Christensen ASSOCIATES

Measurement and Evaluation Research Plan

for

Load Impact Evaluation of SDG&E's Voluntary Residential Smart Pricing Program (SPP) for 2025

FOR

San Diego Gas & Electric

September 17, 2025

800 University Bay Dr #400
Madison, WI 53705-2299

608.231.2266
www.CAEnergy.com

Table of Contents

1. INTRODUCTION AND KEY ISSUES

This research plan describes how Christensen Associates Energy Consulting, LLC (CA Energy Consulting) plans to conduct a load impact evaluation of San Diego Gas & Electric's (SDG&E) voluntary residential critical peak pricing (CPP) and time-of-use (TOU) rates for 2025. The rates, referred to collectively as residential Smart Pricing Program (SPP) rates, are TOU-DR (a traditional non-event TOU rate), TOU-DR-P (a TOU rate with an event-based CPP component), and EV-TOU-5-P (an electric vehicle TOU rate with an event-based CPP component). [1]

Updated TOU time periods became effective on December 1, 2017, pursuant to D.17-080-030. The time periods address the timing of the utility's and the state's peak demand. Table 1 contains the TOU pricing periods currently in effect. The TOU periods in Summer are centered around an on-peak period of 4:00 p.m. to 9:00 p.m. on all days, which is surrounded by morning and evening off-peak periods, and an overnight super off-peak period. The off-peak and super-off-peak periods differ by day type (i.e., weekdays, weekends) as well as season (i.e., Summer, Winter), as can be seen in Table 1. The Summer season covers June 1st through October 31st, and the Winter season is from November 1st through May 31st.

Table 1: Current SPP TOU Periods

Day Type	TOU Period	Summer	Winter
Weekdays	On-Peak	4:00 p.m. – 9:00 p.m.	4:00 p.m. – 9:00 p.m.
	Off-Peak	6:00 a.m. – 4:00 p.m.; 9:00 p.m. – Midnight	6:00 a.m. – 4:00 p.m.
			Excluding 10:00 a.m. – 2:00 p.m. in March and April;
			9:00 p.m. - Midnight
	Super-Off-Peak	Midnight – 6:00 a.m.	Midnight – 6:00 a.m.;
			10:00 a.m. – 2:00 p.m. in March and April
Weekends and Holidays	On-Peak	4:00 p.m. – 9:00 p.m.	4:00 p.m. – 9:00 p.m.
	Off-Peak	2:00 p.m. – 4:00 p.m.;	2:00 p.m. – 4:00 p.m.;
		9:00 p.m. - Midnight	9:00 p.m. - Midnight
	Super-Off-Peak	Midnight – 2:00 p.m.	Midnight – 2:00 p.m.

CPP events in which the CPP rate applies may be called during the 4:00 p.m. to 9:00 p.m. period on any day (including weekends) throughout the year.

[1] EV-TOU5-P customers are only included in the CPP part of the ex-post and ex-ante analysis.

1.1 Project Goals

The primary goals for this evaluation are the following:

1. Estimate hourly ex-post load impacts for the residential voluntary TOU and CPP rates for 2025, including:
   - Event-day hourly load impacts for CPP, if an event is called during the program year.
   - Non-event day load impacts for both TOU and CPP.[2]
2. Produce ex-ante load impact forecasts for both TOU and CPP through 2036.

The evaluations shall conform to the Load Impact Protocols adopted by the California Public Utilities Commission (CPUC) in April 2008 (D.08-04-050), including both event-based and non-event-based protocols.

1.2 Roadmap

Section 2 discusses technical issues and our approach for conducting the study. Section 3 lists the data sources. Section 4 contains detailed work plan by task for meeting the study objectives, including a task list with the associated schedule and deliverables. Section 5 describes our quality control mechanisms and processes.

2. STUDY METHOD

This section discusses technical issues to be addressed in this study, and our planned approach to resolving those issues. We begin by describing the planned ex-post load impact estimation methods and then turn to development of the ex-ante forecasts.

2.1 2025 CPP Program Activity

No residential CPP events were called as of September 5, 2025.

2.2 Evaluation Design

The ex-post event-day impacts, if applicable,[3] and non-event day impacts will be estimated using difference-in-differences evaluation approaches that compare treatment and quasi-experimental matched control group customer usage on relevant days or time periods, adjusted by their usage differences on pre-treatment or non-event days. The control groups will be selected by matching each treatment customer to one of an initial sample of eligible non-treatment customers in relevant population segments (e.g., climate zone and CARE status), based on the closest match

[2] For non-event-based rates, the Load Impact Protocols call for estimating monthly system worst day load impacts. We will also provide average weekday load impacts by month.

[3] If no event is called, event-day impact estimation is omitted, as the absence of an event precludes conducting an ex-post load impact analysis.

of load profiles. The initial samples of eligible control group customers will be developed within each segment from the eligible population of SDG&E residential customers. Ideally, the control group will draw from an existing pool of non-TOU customers who have not yet been defaulted onto TOU rates. However, if this pool does not contain a sufficient number of non-TOU customers, the control group will consist of customers on a TOU rate over the entire study period or customers who have opted-out of TOU rates.

When estimating TOU impacts using a non-TOU control group (for both TOU-DR and TOU-DR-P customers, relative to a non-TOU counterfactual rate), the treatment customers will be matched by comparing loads in the pre-treatment period (i.e., before the customer enrolled in the TOU rate). The TOU customers will be matched separately by season, based on two pairs of hourly loads for each season—one for all weekdays, and one for a subset of the hottest (or coldest) weekdays. Matching for the non-summer season will use data for the November through May preceding TOU enrollment, while matching for the summer season will use data for the June through October preceding TOU enrollment.[4] If the non-TOU control group is not viable, the match will occur during the treatment period when both treatment and control customers are on a TOU rate. Otherwise, it will follow the same methodology described above.

Table 3 summarizes the ex-post load impact analyses described above, including the treatment customers, the load impact to be estimated, whether a control group will be used, and the day types for which load impacts will be estimated.

Table 2: Summary of Ex-Post Load Impact Analyses

Treatment Customers	Load Impact Represents…	Control Group?	Day Types
TOU-DR enrolled on or after 10/1/2024	Current TOU periods vs. non-TOU rate	Yes; non-TOU customers	Monthly peak days, typical event day
TOU-DR-P enrolled on or after 10/1/2024	Current TOU periods vs. non-TOU rate	Yes; non-TOU customers	Monthly peak days, typical event day
TOU-DR-P and EV-TOU-5-P enrolled at any time during PY2025	CPP event days vs. non-event days	Yes; TOU-DR and EV-TOU-5 customers[5]	Each event called during PY2025, if applicable

We will select matched control groups separately for TOU and CPP load impacts. For TOU load impacts (TOU-DR and TOU-DR-P), we will find a matched control group for incremental TOU customers only (i.e., customers that joined TOU after the program year began). Load data for embedded TOU customers will be used to help develop reference loads for all customers on the program.[6] For CPP load impacts (TOU-DR-P and EV-TOU-5-P), matched control groups will be created if an event has been called during the program year. EV-TOU-5-P participants will be matched only to customers on the non-CPP "EV-TOU-5" rates, while TOU-DR-P participants will

[4] The Summer matching period is October 2023 and June through September 2024.

[5] We may also include non-TOU customers as a control group for TOU-DR-P customers depending on the sample size of TOU customers (TOU-DR) relative to CPP customers (TOU-DR-P) and the resulting match quality.

[6] Incremental customers are used to estimate ex-post TOU load impacts. The estimated TOU load impacts can then be applied to all TOU customers (e.g., incremental, embedded) to provide program-level estimates.

be matched to customers on a TOU-DR rate. We anticipate that the matched control groups of non-TOU and non-CPP participants will be of similar size to the participant groups.[7]

The objective in selecting a quasi-experimental matched control group is to identify a group of customers that is as comparable as possible to the treatment customers, focusing on their hourly usage prior to program enrollment. The match will account for customer usage levels on both hotter than normal days (i.e., similar to days on which CPP events tend to be called) and a set of moderate temperature days. The use of profiles from both hot and milder weather days allows the match to account for the weather sensitivity of the customer's usage. To improve the efficiency of the search for comparable customers, we will match customers within segments defined by location (i.e., climate zone) with separate matches for TOU-DR, TOU-DR-P, and EV-TOU-5-P customers.[8]

Once the candidate control group customers have been segmented, we will conduct a matching analysis within each group of customers, using hourly load profiles by weather day type as the basis of the match. The matching process will be conducted using the Euclidean Distance method. This method is based on a direct comparison of usage profiles of treatment and potential control customers during pre-treatment periods for TOU load impacts, or on non-event days for CPP load impacts, selecting the match that minimizes the "distance" (difference) between the treatment customer and the control-group customer.[9] That is, it selects the customer with the most similar load profile in the group, where matches may be segmented by location, CARE status, etc. A tolerance level can be set to reject matches (i.e., leave the treatment customer unmatched) for which the Euclidean distance exceeds a specified level.

For NEM customers, the matching process is modified in three ways. First, only customers that are NEM for the entire analysis period and have not made changes to their solar PV system are included. Second, NEM treatment customers must be matched to NEM control customers that have comparable solar photovoltaic generation capacity sizes. Third, customers with large changes in net profiles between periods are not used in the analysis because the differences are more likely caused by unobserved structural changes to a customer's solar PV system. Each of these requirements helps prevent estimating load impacts (TOU or CPP) that are confounded by differences in solar generation capacity between periods and/or between the treatment and control groups, as opposed to only a behavioral response to TOU rates or CPP events.

Once matched control group customer accounts have been selected for each TOU and CPP participant, we set up difference-in-differences fixed-effects panel regression models for each relevant group (e.g., separate groups for TOU and CPP, by Coastal and Inland climate zones, NEM). The models include hourly load data for the relevant period for each participant in the

[7] We allow selection with replacement for the matched control group from the relevant population, such that some customers may serve as matches for more than one TOU or CPP customer. In these cases, the customers with multiple matches are duplicated in the analysis database to effectively apply appropriate weighting.
[8] TOU-DR-P rate customers will have separate matches for the TOU and CPP load impact estimates. This is because the TOU load impacts require matching on prior-year usage, while CPP load impacts can use matches based on non-event days during the current program year.
[9] Incremental TOU customers without complete pre- and post-treatment data for the analysis period can cause biases in the matched and difference-in-difference analysis. Pre-treatment periods will be established for TOU customers to maximize the number of incremental customers that have complete data and can be included in the analysis. Similarly, non-event days will be used to match CPP customers to maximize the number of customers included in the regression analysis.

group, along with their matched control group customer, as well as data for the pre-treatment period. The models are described in detail in Section 2.3.

2.3 Ex-Post Load Impact Evaluation

The primary objectives of the ex-post impact evaluation were described in Section 1.1. This section describes the data and specific methods that we plan to use, including a discussion of the estimation of uncertainty-adjusted load impacts and distributions of load impacts. The methods described here focus on the control-group methods, as those will be the basis for the impacts reported under the Protocols.

2.3.1 Data

Analysis that addresses each of the load impact objectives listed in Section 1.1 requires the following types of data:

- Customer information for the residential TOU and CPP enrollees and potential control group customers (e.g., location indicator for matching to climate zone, and a summary indicator of their usage level);
- Billing-based interval load data (i.e., hourly loads for each TOU and CPP enrollee, and potential control group customers);
- Weather data (i.e., hourly temperatures and other variables for the relevant time period, for both climate zones—coastal and inland);
- Program event data (i.e., dates and hours of CPP events with notification status, and event triggers).

2.3.2 Analysis Methods

This section describes the process that we plan to follow in estimating program load impacts. Estimating load impacts using data for both participants and matched control group customers involves three steps. First, we request hourly load data for the TOU and CPP enrollees, and potential control group customers, for the current year and pre-enrollment year. Second, we select matched control group customers for the TOU and CPP enrollees, as described above. Third, we estimate fixed-effects panel regression models, representing difference-in-differences estimates of event load impacts (for CPP), if applicable, and average TOU period load impacts (for both TOU and for CPP non-event days).

Fixed-effects panel regression models

The formal ex-post load impact estimates will be based on fixed-effects panel regression models. These models are appropriate in situations like the current study, in which observed data are available for both multiple individual customers (cross-section) and multiple days, or time periods (time-series). The advantages of estimating such models include: 1) accounting for the effect of relevant factors on the variation in usage across customers and days, 2) accounting for the effects of weather conditions on usage, and 3) calculation of standard errors around the estimated load impact coefficients, thus allowing construction of confidence intervals.

Estimating hourly ex-post load impacts by subgroup

We typically estimate two versions of fixed-effects models. The first version is used to estimate CPP event-day hourly load impacts, if applicable, for TOU-DR-P and EV-TOU-5-P customers. Weekend CPP event load impacts are estimated separately from weekday event impacts since load patterns may vary between weekdays and weekend days. The CPP event load impacts are also estimated separately across rates, with EV-TOU-5-P CPP load impacts being estimated using EV-TOU-5-P customers and TOU-DR-P load impacts being estimated using the TOU-DR-P customers.[10] The second version is used to estimate the TOU load impacts, which include interaction terms to estimate potential differences in TOU load impacts between TOU-DR and TOU-DR-P customers.

The load impact estimation model for CPP estimates the CPP load impact as the difference between CPP and control-group customer loads on event days less the difference on non-event days. The following model is estimated for each hour of the day:

$$kWh_{c,d} = \beta_0 + \sum_{Evts(i)}(\beta_{1,i} \times NonDual_{c,d} \times Evt_{i,d}) + \sum_{Evts(i)}(\beta_{2,i} \times Dual_{c,d} \times Evt_{i,d}) + \sum_{Evts(i)}(\beta_{3,i} \times NonDual\ Control_{c,d} \times Evt_{i,d}) + \sum_{Evts(i)}(\beta_{4,i} \times Dual\ Control_{c,d} \times Evt_{i,d}) + \beta_5 \times CPP_{c,d} + \beta_6 \times CDD60_{c,d} + C_c + D_d + \varepsilon_{c,d}$$

The variables and coefficients in the equation are described in the following table:

Table 3: Description of Variables Used in the CPP Analysis Regressions

Symbol	Description
$kWh_{c,d}$	Load in a particular hour for customer *c* on date *d*
$NonDual_{c,d}$	Variable indicating whether customer *c* is a non-dual *CPP* customer on date *d* (1 = yes, 0 if not)
$Dual_{c,d}$	Variable indicating whether customer *c* is a dually enrolled *CPP* customer on date *d* (1 = yes, 0 if not)
$NonDual\_Control_{c,d}$	Variable indicating whether customer *c* is a control customer matched to a *CPP* customer who is not dually enrolled, on date *d* (1 = yes, 0 if not)
$Dual\_Control_{c,d}$	Variable indicating whether customer *c* is a control customer matched to a dually enrolled *CPP* customer, on date *d* (1 = yes, 0 if not)
$Evt_{i,d}$	Variable indicating that date *d* is the i^{th} event day (1=i^{th} event, 0 if not)
$CDD60_{c,d}$	Variable indicating the cooling degree days, base of 60 degrees Fahrenheit, for customer *c* on date *d*
C_c	Customer Fixed Effects
D_d	Date Fixed Effects
$\varepsilon_{c,d}$	Error term
β_0	Estimated constant coefficient
$\beta_{1,i}$	Estimated load impact for event *i* for non-dual *CPP* customers
$\beta_{2,i}$	Estimated load impact for event *i* for dually enrolled *CPP* customers
$\beta_{3,i}$	Estimated load impact for event *i* for control customers matched to non-dual *CPP* customers
$\beta_{4,i}$	Estimated load impact for event *i* for control customers matched to dually enrolled *CPP* customers

[10] If the number of customers enrolled in EV-TOU-5-P are insufficient, the load impacts for EV-TOU-5-P customers will be estimated using both EV-TOU-5-P and TOU-DR-P customers.

Symbol	Description
β_5	Estimated non-event day response for incremental *CPP* customers
β_6	Estimated coefficient for a $CDD60_{c,d}$ value.

The model includes date and customer fixed effects to account for factors that commonly affect all customers over time (e.g., weather conditions and day-type factors) and time-invariant customer characteristics (e.g., home size). The $\beta_{1,i}$ coefficients represent the estimated average load impacts for each hour of every event day for CPP customers who are not dually enrolled. The $\beta_{2,i}$ coefficients separately estimate load impacts for customers dually enrolled in CPP and a dual group of interest. We apply this interacted model to produce separate estimates for customers dually enrolled in emergency load reduction program ("ELRP"). This model is also estimated for customers who receive notifications and customers who do not receive notifications.

Results are scaled to enrollment numbers because a portion of residential CPP customers are removed from the analysis based upon insufficient load quality and NEM customer restrictions. To produce load impact estimates for specific customer segments (e.g., by climate zone, NEM), the model is estimated for the subset of customers in each segment.

The load impact estimation model for TOU estimates the TOU load impact as the difference between TOU and non-TOU (DR) control-group customer loads during the post-TOU enrollment period less the difference during the pre-enrollment period. The following model is estimated for each season[11] and hour of the day:

$$kWh_{c,d} = \beta_0 + \beta_1 \times TOU_c \times Post_{c,d} + \beta_2 \times Post_{c,d} + \beta_3 \times TOU_c \times Post_{c,d} \times CPP_c$$
$$+ \beta_4 \times Weather_{c,d} + \beta_5 \times Weather_{c,d} \times NEM_c + \beta_6 \times Inland_c \times Weather_{c,d}$$
$$+ \beta_7 \times TOU_c \times Post_{c,d} \times Weather_{c,d} + C_c + D_d + \varepsilon_{c,d}$$

The variables and coefficients in the equation are described in the following table:

[11] The model is estimated for the three TOU seasons: summer, winter, and March through April. The summer season includes June, July, August, September, and October, while the winter season includes January, February, May, November, and December.

Table 4: Description of Variables Used in the TOU Analysis Regressions

Symbol	Description
$kWh_{c,d}$	Load in a particular hour for customer *c* on date *d*
TOU_c	Variable indicating whether customer *c* is in TOU (1) or Control (0) customer
CPP_c	Variable indicating whether customer *c* is in CPP (1) or Control (0) customer
NEM_c	Variable indicating whether customer *c* is a NEM (1) customer or a non-NEM (0) customer
$Inland_c$	Variable indicating whether customer *c* is an Inland climate zone (1) customer or is a Coastal climate zone (0) customer
$Post_{c,d}$	Variable indicating that date *d* is in the post-enrollment period for customer *c*
$Weather_{c,d}$	Weather conditions on day *d* for customer *c*
C_c	Customer Fixed Effects
D_d	Date Fixed Effects
$\varepsilon_{c,d}$	Error term
β_0	Estimated constant coefficient
β_1	Estimated TOU load impact for all TOU customers
β_2	Estimated load impact for control customers during post-enrollment period
β_3	Estimated incremental TOU load impact for CPP customers
β_4	Estimated load impact of weather
β_5	Estimated load impact of NEM status interacted with weather
β_6	Estimated load impact of Inland climate zone interacted with weather
β_7	Estimated TOU load impact interacted with weather

The model is estimated for each TOU season.[12] Interactions between the treatment effect and weather allow the load impact to vary based on weather conditions in a given month or on a given peak day within a month. The β_1 coefficient is the estimated average TOU load impact for each season and hour. The β_7 coefficient is the incremental load impact associated with a change in weather conditions. The estimated load impact for a given month is obtained by the following formula:

$$Load\ Impact_{month\ m} = \hat{\beta}_1 + \hat{\beta}_3 \times CPP_c + \hat{\beta}_7 \times \overline{Weather}_{month\ m}$$

The first term indicates the load impact for a customer that adopted a TOU rate (TOU-DR or TOU-DR-P), while the second term indicates the incremental load impact for TOU customers that are enrolled in CPP (TOU-DR-P). The third term multiplies the average weather conditions during month *m* by the estimated coefficient for the interaction term between the treatment effect and weather. The same formula is applied using weather conditions for each monthly system worst day to produce TOU load impacts for monthly system worst days.

The model includes date and customer fixed effects to account for factors that commonly affect all customers over time (e.g., day-type factors) and time-invariant customer characteristics

[12] We will investigate estimating an annual version of the model that still incorporates seasonal matches. The purpose would be to evaluate if a shared weather coefficient between seasons improves continuity of the load impact estimates between seasons, particularly for swing months.

(e.g., home size). Incremental customers along with their matched control group are used to estimate the TOU load impacts in each regression. Event days are removed from the dataset when estimating TOU load impacts. Results are then scaled to the program level of enrollments. To produce load impact estimates for specific customer segments (e.g., TOU vs. CPP rate, climate zone, NEM), the model is estimated for the subset of customers in each segment.

Estimating distributions of load impacts for different customer segments

We will produce distributions of load impacts by percentiles of usage from the statistical comparison of event-day treatment and control groups separated by categories of average hourly peak-period usage. That is, the models described above can be estimated on different sub-sets of customers, allowing us to estimate, for example, load impacts by climate zone.

Calculating uncertainty-adjusted load impacts

The Load Impact Protocols require the estimation of uncertainty-adjusted load impacts. In the case of ex-post load impacts, the coefficients that represent the estimated load impacts in the fixed-effects regressions are not estimated with certainty, but with a range of uncertainty indicated by the variance of the estimates. Therefore, we will base the uncertainty-adjusted load impacts on the variances associated with the estimated load impact coefficients (e.g., the event-day or treatment-period coefficients in the twenty-four hourly regressions).

The uncertainty-adjusted scenarios will then be simulated under the assumption that each hour's load impact is normally distributed with the mean equal to the sum of the estimated load impacts and the standard deviation equal to the square root of the sum of the variances of the errors around the estimates of the load impacts. Results for the 5h, 50th, and 95th percentile scenarios will be generated from these distributions.

In order to develop the uncertainty-adjusted load impacts associated with the average event hour or by TOU pricing period (i.e., the bottom rows in the tables produced by the ex-post table generator), we will estimate additional sets of regression models in which the load impact variable is constrained to be the same across the applicable hours (e.g., we directly estimate an average event-hour CPP load impact). If no CPP events are called, this step applies only to TOU impacts. The associated standard errors will then be used to develop the uncertainty-adjusted load impacts in the same manner described above.

We will also develop an average event hour load impact during the peak and event hours.

Validity assessment

Because we are employing a control-group approach, our validity assessment will focus on comparisons of treatment and control-group loads for selected non-event or pre-treatment days. To the extent that the two groups differ systematically, we will assess the ability of our models to properly implement the difference-in-differences approach. This will be implemented by comparing simulated loads to observed loads on event-like non-event or pre-treatment days. The performance of the models will be evaluated in terms of accuracy and potential bias (e.g., do the equations systematically understate load on hot days?). We will also report statistics like relative root mean square error and median percent error, which provide formal estimates of the percent differences between observed and simulated loads.

Prevailing and UTC-8 Time

The TOU analysis will be conducted in the prevailing time. During the Daylight-Saving Period (March through November), the protocol table will calculate UTC-8 results by shifting prevailing time results back by one hour (e.g., UTC-8 HE16 corresponds to HE17 in the prevailing time), with UTC-8 HE24 aligning with HE1 in the prevailing time. In contrast, the CPP analysis, will be carried out directly in UTC-8 time to capture potential post-event snapback effects occurring in UTC-8 HE24 (equivalent to HE1 of the following day in prevailing time). Prevailing time results for CPP will then be calculated in the protocol table generators by shifting UTC-8 results forward be one hour (e.g., HE18 in prevailing time corresponds to UTC-8 HE17). In the case of no CPP event during the program year, the CPP shift will only be applied in the ex-ante part of the analysis.

2.4 Developing Ex-Ante Load Impacts

Estimating ex-ante load impacts for future years for a particular DR rate or program requires three key pieces of information:

- An enrollment forecast for relevant elements of the program;
- Reference loads by customer type;
- A forecast of load impacts per customer, again by relevant customer type, where the load impact forecast also varies with weather conditions, as determined in the ex-post evaluation.

SDG&E will provide the first of the three required items, the enrollment forecast. The second and third items (per-customer reference loads and load impacts) will be simulated using a modified version of the regression model presented in Section 2.3. Specifically, we will add an interaction between the load impact variable and weather to the "descriptive" model (with weather variables, etc. in place of daily fixed effects). This will allow us to simulate both the reference loads (using predicted loads with the load impact variables "turned off") and the load impacts (using only the load impact variables, including the estimated effect of weather on the load impact). If the estimated load impact does not vary with weather (or if the relationship can't be estimated due to a low number of events), then we propose applying the ex-post load impact percentage to simulated reference loads to calculate the ex-ante load impact.

Reference loads and load impacts are simulated using the appropriate weather scenario data (i.e., the 1-in-2, 1-in-10 weather-year, and worst-case conditions to be provided by SDG&E) and event-day characteristics. If SDG&E determines that future participants will be systematically different from current participants, we will explore the availability of interval data for more representative customers that can be used to develop the ex-ante reference loads and load impacts. We then apply the per-customer reference loads and load impacts to SDG&E's enrollment forecast to generate ex-ante forecasts.

We will also develop an average event hour load impact during the RA window, 5-10 p.m. for November through May and 4-9 p.m. for all other months.

Uncertainty-adjusted load impacts will be generated from variations in the ex-post percent load impacts across events for CPP, or the ex-post estimation precision by day type/hour for TOU.

Scenario-specific percent load impacts will be developed from 5th, 50th, and 95th percentile load changes estimated for the relevant program year.

In addition to an ex-ante forecast that conforms with the load impact protocols, we will also produce a time-temperature matrix similar to the one produced in PY2024. The time-temperature matrix is a useful tool for program managers that displays the load impacts across temperatures that vary between 50- and 110-degrees Fahrenheit for various customer segments.

We will also include with the load impact protocols "Slice-of-Day" results which will display hourly CPP load impacts by month for selected results (e.g., forecast year). The 24-hour slice-of-day framework is a California Independent System Operator (CAISO) requirement that SDG&E demonstrates it has enough capacity to satisfy its specific gross load profile in all 24 hours on the CAISO's "worst day" in that month. [13] Providing CPP slice-of-day results will assist SDG&E in fulfilling this requirement.

In the event that no CPP events are called during the program year, the CPP ex-ante analysis will be anchored to the most recent program year in which CPP events were observed. Specifically, the load impacts estimated from that prior year's ex-post analysis will serve as the basis for forecasting, while the current program year's reference loads will be applied to ensure that results reflect prevailing usage patterns, customer characteristics, and load shapes. This approach maintains internal consistency with the reference load framework by scaling previously observed treatment effects to current baseline conditions.

3. DATA SOURCES

SDG&E will provide the required data, including customer characteristics; interval load data; weather data; program participation and event data; and ex-ante scenario data (i.e., the weather conditions associated with each required scenario).

4. DETAILED PLAN OF WORK

This section describes our work plan for conducting the project, which consists of seven tasks.

Task 1: Conduct Project Initiation Meeting

A project initiation (PI) meeting was held on September 5, 2025, by Microsoft Teams call. We provided a meeting agenda prior to the meeting along with a meeting summary memorandum the same day.

Deliverables:

- PI Meeting agenda — September 4, 2025
- PI Meeting — September 5, 2025

[13] The slice-of-day framework requirement was established in D.22-060-050, Appendix A.

- PI Meeting memorandum — September 5, 2025

Task 2: Develop Measurement and Evaluation Plan

CA Energy Consulting will draft a measurement and evaluation (M&E) plan (this document), which builds on our proposal document and takes into account discussions at the PI meeting. The plan is organized around the following outline:

- Introduction and Key Issues.
- Study Method (e.g., show specifics on how the data collection and research plan will address all of the research objectives outlined in the introduction).
- Data Sources. This section specifies data sources needed to successfully complete the evaluation, including customer information for any planned samples, program implementation information, and smart meter interval load and billing data.
- Detailed Plan and Work. This section describes planned tasks and sub-tasks for completing the evaluation, including task definitions and deliverables.
- Deliverables Schedule and Due Dates. This section summarizes deliverables and due dates and provides a timeline for the project.
- Quality Control Mechanisms and Processes. This section outlines our plans to ensure the tables, figures, data files, and table generators have been checked for accuracy and are error-free.

Deliverables:

- Draft M&E plan — September 17, 2025
- Final M&E plan — 5 business days after receipt of comments

Task 3: Impact Evaluation

This task involves assembling data and conducting the ex-post and ex-ante evaluations.

Task 3.1: Data Collection and Validation

CA Energy Consulting will prepare a data request memorandum for SDG&E specifying the information required to conduct the analysis. The requested data will include but is not limited to:

- Customer IDs
    - Account number
    - Premise ID
    - Service point ID
    - Channel ID
- Location variables
    - ZIP code
    - Climate zone
    - Weather station
    - Busbar ID

    - Circuit ID

- Billing-based interval load data for each sample customer
- Outage information for each customer
- Date enrolled and de-enrolled (where applicable) in TOU or CPP
- Dates called for CPP events (where applicable)
    - Notification status by customer and event
- Date enrolled and de-enrolled (where applicable) in other DR programs
    - Emergency Load Reduction Program
- Dates called for other DR program events (e.g., ELRP)
- Date enrolled in NEM (where applicable) and solar PV characteristics
    - Solar PV Size
    - For customers that change their solar PV size, a history of PV size
- Battery installation date and size

As described in Section 2.2, for purposes of selecting the matched control groups, we will also need customer characteristics (e.g., climate zone) and interval load data for the set of potential control-group customers. We will work with SDG&E staff to determine an appropriate number of customers to include in the set of potential matched control group customers and a method for drawing them.

We will examine the data as it arrives to ensure that the customer information can be matched to hourly load data; and to ensure that the hourly load data appear to be accurate. CA Energy Consulting will then create the databases required to conduct the analyses.

Deliverables:

- Initial data request September 17, 2025
- Final data request Late-September 2025

Task 3.2: Ex-post Load Impact Analysis

We will estimate average TOU load impacts, and hourly load impacts and reference loads for each CPP event, at the program and average customer level, using methods as described in Section 2.3, and as agreed upon with the SDG&E project manager. Uncertainty-adjusted load impacts and distributions of load impacts by customer subgroups will be developed as described in Section 2.3.

Task 3.3: Ex-ante Impact Analysis

Forecasted load impacts and reference loads for 2025 through 2036 will be produced for 1-in-2 and 1-in-10 weather year conditions, for all three SPP rates, on a per-customer and aggregate basis. Results shall be provided for:

- The typical event day (for CPP).

- For TOU and the non-event portion of CPP, forecasts shall be provided for the monthly system peak day and average weekday and weekend, for each month that the rates will be available, under both 1-in-2 and 1-in-10 weather year conditions, for both CAISO and SDG&E monthly peak days.
- Forecasts for the average day by month in both 1-in-2 and 1-in-10 weather year conditions.
- Uncertainty-adjusted load impacts shall be estimated on an aggregate and per-customer basis.

In addition, a time-temperature matrix that displays load impacts over the range of weather temperatures from 50 to 110 degrees Fahrenheit will be provided.

Finally, SDG&E may request that we produce an updated ex-ante forecast for a July 1st filing. SDG&E has the option to make the filing if the forecast load impacts increase by 20% or 10 MW above the assigned QC value.

Task 4: Prepare Reports

CA Energy Consulting will prepare draft, high-level summary, and final reports that summarize the load impacts estimated in Tasks 3.2 and 3.3, in the schedule provided below. The report will contain a non-technical abstract and executive summary; an introduction summarizing objectives and an overview of the program and project; a section describing the data used and analysis techniques employed; a results section presenting ex-post load impacts; a validity assessment of the findings discussing any threats to the reliability of the results; and a conclusion section summarizing findings and recommendations. In conjunction with the final report, we will deliver spreadsheet-based Protocol table generators, which will provide the user with explanations for why some data may not be reported in the table (e.g., no customers in the cells, or restrictions to maintain customer confidentiality). The report will include an abstract of less than 3,000 characters that is suitable for posting on the CALMAC website.

In addition, we will provide a Quality Control (QC) report that will demonstrate that load impacts add up correctly, demonstrate that the number of customers in the program agrees with the datasets provided, compare ex-post and ex-ante load impacts, and ensure that MW levels are consistent with the enrollment forecasts.

Deliverables:

- Draft ex-post LI estimates (report/table generators) — Late December 2025
- Final ex-post LI estimates (report/table generators) — Early January 2026
- Time-temperature matrix — Late January 2026
- Draft ex-ante LI estimates (report/table generators) — February 16, 2026
- Final ex-ante LI estimates (report/table generators) — March 2, 2026
- Final hourly and monthly ex-post and ex-ante datasets — March 2, 2026
- Executive Summary write-up for April 1st reports — March 9, 2026
- Non-technical abstract for CALMAC website — April 10, 2026

Task 5: Presentation of Results

CA Energy Consulting will attend the DRMEC load impact workshop that traditionally follows the submittal of the utilities' impact evaluation reports and will present results of TOU and CPP load impacts.

Task 6: Project Management and Progress Reporting

The CA Energy Consulting project manager (Dr. Mike Clark) shall manage all day-to-day details of the project. He will work closely with the SDG&E project manager to ensure smooth operation of the project.

We shall participate in conference calls as requested and shall provide monthly written status reports by the 10th day of each month.

Deliverables:

- Monthly or bi-weekly conference calls. TBD
- Monthly status reports showing:
  1. summary of accomplishments in previous month;
  2. current month's planned activities; and
  3. any variances in schedule and budget, with explanations as needed.

Task 7: Database Documentation

Upon Program Manager's request, CA Energy Consulting shall provide an integrated project database consisting of all the data collected and developed in the project and produce detailed documentation of all variables used in the database.

Deliverables

- Integrated project database March 2, 2026
- Database specifications and documentation March 2, 2026

5. QUALITY CONTROL MECHANISMS AND PROCESSES

CA Energy Consulting will conduct a variety of quality assurance procedures, as described below.

- *Database review.* We will evaluate the interval data to ensure consistency and regularity, checking it against billing data if necessary.
- *Evaluation of estimated reference loads.* We will compare our estimated load impacts to program-based estimates and results from an informal "day matching" method. In the latter case, we compare loads on event and comparable non-event days to develop a load impact estimate that we compare to the econometrically estimated load impacts.

- *Reporting checklist.* We have developed a checklist that the project team will apply to each results table generator and to the evaluation report. This will help ensure that results are correct, complete, consistent, and properly labeled.

CA Energy Consulting will also carefully review the databases that must be provided to comply with the Protocols.