11,244	52.4	1.40	-0.46	15.78	-5.13	32.5%
	2023-Dec	11,180	49.5	1.52	-0.42	17.00	-4.67	27.5%
	2024-Jan	11,122	48.3	1.51	-0.44	16.75	-4.93	29.4%
	2024-Feb	11,066	49.3	1.50	-0.47	16.61	-5.24	31.5%
	2024-Mar	10,994	50.8	1.44	-0.52	15.87	-5.67	35.7%
	2024-Apr	10,959	52.9	1.40	-0.48	15.38	-5.29	34.4%
	2024-May	10,883	57.5	1.38	-0.51	15.07	-5.52	36.7%
	2024-Jun	10,819	60.7	1.36	-0.51	14.68	-5.51	37.5%
	2024-Jul	10,711	65.1	1.54	-0.48	16.48	-5.13	31.2%
	2024-Aug	10,630	66.6	1.58	-0.52	16.83	-5.49	32.6%
	2024-Sep	10,538	65.0	1.53	-0.51	16.15	-5.34	33.0%

[1] Participant weighted average temperature. SDG&E maps all customers to eight weather stations.

4.5 LOAD IMPACTS BY CUSTOMER TYPE

Figure 16 shows the impacts of key customer segments for the peak period (4-9PM) on the ten highest CAISO system load days. The summary is descriptive, not causal, but informative nonetheless. We caution that results are noisier when the estimating sample size is smaller such as for the EV-TOU-2 rate or TOU-ELEC. Additionally, TOU-ELEC shows a positive load impact, however, it is important to notice that there are only 45 customers in this segment.

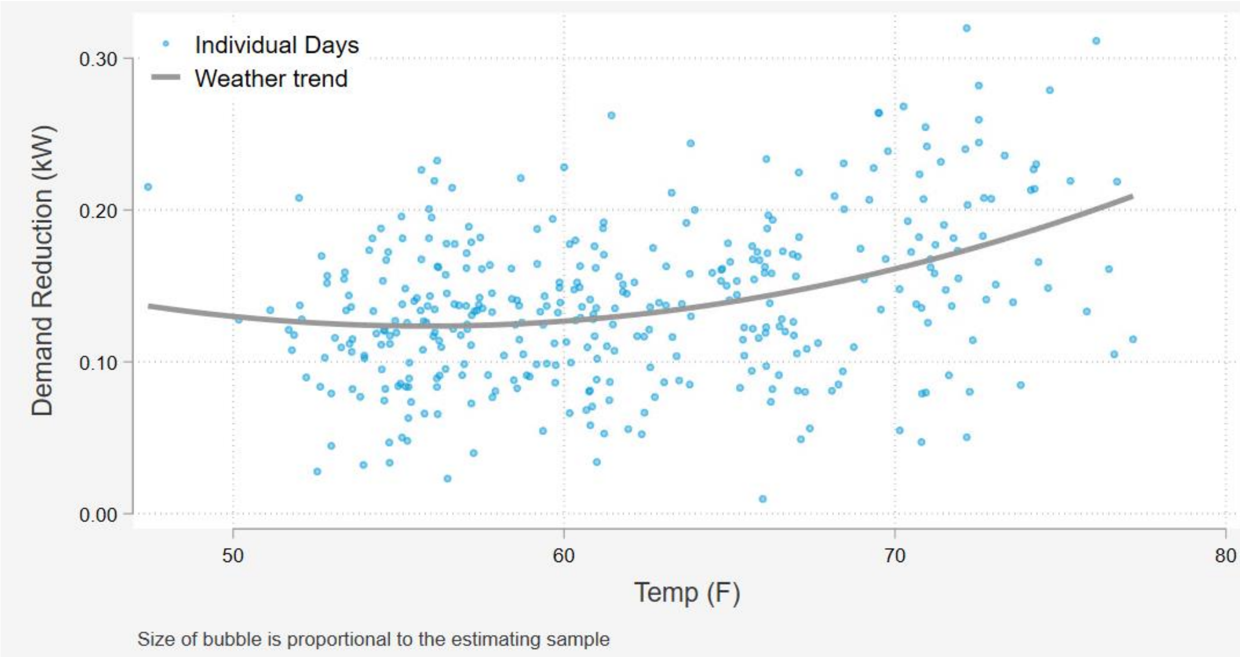
Figure 16: Load Impacts per Site for Key Customer Segments



4.6 WEATHER SENSITIVITY OF LOAD IMPACTS

A key question for residential rates is whether the peak period load impacts are weather sensitive. While the electric vehicle rates are designed to encourage charging during super off-peak hours, the rates apply to the energy used by the whole home. Thus, customers have an incentive not only to modulate their electric vehicle charge but to modify demand for other peak period end uses. As part of the evaluation, we estimated the demand reductions for each day and hour of the year using the differences-in-differences technique. Figure 17 shows the relationship between the daily peak period (4-9) load impacts and weather for days after the transition to TOU rates for electric vehicles. In general, the demand reductions grow larger when temperatures are hotter, and more so at higher temperatures. Customers have an incentive to shift non-EV loads because the rates apply to the whole home, not just the electric vehicle.

Figure 17: Peak Period (4-9 PM) Demand Reduction Weather Sensitivity



4.7 KEY FINDINGS

- This year's EV market share growth has stagnated compared to previous years.
- Most new enrollment is occurring on the EV-TOU-5 rate.
- The number of sites shifting from the EV-TOU-2 to the EV-TOU-5 rate is now negligible.
- There are too few sites on the TOU-ELEC rate to draw reliable conclusions about its impacts. Consequently, TOU-ELEC customers were excluded from the ex-ante analysis.
- Customers who enroll on electric vehicle TOU rate decrease demand when prices are higher usage when the prices are lowest. Moreover, the change in load patterns coincides with the enrollment on TOU rates for electric vehicles.
- Customers deliver slightly larger peak demand reductions on the hotter days.
- In 2024, on top 10 highest CAISO gross, CAISO net, and SDG&E system load days over the study period, customers reduced demand by 0.19 kW, 0.18 kW, and 0.18 kW per home, on average, over the 4-9 PM peak period. This amounted to reduction in demand between 10%-12% of the household load, and led to over 10 MW in total demand reductions during those days.

5 ELECTRIC VEHICLE TOU EX-ANTE RESULTS

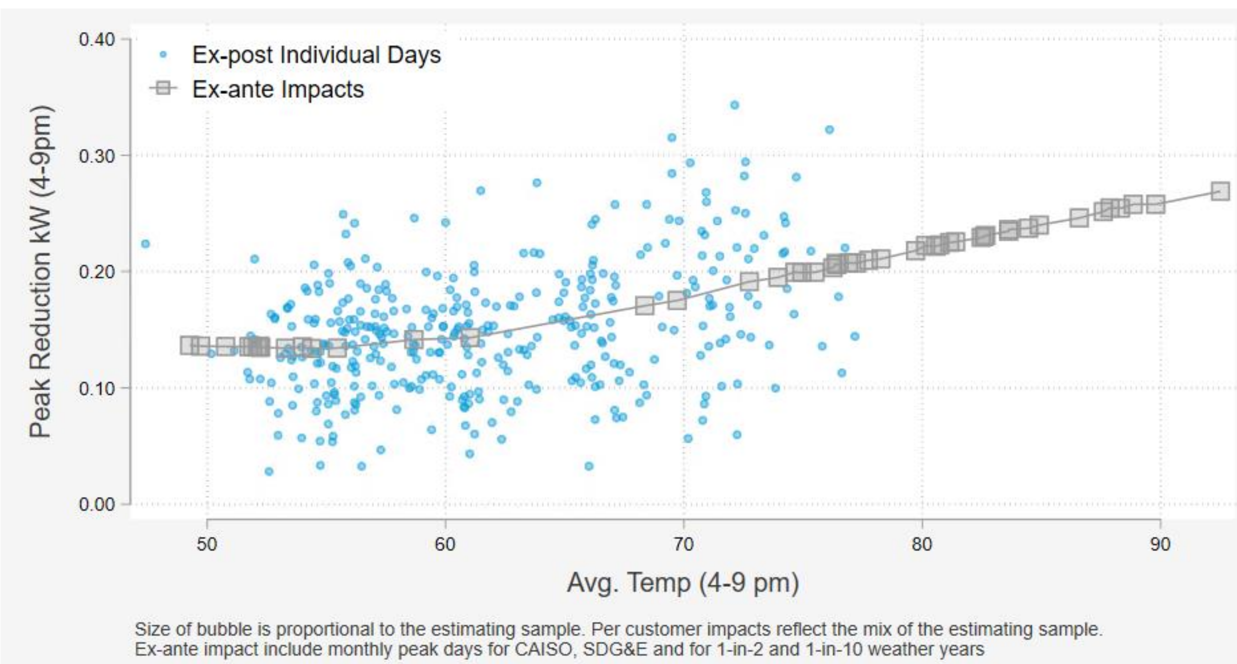
Ex-ante impacts describe the magnitude of program resources available under planning conditions defined by weather. The ex-ante estimates are developed for both SDG&E and California ISO peak conditions under normal (1-in-2) and extreme (1-in-10) peak planning conditions. We estimated ex-ante impacts based on the relationship between demand reductions and weather using the ex-post performance over the analysis period (October 2023 to September 2024) and factored in projected changes in enrollment.

5.1 DEVELOPMENT OF EX-ANTE IMPACTS

The ex-ante impacts were developed by estimating the relationship between weather and demand reductions for customers for who enrolled over the analysis period, had an electric vehicle for the year before they signed onto the rate, and did not install solar or battery storage (a major non-routine event) in the pre-treatment year or the analysis period.

In total, we estimated the relationship between hourly (8,760 hours per year) demand reductions and weather for 4 distinct segments – defined by the rate type (EV-TOU-2 or EV-TOU-5) and the presence of rooftop solar. The segmentation allows SDG&E to account for changes in the customer mix, namely that most new participants enroll in EV-TOU-5, and share of sites with solar is growing. The hourly (8760) pattern of ex-post reductions was analyzed using a multi-variate regression model to estimate ex-ante impact under planning conditions. A separate model was estimated for each segment and hour of day. The model accounts for the effects day of week, and weather. Figure 18 overlays the per-customer ex-ante impacts for 4-9 PM on top of the ex-post impacts for each individual day over the analysis period.

Figure 18: Ex-ante and Ex-post Per Customer Peak Demand Reductions (4-9 PM)



5.2 OVERALL RESULTS

Figure 19 shows a heat map of the per-customer load reduction by month and hour of day for SDG&E 1-in-2 monthly peak day weather conditions. The results are scaled to reflect the current mix of customers on electric vehicle TOU rates (versus the available estimating sample). Table 10 and Table 11 show the per-customer hourly impacts for each month under CAISO and SDG&E monthly peaking conditions, respectively. The tables are designed to enable the CPUC's Slice-of-Day Resource Adequacy requirements. The estimated reductions are greater on monthly worst days than on average weekdays and reductions are greater in hotter months than in cooler ones. The load reductions also coincide with the hours (4-9 PM) and months (August and September) when reductions are needed most.

Figure 19: Heat map of Per Customer Ex-ante Demand Reductions by Hour and Month

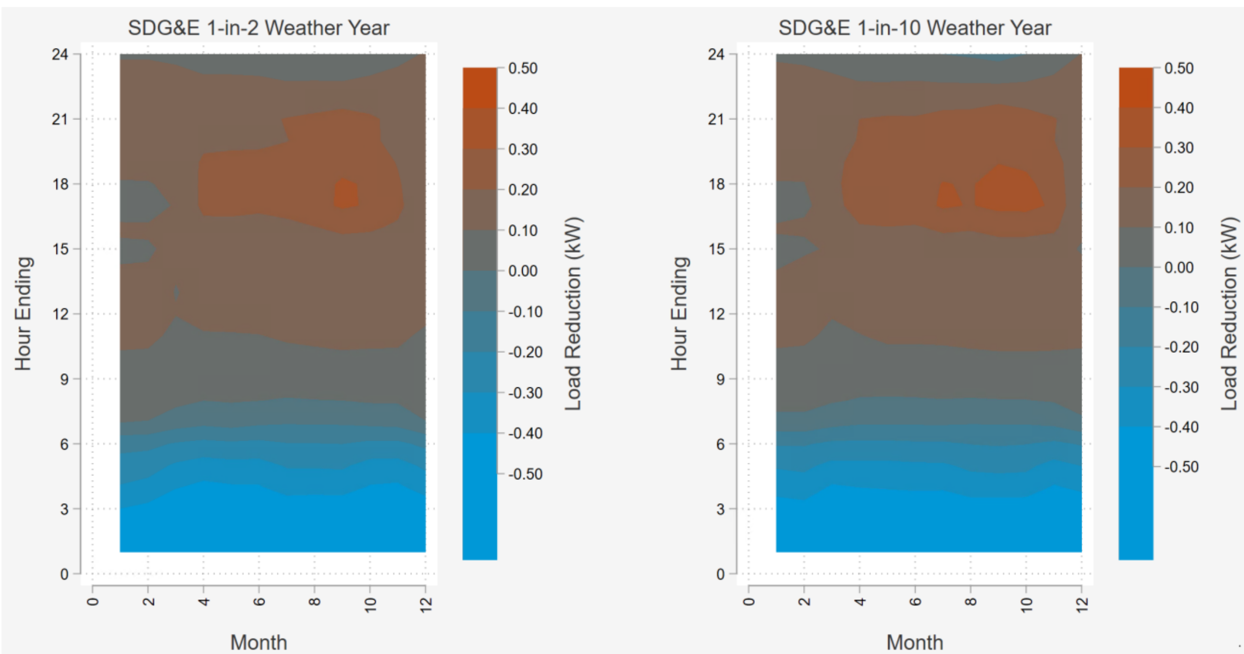


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Table 10: Slice of Day Table for CAISO 1-in-2 Weather Year Monthly Worst Day (Per Customer Demand Reductions)

Hour Ending	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
1	-0.49	-0.49	-0.53	-0.57	-0.59	-0.62	-0.67	-0.70	-0.70	-0.65	-0.58	-0.50
2	-0.53	-0.53	-0.56	-0.58	-0.59	-0.59	-0.60	-0.60	-0.60	-0.60	-0.59	-0.54
3	-0.45	-0.45	-0.48	-0.51	-0.51	-0.50	-0.48	-0.47	-0.47	-0.50	-0.52	-0.44
4	-0.35	-0.36	-0.39	-0.42	-0.42	-0.40	-0.37	-0.37	-0.36	-0.39	-0.41	-0.34
5	-0.28	-0.28	-0.31	-0.34	-0.34	-0.33	-0.30	-0.30	-0.29	-0.32	-0.33	-0.26
6	-0.19	-0.19	-0.21	-0.22	-0.23	-0.22	-0.21	-0.21	-0.20	-0.22	-0.22	-0.16
7	-0.03	-0.03	-0.05	-0.07	-0.08	-0.08	-0.09	-0.09	-0.08	-0.08	-0.06	0.01
8	0.03	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.08
9	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.08
10	0.08	0.08	0.08	0.07	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.11
11	0.13	0.14	0.11	0.09	0.09	0.10	0.10	0.11	0.11	0.12	0.11	0.20
12	0.22	0.22	0.15	0.12	0.11	0.12	0.13	0.13	0.13	0.14	0.14	0.26
13	0.21	0.19	0.14	0.11	0.11	0.12	0.12	0.12	0.13	0.13	0.13	0.25
14	0.16	0.14	0.11	0.12	0.12	0.13	0.13	0.14	0.14	0.14	0.14	0.17
15	0.07	0.08	0.09	0.13	0.12	0.13	0.14	0.15	0.15	0.15	0.15	0.08
16	0.12	0.12	0.11	0.17	0.15	0.17	0.18	0.20	0.20	0.20	0.19	0.13
17	0.08	0.08	0.08	0.21	0.16	0.21	0.23	0.26	0.27	0.28	0.24	0.09
18	0.10	0.10	0.10	0.20	0.17	0.22	0.23	0.26	0.26	0.28	0.23	0.12
19	0.12	0.12	0.12	0.20	0.17	0.21	0.22	0.23	0.24	0.26	0.20	0.14
20	0.13	0.14	0.13	0.17	0.16	0.18	0.19	0.21	0.21	0.22	0.18	0.17
21	0.13	0.14	0.14	0.16	0.15	0.18	0.20	0.21	0.22	0.22	0.18	0.17
22	0.13	0.15	0.13	0.12	0.13	0.13	0.14	0.15	0.16	0.16	0.14	0.18
23	0.12	0.14	0.13	0.10	0.11	0.10	0.09	0.09	0.08	0.09	0.12	0.17
24	0.08	0.09	0.08	0.06	0.06	0.05	0.02	0.02	0.01	0.03	0.08	0.11

Demand Reductions are positive (Blue)

Load increase are negative (Orange)

Table 11: Slice of Day Table for SDG&E 1-in-2 Weather Year Monthly Worst Day (Per Customer Demand Reductions)

Hour Ending	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
1	-0.46	-0.49	-0.53	-0.59	-0.57	-0.60	-0.70	-0.70	-0.71	-0.62	-0.58	-0.52
2	-0.49	-0.52	-0.56	-0.58	-0.58	-0.59	-0.60	-0.60	-0.60	-0.59	-0.59	-0.55
3	-0.40	-0.43	-0.48	-0.52	-0.51	-0.51	-0.47	-0.47	-0.47	-0.51	-0.52	-0.46
4	-0.31	-0.33	-0.39	-0.42	-0.41	-0.41	-0.36	-0.36	-0.36	-0.41	-0.42	-0.36
5	-0.24	-0.26	-0.31	-0.34	-0.33	-0.33	-0.29	-0.29	-0.29	-0.33	-0.34	-0.28
6	-0.16	-0.17	-0.21	-0.23	-0.22	-0.23	-0.20	-0.20	-0.20	-0.22	-0.22	-0.18
7	0.00	0.00	-0.05	-0.07	-0.06	-0.08	-0.09	-0.09	-0.09	-0.07	-0.06	0.00
8	0.06	0.06	0.02	0.00	0.01	0.00	-0.01	0.00	0.00	0.01	0.01	0.06
9	0.06	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.07
10	0.08	0.08	0.07	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.09
11	0.13	0.13	0.08	0.10	0.10	0.10	0.11	0.11	0.12	0.12	0.11	0.09
12	0.16	0.15	0.10	0.12	0.12	0.12	0.13	0.13	0.14	0.14	0.14	0.12
13	0.12	0.12	0.10	0.11	0.11	0.12	0.12	0.13	0.13	0.13	0.13	0.11
14	0.10	0.10	0.10	0.13	0.12	0.13	0.13	0.14	0.15	0.15	0.14	0.12
15	0.09	0.10	0.11	0.14	0.13	0.13	0.14	0.15	0.16	0.16	0.15	0.12
16	0.11	0.11	0.13	0.17	0.18	0.17	0.18	0.20	0.22	0.21	0.19	0.14
17	0.08	0.07	0.11	0.22	0.22	0.22	0.23	0.27	0.31	0.29	0.22	0.12
18	0.10	0.10	0.11	0.22	0.23	0.22	0.23	0.27	0.31	0.29	0.21	0.12
19	0.12	0.12	0.13	0.21	0.22	0.21	0.22	0.25	0.27	0.26	0.19	0.14
20	0.13	0.13	0.13	0.18	0.19	0.19	0.20	0.22	0.23	0.22	0.17	0.15
21	0.14	0.14	0.13	0.17	0.17	0.18	0.20	0.22	0.24	0.21	0.17	0.15
22	0.14	0.14	0.13	0.12	0.13	0.14	0.15	0.15	0.16	0.15	0.14	0.16
23	0.14	0.14	0.12	0.10	0.10	0.10	0.08	0.09	0.08	0.10	0.12	0.16
24	0.09	0.09	0.08	0.06	0.06	0.05	0.01	0.01	0.00	0.04	0.07	0.11

Demand Reductions are positive (Blue)
Load increase are negative (Orange)

Table 12 shows aggregate ex-ante demand reduction forecasts for an August monthly system worst day. Forecasts are shown under the four weather scenarios identified above. The increase in the demand reductions throughout the forecast years can be explained by the expected growth of electric vehicles and the corresponding growth in electric vehicle TOU rate enrollments. Ex-ante weather conditions are static through the forecast window. There is a small amount of variation in participant-level impacts through the forecast window due to the expected enrollments by rate and solar status. Most future participants are projected to enroll on the EV-TOU-5 rate.

Table 12: Aggregate August Monthly System Worst Day (SDG&E) Demand Reduction Forecast (MW)

Forecast Year	Enrollment Forecast	SDG&E Weather		CAISO Weather	
		1-in-2	1-in-10	1-in-2	1-in-10
2024	62,240	15.2	16.5	14.5	15.8
2025	81,370	20.2	21.9	19.3	21.0
2026	100,895	25.2	27.2	24.1	26.1
2027	122,289	30.6	33.1	29.3	31.8
2028	145,748	36.6	39.5	35.0	37.9
2029	172,734	43.5	46.9	41.6	45.0
2030	203,648	51.3	55.3	49.1	53.2
2031	237,754	60.0	64.7	57.4	62.1
2032	274,531	69.3	74.7	66.3	71.8
2033	312,142	78.9	85.0	75.5	81.7
2034	352,755	89.2	96.1	85.3	92.4
2035	387,237	98.0	105.6	93.7	101.4

Figure 20 and

Figure 21 show the estimated ex-ante load profiles for sites on electric vehicle TOU rates. Both figures show profiles for the August worst day, and both figures use SDG&E weather conditions rather than CAISO conditions. Figure 20 shows profiles under 1-in-2 weather conditions, and

Figure 21 shows profiles for 1-in-10. Note that the forecast year shown is 2025. The confidence band for the average impact over the 4-9 PM window is narrower than for individual hours.

Figure 20: Aggregate Ex-ante Impact for 1-in-2 Weather Conditions, August Worst Day 2025

San Diego Gas & Electric
PY2024 EV TOU Rates Ex Ante Impacts

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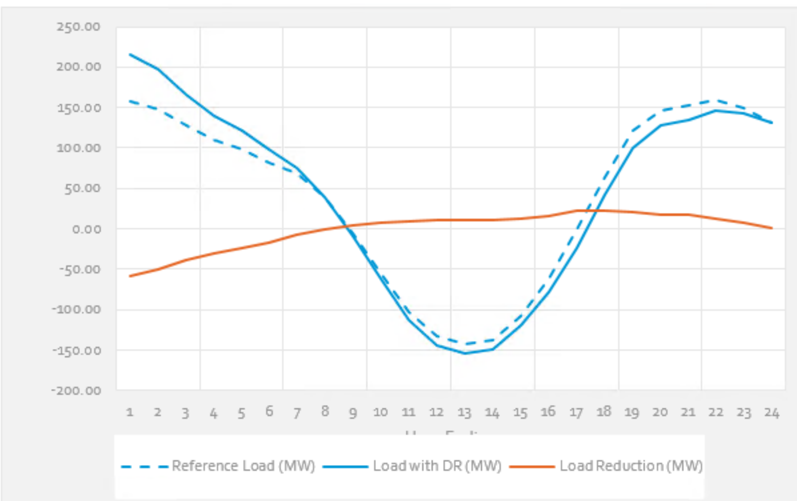
Table 1: Menu options

Type of Result	Aggregate Total
System (CAISO/SDG&E)	SDG&E
Weather Year	1-IN-2
Forecast Year	2025
Category	All
Subcategory	All
Day type	MONTHLY SYSTEM WORST DAY
Month	08 Aug
Hour Ending View	HE (Prevailing Time)

Table 2: Event day information

Total sites	81,370
Daily Max Temp	89.3
Peak Period (4pm-9pm) Impact (MW)	20.24
Peak Period (4pm-9pm) Impact (%)	21.0%



Hour Ending	Reference Load (MW)	Load with DR (MW)	Load Reduction (MW)	% Load Reduction	Avg Temp (°F, Site-Weighted)	Uncertainty Adjusted 5th	Uncertainty Adjusted 95th	Standard Error	T-Statistic
1	157.19	214.96	-57.77	-36.8%	72.4	-72.97	-42.57	9.24	-6.25
2	147.48	196.89	-49.40	-33.5%	71.5	-65.01	-33.80	9.49	-5.21
3	127.84	166.61	-38.77	-30.3%	71.1	-52.65	-24.89	8.44	-4.60
4	109.70	139.20	-29.51	-26.9%	70.8	-42.60	-16.41	7.96	-3.71
5	98.08	121.69	-23.61	-24.1%	70.7	-35.48	-11.74	7.22	-3.27
6	82.42	98.80	-16.38	-19.9%	70.3	-25.84	-6.91	5.75	-2.85
7	68.44	75.27	-6.83	-10.0%	70.3	-13.55	-0.11	4.09	-1.67
8	38.88	38.76	0.11	0.3%	70.8	-6.78	7.01	4.19	0.03
9	-5.29	-8.99	3.70	-69.9%	74.4	-3.62	11.01	4.45	0.83
10	-54.57	-61.93	7.36	-13.5%	79.1	-1.96	16.68	5.67	1.30
11	-102.34	-111.99	9.64	-9.4%	84.0	-0.99	20.27	6.46	1.49
12	-132.45	-143.83	11.38	-8.6%	87.2	-0.87	23.64	7.45	1.53
13	-142.81	-153.45	10.64	-7.5%	88.9	-2.33	23.61	7.89	1.35
14	-136.59	-148.27	11.68	-8.5%	89.3	-2.04	25.40	8.34	1.40
15	-107.16	-119.51	12.35	-11.5%	87.1	-1.09	25.80	8.17	1.51
16	-61.63	-78.07	16.43	-26.7%	87.1	4.18	28.69	7.45	2.21
17	-0.81	-23.28	22.47	-2783.8%	86.90	10.49	34.45	7.29	3.08
18	64.35	41.90	22.45	34.9%	85.67	11.40	33.50	6.72	3.34
19	121.09	100.72	20.37	16.8%	83.16	9.88	30.86	6.38	3.19
20	145.43	127.63	17.80	12.2%	80.56	6.79	28.80	6.69	2.66
21	152.16	134.05	18.11	11.9%	77.32	7.00	29.22	6.75	2.68
22	159.25	146.42	12.83	8.1%	75.4	1.25	24.42	7.04	1.82
23	150.14	142.67	7.47	5.0%	74.1	-4.61	19.56	7.34	1.02
24	131.93	130.69	1.25	0.9%	73.2	-11.05	13.54	7.47	0.17

Daily	Reference Load (MW) MWh	Load with DR (MW) MWh	Load Reduction (MW) MWh	% Change	Avg Temp (°F, Site-Weighted) F	Uncertainty Adjusted Impact - 5th	Uncertainty Adjusted Impact - 95th	Std Err	T-statistic
Overall	1010.73	1026.95	-16.21	-1.6%	78.4	-27.95	-4.48	7.13	-2.27
Peak Hours	482.23	381.03	101.20	21.0%	82.7	90.06	112.34	6.77	14.95

Figure 21: Aggregate Ex-ante Impact for 1-in-10 Weather Conditions, August Worst Day 2025

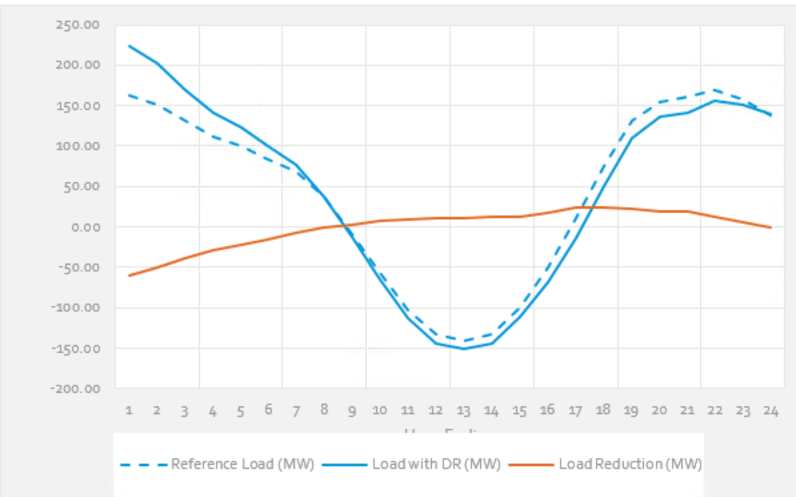
San Diego Gas & Electric
PY2024 EV TOU Rates Ex Ante Impacts

Table 1: Menu options

Type of Result	Aggregate Total
System (CAISO/SDG&E)	SDG&E
Weather Year	1-IN-10
Forecast Year	2025
Category	All
Subcategory	All
Day type	MONTHLY SYSTEM WORST DAY
Month	08 Aug
Hour Ending View	HE (Prevailing Time)

Table 2: Event day information

Total sites	81,370
Daily Max Temp	92.0
Peak Period (4pm-9pm) Impact (MW)	21.88
Peak Period (4pm-9pm) Impact (%)	20.4%



Hour Ending	Reference Load (MW)	Load with DR (MW)	Load Reduction (MW)	% Load Reduction	Avg Temp (°F, Site-Weighted)	Uncertainty Adjusted 5th	Uncertainty Adjusted 95th	Standard Error	T-Statistic
1	162.06	222.81	-60.75	-37.5%	75.8	-75.95	-45.55	9.24	-6.58
2	151.82	201.52	-49.70	-32.7%	75.1	-65.31	-34.10	9.49	-5.24
3	130.88	168.58	-37.70	-28.8%	74.2	-51.57	-23.82	8.44	-4.47
4	112.13	140.49	-28.36	-25.3%	73.3	-41.46	-15.26	7.96	-3.56
5	100.16	122.95	-22.79	-22.7%	72.9	-34.66	-10.91	7.22	-3.16
6	84.15	100.05	-15.91	-18.9%	72.8	-25.37	-6.45	5.75	-2.77
7	69.14	76.23	-7.09	-10.3%	72.1	-13.81	-0.37	4.09	-1.74
8	36.87	37.07	-0.20	-0.6%	74.5	-7.10	6.69	4.19	-0.05
9	-8.60	-12.08	3.48	-40.4%	78.8	-3.84	10.79	4.45	0.78
10	-56.75	-64.19	7.44	-13.1%	84.0	-1.88	16.76	5.67	1.31
11	-103.08	-113.17	10.09	-9.8%	88.9	-0.54	20.73	6.46	1.56
12	-131.82	-143.48	11.65	-8.8%	91.2	-0.60	23.91	7.45	1.56
13	-140.63	-151.41	10.78	-7.7%	92.0	-2.19	23.75	7.89	1.37
14	-132.29	-144.17	11.88	-9.0%	91.8	-1.84	25.60	8.34	1.42
15	-98.73	-111.53	12.80	-13.0%	91.2	-0.64	26.24	8.17	1.57
16	-50.44	-67.79	17.35	-34.4%	91.2	5.10	29.60	7.45	2.33
17	11.15	-13.45	24.60	220.6%	90.81	12.62	36.59	7.29	3.38
18	75.63	51.31	24.32	32.2%	89.39	13.27	35.37	6.72	3.62
19	131.86	109.98	21.89	16.6%	87.17	11.40	32.37	6.38	3.43
20	155.07	136.04	19.04	12.3%	84.70	8.03	30.04	6.69	2.85
21	161.50	141.94	19.56	12.1%	81.29	8.45	30.67	6.75	2.90
22	168.92	155.74	13.18	7.8%	79.3	1.59	24.76	7.04	1.87
23	158.21	151.84	6.37	4.0%	78.1	-5.71	18.45	7.34	0.87
24	138.33	139.10	-0.76	-0.6%	77.4	-13.06	11.53	7.47	-0.10
Daily	**Reference Load (MW)**	**Load with DR (MW)**	**Load Reduction (MW)**	**% Change**	**Avg Temp (°F, Site-Weighted)**	**Uncertainty Adjusted Impact -**		**Std Err**	**T-statistic**
	MWh	**MWh**	**MWh**		**F**	**5th**	**95th**		
Overall	1125.54	1134.36	-8.82	-0.8%	82.0	-20.56	2.91	7.13	-1.24
Peak Hours	535.22	425.81	109.41	20.4%	86.7	98.27	120.54	6.77	16.16

5.3 COMPARISON TO PRIOR YEAR

Table 13 shows a comparison of vintage year PY2023 and PY2024ex-ante impacts for the two different weather scenarios at the participant level. All impacts represent monthly worst day impact estimates, and SDG&E weather conditions are used. There are two main differences:

1. The PY2023 evaluation includes incremental sites that enrolled on the rate between October 1, 2022 and April 30, 2023 thereby beginning their full first summer of savings on May 1, 2023. As a result, the number of sites evaluated for October was small and grows during the study period. Restricting to customers in that window was necessary due to data gaps in 2021 that occurred due to SDG&E's transition from one data storage system to another. The approached creates two challenges. The sample size for early months was inherently small, and there was little data on behavior with TOU rates for the most recent enrollments. Nevertheless the October results shown in Table 13 are commensurate. The PY2024 evaluation relied on all sites that reached a full year of enrollment in electric vehicle time-of-use rates to estimate impacts.
2. The mix of participants analyzed differs slightly because only sites that recently transitioned onto the electric vehicle TOU rates can be evaluated.

Compared with PY2033, the latest PY2024 EV-TOU-5 load impacts are higher for the core summer months under 1-in-2 and 1-in-10 conditions, while the EV-TOU-2 load impacts are lower. In the PY2024 evaluation, impacts were more weather-sensitive than in PY2023, which contributes to highere 1-in-10 impacts and higher impacts in the hotter summer months for EV-TOU-5. Differences in EV-TOU-2 can largely be attributed to the small estimating sample sizes. Most new participants sign onto EV-TOU-5 and few sites are left for evaluating EV-TOU-2 impacts after screening for sites that did not have major changes – add an electric vehicle, install solar or battery – in the year before and after the transition onto the electric vehicle TOU rate.

Table 13: Comparison of Per Participant Ex-ante Demand Reductions under SDG&E Weather Scenarios (kW)

	PY23 Evaluation				PY24 Evaluation			
	EVTOU5		EVTOU2		EVTOU5		EVTOU2	
	1-in-2	1-in-10	1-in-2	1-in-10	1-in-2	1-in-10	1-in-2	1-in-10
May	0.22	0.23	0.27	0.33	0.21	0.25	0.17	0.26
June	0.22	0.23	0.27	0.32	0.21	0.24	0.16	0.23
July	0.22	0.23	0.28	0.36	0.22	0.27	0.18	0.30
August	0.23	0.23	0.32	0.35	0.25	0.26	0.24	0.28
September	0.23	0.23	0.36	0.40	0.27	0.29	0.29	0.35
October	0.23	0.23	0.33	0.36	0.26	0.28	0.25	0.30

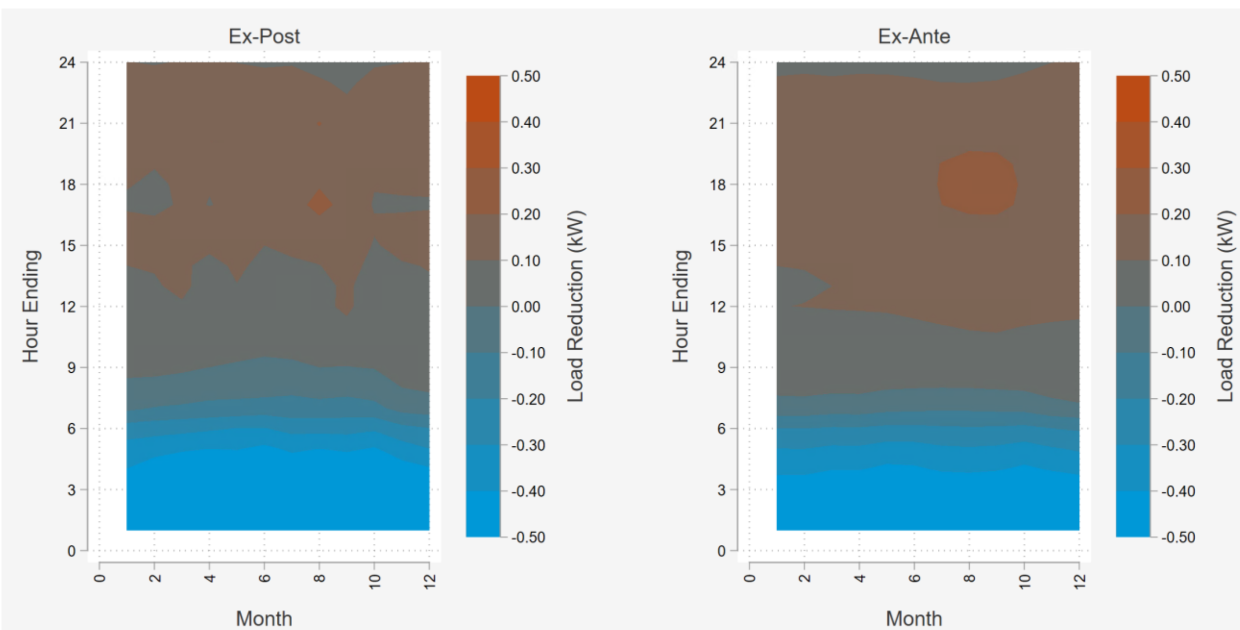
*Per Customer impacts for 2023

5.4 EX-POST TO EX-ANTE COMPARISON

When comparing ex-post and ex-ante, it is important to keep the distinction between the two estimates in mind. Ex-ante impacts are estimates of the future resources available under standardized planning conditions (defined by weather). Ex-post impacts are estimates of what past impacts were given the weather, conditions, and magnitude of resources available. The ex-ante impacts are based on the ex-post impact and weather trends, as shown earlier in Figure 18.

Figure 22 compares the per site ex-post load impacts to the ex-ante load impacts for the average weekday by month and hour. The ex-post load impacts are very similar in magnitude to the ex-ante impact estimates shown in the table. Ex-post results show similar reductions from March through October while ex-ante show larger demand reductions from July through October around the evening hours. The differences are due to weather and composition of the samples. The ex-ante standardized weather indicates hotter weather conditions typically occur in August in September and this is reflected in higher impacts in those months. The percentage of customers on EV-TOU-2 differs between the two samples. EV-TOU-2 makes up 14% of ex ante enrollment but only 7% of the ex post analysis sample. The proportion of solar customers is similar in the two populations: solar make up 58% of both the ex ante enrollment in 2024 and the ex post estimation sample in 2024. Nevertheless, because of uncertainty introduced when a sample is split into sub-populations, estimating effects on subpopulations and then aggregating can result in different estimates than when effects are estimated on the pooled population.

Figure 22: Comparison of Ex-Post and Ex-Ante Per Customer Demand Reductions under SDG&E peak conditions (2024)



6 RECOMMENDATIONS

Electric vehicles have the potential to transform the electric grid fundamentally. They are a new, incremental, flexible, and critical load. As the residential electric vehicle market grows, it will impact all aspects of the electric grid. The efforts to ensure electric vehicles are a flexible load over the next few years will be vital as the market share increases. There are over 2.9M vehicles in SDG&E territory and the implications of transportation electrification for the electric grid are large. Moreover, electric vehicles are quickly maturing from an early adopter technology to mass adoption. The transformation is most evident for new vehicles, where electric vehicles constitute 26% of the market in San Diego County and 31% of the new vehicle market in Orange County. Thus, it has become increasingly important to provide customers incentives and tools to manage charging to lower bills and reduce use during peak hours.

Key recommendations from the evaluation are:

- **Study the persistence of impacts and cohort effects.** Currently, ex post estimates from incremental sites that recently enrolled are currently applied to all enrolled sites in order to produce ex ante estimates. If effect varies with cohort (for example if the early enrollees were more engaged and provide larger estimates), or if effects change over time for a cohort (for example if reductions grow over time due to learning), then this method yields biased estimates for the full population. For future years, we should undertake an analysis of persistence of impacts over time. This analysis will yield parameters that could be used to scale impacts for ex ante based on duration a customer has been enrolled. Furthermore, we should examine how incremental estimates have changed over time for each cohort.
- **Assess whether SDG&E can incorporate California Department of Motor Vehicle (DMV) registration data to identify control sites** – sites with electric vehicles that are not enrolled on EV-TOU-5 or EV-TOU-2. The DMV makes vehicle registration data available for public use but with limitations on how it is used and requirements regarding public notices and data security. While algorithms to identify electric vehicles using AMI data are helpful, vehicle registration data is a better source of information.
- **Consider modifying the building blocks used for ex-ante impacts.** Currently, the ex-ante impacts are based on four types of sites, customers on EV-TOU-5 and EV-TOU-2 with and without solar. Few new sites are enrolling on EV-TOU-2 and most new enrollment are on EV-TOU-5. As a result, the EV-TOU-2 analysis relies on an estimating sample that is small. For future years, we recommend that SDG&E build its ex-ante forecast based on sites on electric vehicle TOU rates with and without solar, eliminating the distinction between EV-TOU-5 and EV-TOU-2.