



**Demand Side Analytics**  
DATA DRIVEN RESEARCH AND INSIGHTS

# EVALUATION PLAN FINAL

## 2022 Load Impact Evaluation of San Diego Gas and Electric's Electric Vehicles Time-of-Use (TOU) Rates



Prepared for San Diego Gas &  
Electric

By Demand Side Analytics, LLC  
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## ***ACKNOWLEDGEMENTS***

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# 1 INTRODUCTION

This evaluation plan lays out the analysis approach and requirements for evaluating impacts for SDG&E's EV TOU and Power Your Drive Rate Programs. Throughout this document these will be referred to as:

- Residential: EV-TOU, EV-TOU-2, EV-TOU-5
- Residential & Commercial: VGI/PYD

There are two main objectives for this evaluation plan. The primary objective is to engage in science and avoid after-the-fact analysis and decisions where there is a temptation to modify models to find the desired results. This requires documenting the hypothesis, specifying the intervention, establishing the sample size and the ability to detect a meaningful effect, identifying the data that will be collected and analyzed, identifying the outcomes that will be analyzed and segments of interest, and documenting in advance the statistical techniques and models that will be used to estimate energy savings and demand reductions. The goal is to leave little to no ambiguity regarding what data will be collected or how the data will be analyzed. The secondary objective is to comply with the California Load Impact Evaluation Planning Protocols (Protocol #2). As a result, the evaluation plan is customized to explicitly address the 12 questions in the planning protocol.

Key issues that affect the evaluation approach are:

- **Identifying an appropriate control pool.** COVID conditions led to changes in driving patterns in recent years and, thus, a control pool is more critical than in the past. The primary challenge in evaluating electric vehicle programs is in finding appropriate control customers. The evaluation must be able to distinguish the impact of the electric vehicle rate on overall electric consumption from the impact of simply having an electric vehicle, meaning that eligible control customers must also have electric vehicles. That requires identifying customers that have electric vehicles who are not on an EV TOU rate.
- **Electric vehicle adoption often coincides with enrollment in the TOU rate and adoption of solar or battery storage.** When multiple changes occur at once, it is more difficult to isolate the effect of the TOU rates. Thus the analysis requires careful attention to other large changes in energy use that can be confounded with electric vehicle impacts.
- **The effects of the COVID-19 pandemic on underlying load patterns in 2020 and possibly thereafter.** The COVID pandemic fundamentally changed commute patterns and those effects are expected to persist. From an evaluation standpoint, it poses a key challenge in the driving behavior is evolving over time as the pandemic effects subside and the California reopens. Thus, 2020 driving and charging behavior is inadequate for establishing a credible baseline for how customers would have behaved without TOU rates absent a control group. Thus, given COVID's impact on commute patterns, a control group is essential to the evaluation.

- The Power Your Drive Customers face wholesale market prices and at no time experience the otherwise applicable tariff. Thus, the analysis relies on estimating the relationship between charging behavior and market prices.
- Both TOU and Power Your Drive are non-event based options. Once a customer enrolls on TOU or RTP, they are always on that rate and do not experience and the ON/OFF pattern common to dispatchable DR programs.

## 2 METHODS

Table 1 summarizes the key research questions pertinent to the evaluation of the EV Rate Programs.

Table 1: Key Research Questions

Research Question	
1	What was the load shift in 2022 for each EV rate?
3	How does weather and market prices influence the magnitude of demand response, if at all?
4	How do load impacts vary for different customer sizes, locations, and customer segments?
5	What is the ex-ante load reduction capability under resource adequacy planning conditions? And how well does it align with ex-post results and prior ex-ante forecasts?
6	What concrete steps or experimental tests can be undertaken to improve program performance?

Table 2 summarizes the data sources, segmentation and estimation methods to be used for each program. The segmentation is of particular importance because the evaluation will use a bottom up approach to estimate impacts for each segment and ensure that aggregate impacts across segments add up to the sum of the parts. This will be done to address discrepancies between segment and aggregate impacts in past evaluations which took a top down approach for aggregate impacts. Because impacts for each segment will be added together it is important that segmentation be structured to be mutually exclusive and completely exhaustive. In other words, every customer needs to be assigned to exactly one segment.

Table 2: Evaluation Methods EV TOU

Methodology Component	Approach
<b>Data Sources/Samples</b>	Our plan is to analyze the full population of participants and a matched control group. The analysis will include all PY2022 data. For ex-ante, we will need three years of historical data for each customer. PSPS and other outage days will be removed from the analysis for customers affected by these events.
<b>Segmentation of impact results</b>	<p>The results will be segmented by:</p> <ul style="list-style-type: none"> <li>▪ Aggregate and Average Customer;</li> <li>▪ Program and Portfolio;</li> <li>▪ Local Capacity Area (LCA);</li> <li>▪ Climate zone;</li> <li>▪ NEM status;</li> <li>▪ Solar vs. non-solar customers</li> <li>▪ Presence of battery storage</li> </ul>

- Rate to Driver v. Rate to Host (PYD only)
- Multi-family v. Workplace (PYD only)

**Estimation Method:**  
**Ex-Post**

We will attempt to develop a matched control group of customers who have electric vehicles but are not on SDG&E's EV TOU rates. The process involves two steps.

- First, pull AMI data for a control pool with oversampling of locations with higher EV incidence rates.
- Next, we use the AMI data to identify customers who have electric vehicles and are not on TOU rates. The goal is to identify the unique load patterns that indicate the presence of electric vehicles in the AMI data. As part of the analysis we will also seek to identify the date the electric vehicle(s) arrived at the household.
- Once control candidates with electric vehicles have been identified, we develop the matched control groups and match
- Impacts will be estimated using difference-in-differences with matched controls.
- Impacts will be estimated for all dates and hours of the evaluation period.
- Impacts will be estimated for all new sites – some of which may not have a full year of data – for historical purposes
- Impacts will also be estimated for all sites that have a full year of experience with electric vehicle time-of-use rates.
- The study will exclude sites that whose enrollment on electric vehicle TOU rates coincides with the introduction of the electric vehicle into the home and sites that installed solar or battery storage in the pre-post EVTOU transition year. The goal will be to isolate site who only had changes in the EV TOU status.
- Ex-post tables will be produced for EV TOU rates in compliance with the Load Impact Protocols

**Estimation Method:**  
**Ex-Ante**

The key steps for customer-level ex-ante impacts will be:

- Use two years of historical load data for relevant customers: 2021 and 2022
- Decide on an adequate segmentation to reflect changes in participant characteristics.
- Estimate the relationship between reference loads and weather and estimate whole house and disaggregated cooling loads on a per household basis.
- Use the models to predict reference loads for 1-in-2 and 1-in-10 weather year conditions.
- Develop an enrollment forecast that incorporates new enrollment projections, site retention, and electric vehicle adoption trends over time.
- Incorporate enrollment forecast with forecast loads and impacts per household
- Ex-ante tables will be produced for EV TOU rates in compliance with the Load Impact Protocols

Table 3: Evaluation Methods PYD

Methodology Component	Approach
<b>Data Sources/Samples</b>	Our plan is to analyze the EV session data for all EV ports. The analysis will include all PY 2021 and PY2022 data. The data fill in gaps with zero values focus on charging (not just whether is plugged in)
<b>Segmentation of impact results</b>	The results will be segmented by: <ul style="list-style-type: none"> <li>▪ Aggregate and Average Customer;</li> <li>▪ Rate to Driver v. Rate to Host (PYD only)</li> <li>▪ Multi-family v. Workplace (PYD only)</li> <li>▪ Max Daily Price</li> </ul>
<b>Estimation Method: Ex-Post</b>	The date will be analyzed in two ways. <ul style="list-style-type: none"> <li>▪ A panel regression with fixed effects and time effects that estimates the relationship between peak pricing and peak energy use (price elasticity)</li> <li>▪ A panel regression that treats supply and distribution adders as events.</li> <li>▪ No control group will be used.</li> <li>▪ Separate regression will be estimated for multi-family, workplace rate-to-driver, and workplace rate-to-host</li> <li>▪ Ex-post tables will not be produced for PYD</li> </ul>
<b>Estimation Method: Ex-Ante</b>	Ex-ante Impacts are not required for PYD



### 3 EVALUATION PLANNING PROTOCOL

Table 6 lists the study design question in the California Load Impact Protocols and details how the evaluation plan addresses each study design issue for each program.

Table 6: Evaluation Planning Questionnaire

#	Study design issue	EVTOU	PYD
1	Will the evaluation rely on a control group? If so, how will it be developed and what comparisons between the treatment and control group will be made?	A matched control group will be developed for each segment from customers who have EVs but are not enrolled in an EV rate plan.	No. The study will rely on daily and hourly price variation to assess the relationship between charging behavior and prices
2	Will the evaluation rely on pre-intervention data to establish a baseline?	Yes.	No. Charging session without the real time pricing is not available
3	Will the study rely on a sample or include the full population receiving the intervention? If a sample is used, does it meet 90/10 precision requirements?	The study will include the full population receiving the intervention.	The study will include the full population receiving the intervention.
4	Is the study designed to detect a specific effect size? And, if so, how was statistical power assessed?	N/A	N/A
5	What is the study's threshold for statistical significance?	90% confidence using a two-tailed test	90% confidence using a two-tailed test
6	What is the size of the control and treatment groups, if applicable?	<p>Treatment:</p> <ul style="list-style-type: none"> <li>▪ EV-TOU-2: all sites that enrolled in PY2022</li> <li>▪ EV-TOU-5: all sites that enrolled in PY2022</li> </ul> <p>Control:</p> <ul style="list-style-type: none"> <li>▪ Control group will be same size as participant population. We will allow matching with replacement</li> </ul>	N/A
7	How will the evaluation address outliers?	Customers for whom a matched control group cannot be identified (due to score distance) will not be included.	Observation where usage exceeds the charger throughput will be dropped.
8	How will the evaluation address attrition?	Not applicable. Different rates of attribution are not expected. The EV TOU rates are unlikely to cause customers to relocate.	Not applicable.
9	How will standard errors be calculated?	Time and fixed effects diff-in-diff regression using clustered (at	Time and fixed effects panel regression using clustered (at

#	Study design issue	EVTUO	PYD
		customer level), robust standard errors	customer level), robust standard errors
10	Will estimates be developed for subcategories? If so, please define them.	Yes, refer to segmentation in Table 2.	Yes, refer to segmentation in Table 5
11	Will energy savings be estimated?	No	No
12	Will overlap with energy efficiency programs be estimated?	No	No

## 4 DATA NEEDED

Demand Side Analytics delivered a data request for the EV-TOU analysis on September 30<sup>th</sup>, 2022. At a high level, the data request includes five items:

1. A customer characteristic file for all sites on an EV TOU or PYD rate at any time in 2021 or 2022 and a random sample of residential non-participant sites.
2. Hourly interval data for EV TOU participant sites and control pool sites
3. Enrollment Forecasts for EV TOU rates
4. PYD site characteristics
5. Hourly Vehicle charger sessions data for all EV chargers
6. Power Your Drive Hourly Pricing Data by location

## 5 TIMELINE

The evaluation work has been scoped into seven tasks. All but Task 6 (Project Management) have corresponding deliverables, laid out in Table 4.

Table 4: Evaluation Timeline and Deliverables

Task	Deliverable PY 2022	Due Date	Completed
Task 1 Conduct Project Initiation Meeting	PI Meeting:	September 2022	9/30/2022
	PI Meeting Memorandum:	Five business days after the PI Meeting	10/7/2022
Task 2 Develop Measurement and Evaluation Plan	Draft EM&V Plan:	October 2022	10/21/2022
	Final EM&V Plan:		11/1/2022
Task 3.1 Data Collection and Validation	Draft Data Request	Within 5 days of kickoff meeting	9/30/2022
	Final Data Request	Within 10 days of kickoff meeting	
Tasks 3 & 4 Impact Analysis & Reports	Draft Ex-Post LI Estimates (table generators/report)	Due late December, 2022	
	Final Ex-Post LI Estimates (table generators/report)	Due early January, 2023	
	Draft Ex-Ante LI Estimates (table generators/report)	Due February 15th, 2023	
	Final Ex-Ante LI Estimates (table generators/report)	Due March 1st, 2023	
	Final hourly and monthly Ex-Post and Ex-Ante datasets	Due March 1st, 2023	
	Executive Summary write-up for April 1st reports	Due March 15th, 2023	
	Non-technical abstract for CALMAC website	Due April 10th, 2023	
Task 5 Presentation of Results	Presentation	Date to be determined	
Task 7 Database documentation	2017 Integrated project database	March 1st, 2023	
	2017 Database specifications and documentation	March 1st, 2023	