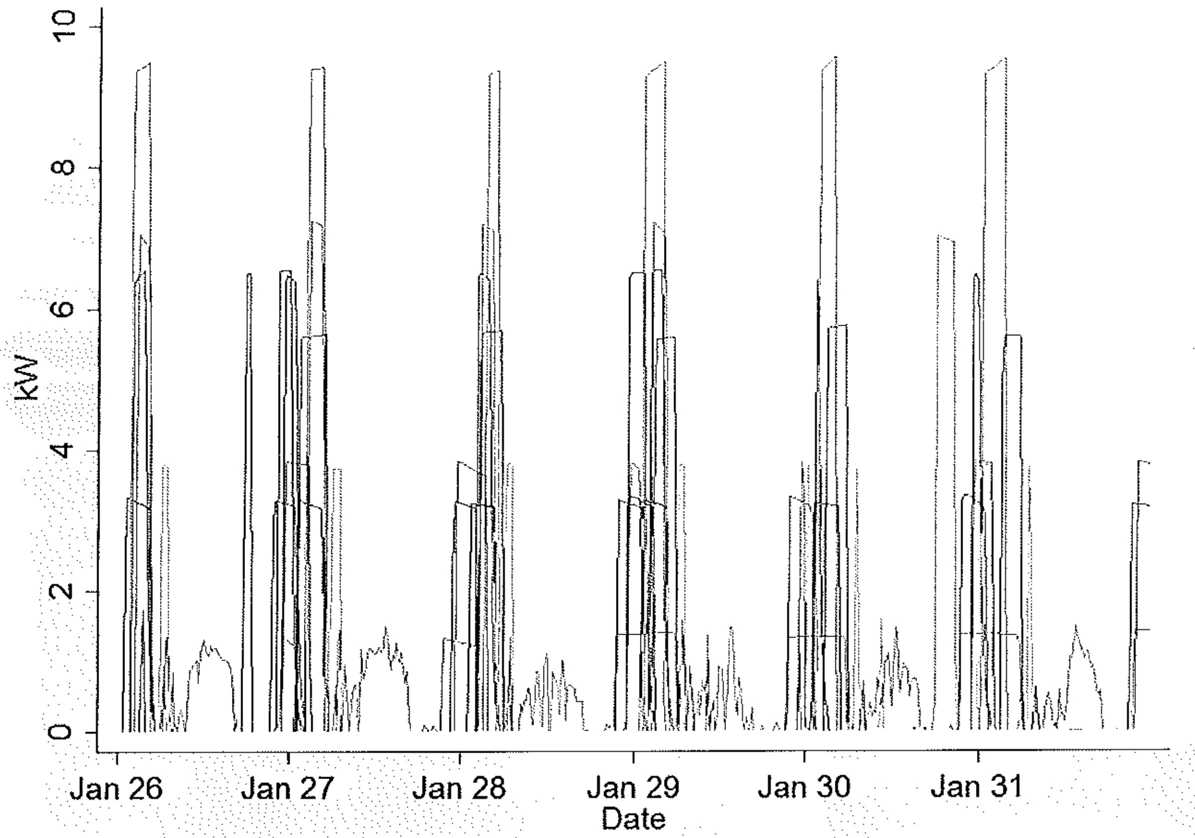
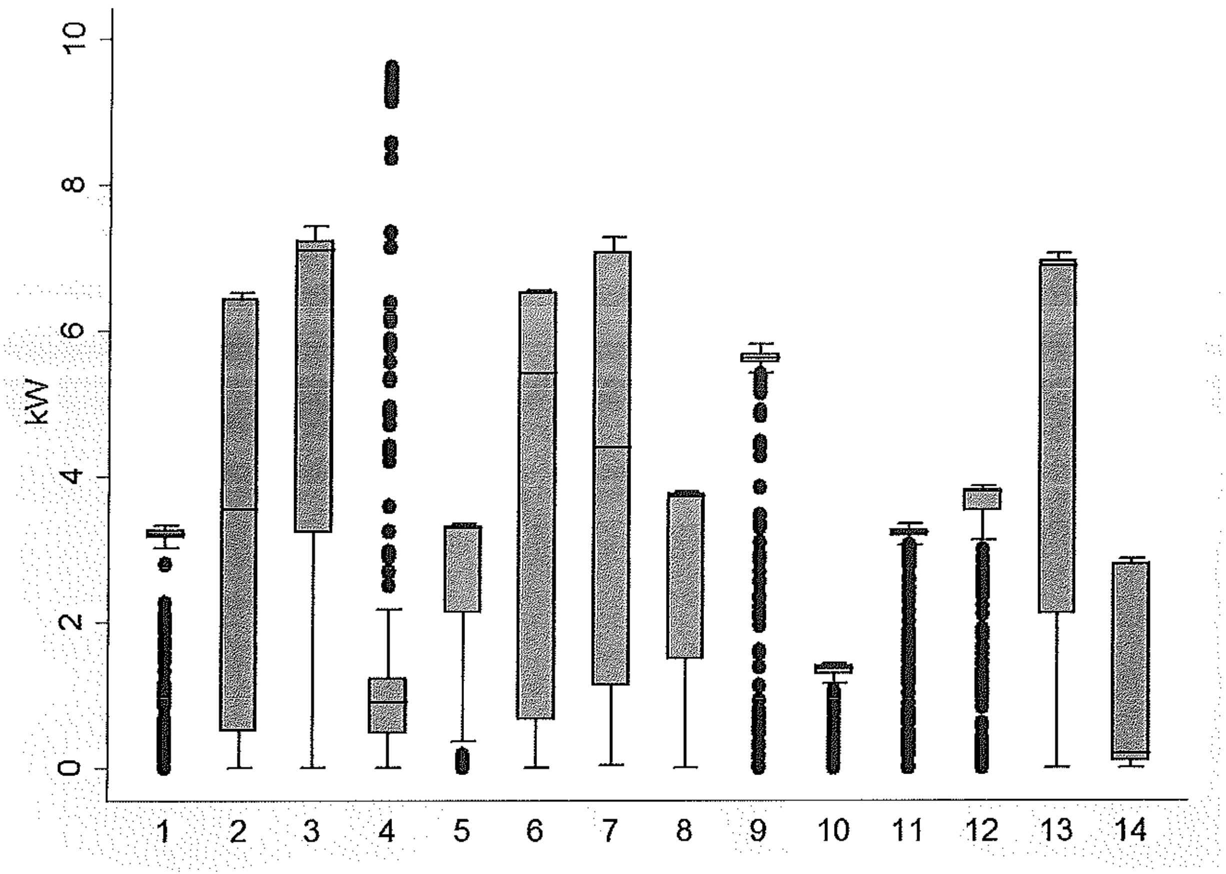
Figure 4-2: Time Plots for Submeters in Accuracy Sample



Box plots showing the distributions of non-zero measurements are shown in Figure 4-3. For most submeters, the distribution is very skewed with a long tail either extending toward zero or the top end of the distribution. Tails toward zero are an artifact of discretizing continuous time since it is unlikely that charging will begin or end exactly at the end of a 15 minute interval. Outliers in each distribution are denoted as individual points.

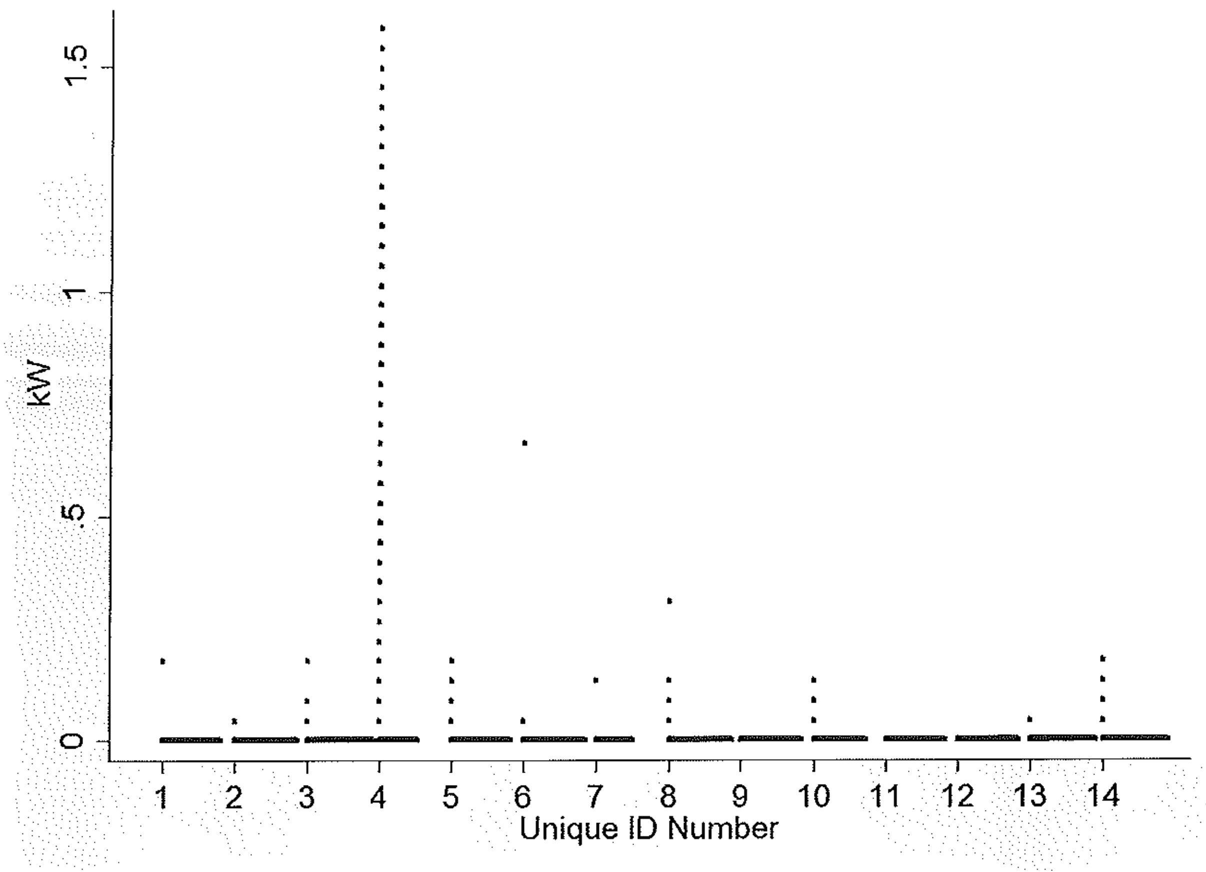
Figure 4-3: Box Plots of Non-zero Submeter Measurements



The on/off nature of charging loads suggests a two-pronged approach for assessing accuracy. First, it is informative to examine whether submeters are recording values of zero when there is no charging occurring. Figure 4-4 shows dot plots for each submeter in the sample for all intervals where a logger has a reading of zero. Each dot represents a single 15 minute interval and the plots show that the number of incorrect submeter measurements when PEV usage is zero is very small.[65]

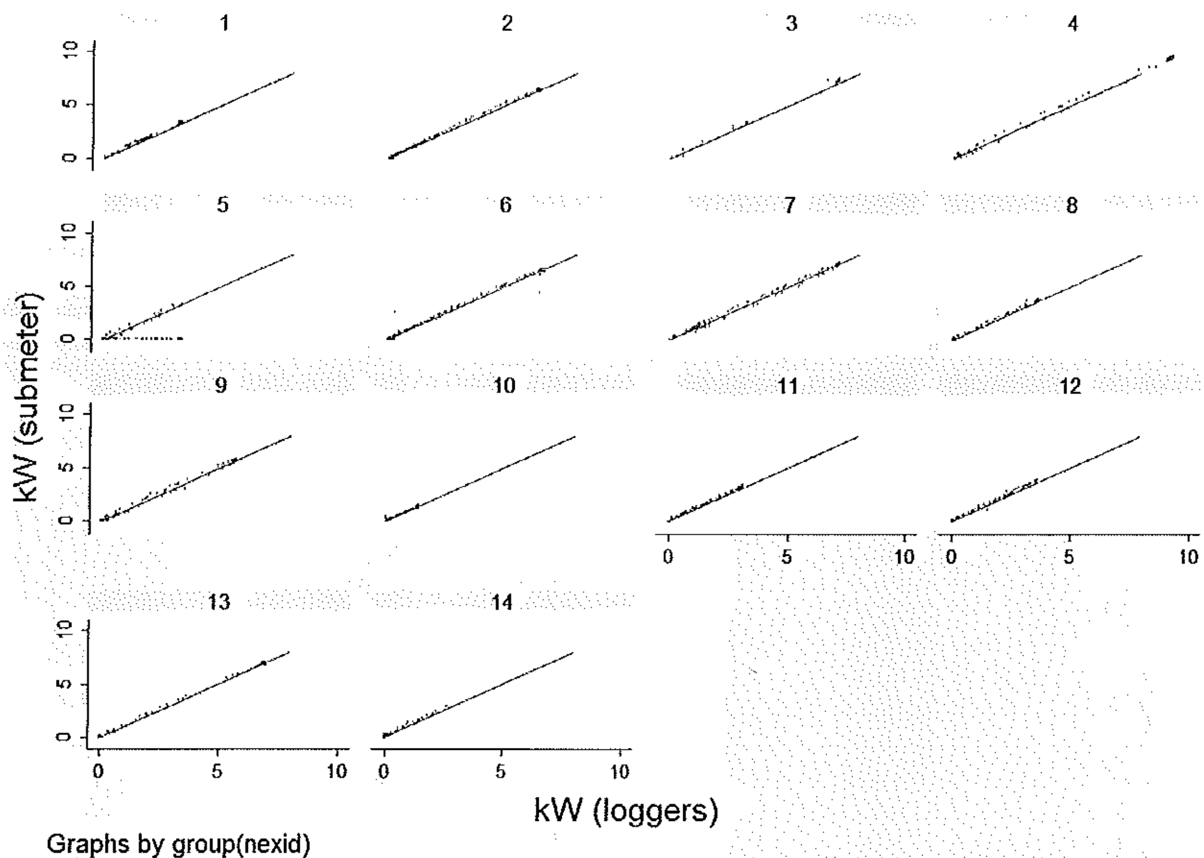
[65] The total number of observations for each submeter ranges from 1,000 to 2,000. Submeter measurements of zero stack up in the figure so that they resemble a line.

Figure 4-4: Submeter Measurements when PEV is Not Charging



For intervals where charging usage was greater than zero according to the logger, submeter measurements were directly compared to logger readings. Figure 4-5 shows these comparisons for each submeter in the form of scatter plots. Each interval is represented in the figure by a red dot. Perfect agreement between the submeters and loggers is represented by the blue 45 degree line. According to this preliminary examination, most of the plots show strong agreement between submeter measurements and their corresponding logger readings. The exception to this is submeter number 5, which did not record any usage for most of the study period, but then accurately recorded usage at the end of the period.

Figure 4-5: Submeter Measurements vs. Logger Readings for Non-zero Usage Intervals



To formally test the similarities between the submeter measurements and logger readings, an equivalence testing approach with a threshold of 5% (see Section 3.2) was used in two distinct ways. The first was to use a paired t-test approach consisting of two separate tests, one of the null hypothesis that the submeter mean is at least 5% less than the logger mean and the second of the null hypothesis that the submeter mean is at least 5% greater than the logger mean. The results of the equivalence tests for each submeter are shown in Table 4-1 and show that all submeters in the data except for number 5 easily reject the null hypotheses of greater than 5% error.

Table 4-1: Equivalence Test Results for Mean Submeter and Logger Measurements

Unique ID	Mean		P-Value		Number of Observations
	Submeter Data	Logger Data	Lower	Upper	
1	2.79	2.78	0.00	0.00	479
2	3.32	3.29	0.00	0.00	349
3	5.40	5.28	0.00	0.00	100
4	6.75	6.59	0.00	0.00	385
5	0.65	2.70	0.00	1.00	445
6	3.77	3.81	0.00	0.00	364
7	4.03	4.04	0.00	0.00	247
8	2.79	2.78	0.00	0.00	274
9	4.94	4.93	0.00	0.00	447
10	1.23	1.24	0.00	0.00	723
11	2.93	2.84	0.00	0.00	411
12	3.26	3.15	0.00	0.00	375
13	4.88	4.91	0.00	0.00	132
14	2.18	2.12	0.00	0.00	114

The second method for conducting the equivalence test is to use a regression approach consisting of the following three steps:

1. Establish 5% region of equivalence for the slope (β1) equal to (0.95, 1.05).
2. Fit linear regression using the logger as the independent variable and the submeter observations as the dependent variable.
3. Test the slope for equality to 1 by calculating two one-sided confidence intervals for the slope using the regression output and determine whether this interval is contained within the region of equivalence.

Equivalence test results using the regression approach are presented in Table 4-2.

Table 4-2: Equivalence Test Results Using Regression

Unique ID	Regression Coefficient	Standard Error	95% Lower	95% Upper	Reject Test of >5% Error	Count
1	1.00	0.00	1.00	1.01	Yes	479
2	1.02	0.00	1.01	1.02	Yes	349
3	1.03	0.00	1.02	1.04	Yes	100
4	1.03	0.00	1.02	1.03	Yes	385
5	0.24	0.05	0.16	0.33	No	445
6	0.99	0.00	0.99	1.00	Yes	364
7	1.00	0.00	0.99	1.00	Yes	247
8	1.01	0.00	1.01	1.02	Yes	274
9	1.00	0.00	1.00	1.01	Yes	447
10	0.96	0.00	0.95	0.97	Yes	723
11	1.02	0.00	1.01	1.02	Yes	411
12	1.04	0.00	1.03	1.04	Yes	375
13	1.00	0.00	1.00	1.00	Yes	132
14	1.00	0.01	0.99	1.01	Yes	114

The regression results demonstrate equivalence between the submeter and logger data, which corroborates the results of the tests using mean values as well as the visual diagnostics in Figure 4-5. As a final test of submeter accuracy, usage from the submeter was summed in each TOU period over the course of the study period—Jan 9 through Feb 12—and compared to aggregated logger data to simulate a billing cycle. These comparisons are shown in Table 4-3.

Table 4-3: Comparing Submeter and Logger Data for Simulated Billing Month

Utility	Unique ID	Off Peak (kWh)		Partial Peak (kWh)		Peak (kWh)		Achieves 5% Accuracy for All Periods
		Submeter	Logger	Submeter	Logger	Submeter	Logger	
SDG&E	1	290	288	2	2	7	7	Yes
PG&E	2	185	183	0	0	83	82	Yes
PG&E	3	135	132	0	0	0	0	Yes
PG&E	4	627	575	97	2	52	0	No
PG&E	5	53	229	3	7	17	45	No
PG&E	6	314	317	0	0	0	0	Yes
PG&E	8	173	172	2	2	6	6	Yes
PG&E	9	473	472	0	0	0	0	Yes
SCE	10	205	208	0	0	1	0	Yes
SCE	11	277	268	0	0	0	0	Yes
SCE	12	214	207	0	0	39	38	Yes
SCE	13	80	80	0	0	34	34	Yes
SCE	14	20	18	0	0	35	33	No*

* This is a result of low total usage for this submeter over the course of the month

Based on the results of the various equivalence tests, most submeters for which data was available meet the 5% accuracy threshold specified by Phase 1 of the pilot. However, one submeter in the sample was offline for a portion of the study period and a second incorrectly allocated some usage to the peak and partial peak periods during the simulated billing cycle. In addition, the results should be caveated by the fact that 4 out of 31 eMW submeters in the analysis sample were not included in the analysis due to data issues and half of the analysis period was affected by a software malfunction that caused data errors for some eMW customers. These measurement errors would certainly have affected customer bills and may account for some of the dissatisfaction customers expressed about billing accuracy.

4.3 Customer Experience during Pilot

A key objective for Phase 1 was to evaluate the customer experience in order to determine customer benefits under submetering.[66] To that end, all Phase 1 pilot participants were contacted with a request to complete a participant survey in November 2015.[67] This survey was designed to collect information on a number of topics related to the pilot:

- PEV ownership and usage;
- Customer knowledge of the submetering process and electric rate structure;

[66] See page 18 of the CPUC Decision 13-11.002 for a list of the goals of the California PEV Submetering Pilot.

[67] Phase 1 pilot participants will be contacted again in 2016 with a request to complete a follow-up survey.

- Customer satisfaction; and
- Issue resolution.

Information collected from the participant survey—in addition to the data collected by the other components of this evaluation—was analyzed to identify ways to improve submetering service and identify opportunities to expand submetering tariffs or programs to additional PEV customers. In addition, the participant survey provides an opportunity to identify ways to improve the experience of customers who participate in Phase 2 of the pilot.

The remainder of this section presents the survey results associated with each of the research topics described above.

4.3.1 PEV Ownership and Usage

The survey showed that Phase 1 participants predominantly own a single PEV that was purchased or leased in 2014 or 2015. Specifically, 80% of respondents reported owning one PEV, while 18% own two PEVs and 2% own three or more PEVs. A total of 80% of respondents acquired their PEV(s) in either 2014 or 2015, while 16% of respondents' PEVs were purchased in 2012 or 2013, and 3% were purchased in 2010 or 2011. A majority (61%) of survey respondents report having PEVs manufactured by Chevrolet, Nissan, Tesla, or Toyota. Despite this concentration, responses to this survey indicate that the California PEV market is beginning to diversify. Table 4-4 presents frequencies of vehicle make and model as reported by survey respondents and includes 12 manufacturers in addition to the 4 listed above[68].

Table 4-4: Frequencies of PEV Make and Model Owned by Pilot Participants

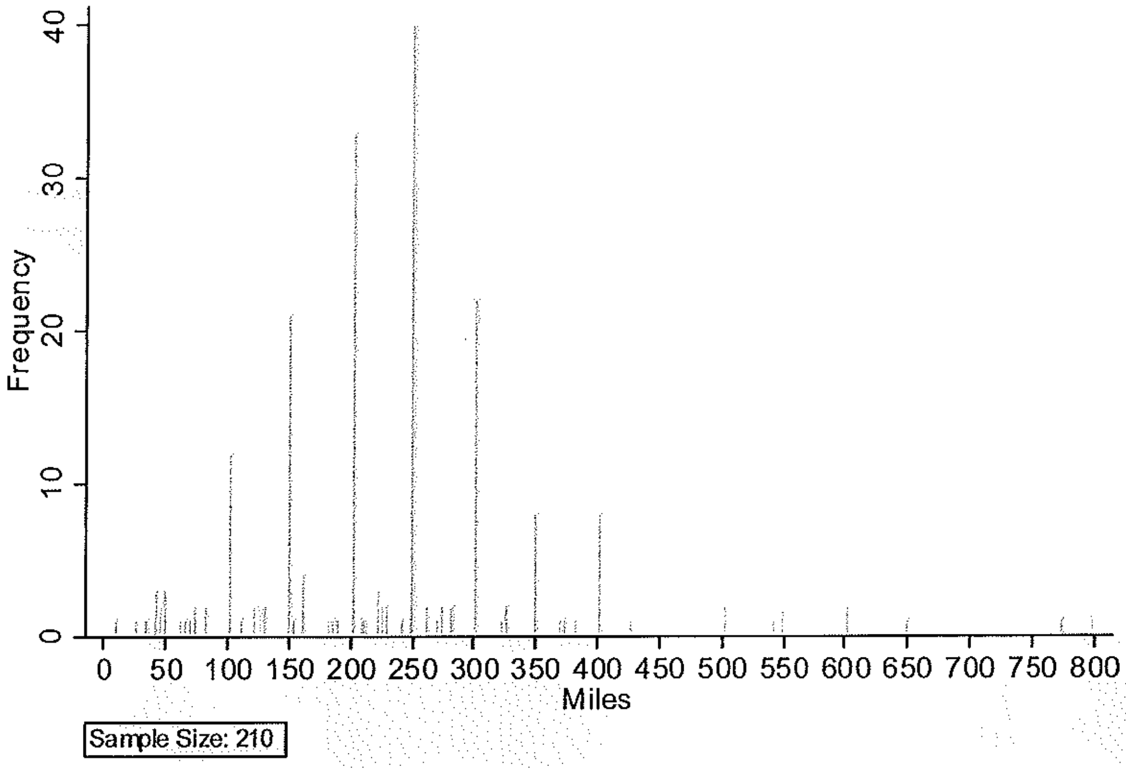
Make and Model	Frequency	Make and Model	Frequency
Nissan LEAF	47	Honda Fit EV	5
Chevrolet Volt	41	Toyota Prius Plug-in	5
Toyota RAV4 EV	26	Kia Soul EV	4
Tesla Model S	24	Ford C-Max Energi	3
Fiat 500e	23	Smart fortwo electric drive	2
BMW i3	17	Volkswagen EV Conversion	2
Chevrolet Spark EV	14	Corbin Sparrow	1
Ford Focus Electric	14	Honda Accord	1
Volkswagen e-Golf	8	MG BGT EV	1
Mercedes-Benz B-Class Electric Drive	6	Mitsubishi i-MiEV	1
Coda Sedan	5	Zero S[69] 11.4	1
Ford Fusion Energi	5	**Total**	**256**

68 The total number of PEVs shown in Table 4-4does not total 210 due to the fact that customers report owning more than one PEV in some cases.

69 The Zero S is an electric motorcycle.

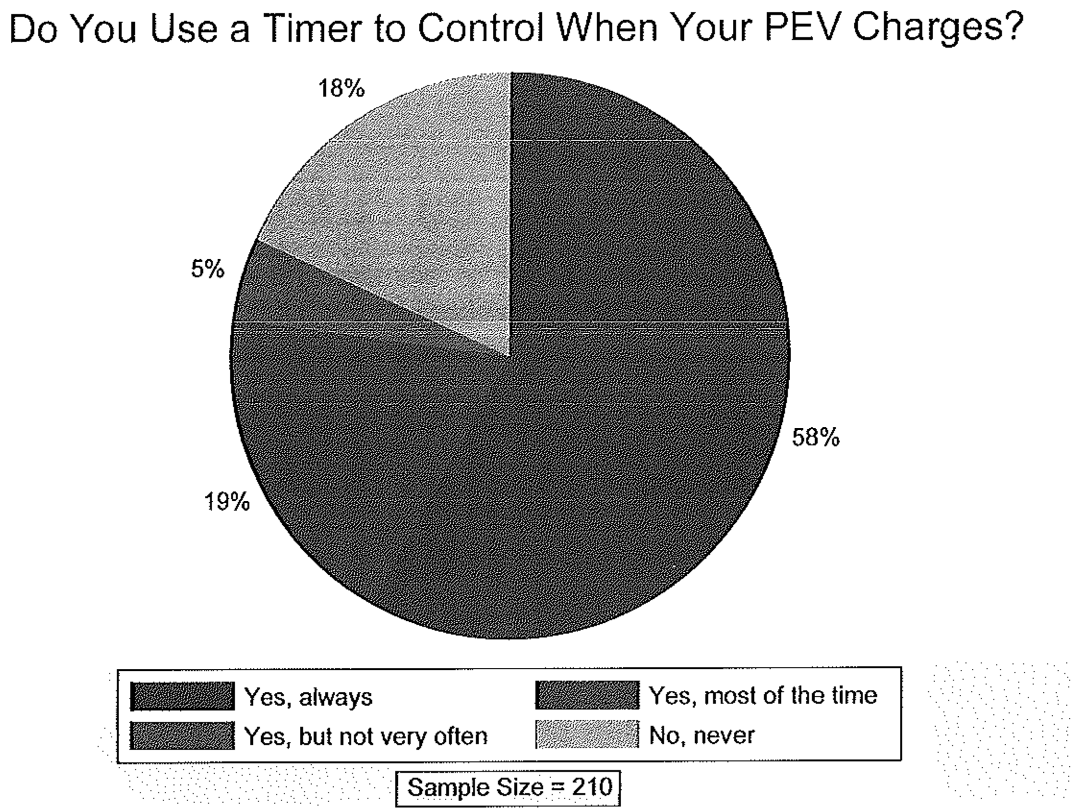
Survey respondents were also asked about how much they use their PEV in a typical week. Most respondents reported driving between 100 and 400 miles in their PEV during the work week—Monday through Friday. Figure 4-6 presents response frequencies; the modal, or most common, response was 250 miles driven per workweek.

Figure 4-6: PEV Weekly (Monday through Friday) Mileage



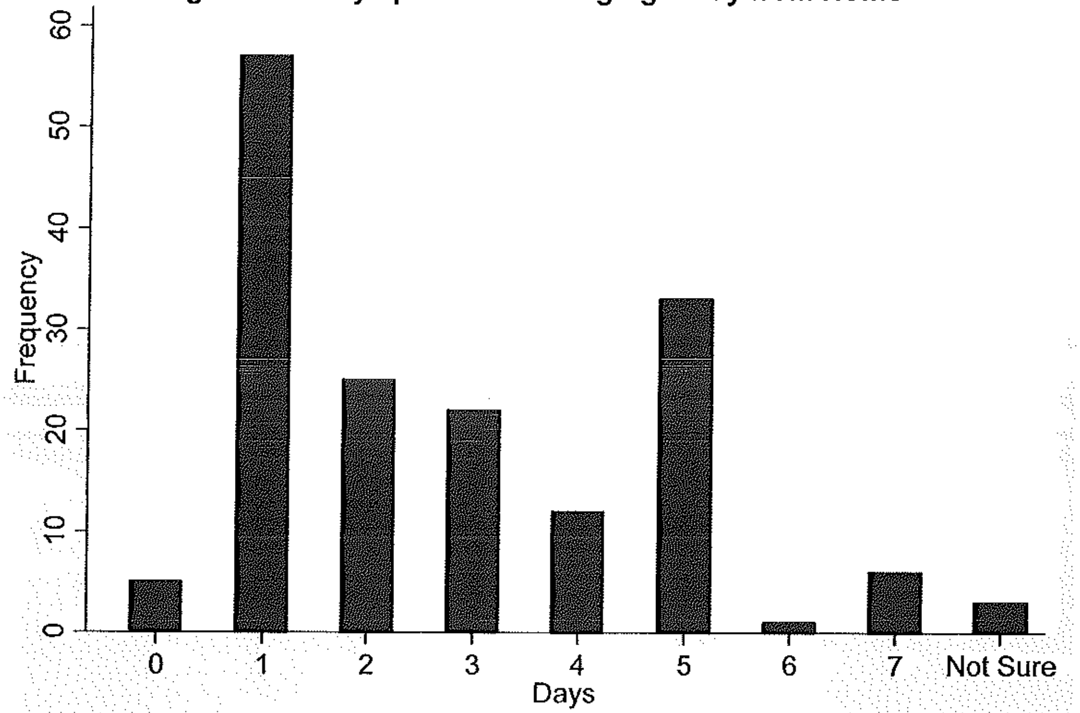
A majority of survey respondents (58%) also reported that they always use a timer when they charge their PEV, while only 18% reported that they never use a timer to control their PEV charging. Figure 4-7 shows the distribution of responses to the question of how often Phase 1 pilot participants use timers to control when their PEV charges.

Figure 4-7: Timer Use to Control Charging



The survey also included questions about pilot participants' charging behavior away from home, since away-from-home charging is not observed by the IOUs, but can affect how much charging is done at home. Thirty-seven percent of respondents reported that they do not ever charge their PEV away from home, while half of customers who do charge away from home do so two days a week or fewer. Figure 4-8 shows the response frequencies for reported number of days of PEV charging away from the home.

Figure 4-8: Days per Week Charging Away from Home



When charging away from home, a majority of respondents (76%) reported using Level 2 charging stations, 19% reported using DC fast charging stations, and the remaining 5% of respondents stated that they are not sure about what type of charging station they use away from home. Table 4-5 tabulates the frequency of responses for each response category for average duration of away-from-home charging sessions. Charging sessions away from home were nearly equally divided between the choices of less than one hour, between one and two hours, between two and three hours, and between three and four hours. This result shows that there is no "typical" duration of charging sessions away from the home for the PEV owners who participated in Phase 1.

Table 4-5: Average Duration of Charging Away from Home

Average Duration	Frequency
Less than 1 hour	35
Between 1 and 2 hours	38
Between 2 and 3 hours	35
Between 3 and 4 hours	34
More than 4 hours	21
Not sure	1

4.3.2 Customer Knowledge of Submetering Process and Electric Rates

A critical component of future submetering programs will be success in creating awareness of the program among potential participants and providing useful information about how the program works vis a vis other electric rate options on offer. Phase 1 appears to have succeeded in educating participants on the electric rate options available to them for both the whole house and also the PEV charger. A total of 93% of survey respondents correctly stated that the price structure of electricity used by their PEV is more expensive when charged during the peak period and less expensive during the off-peak period. Similarly, 93% of respondents said that they were aware at the time of enrollment in the pilot that whole-house TOU electricity rates were also available to them.

Participants were also asked about their knowledge of their whole-house rate. While 68% of the customers who completed the survey actually have a whole-house electric rate that is not time-differentiated, only 57% reported that their whole-house electric rate is not time-differentiated. This means that 22 customers or about 10% of survey respondents incorrectly identified the type of whole-house electric rate, which is only somewhat higher than the percent of respondents (7%) that incorrectly identified their type of PEV submeter rate.

4.3.3 Customer Satisfaction

One of the most important metrics for the Phase 1 evaluation is the extent to which pilot participants were satisfied with the submetering service they received. To be properly interpreted, reported levels of satisfaction should be grounded by information on what motivated a customer to participate in the pilot in the first place. The survey results show that the three most important motivations for enrolling in the Phase 1 pilot were the following:

- Ability to pay a lower rate for electricity used by the PEV;
- The availability of an incentive for the PEV meter; and
- Ability to measure the amount of electricity my vehicle is using.

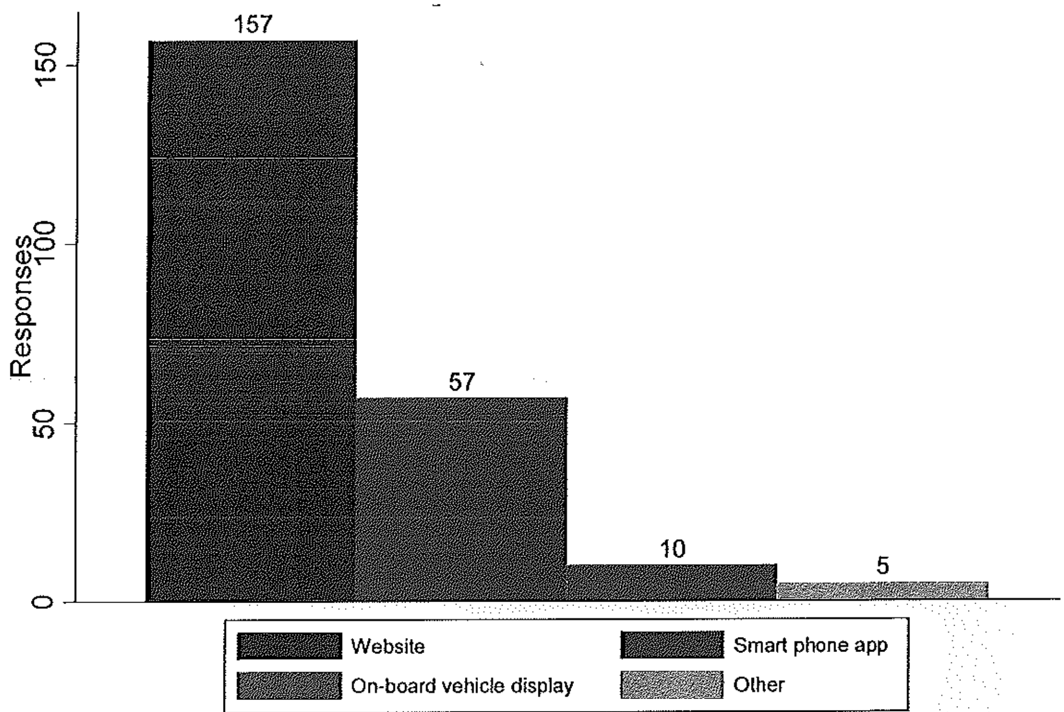
These three aspects of the pilot received top 2 box scores over 80%, meaning that more than 80% of customers thought that these considerations were either extremely important or somewhat important in their decision to participate in the pilot. The ability to pay a lower rate for electricity used by the PEV received a very high top 2 box score of 98%.Table 4-6 summarizes the motivations for Phase 1 participation.

Table 4-6: Importance of Factors in Deciding to Enroll in the Pilot

How important was each of the following aspects of submetering in deciding to sign up for the pilot?	Not Important at All	Somewhat Unimportant	Somewhat Important	Extremely Important	Top 2 Box
Ability to pay a lower rate for electricity used by my PEV	1%	1%	8%	90%	98%
The availability of an incentive for the PEV meter	4%	9%	31%	56%	87%
Ability to measure the amount of electricity my vehicle is using	6%	11%	45%	38%	83%
The cost of the vehicle charger	17%	11%	35%	38%	73%
The safety and reliability of the charging station	17%	16%	32%	35%	67%
The monthly service charge	19%	17%	32%	32%	64%
Ability to charge my vehicle more quickly	28%	13%	29%	31%	60%
The ability to control the charging station from my smart phone	30%	27%	25%	19%	44%

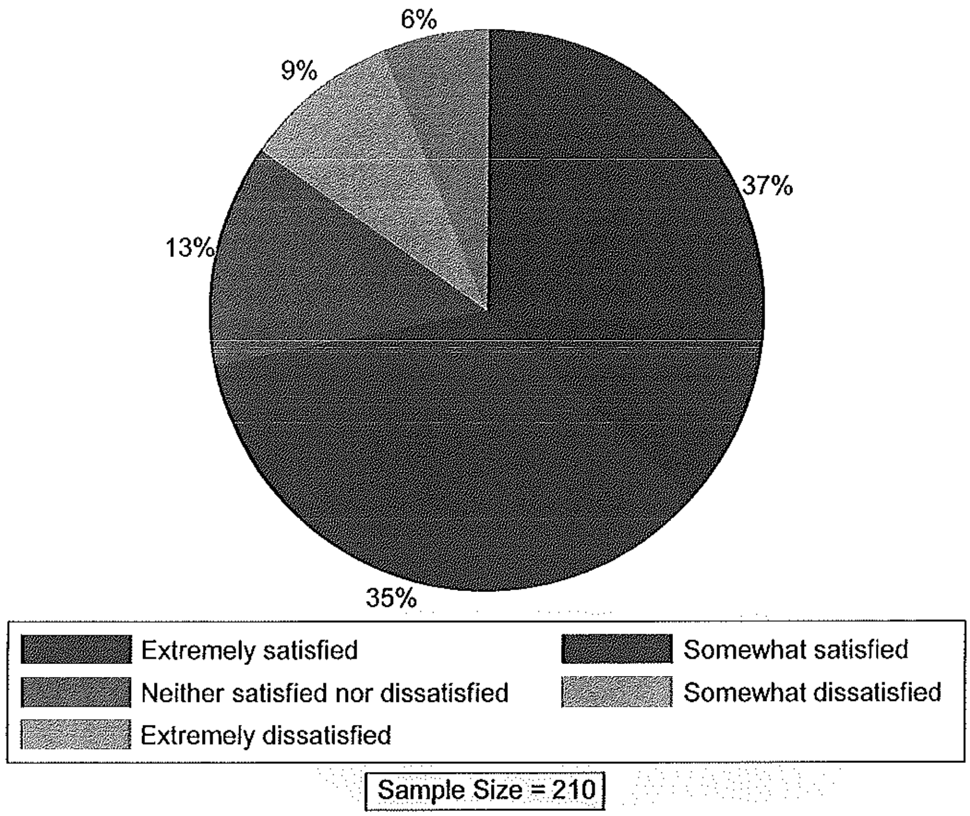
The ability to measure the amount of electricity that the PEV is using was rated third highest in terms of importance as a factor in deciding to enroll in the pilot. One feature of PEV submetering is that it affords the customer an opportunity to access this data directly, including other information derived from the interval consumption data recorded by the PEV submeter such as the cost of the electricity used by the PEV charger and the carbon emissions associated with that electricity usage. Eighty percent of respondents stated that they accessed the data collected by their submeter. All of those customers reported viewing their PEV usage data, but only 40% reported looking at the data pertaining to the cost of charging. Just 4% of respondents reported viewing the emissions data pertaining to their PEV electricity usage. Most survey respondents (93%) reported using their MDMA's website to access their submeter data, while 34% reported using a smartphone app and 6% reported using their PEV's onboard display to view the data. Figure 4-9 shows the distribution of responses to the question of how Phase 1 pilot participants access their charging data.

Figure 4-9: Modes for Accessing PEV Charging Data



Several questions towards the end of the survey dealt with the topic of customer satisfaction in Phase 1. Participants were first asked to rate their overall satisfaction with their submetering service using a 5 point scale, which covered the following ratings: "extremely satisfied," "somewhat satisfied," "neither satisfied nor dissatisfied," "somewhat dissatisfied," and "extremely dissatisfied." Figure 4-10 illustrates the distribution of responses to the overall satisfaction survey question. A majority of customers (72%) said that they were "extremely satisfied" or "somewhat satisfied," while 15% of respondents rated their level of satisfaction as "somewhat dissatisfied" or "extremely dissatisfied." The remaining 13% responded as "neither satisfied nor dissatisfied. "

Figure 4-10: Overall Customer Satisfaction with Submetering Service



Of the 32 respondents who were dissatisfied, nearly three quarters (23) reported that their dissatisfaction was a result of billing issues or poor customer service/support from their IOU or MDMA. When asked to expand upon their satisfaction, 50% of respondents reiterated their overall satisfaction with the pilot, stated that they liked paying a lower electricity rate for their PEV charging or said that they like reducing their monthly bill. Table 4-7 and 4-8 summarizes the open-ended responses about the specific reasons for dissatisfaction or satisfaction.[70]

Table 4-7: Reasons for Dissatisfaction with the Phase 1 Pilot

Dissatisfaction Responses	Frequency
I've had billing issues	12
I've experienced poor customer service or support from IOU or MDMA	11
Other	5
I've experienced technical problems	4
Total	**32**

[70] Customers who gave a satisfaction rating of "neither satisfied nor dissatisfied" did not see the open-ended follow up question for rationale and are therefore not included in the tables.

Table 4-8: Reasons for Satisfaction with the Phase 1 Pilot

Satisfaction Responses	Frequency
I'm satisfied with the program overall	38
I like paying a lower rate, reducing my electricity bill	37
Other	26
I've experienced billing issues	17
I can track how much I pay for my EV usage separate from my household usage	13
It's easy to set up and configure	12
I avoid the cost of installing a second meter	8
Total	**151**

In addition to overall satisfaction with the pilot, the survey also asked about satisfaction with more specific aspects of the participant experience. Table 4-9 presents customer ratings of various aspects of the submetering service. The percentage shares for each rating and the top two box score in the table only reflect those customers who did not select "no experience." The aspects of the pilot that respondents reported the least experience with were the installation appointment and controlling their PEV charger remotely. Nearly half (45%) of respondents indicated that they had no experience with the PEV submeter installation, while 39% indicated that they were not involved in the scheduling of the installation appointment. Additionally, 58% of respondents stated that they had no experience remotely controlling their charging station. Notably, 17 customers who identified themselves as satisfied used the prompt as an opportunity to describe billing problems that they had experienced. As a result, the total number of customers who report billing issues is more than double than the count in Table 4-7 indicates.

Among respondents who did have experience with the aspects of the pilot shown in Table 4-9, the highest rated aspects in terms of customer satisfaction were the safety and reliability of the charging station, which both had top two box satisfaction scores over 80%. In this case, the top two box scores represent the percentage of customers that express high satisfaction ratings for each aspect of the service. The perceived accuracy of the measurement of electricity used by the PEV was third highest with a top-two box satisfaction score of 72%. The next tier of satisfaction includes installation, access to charger data and customer service from the MDMA, which all had top two box scores between 60% and 69%. The aspects of the pilot with the lowest satisfaction ratings—as measured by the top two box score—were related to enrollment, IOU customer service, and billing. Customers had mixed feelings about the accuracy of the PEV portion of their bills—top two score of 58%—while the experience of signing up for the PEV rate with the IOU and customer service after the rate began received top two box scores of 35% and 46%, respectively.

Table 4-9: Satisfaction Ratings for Specific Aspects of Phase 1 Pilot

Please rate the following aspects of your submetering service		No Experience	Poor	Fair	Good	Very Good	Excellent	Top 2 Box
Reliability of my charging station		10%	2%	5%	7%	18%	68%	86%
Safety of my charging station		17%	1%	2%	15%	20%	62%	82%
Accuracy of the measurement of electricity used by my PEV		24%	8%	8%	13%	24%	48%	72%
Installation		45%	6%	8%	17%	20%	49%	69%
Access to information about whether and when my vehicle is charging remotely		30%	7%	7%	18%	28%	39%	67%
Scheduling the installation of the meter or charging station		39%	4%	9%	24%	21%	42%	63%
Customer service provided by (insert MDMA name) after the meter or charging station was installed		14%	12%	6%	21%	20%	40%	60%
Accuracy of the PEV portion of my bill		27%	18%	7%	18%	22%	36%	58%
Ability to control my charging station remotely		58%	15%	7%	25%	19%	35%	54%
Signing up for the PEV rate	PG&E	5%	11%	19%	26%	19%	25%	44%
	SCE	1%	21%	10%	26%	23%	20%	43%
	SDG&E	0%	7%	13%	13%	20%	47%	67%
	All IOUs	**3%**	**15%**	**15%**	**25%**	**21%**	**25%**	**46%**
Customer service provided by IOU after PEV rate started	PG&E	33%	28%	18%	18%	17%	18%	36%
	SCE	32%	23%	18%	27%	18%	14%	32%
	SDG&E	27%	18%	18%	18%	9%	36%	45%
	All IOUs	**32%**	**25%**	**18%**	**22%**	**17%**	**18%**	**35%**

4.3.4 Issue Resolution

To further understand the underlying causes of satisfaction and dissatisfaction, the survey asked participants about whether or not they experienced different types of issues, including technical problems related to the submeter and problems related to billing. In addition to asking whether participants experienced these issues, follow-up questions were asked about how well the problems were resolved.

Most pilot participants (83%) reported that they have not experienced any technical problems with their charging station. Of the 12% (26 respondents) that did report technical problems, most reported issues were related to Wi-Fi connectivity, general failure of charging equipment, inaccurate measurement data, or unsuccessful transmittal of measurement data to the IOU. Table 4-10 presents satisfaction ratings for the resolution of these technical problems.[71] About a quarter (23%) of respondents who experienced technical problems stated that the problem was still unresolved. Among those whose problems had been solved, the top two box satisfaction score is 75%.

Table 4-10: Satisfaction Ratings for Resolution of Technical Problems

	The Problem(s) is/are Still Unresolved	Extremely Dissatisfied	Somewhat Dissatisfied	Neither Satisfied nor Dissatisfied	Somewhat Satisfied	Extremely Satisfied	Top 2 Box
How satisfied were you with the resolution of the technical problem(s)?	23%	0%	15%	10%	25%	50%	75%

Pilot participants were also asked whether they experienced any billing problems associated with their submetering service. Thirty percent of participants indicated that they had experienced billing problems, while another 23% responded that they were not sure if they have experienced billing problems. A total of 62 participants experienced problems with their bills—34 PG&E customers, 18 SCE customers and 10 SDG&E customers. Most of these customers described the problem as receiving a delayed bill, which caused them to pay for multiple months of service at once. Others responded that their bill inaccurately reflected their PEV's usage. Table 4-11 presents satisfaction ratings for the resolution of billing problems. Notably, 48% of respondents say that their billing problem is still unresolved. Among the other respondents with resolved billing problems, the top two box satisfaction score is only 47%.

Table 4-11: Satisfaction Ratings for Resolution of Billing Problems

Question	The Problem(s) is/are Still Unresolved	Extremely Dissatisfied	Somewhat Dissatisfied	Neither Satisfied nor Dissatisfied	Somewhat Satisfied	Extremely Satisfied	Top 2 Box
How satisfied were you with the resolution of the billing problem(s)?	48%	9%	16%	28%	34%	13%	47%

71 , This question was only answer by participants who reported having technical problems.

In the final part of the survey, Phase 1 pilot participants were given an opportunity to describe what improvements they would like to see in their submetering service. The most common response (21%) was "None;" however, the next two most common responses were better support and communication from the IOU or MDMA and improvements in the accuracy and timeliness of billing. Together, those two response categories accounted for 32% of the total responses. Table 4-12 organizes the open ended responses into nine broad categories and shows the number of participants who mentioned each one.

Table 4-12: Suggested Improvements in Submetering Service

Responses	Frequency
None	44
Better support and communication from the IOU or MDMA	36
Improve inaccurate and delayed billing	32
Better reporting and real time usage viewing	29
Technical improvements	29
Better remote access via an app	12
Other	12
Clearer instructions regarding the program and timeline of the process	9
Ability to have continued use after pilot program is complete	7
Total	**210**

4.4 Factors Affecting Future Submetering Adoption

The conjoint survey described in Section 3.4 evaluated customer preferences for different options within six submetering plan attributes and the impact on enrollment likelihood of the various options. This section presents results based on the information collected from the survey. Customers were sampled equally from the IOUs with a goal of obtaining 200 completed surveys from each one. This approach was taken to ensure sufficient sample from each IOU to produce statistically significant results. In order to enable interpretation of average survey results as indicative of preferences for the average California PEV owner—or future PEV owners—it was necessary to weight respondents to reflect the residential customer population within each IOU. Table 4-13 summarizes the population percentages used to create the weights used throughout the analysis.

Table 4-13: Population distribution used for weights

Utility	Residential Customer Population Count[72]	Population %	Sample Size for Survey	Sample %
PG&E	4,792,227	46.1%	209	33.4%
SCE	4,333,875	41.7%	233	37.2%
SDG&E	1,251,312	12.0%	184	29.4%

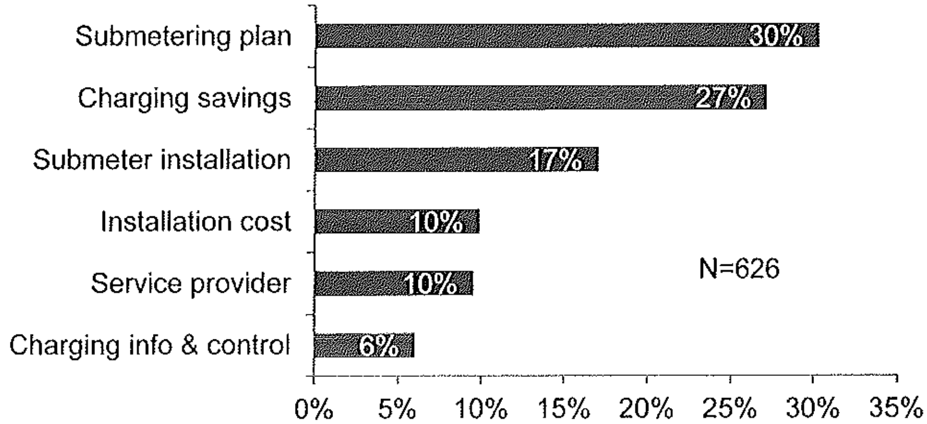
4.4.1 Relative attribute importance

The conjoint survey measured attribute importance by asking respondents to make choices between the options available for the different product attributes under study. For example, a PEV owner was asked to choose between a submetering service with a $150 installation charge offered by a utility and another submetering service offered by a third party that involved no installation cost; and vice versa. From the choices customers made, it is possible to infer how important the different attributes are in the customers' decision making process. One of the strengths of the conjoint design is that such tradeoffs elicit more differentiation in the importance of different attributes than asking respondents to directly assess importance.

Evaluating the importance of each attribute was done for individual respondents using the adaptive conjoint methodology described in Appendix C. Attribute preferences provide a measure of how much each attribute influenced respondent choices, given the levels tested in the survey. Relative importance values for each attribute sum to 100% since they represent portions of a single decision. Figure 4-11 summarizes the relative importance of each attribute in the study. Because there are six attributes, the average importance is 17%; attributes with greater importance have above average importance and vice versa. These relative importance values appear to reflect two tiers of attributes. Submetering plan—e.g., discounted rate or flat charging fee—Charging savings, and Submeter installation—e.g., plug-in, mobile, professionally installed submeter, or submeter plus Level 2 charger—form a top tier which influences 74% of the enrollment decision. Installation cost, service provider, and charging information comprise a second tier of attributes, which drive the remaining 26% of the decision. These second tier attributes do influence enrollment choices but none on its own is likely to be a key or important driver of the decision—unlike the attributes in the higher tier.

[72] Source: Form EIA-861 available at https://www.eia.gov/electricity/data/eia861/

Figure 4-11: Relative Attribute Importance



When interpreting this result it is important to remember that values reflect the specific levels tested for each attribute. For example, the levels tested for Submetering Plan and Submeter Installation each included a level that was excluded from the conjoint for respondents for whom the level was determined to be infeasible based on pre-conjoint questions.[73] These levels were:

- Discounted rate plus grid services[74] submetering plan: infeasible for 36% of respondents; and
- Professionally installed submeter plus Level 2 charger at a cost of $600—incremental to a submeter installation cost of $150 to $300[75]: infeasible for 55% of respondents—43% due to already having a Level 2 charger at home and the remaining 12% after evaluating the option in the ACBC. It is possible the cost of the Level 2 charger contributed to its infeasibility for respondents.

Despite these caveats, it is still a noteworthy research finding that charging savings was not the most important attribute; it was about as important as the type of submetering plan. Also noteworthy is that submeter installation was a very important attribute responsible for 17% of the decision, but submeter cost was a less important factor that was responsible for only 10% of enrollment choice. What this shows is that monetary benefits explain only about half[76] of customer choices for submetering plans.

4.4.2 Level preferences

The attributes and levels included in the survey were carefully selected to construct an enrollment choice model that would allow for key research questions to be addressed and

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73 Utilities for these excluded levels were assumed to be below those for the remaining levels, thereby driving broader variation in level utilities and a contributing to higher relative importance

74 Excluded for respondents who stated they would not "at least consider" grid services after the concept was thoroughly described

75 Excluded for respondents who already had a level 2 charger at home

76 27% for Charging savings plus 10% for Submeter cost plus perhaps some portion of the importance of Submetering installation, though only 20% of respondents determined the level 2 charger option to be an infeasible option after being exposed to its incremental cost

the Phase 1 submetering offer to be modeled. The enrollment choice model consists of predicting the impact of different attribute levels on program enrollment for each respondent, given a program design consisting of any one level for each attribute.

The choice model was estimated using the survey data collected and allows for comparing predicted respondent preferences for different program designs. This section discusses the predicted impact on enrollment for each level as compared to a baseline level. The baseline level for each attribute is defined as the level that best describes the submetering offer in Phase 1. Table 4-14 summarizes the level definitions for the prototypical pilot design. It also summarizes two other submetering plan designs and their predicted relative impact on program enrollment as compared to the Phase 1 pilot. The design on the left denotes the least attractive offer, which shows the combined effects of switching out levels in the pilot design for levels of any attribute where a less preferred level was tested. The most attractive offer in the right column is defined in a corresponding manner and shows the combination of attributes that had the highest enrollment likelihood.

The combined impact of adjusting attributes from their levels in the pilot to the levels in the least attractive offer would be a decrease in enrollment of about 64% compared to the actual pilot enrollment rates. Similarly, the combined impact of adjusting attributes from their levels in the pilot to the levels in the most attractive offer would be an increase in enrollment of about 126%—i.e., a 2.26 fold increase compared to enrollment rates for the pilot. It is notable that there appears to be far more potential upside in enrollment than downside—an increase of 126% is greater in magnitude than a decrease of 64%, though both are substantial.

Table 4-14: Combined Enrollment Impact of Levels Tested as Compared to Phase 1 Pilot

	Least Attractive	Pilot	Most Attractive
Submetering Plan	Discounted rate + grid services	Discounted rate	Discounted rate
Charging Info & Control	Bill only	Info	Info + Control
Service Provider	Independent charging company	Independent charging company	Utility
Submeter Installation	Pro-install + Level 2 charger (+$600 submeter cost)	Pro-install	Mobile (in-car)
Installation Cost	$300	None	None
Charging savings	16%	30%	81%
Change in enrollment over Pilot	-64%	**0%**	+126%
Change in enrollment if savings stay at 30%	-62%	**0%**	+81%

The range of enrollment impacts from least attractive to most attractive represents lower and upper bounds for enrollment likelihood impacts tested in the adaptive choice model. The following sections will describe in more detail the incremental enrollment impact of each level compared to the pilot. This means that results should be interpreted as "all else equal" program designs where the only change to the pilot is a single level of interest. Some levels have relative enrollment impacts that are quite high; others have almost zero impact. However, because the choice model is a logistic model, these individual level impacts are non-additive. For example, if the impact of adjusting the pilot design by switching to another level for attribute A is an enrollment decrease of 30% and the impact of switching to another level for attribute B is an enrollment decrease of 15%, the impact of switching to those levels for attributes A and B will not be an enrollment decrease of 45%.[77]

Second, these two extremes are meant to represent extreme enrollment outcomes in a range of possible submetering design scenarios. As such the least attractive and most attractive offers are not necessarily meant to represent realistic designs, nor should they be misinterpreted as "best" or "worst." Indeed, considerations beyond enrollment, such as cost-effectiveness may make a scenario infeasible and unattractive.

The third point to keep in mind when interpreting the results in Table 4-14, and in the following sections, is that the range of enrollment impacts is directly driven by the choice of attributes and levels tested. Many of the options tested do not yet exist and may takes month or years to develop, especially for the case of the Charging information/control and mobile submeter options in the most attractive offer. The remainder of this section discusses estimates of baseline demand for submetering among current PEV customers as well as the impacts of the monetary and experience related submetering attributes tested in the choice set on enrollment likelihood.

Baseline Demand for Submetering

One key area that is informed by the analysis of the conjoint survey is the demand for submetering in the population of existing PEV owners. Table 4-15 shows enrollment likelihoods for all combinations of the attributes tested as part of the survey. For analysis purposes, a baseline offering (shaded) was defined to resemble the submetering offer available in Phase 1 as closely as possible within the constraints of the model. This baseline is important because it serves as an anchor point to interpret the remaining results. The enrollment likelihood in each cell corresponds to a submetering offer consisting of that specific attribute level and the baseline levels for all other attributes. This allows differences between cells to be interpreted as the marginal effect of each level on the likelihood of enrollment, while holding all other attributes constant.

77 The combined effect will be less.

Table 4-15: Demand for Submetering Services in Existing PEV Customer Population

Attribute	Level	Baseline level	Enrollment Likelihood	Pref. share as % change over baseline
Submetering Plan	Flat monthly fee (charge anywhere)		30%	-26%
	Flat monthly fee (charge at home)		34%	-18%
	Electricity discount	•	41%	0%
	Electricity discount + grid services		29%	-28%
Charging Info & Control	Bill only		36%	-12%
	Info	•	41%	0%
	Info + control		46%	12%
Service Provider	Utility logo		61%	48%
	Car brand name (or logo)		49%	18%
	Independent EV charging company	•	41%	0%
Submeter Installation	Simply plug-in		50%	23%
	Mobile (in-car)		54%	32%
	Meter (pro-install)	•	41%	0%
	Meter (pro-install) + Level 2 charger [Add $600 (or $12/mo) to submeter cost]		32%	-23%
Installation Cost	None	•	41%	0%
	$150 (or $3/mo for 60 months)		27%	-34%
	$300 (or $6/mo for 60 months)		21%	-49%
Charging savings	16% (min tested)		40%	-3%
	30%	•	41%	0%
	45%		63%	54%
	60%		74%	80%
	81% (max tested)		83%	103%

Within the context of the survey, the average PEV customer would enroll in the Phase 1 submetering offer with a probability of 0.41. Put another way, 41% of current PEV customers said that they would enroll in the Phase 1 submetering offer if it was made available to them. Several caveats are necessary for this important result. The most important caveat is that the enrollment likelihood likely suffers from "hypothetical bias" that often exists with stated preference surveys. Simply put, there is often a difference between what survey respondents say they will do and what they will actually do.[78] Hypothetical bias is generally positive, meaning that survey respondents would be prone to overstate their true likelihood of enrolling in submetering. Another important caveat is that there is no guarantee that the current population of PEV owners will resemble the population of PEV owners that may exist in the future when some attributes may become available. Despite these limitations, the results in Table 4-15 illustrate that there is significant demand for submetering among current PEV owners and that there are several ways in which new offers could be made that would increase the likelihood of adoption. The effects of each attribute are discussed in the following two subsections.

Monetary Attributes

One goal of the PEV submetering pilot was to gain a better understanding of the extent to which enrollment would be changed by altering the economics of submetering plans, be it by varying achievable charging savings (up or down) or by asking participants to contribute to the cost of submeter installation (installation was largely subsidized during the Phase 1 pilot). To this aim, the choice survey included charging savings and submeter installation cost as attributes to be tested. Figure 4-12 summarizes these attributes and levels along with the modeled relative enrollment impact each level would have as compared to the levels comprising a prototypical program design similar to those offered in the Phase 1 pilot.

Figure 4-12: Relative Impact on Enrollment Compared to Pilot: Financial Attributes

Installation cost	None [pilot]		
	$150 (or $3/mo for 60 months)	-34%	
	$300 (or $6/mo for 60 months)	-49%	
Charging savings (%)	16%	-2%	
	30% [pilot]		
	45%		+54%
	60%		+80%
	81%		+103%

Intuitively, increasing submeter installation costs for participants would decrease enrollment. It is important to clarify that this attribute was conceptually designed to test participant costs and so is not meant to distinguish between hardware, installation, and any other costs. This allows for flexibility in modeling potential future submetering plans for which these costs may be partially subsidized or for which these costs may vary. All else equal, passing $150 of these installation costs to participants could reduce enrollment by over a third (36%) and passing on $300 of these costs could cut enrollment in half. Such enrollment decreases would have to be balanced against the potential benefit of reducing costs to service providers—or entities considering subsidization.

78 See https://www.unisa.edu.au/Global/business/centres/i4c/docs/publications/hypothetical%20bias%20in%20stated%20choice%20experiments.pdf

It is important to note that the survey also controlled for underlying respondent preferences for upfront versus monthly payments, as recognition that reducing upfront costs may reduce the burden for some participants. Before the conjoint exercise, respondents were told of the possibility of installation costs and asked if they would prefer to spread the cost of the submeter over five years for a small fee. While a plurality of respondents (43%) preferred the upfront charge, about 23% preferred the monthly payment option and the remaining 34% had no preference. These preferences were significantly correlated with income level: preference for the upfront payment increased steadily and significantly across increasing income groups. Preference for the upfront payment ranged from 18% for respondents with annual incomes below $50,000 to 55% for respondents with incomes above $250,000. Throughout the conjoint, all installation costs were displayed using the respondent's preferred payment structure.[79]

The other attribute with a monetary impact on participants was the charging savings, which was tested in the conjoint as a percent savings. On every screen in the conjoint this percent savings was displayed adjacent to a respondent's specific monthly charging cost that was estimated using customer responses to survey questions prior to the conjoint exercise.[80,81] Because savings can vary widely, it is important to reemphasize that the 30% pilot baseline figure is meant to be a rough, yet reasonable approximation for average savings across participants. Ultimately, some of the most meaningful parts of the interpretation of the resulting percent enrollment impact figures are their relative values. For example, there is a nearly insignificant 2% change in enrollment between 30% savings and 16% savings but that there is a substantial 54% enrollment increase for a similar increase in percent savings from 30% to 45%. This indicates that somewhere between 30% and 45% there is a psychological threshold beyond which savings become meaningful. Increased savings beyond 45% by similar margins produces diminishing enrollment impacts.

Interestingly, percent savings is the attribute that exhibited the widest potential enrollment impacts—the only one with the capacity to more than double enrollment—though that would require substantial savings levels of over 60%. For certain segments, enrollment impacts are even more pronounced. In particular, respondents on NEM rates and SDG&E customers—which have a large degree of overlap[82]—would enroll in submetering plans at even higher rates. Respondents whose estimated monthly charging costs were above $50 were also more responsive to higher percent savings. For these customers, increasing percent savings from

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79 Payment structure was randomly assigned to respondents with no preference to avoiding biasing one way or another.

80 This estimate was based on self-reported monthly miles driven, percent of charging done at home, a marginal electricity price estimate based on each respondent's current electricity rate, and a conversion factor of miles to kWh based on the respondent's PEV category also stated earlier in the survey. To ensure the most numerically and cognitively valid estimates, respondents were given a choice of how to estimate miles driven–weekly average or age of vehicle and mileage–asked to confirm the estimate, and then finally given the opportunity to change the estimate to a manually entered value within a reasonable range. Average monthly cost was $53–a standard deviation of $49 reflects that most monthly charging cost estimates fell between $0 and $100.

81 Because the perceived and actual dollar value of a percent change in cost will vary with the basis to which the percent change is applied–e.g., monthly charging cost–this charging cost was used as a covariate when calculating utilities to ensure this variation was captured in the utilities for a different savings level.

82 There is a large degree of overlap between these segments: 77% of SDG&E respondents were net metered compared to just 28% of PG&E respondents and 0% of SCE respondents.

30% to 60% could increase enrollment by 101% compared to only a 65% increase for respondents with charging cost below the $50 threshold.

Business Model and Participant Experience Attributes

Another goal of the research was to gain a better understanding of which potential future business models and features for submetering plans could increase appeal to PEV owners. To address this research question, four attributes relating to participant experience were tested—plan type, charging info & control, service provider, submetering installation. Figure 4-13 summarizes these attributes and levels along with the modeled relative enrollment impact each level would have compared to the corresponding levels of a prototypical submetering similar to Phase 1.

Figure 4-13: Relative Impact on Enrollment Compared to Phase 1: Business Model and Participant Experience Attributes

Submetering plan	Flat monthly fee (charge anywhere)	-26%	
	Flat monthly fee (charge at home)	-18%	
	Electricity discount [pilot]		
	Electricity discount + grid services	-28%	
Charging info & control	Bill only	-12%	
	Info [pilot]		
	Info + con (Ctrl)		+12%
Service provider	Utility [logo shown]		+48%
	Car brand name [logo shown]		+18%
	Independent EV charging company [pilot]		
Submeter installation	Simply plug-in		+23%
	Mobile (in-car)		+32%
	Meter (pro-install) [pilot]		
	Pro + level 2 charger [Add $600]	-23%	

The submetering plan attribute was intended to test the openness of PEV owners to different possible submetering business models. In particular, it tested a flat monthly charging fee—which may or may not include charging on a network of public chargers for no extra cost—and a discounted rate that may or may not include a higher discount in return grid services through demand response. As described in Section 3.4.2, respondents were carefully educated on the concept of grid services before the conjoint and an option was only included for respondents who indicated they might consider it. The current submetering plan, which simply includes access to a discounted rate, was largely preferred. However, the preference against the other submetering models was small enough that it could be addressed by designing a plan with other more desirable options to counterbalance the enrollment impacts.

Such plans may also be more effective if targeted at segments more open to these new business models. One reasonable indicator of this is current rate. Customers who are not currently net metered and who are on a time-of-use (TOU) rate are far more open to a flat charging fee.[83] Similarly, PG&E respondents indicated at much higher rates than the other IOUs that they would consider a discounted rate, which required them to provide gird services—just 27% of PG&E would not consider grid services compared with 42% and 45% for SCE and SDG&E respectively. Among respondents who were open to grid services, modeled enrollment actually increased by 6% by moving to that design and holding all other attributes equal to those in the pilot.

Submeter installation was the other attribute from which a level was removed for certain respondents.[84] Once again, significant differentiation between respondents from different IOUs was evident. While only 44% of PG&E respondents and 39% of SCE respondents reported having a Level 2 charger, 75% of SDG&E respondents reported having a Level 2 charger.[85] An additional 10% each of PG&E and SCE respondents evaluated the submeter plus Level 2 charger option in the conjoint but still determined the option to be unacceptable—likely due to the $600 incremental cost.

The two other submeter installation options tested were simply plug-in and mobile submetering, which are not currently widely available. Both of these features were positively perceived by respondents and could increase enrollment by 23% and 32%, respectively. The mobile metering option was particularly popular among SDG&E respondents (+39% enrollment impact) and PG&E respondents (+35%), but was less appealing to SCE respondents (+27%). SCE respondents had no preference between the mobile metering and the simply plug-in option, as either would increase enrollment by about 27%.

Charging Information & Control and Service Provider are the two remaining participant experience related attributes. For Charging Info & Control, SDG&E respondents once again exhibited more pronounced preferences. Relative degrees of enrollment impacts appear to reflect the same ordering between IOUs as with mobile submetering—the other new, as yet undeveloped feature. That is to say, SDG&E and PG&E customers would be most swayed to enroll at higher rates (+14% each) due to additional info and control features, followed by SCE (+9%).

The three levels tested for the Service provider attribute were the respondent's IOU, the respondent's PEV manufacturer—both of which were displayed using logos—and an independent EV charging company—e.g., the vendors in the Phase 1 pilot. IOU and PEV manufacturers were preferred to independent charging companies as service providers and most respondents largely preferred a utility service provider to a PEV manufacturer. While there was a preference for the IOU or the PEV manufacturer to play the role of service provider, this was less pronounced for PG&E respondents, who had an average enrollment impact that was 10 to 15 percentage points below the impact for SCE and SDG&E respondents. The exceptions to this result were owners of high mileage EVs, nearly all of whom were Tesla

83 30% of NEM respondents and 28% of TOU respondents found at least one of the flat monthly fee plans to be unacceptable, compared with 18% of non-NEM and 15% of non-TOU respondents.

84 Those who reported already having a Level 2 charger at home were not shown this option.

85 This is likely due to past PEV pilot programs that have been conducted by SDG&E.

owners. For this group a PEV manufacturer would elicit a 42% enrollment increase compared to a 50% increase for a utility provider—both as compared to the independent charging company.

5 Conclusions and Recommendations for Phase 2

Phase 1 of the PEV Submetering pilot successfully established third party submetering service for 241 customers throughout California. The primary motivations for customers to participate in the pilot were the opportunity to pay a lower rate for electricity used by the PEV, the availability of an incentive for the PEV submeter, and the ability to monitor the amount of electricity used by PEVs. During the course of the pilot, several technical and customer service-oriented challenges were encountered by the participating MDMAs and IOUs that demonstrate areas where submetering operations and customer service can be improved in the future.

By all accounts, the enrollment process for Phase 1 was cumbersome and required a large number of manual processes and repeated customer interactions, which resulted in long processing times for CEAs and frustrations for customers, MDMAs, and IOUs alike. Only 46% of participants rated the process of signing up for the pilot as either very good or excellent. Customers often needed assistance from the MDMAs to complete the required forms, which were submitted to IOUs via email as attached PDFs and regularly needed to be sent back for revisions due to missing or incomplete information. Numerous interactions between customers, MDMAs, and IOUs were required to successfully enroll a customer and all of these interactions were initiated manually by one of the stakeholders. Streamlining the enrollment process should be a priority for Phase 2 and include efforts to improve communication between the MDMAs and IOUs regarding what is required from the customer as well as an investigation into whether infrastructure can be set up for CEAs to be completed more efficiently. This infrastructure could include the development of a website accessible by the MDMAs that creates a structured data environment for CEAs that is less prone to error than the manual process used in Phase 1.

Once customers were able to successfully enroll in the pilot, most (72%) said that they were satisfied with the overall service they received. However, 15% of participants reported being dissatisfied with their submetering service and highlighted areas where submetering operations could be improved. The primary causes of dissatisfaction were billing issues and poor customer service from the MDMA and/or IOU. Thirty percent of customers who responded to the participant survey reported experiencing a problem with their bills—delays were the most common description—and half of these customers said that their issues had not yet been resolved. When asked how to improve the pilot experience, the most common response from participants was for the IOUs/MDMAs to provide better support and communication.

The billing issues experienced by Phase 1 participants were likely a result of several different factors. First, the IOU subtractive billing processes created for the pilot existed outside the robust billing systems used for standard billing operations. Early in Phase 1, the IOUs spent significant effort educating the MDMAs about the intricacies of customer billing protocols and the data format necessary to ensure accurate billing. Submeter data from the MDMAs was transferred manually via SFTP and required cleaning and processing before being combined with interval data from the IOUs' internal systems. Due to the manual nature of these steps, errors occurred at a higher rate than normal and the amount of time required for preparing customer bills increased. To the extent that these processes can be automated, the timeliness and accuracy of subtractive billing would improve.

Another factor that has an impact on the accuracy of customer bills is the accuracy of the submeters. Analysis comparing a sample of submeters to independently installed loggers revealed that most submeters were able to accurately record PEV usage data, but that 10 to 20% likely experienced some kind of accuracy problem during Phase 1 that led to billing errors. These problems resulted from spotty data coverage, submeters going offline for a period of time, and a server software malfunction that caused time shifts in the data for some submeters. All three of these events caused delays in billing and some resulted in erroneous bills being delivered to customers. For Phase 2, Nexant recommends that additional submeter accuracy testing be conducted using a threshold of +/- 1% in order to improve billing accuracy and reduce the number of billing disputes with participants. This testing would preferably be done in a laboratory setting prior to installation to avoid the difficulties and limitations associated with measuring accuracy in the field and should include tests to ensure that submeter clocks are capable of proper time synchronization with IOU AMI systems. New metering standards and testing protocols related to submeters currently being developed by the National Institute of Standards and Technology (NIST) and the California Division of Measurement Standards may be able to be leveraged as a guide for best practices.

In addition to analyzing the processes, customer experiences, and accuracy that were specific to Phase 1, Nexant also surveyed non-submetered PEV customers to analyze customer preferences for different submetering features and identify factors that are likely to drive future uptake of submetering. This analysis showed that the type of submetering plan, magnitude of charging cost savings, and type of submeter installation—e.g., plug-in, mobile, professionally installed submeter or submeter plus Level 2 charger—are the most important factors that influence submetering adoption decisions. In the context of the survey, about 40% of survey respondents said that they would sign up for the submetering arrangement offered during Phase 1. For submetering to be attractive, a minimum amount of charging savings of 30 to 45% is needed and installation costs need to be kept low. Depending on the price differentials established for the opt-out TOU rates that will be rolled out to residential customers beginning in 2019, submetering plans with charging savings of 30-45% may be difficult to offer.

Installation cost, service provider, and charging information comprise a second tier of attributes that affect submetering adoption decisions. A mobile metering option was particularly popular among SDG&E respondents (+49% enrollment impact) and PG&E respondents (+41%), but had less of an impact on SCE respondents (+31%). While there was a preference for the utility or the PEV manufacturer to play the role of service provider, this was less pronounced for PG&E respondents than the other two IOUs. Nexant recommends offering additional submetering plans and pricing structures in Phase 2 along with exploring partnerships between MDMAs and IOUs as a way to provide more seamless service to the customer and achieve stronger brand equity.

Appendix A Question Bank and Guide for MDMA/IOU interviews

A.1 IOU Interviews

A.1.1 IOU role and responsibilities

- What changes to utility operations were required in order to carry out Phase 1 (i.e., enrolling customers in EV TOU tariffs, billing, project management, etc.?)
- How many FTE were required to support the Phase 1 Pilot?
- Briefly describe the day to day operations required to support Phase 1.
- Assuming Phase 2 proceeds as planned, how will operations have to change to accommodate more customers?

A.1.2 Costs

- What costs (operations, administrative, customer service, etc.) were experienced in providing submetering service? (Focus on categories of costs, we can ask for specific numbers via data request.)
- How would the costs of submetering scale with larger customer participation?
    - Are there any economies of scale associated with providing billing for submetering? (Another way to ask this would be to ask about the breakdown of fixed vs. variable costs for the MDMA.)

A.1.3 Pilot Enrollment

- Did customers reach out to you with questions about the pilot before enrolling? What did they ask you about and how did you respond?
- If your company was entirely responsible for getting customers enrolled in the pilot, how would they go about offering submetering as a service?

A.1.4 Relationship with MDMAs and Customers

- Describe your day to day interactions with the MDMAs (i.e., data transfer process, quality assurance, problem resolution process… common issues and resolution processes).
- Were there any issues that occurred during the pilot that required resolution of customer complaints or questions? What were they?
- What (if any) restrictions were there about how you interacted with customers during the pilot regarding submetering?
- Walk me through the process of how usage data is recorded by the submeter, transferred to the IOU, and then incorporated into a customer's bill.
    - Need details here, so don't be afraid to get into the weeds and spend some significant time.

A.1.5 Subtractive Billing Processes

- What internal preparations needed to be made in order to allow for subtractive billing?
    - What other departments of each IOU needed to be involved in these preparations?

- Approximately how many IOU staff were involved in the pilot in any capacity?
  - What types of preparation entailed fixed costs versus variable?
- What was the most challenging aspect of the pilot from your perspective (processing enrollments, coordinating with MDMAs, developing billing procedures, etc.)?

A.1.6 Issue Resolution

- What types of customer-related issues (if any) did you run into during the pilot (enrollment, billing complaints, de-enrollment, customer education, etc.)?
  - How were the issues resolved?
  - Were there any instances in which you were contacted by customers with questions about their bills related to the submetering? If yes, please provide the details of each interaction…what the issue was and how it was resolved or not.
  - How could these issues be mitigated during Phase 2?
- What specific MDMA-related issues did you experience during the pilot? (data transfer, technology problems, etc.)
  - How were the issues resolved?
  - How could they be mitigated during Phase 2?

A.1.7 Miscellaneous

- If you already have submetered EV-TOU rates (PG&E definitely does), how have you marketed those rates to customers? Do you actively market those rates?
- Do you have the ability to disconnect electric service at the primary meter for customers receiving submetering services?
- Based on your experience in Phase 1, what minimum technical standards do you think are necessary (if any) to allow for submetering? Have them explain why not having a standard would be costly or problematic.
- What are the biggest lessons you learned from Phase 1 that can be applied to Phase 2?

A.2 MDMA Interviews

Questions	Relevant MDMAs
Costs	
What are the costs associated with providing submetering service and who (MDMA or customer) is responsible for paying each type of cost in the pilot? (Focus on categories of costs, we can ask for specific numbers via data request)	All
How many FTE were required during Phase 1? How many FTE do you expect to need for Phase 2?	All
Describe the fee structure offered to customers for the submetering service (i.e., one time installation cost, monthly flat fee, monthly fee related to usage, etc.)	All
Business Model and Processes	

Question Bank and Guide for MDMA/IOU interviews

Questions	Relevant MDMAs
Describe your day to day interaction with each of the IOUs during the course of the pilot? How enrollment was handled, how about data transfer, how about bill complaints?	All
What (if any) restrictions were there about how you were allowed to interact with customers as an MDMA?	All
What benefits (if any) did you emphasize in marketing materials or communications with customers? Alternatively, if you were approached by customers, what motivations did they share with you about why they were interested in submetering?	All
Did you actively market submetering services to new customers? If not, what challenges do you foresee in marketing submetering to the broader EV-owning population?	All
Describe the process involved in enrolling customers in submetering and installing their submeters	
What was the most challenging aspect of the pilot in terms of enrolling customers in EV-TOU rates?	All
What was the most challenging aspect of the pilot in terms of getting submeters installed (reaching customers, coordinating with IOUs, developing technology, etc.)?	All
Walk me through the process of how usage data is recorded by the submeter and then transferred to the utility for billing.	eMW, NRG
How often do you routinely communicate with pilot participants? Describe the content of these communications.	Ohm, eMW
What is the business case for MDMA submetering beyond the pilot? What are the revenue streams for the MDMA? What kind of customer-MDMA business models do you think could be beneficial for both parties?	All
Service and Technology Innovations	
Are you currently offering any services through the pilot other than access to submetered TOU rates for PEV charging? (Level 2 charging, access to public charging network, customer software/apps that allow for information feedback on bills/charging behavior)	All
Looking forward, do you see your company offering submetering as a stand-alone service, or as one piece of a larger, more diverse service offering (which may or may not be related only to PEVs)? What other services do you contemplate offering related to the submetering business?	All
Where do charger/submetering technology have room to grow? What are the biggest challenges with the technology?	eMW, NRG
Issue Resolution	
What types of customer-related issues (if any) did you encounter during the pilot? (enrollment, charging performance, de-enrollment, customer education, etc.) How were the issues resolved?	All
What specific IOU-related issues did you experience during the pilot? How were the issues resolved?	All

Appendix B Participant Survey Instrument

The survey instrument used to assess customer experience during Phase 1 is presented below. The survey was administered online and highlighted sections represent programming notes.

B.1 About your plug-in electric vehicle (PEV)

1. How many PEVs do you own? ______
2. Please list the make, model and year of your PEV(s) (number of rows to fill in is equal to the answer provided in Q1):

Make	Model	Year	Month and year of lease/purchase	Miles driven in a typical weekday (M-F)

3. Please describe how often you typically charge your PEV away from home (drop downs, customers can fill in up to three rows):

Days per week	Charger Type	Avg. Duration
0 days 1 day 2 days 3 days 4 days 5 days 6 days 7 days Not sure	DC Fast Charging Level 2 Charging Not sure	Less than 1 hour Between 1 and 2 hours Between 2 and 3 hours Between 3 and 4 hours More than 4 hours Not sure

B.2 About your submetering service

4. How did you learn about the PEV submetering pilot? (Check all that apply)
   - Contacted by (insert MDMA name)
   - Contacted by my utility
   - Auto dealer
   - PEV rebate website
   - Internet search. What terminologies or topics did you search for? ___________
   - A neighbor or friend
   - Electric Vehicle Group
   - Other ______________________________________

5. How important was each of the following aspects of submetering in deciding to sign up for the pilot?

	Extremely important	Somewhat important	Somewhat unimportant	Not important at all
Ability to charge my vehicle more quickly				
The cost of the vehicle charger				
Ability to pay a lower rate for electricity used by my PEV				
The monthly service charge				
The ability to control the charging station from my smart phone				
The safety and reliability of the charging station				
Ability to measure the amount of electricity my vehicle is using				
The availability of an incentive for the PEV meter				
Other (please insert)				

6.

Q6a. Which of the following best describes the price structure of electricity specifically for your PEV?

- Same price for all hours of the day
- More expensive during peak period and less expensive during off-peak period

Q6b. Which of the following best describes the price structure for electricity used for the rest of your home?

- Same price for all hours of the day
- More expensive during peak period and less expensive during off-peak period

7. When you enrolled in the PEV submetering pilot, were you aware that a time-of-use (TOU) rate for your whole house (including your PEV) was available to you from (Insert IOU Name)?

- Yes
- No
- Not sure

IF Q7= "NO" OR "NOT SURE", SKIP TO Q9

8. Why did you choose submetering over a rate that applies to your whole house? (Check all that apply)
   - My bills are lower with submetering
   - Submetering was recommended to me by ______________________
   - I received an incentive for the PEV meter
   - Other ____

9. Have you accessed any data collected by your submeter during the pilot?
   - Yes
   - No
   - Not sure

IF Q9 = "NO" OR "NOT SURE", SKIP TO Q12

10. What type of data did you access?
    - Electricity usage
    - Cost
    - Emissions
    - Other ____

11. What tools or technologies did you use to access the data?
    - Website
    - Smart phone app
    - On-board vehicle display
    - Other ____

B.3 Customer Service

12. How would you rate your overall satisfaction with your submetering service?
    - Extremely satisfied
    - Somewhat satisfied
    - Neither satisfied nor dissatisfied
    - Somewhat dissatisfied
    - Extremely dissatisfied

IF Q12 = "NEITHER SATISFIED NOR DISSATISFIED", SKIP TO Q15

IF Q12= "EXTREMELY SATISFIED" OR "SOMEWHAT SATISFIED", SKIP TO Q14

13. Please explain your dissatisfaction with your submetering service briefly below.

SKIP TO Q15

14. Please explain your satisfaction with your submetering service briefly below.

15. Please rate the following aspects of your submetering service.

	Excellent	Very good	Good	Fair	Poor	No experience
Scheduling the installation of the meter or charging station						
The installation appointment						
Signing up for the PEV rate with (insert IOU name)						
Accuracy of the PEV portion of your bill						
Customer service provided by (insert IOU name) after PEV rate started						
Customer service provided by (insert MDMA name) after the meter or charging station was installed						
Safety of my charging station						
Accuracy of the measurement of electricity used by my PEV						
Reliability of my charging station						
Ability to control my charging station remotely						
Access to information about whether and when my vehicle is charging remotely						

16. Have you experienced any technical problems with your charging station?
    - ▫ Yes
    - ▫ No
    - ▫ Not sure

If Q16 = "NO" OR "NOT SURE", SKIP TO Q19

17. Please describe the technical problem(s) you experienced below:

18. How satisfied were you with the resolution of the technical problem(s)?
    - ▫ Extremely satisfied
    - ▫ Somewhat satisfied
    - ▫ Neither satisfied nor dissatisfied
    - ▫ Somewhat dissatisfied
    - ▫ Extremely dissatisfied
    - ▫ The problem(s) is/are still unresolved

19. Have you experienced any billing problems associated with your submetering service?
    - ▫ Yes
    - ▫ No
    - ▫ Not sure

IF Q19 "NO" OR "NOT SURE", SKIP TO Q22

20. Please describe the billing problem(s) you experienced below:

21. How satisfied were you with the resolution of the billing problem(s)?
    - ▫ Extremely Satisfied
    - ▫ Somewhat satisfied
    - ▫ Neither satisfied nor dissatisfied

- Somewhat dissatisfied
- Extremely dissatisfied
- The problem(s) is/are still unresolved

22. Do you use a timer to control when your PEV charges?
    - Yes, always
    - Yes, most of the time
    - Yes, but not very often
    - No, never

23. What improvements would you like to see in your submetering service?

24. Would you participate in another pilot related to PEVs?
    - Yes
    - No
    - Not sure

25. Would you be interested in participating in a second phase of the current pilot where you would receive a bill for your EV charging from (Insert MDMA Name)?
    - Yes
    - No
    - Not sure

End of Survey Recruitment for logger installations:

Proposed Wording:

There may be additional opportunity for you to participate in a $150 paid study. If such an opportunity were to become available, a Nexant staff member will contact you to schedule an appointment so that an engineer can visit your home to install a data logging device near your submeter. The appointment will take about 45 minutes and you will receive a $100 Visa Gift Card. About two months later, the engineer will return to retrieve the device. At that time, you will receive a $50 Visa gift card. The second appointment usually takes less than 45 minutes.

If such an opportunity were to become available, would you like a Nexant staff member to contact you?

- Yes, OK to contact me. – Name: ______________ Phone: _______________
- No thanks, I'm not interested

Appendix C Adaptive Choice Survey Methodology

A choice based survey measures the impact of different variables, or attributes, on respondent preferences. In the research design, the product or program being tested is decomposed into a set of attributes, each of which has different mutually exclusive options or levels. As an example, color may be an attribute and the levels could be red, yellow, or green. A product or program design, or concept, is composed of one level option of each defined attribute. A respondent is asked to evaluate each concept,[86] revealing preferences for each attribute level. In classic discrete choice modeling (DCM) conjoint design simply includes a series of choice tasks, asking the respondent to choose a preferred concept from a choice set. The choice sets presented include concepts evenly balanced across each attribute level. For example, if an attribute has three levels, each level will be presented in one third of the concepts. Regression analysis can then be used to determine the incremental impact of each attribute and level on each respondent's tendency to prefer one design over another.

The choice based surveying methodology used for this study was Adaptive Choice-Based Conjoint (ACBC). ACBC is a methodology well vetted in the field of decision science in use since the mid-2000s. As its name indicates, ACBC is adaptive in nature. Core to the ACBC methodology is the tailoring of choice sets to each respondent's underlying preferences. This means that a respondent is only evaluating concepts that are personally relevant. While this means that some levels are shown more often than others, those that are shown are more relevant to the respondent, enabling more choice data to be collected on those levels that have a greater impact on respondent preferences.

The ACBC methodology includes four tasks that serve to tailor the conjoint exercise to each respondent's relevant consideration set. These four tasks are:

- **The "Build-Your-Own" task**: Respondents select their preferred level for each (pre-selected) attribute to design their own preferred submetering offer;
- **The screening task**: Respondents are shown several program offers that are similar to but different than their preferred offer and asked to indicate which offers they might consider (the "consideration set"). This screens out program characteristics that are unacceptable and identifies characteristics that are requirements for adoption of the program in the eyes of individual respondents;
- **The choice task or tournament task**: Respondents are shown a series of screens with a set of program offers, similar to DCM choice tasks. The offers shown are those that were classified as acceptable possibilities in the screening task. On each screen respondents must choose the preferred offer from these possibilities. Differences between offers are visually highlighted to help the respondent focus on the differences when choosing between offers; and
- **The calibration task**: Respondents are shown and asked to rate their adoption likelihood for the offer they selected in the "Build-Your-Own" task, for an unacceptable offer, and for the offer they preferred among all those shown in the choice task. This helps identify the intensity of preferences between acceptable and unacceptable offers.

86 Depending on the methodology, a respondent can be asked to evaluate designs in a variety of ways, including indicating a preferred design among a set of designs, indicating a relative preference using a scale, etc.

The first benefit of this adaptive design is a technical one. Creating a design that is focused on relevant parameters means preference data can be collected for more attributes across a smaller sample (or alternatively, fewer choice sets) than is necessary for DCM.[87] Design efficiency is greatly improved with ACBC because the choice sets are dynamically adapted to include concepts that are ever more similar and relevant to the respondent, honing in on and testing relative respondent preferences. The second benefit of an adaptive design is behavioral. Enabling the respondent to focus on a more relevant, tailored choice set also eases the cognitive task of evaluating different concepts—both by reducing the quantity of choice sets as well as by better engaging the respondent.

C.1 Conjoint design

A conjoint design is defined by the product or program attributes to be tested and the potential levels, or options, for each attribute. The PEV submetering ACBC design consisted of the six attributes[88] summarized in Table C-1. The attribute description column shows the definitions that were provided for respondents during the education section of the survey before the ACBC. These attributes were carefully selected to ensure that the design addressed key research questions, covering the research topics of submetering business model, additional services, submeter installation and cost, and charging savings.

Table C-1: Conjoint Design Parameters

Attribute	Attribute Description (provided during the education section)
Submetering plan	A submetering plan could be structured in different ways that would give you access to different benefits (electricity discount vs flat monthly fee).
Charging info & control	Because the submeter collects your charging information, a submetering plan could also provide you with information about your charging habits and allow you to program or otherwise control your charging.
Service provider	Submetering could be provided by your utility, your EV manufacturer, or an independent company.
Submeter installation	In order to qualify for a submetering plan you would need to have a submeter installed to measure the electricity used by your EV. A submeter could be installed in a few ways and may or may not require installation by a qualified contractor.
Installation cost	A submetering plan might include an installation charge between $150 and $300.[89]
Charging savings	Percent of your monthly charging cost[90]

87 See http://www.sawtoothsoftware.com/support/technical-papers/adaptive-cbc-papers/cbc-vs-acbc-comparing-results-with-real-product-selection-2009, which compares sampling requirements for CBC versus adaptive CBC (ACBC) and concludes that the adaptive nature of ACBC leads to the sample size needs being as much as 30% lower for ACBC. Therefore if a 500 sample is needed for CBC a 350 sample could be sufficient for ACBC.

88 Technically speaking, compensation was tested as two attributes: compensation type and compensation amount. In the pre-conjoint importance rating questions only the former was evaluated.

89 This was followed by a question assessing preference for upfront versus monthly payment.

Table C-2 summarizes the levels tested for each attribute. A complete definition of each level was provided to respondents throughout the conjoint exercise via hover text.[91] Note that charging savings—communicated as a percent of the respondent's estimated monthly charging cost—was not tested with discrete levels during most of the adaptive conjoint exercise. Instead, the adaptive design allowed for testing a range of feasible charging savings. The one exception to this was the "Build-Your-Own" task in which respondents were asked to select from attribute levels to design their preferred option. In this task the savings levels in brackets below were associated with each plan type, reflecting that different plan options might be able to offer differing levels of charging savings. It is important to note that while not all customers who enroll in a submetering rate will experience such savings, this feasible range was intended to represent average savings and a broad range was test to enable assessment of a broad range of potential future savings. This approach was taken in lieu of testing specific rate design components—e.g., peak hours, off-peak discount—which might drive savings to allow for more flexibility in assessing the impact on enrollment and to ensure the applicability of research findings to a future state when there is uncertainty around the specific design of default residential rates—or typical rates used by PEV owners.

Table C-2: Conjoint attributes and levels

Attributes	Levels
Submetering plan	Flat monthly fee (charge anywhere) [25% savings]
	Flat monthly fee (charge at home) [35% savings]
	Electricity discount [45% savings]
	Electricity discount + grid services [60% savings]
Charging Info & Control	Bill only
	Info
	Info + control
Service provider	Utility [logo used]
	Car brand name [logo used]
	Independent EV charging company
Submeter installation	Simply plug-in
	Mobile (in-car)
	Meter (pro-install)
	Meter (pro-install) + Level 2 charger (Additional installation cost of $600 or $12/mo for 60 months)
Installation cost	None

90 Tailored cost estimate piped in for each respondent.

91 visible by hovering one's mouse over the level names

Attributes	Levels
	$150 (or $3/mo for 60 months)
	$300 (or $6/mo for 60 months)
Charging savings	Continuous between 16% and 81%

C.2 Adaptive Conjoint Analysis

The choice data collected with a choice based conjoint exercise is simply the composition of each set of concepts shown to each respondent and the choices the respondent made given those concepts. Data collected with an ACBC also includes the following selections made during the course of the survey:

- The composition of the concept designed by the respondent in the "Build-Your-Own" task;
- Any attribute levels denoted to be "Must-have" or "Unacceptable" during the screening task;
- The composition of the concept ("winning concept") that was most preferred during the tournament task; and
- Stated enrollment likelihood for four concepts: the BYO concept, the winning concept, and two other concepts from the screening task—an offer denoted to not be a possibly and an offer denoted to be a possibility.

While all of these data points may be of interest on their own, their primary use is to develop a choice model for each respondent.[92] A choice model includes an estimated impact for each parameter (each level of each attribute) on the likelihood to choose a particular concept design over alternatives. In the context of the PEV submetering survey, a choice model was used to estimate a respondent's preference for a particular submetering plan design concept. Using a choice model it is possible to model a respondent's relative preference, or preference share, between concept alternatives and the option to not select any concept (the "none" option). Preference shares across all modeled alternatives add up to 100% and represent the likelihood with which a respondent will prefer (or select in the survey) each option relative to the others.

It is important to note that preference share is not the same as enrollment likelihood because in a simulated survey setting there is a tendency to overstate the likelihood of actually selecting a concept. To make preference share more reflective of real world choices, it is often tied to actual observed data. Alternatively, preference shares can be compared on a relative basis and differences can be interpreted as relative changes in enrollment likelihood or relative enrollment impact. Either method usually consists of establishing a baseline concept. For the PEV submetering study, this would be the submetering plan design most typical among plans offered in the field pilot. Once a baseline is established, preference share for the baseline can be compared to preference share for other modeled concepts.

92 The exception to this is the "Must-have" or "Unacceptable" data, which is used dynamically during the survey to design more relevant choice sets.

Fundamentally, a choice model is constructed using logistic regression analysis. For an aggregate choice model, it is common to use a multinomial logit function (or similar model) to determine the average impact of each parameter on the decision to choose a concept. This would produce the average impact across respondents. However, different classes of respondents and even different individual respondents may have very different choice models from the average. That is to say that an individual's preferences may be very different than the average preference across respondents. Because of this, using an aggregate model to predict preferences for a set of individuals will introduce error to the extent that each individual's preferences differ substantially from the average.

An alternative is to produce a choice model which captures individual differences, resulting in a separate set of parameter impacts for each respondent. This method, called Hierarchical Bayes (HB), makes the critical assumption that each respondent's preferences for a given parameter come from a distribution of the overall population's preference for that parameter—or attribute level. By making this assumption, the estimation method can link all respondent's preferences for a particular attribute together and provide respondent-level impact estimates that are derived in part from population-level estimates—also called utility values as they represent the value a respondent accords to a parameter. This results in more precise estimates of each respondent's utility values.[93]

The adaptive software used to implement the ACBC[94] study has built in HB estimation capabilities[95] and was used to produce parameter estimates. The output of the HB estimation is a set of utility estimates for each respondent for each attribute level and for the "none" option.[96] The units of these utility estimates are log odds ratios and their values represent the contribution a particular attribute level has towards the total utility of a given concept. As mentioned earlier, a concept is composed of one level for each attribute and the total utility for a concept is the sum of the utilities for the relevant level of each attribute.

To calculate the preference share for a given concept, the total utility for the concept is exponentiated—because it represents the log of an odds ratio—and compared to the odds ratio of other alternatives. These alternatives usually include the "none" option, may also include other concepts, and in general should be a reasonable representation of the real world choice that is being modeled. For example, in a consumer product situation there may be a choice between two well-known brands, a generic brand, (each with specific parameters) and "none." For a customer option such as a submetering plan the only real choice with which a customer may be faced is whether or not to participate, given a single program option—as opposed to

93 Note that the HB modeling assumes that respondent parameter preferences are related and normally distributed. Because, of this respondent level models are different but related, rather than completely separate and unrelated.

94 The software used was the ACBC module from Sawtooth Software, the industry standard for adaptive conjoint studies. Sawtooth Software has many modules and is widely used for surveying.

95 For more technical background see https://www.sawtoothsoftware.com/download/techpap/hbtech.pdf

96 The "none" option represents a respondent's tendency to choose nothing among a set of concepts. A key input to the estimation of this parameter is the respondent's tendency to indicate that concepts are not a possibility in the screening task. The estimation is further refined using the respondent's stated enrollment likelihoods given during the calibration task.

whether or not to participate given multiple plan options[97]. In this case, only the preference shares for two options would be modeled: the choice to enroll in the program and the choice to not enroll in the program.

Equation 1 and Table C-3 detail how preference share would be calculated for the dual-alternative scenario described above. This equation could be extended to multiple options in two ways. In a pure preference share method, exponentiated utilities for other alternatives would simply be added to the denominator. This represents the respondent's preference for one alternative, given a set of alternatives. The disadvantage of this method is that the preference share for a given concept is dependent upon the number of concepts modeled, since adding additional concepts to the denominator reduces the relative value of the preferred concept.

Equation 1: Calculation of Preference Share for a Concept

$$\text{Preference share}_{(\text{concept}|\text{none})} = \frac{e^{U_{\text{concept}}}}{e^{U_{\text{concept}}} + e^{U_{\text{none}}}}$$

$$\text{Where } e^{U_{\text{concept}}} = \textstyle\sum_1^n U_{A_{i,l}}$$

Table C-3: Definition of Variables for Calculation of Preference Share

Variable	Definition
U	Utility value
U_{concept}	Total utility of the concept
U_{none}	Utility of the "none" option
$A_{i,l}$	Level of the i^{th} attribute in the concept
n	Number of attributes

In the second method, a two-step decision process is modeled. Initially, the concept with the highest utility is selected among all modeled alternatives—not including the "none" option. This represents the respondent's preferred concept. Then, the preference share is calculated for the preferred concept given the "none" alternative. This represents the respondent's likelihood of actually selecting that concept over selecting nothing at all and means that a preferred concept will always have the same preference share, regardless of the number of inferior alternative concepts also being modeled. In practical terms, this method assumes a two-step choice process starting with the identification of a preferred concept, followed by a final decision on whether to choose that concept or nothing at all.[98]

97 Though this may also be a plausible scenario

98 The two options described for calculating utilities are applicable only when modeling two or more submetering offers that are available side-by-side. Nexant created a simulator tool as a supplement to this report that includes such scenarios and uses the two-step approach to calculate utilities.

C.3 Assessing Statistical Significance of Adaptive Conjoint Analysis

The simplest type of regression analysis, an ordinary least-squares (OLS) linear regression, has straightforward and relatively well known measured of statistical significance, namely:

- **P-values for each parameter estimate:**[99] the probability that an estimate is different from zero only due to random chance. One minus this number is the "confidence level" of the estimate and a commonly accepted confidence level is 95%, the confidence level is a gradient and a 94% confidence level is still indicative of reasonable confidence in an estimate.
- **R-squared for the model**: the percentage of observed variation that is explained by the model. Adjusted r-squared, a similar statistic, also adjusts for degrees of freedom (including the number of model parameters).[100] There is no commonly accepted significance cutoff for interpreting R-squared or adjusted R-squared, and the interpretation depends on the amount of inherent variance in the variable being modeled. A value below 25% is considered small (though not necessarily indicative of an invalid model) and a value of 50% can actually be indicative of statistically valid predictive power in many situations.

Because of the complexity of a logistic regression, such as a choice model, the assessment of statistical significance or model accuracy is not as straightforward as it is with linear models. That said, several measures can be used in the design and analysis process to ensure a model has statistically valid and significant predictive power.

- **Standard error of parameter estimates**: While the HB estimation method has the advantage over aggregate logistic regression analysis of including individual level variation, logistic regression does have a useful purpose. In particular, an aggregate model can be used to produce standard errors for parameter estimates. This is particularly useful in the research design phase to ensure that the sample size and number of parameters planned should produce statistically significant results. This analysis is done by running an aggregate model (such as an aggregate logit model) on randomly generated data.[101] Since the data is randomly generated parameter estimates are not expected to be different from zero.[102] In other words the choice impact of two alternatives should be no different than random chance (or a 1:1 ratio). While there is no commonly accepted cutoff for standard error values in this context, 0.05 is an empirical target value recommended by the creators of the ACBC software[103] though levels below 0.10 are still deemed acceptable. The technical interpretation of a 0.05 standard error

99 Derived by plotting the ratio of an estimate and its standard error on a normal distribution

100 $R^2 = 1 - \frac{SS_{residual}}{SS_{total}}$, where SS is the sum of squares of the difference between estimates and observations.

$Adjusted\ R^2 = 1 - \frac{(1-R^2)(N-1)}{N-p-1}$, where R^2 is the non-adjusted R^2, p is the number of parameters, and N is the sample size

101 While it is also possibly to use an aggregate model to estimate parameters using actual data once it is collected, such estimates will necessarily differ from HB estimation results, due to the fundamental differences in the two models. Therefore it is not recommended to interpret the values of such aggregate estimates other than to confirm that standard errors are still small.

102 and therefore a p-value interpretation cannot be used since it a test for whether a value is significantly different from zero

103 According to Sawtooth Software, which has observed hundreds of studies, models with parameter estimates at or near 0.05 tend to be more stable and have better predictive power, based on external validation

from randomly generated data is that it represents a variation of +/- 2.5%[104], well in the range of statistically significant validity. A parameter estimate standard error of 0.05 on actual (not randomly generated data) would represent an even lower variation.

- **Root likelihood error**: The error used to evaluate the precision of a choice model for an individual respondent is called root likelihood (RLH) error[105] and represents the accuracy of an individual respondent's choice model in predicting the actual choices that respondent made in the choice exercise. This statistic must be interpreted in the context of the choice task structure. For example, if three alternatives were presented in each choice task, a random chance model would have correctly predict choice about one third of the time, or an RLH value of 0.33. If a choice model has an RLH value of, say 0.67 (correctly predicting choice two thirds of the time) it can be said to be twice as accurate as a random chance model.
- **Percent certainty:**[106] Percent certainty represents the percent of variability in actual choices that is explained by a logistic model. This makes it similar in interpretation to an adjusted R-squared statistic for OLS regressions, with the important distinction that values are typically lower than for R-squared or adjusted R-squared. While there is no commonly accepted threshold for statistical significance, values from 0.2 to 0.4 (or 20% to 40% certainty) represent "excellent model fit" according to the creator of the statistic.[107]
- **Standard error of preference share estimates**: The above three statistics assess either aggregate estimates for parameter utilities (as with aggregate logit standard errors) or predictive power of the model on a whole but not of individual utility estimates (RLH and Percent Certainty). An option for assessing the statistical validity of utility estimates derived using HB estimation is estimating the standard error of preference share[108] estimated across respondents. This provides an assessment of the variation in

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104 In log odds ratio terms, the preference share for a parameter when comparing two alternatives with equal probabilities (e.g. a 1:1 odds ratio, or what would occur with randomly generated data) is $\frac{e^{\log(\frac{1}{1})}}{e^{\log(\frac{1}{1})}+e^{\log(\frac{1}{1})}} = 50\%$, if the error an estimate is 0.05, the preference share is $\frac{e^{\log(\frac{1}{1})+0.05}}{e^{\log(\frac{1}{1})+0.05}+e^{\log(\frac{1}{1})}} = 51.25\%$. This represents a variation of 2.5% because $\frac{51.25\%-50\%}{50\%} = 2.5\%$. A parameter estimate standard error of 0.05 on actual (not randomly generated data) would represent an even lower variation. For example, for a log odds ratio of 2:1, the variation would be 1.0% because the estimate with no error would be $\frac{e^{\log(\frac{2}{1})}}{e^{\log(\frac{2}{1})}+e^{\log(\frac{1}{2})}} = 80\%$, the estimate with error would be $\frac{e^{\log(\frac{2}{1})+0.05}}{e^{\log(\frac{2}{1})+0.05}+e^{\log(\frac{1}{2})}} = 80.8\%$, and $\frac{80.8\%-80\%}{80\%} = 1.0\%$.

105 Root likelihood error is the geometric mean of the probabilities corresponding to the choices made by respondents, obtained by taking the Nkth root of the product of the Nk probabilities. The best possible value of RLH is unity, achieved only if the computed solution correctly accounts for all the choices made in all tasks by all respondents.

106 Also called rho-squared or McFadden's pseudo R-squared. "Conditional logit analysis of qualitative choice behavior." McFadden. 1974.

107 Urban Travel Demand: A Behavioral Analysis. Domencich and McFadden. 1975. Reference to rho-squared appears in Chapter 5, Pages 122 onwards.

108 The preference share for a given concept is the output for which a choice model is designed. Therefore, it is most intuitive and accurate to interpret utility estimates through the preference share transformation, rather than directly. In addition, utility estimates for each attribute are designed to be used together in the full choice model. Analyzing a utility estimate separately from the full choice model will overstate the importance of or variation in that estimate. For example, to understand the importance of, say the first level of an attribute in a three attribute choice model, it is not entirely correct to simply analyze that level against the none option or against the other levels of that attribute. Instead, it is more appropriate to compare two concepts which include one level for each of the three attributes and between which the only difference is that one includes the first level of the first attribute and that the other includes, say the second level. This would be a more correct comparison of the relative preference for levels one and two of the first attribute.

preference share across respondents for given a concept specification. An intuitive way to conduct this analysis is to model preference share for the baseline (current state) concept against which all other concepts will be measured. Then the error across this preference share estimate for each respondent can be calculated.

All four of these methods were used when designing and analyzing the PEV Submetering ACBC study. The choice model (consisting of the attributes and levels tested) was designed to ensure statistical validity and predictive power of the model and analysis of the data collected also indicated that the choice model has strong predictive power as a whole, for individual parameter estimates, and for the three primary test cells—PG&E, SCE, SDG&E.

Table C-4 summarizes the results for each type of analysis described above. From the outset, the choice model was designed to ensure robust statistical significance—standard errors of all parameter estimates were below 0.10 and all but one were either at or near 0.05. Estimates within test cell subsets of the total sample were also statistically significant, even for smaller test cells with sample sizes close to 200. Measures of overall model predictive power (RLH and percent certainty) indicated that the choice model had excellent predictive power.

Table C-4: Results of Tests of Statistical Validity and Predictive Power for Choice Model

Statistic	Result	Interpretation
Standard error of aggregate logit utility estimates using random response data	Error estimates using 200 randomly generated responses were all under 0.10 (and for all levels but Charging Savings were between 0.040 and 0.069. For Charging Savings standard error was 0.098)	Less than 5% variation in aggregate parameter estimates using random data simulated to represent individual segments
Average root likelihood error of HB estimation	0.751	Choice model is more than twice as accurate as a random guess
Percent certainty	64% certainty	Excellent choice model fit
Standard error of preference shares across respondents	1.0% to 1.8% error for preference shares ranging from 36% to 88%	Vary little variation in parameter estimates. Implies a low p-value (below 0.01) and high statistical significance.

ALJ/SL5/MLC/lil

Date of Issuance 6/6/2018

Decision 18-05-040 May 31, 2018

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Application of San Diego Gas & Electric Company (U 902E) for Approval of SB 350 Transportation Electrification Proposals.	Application 17-01-020
And Related Matters.	Application 17-01-021 Application 17-01-022

DECISION ON THE TRANSPORTATION ELECTRIFICATION STANDARD REVIEW PROJECTS

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DECISION ON THE TRANSPORTATION ELECTRIFICATION STANDARD REVIEW PROJECTS

Summary

Today's decision approves, with modifications, transportation electrification projects proposed by California's three largest electric utilities and approves budgets totaling approximately $738 million. This decision further sets aside $29.5 million for evaluation of the projects. The approval and implementation of these transportation electrification projects continues the California Public Utilities Commission's efforts to meet the clean energy and widespread transportation electrification goals of Senate Bill 350. This decision is another step forward in ensuring California meets its clean air and greenhouse gas reduction goals for 2030 and beyond. These proceedings are closed.

1. Background

Senate Bill (SB) 350, the *Clean Energy and Pollution Reduction Act* (Chapter 547, Statutes of 2015), established new clean energy, clean air, and greenhouse gas reduction goals for California for 2030 and beyond. Among other things, SB 350 requires the California Public Utilities Commission, in consultation with the California Air Resources Board (CARB) and the California Energy Commission (CEC), to direct the utilities under our regulatory oversight to undertake transportation electrification activities consistent with Public Utilities Code Sections (Pub. Util. Code §§) 237.5 and 740.12.[1]

Decision (D.) 16-11-005 affirmed the direction to Pacific Gas and Electric Company (PG&E), San Diego Gas & Electric Company (SDG&E), and Southern California Edison Company (SCE) to file their first round of applications by

[1] Unless otherwise stated, all code section references are to the Public Utilities Code.

January 20, 2017. The utilities met this obligation by filing applications and supporting testimony for approval of proposed programs and investments to accelerate widespread transportation electrification on January 20, 2017.[2] Following protests, responses, and a prehearing conference, a Scoping Ruling was issued on April 13, 2017. Among other things, the Scoping Ruling consolidated the three applications, established separate procedural schedules for the processing of the proposed priority[3] and standard review projects, and identified the scope of issues.

The overarching issues within the scope of the standard review phase of this proceeding include (1) Are the proposed standard review projects reasonable and in the ratepayers' interests;[4] and (2) Should the proposed revenue requirement, cost recovery (including balancing account proposal) standard of review, and rate designs associated with the standard review programs be approved.

Opening testimony by non-utility parties on fast charging infrastructure and rates was served on July 25, 2017. Opening testimony on medium/heavy duty and fleet charging infrastructure and commercial Electric Vehicle (EV) rates was served on August 1, 2017. Opening testimony on residential charging infrastructure and rates was served on August 7, 2017. Concurrent rebuttal testimony of all parties was served on September 5, 2017.

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[2] D.18-01-024 sets forth the extensive procedural background leading to these applications, which we do not reiterate here.

[3] D.18-01-024 approved 15 of the priority review projects (PRPs) proposed by SDG&E, SCE, and PG&E totaling approximately $41 million.

[4] Sections 740.3 and 740.8.

Eleven days of evidentiary hearings were held from September 25 to October 12 of 2017. Following evidentiary hearings, a ruling was issued on October 12, 2017 modifying the post-hearing briefing schedule. Opening Briefs were filed on November 21, 2017 by: California Transit Association (CTA); CALSTART; ChargePoint, Inc. (ChargePoint); Clean Energy Fuels Corp (Clean Energy Fuels); Environmental Defense Fund (EDF); East Yard Communities For Environmental Justice, Center for Community Action and Environmental Justice, and Union of Concerned Scientists (UCS) (jointly, EJ parties); Green Power Institute (GPI); Greenlining Institute (Greenlining); National Diversity Coalition (NDC); Natural Resources Defense Council (NRDC), the Greenlining Institute, Plug-In America, the Coalition of California Utility Employees (CCUE), Sierra Club, EDF, UCS, Greenlots, Siemens, and eMotorwerks (jointly, NRDC et al.); Office of Ratepayer Advocates (ORA); PG&E; Small Business Utility Advocates (SBUA); SCE; Santa Clara Valley Transportation Authority (VTA); San Diego Airport Parking (SDAP); SDG&E; Southern California Gas Company (SoCalGas); Tesla; The Utility Reform Network (TURN); and Utility Consumers' Action Network (UCAN).

Concurrent reply briefs were filed on December 21, 2017 by: SDAP; Alliance of Automobile Manufacturers; CALSTART; ChargePoint; Clean Energy Fuels; CCUE; EJ Parties; EDF; GPI; eMeter, a Siemens Business, Greenlots, and Electric Motor Werks (jointly, eMeter); Greenlining; NDC; NRDC; ORA; PG&E; SBUA; SDG&E; SoCalGas; Tesla; TURN; UCAN; and VTA.

In September 2017, the Commission held community meetings in Richmond, Los Angeles, and Chula Vista, CA. Another community meeting was held in Fresno in December 2017. Almost 200 members of the public attended these meetings and provided comments on a range of issues included in the

Priority and Standard Review Projects of the utilities' Transportation Electrification (TE) applications. In these meetings, many members of the public expressed support for some or many of the proposed TE projects, especially in the medium-duty/heavy-duty (MD/HD) vehicle space. Members of the public were especially interested in pollution abatement and any health benefits available from TE in disadvantaged communities (DACs). Many members of the public also expressed concern about the bill impacts of the utility investments and how those would be connected to benefits, including economic, seen in their communities.

On December 14, 2017, CARB unanimously approved its Proposed Fiscal Year 2017-18 Funding Plan for Low Carbon Transportation Incentives, which includes $663 million in incentives for financing zero-emission and plug-in passenger cars, clean trucks and buses, and advanced technology freight projects, of which $398 million is targeted at heavy-duty and off-road vehicle sectors.[5]

This matter was submitted on December 21, 2017, upon the filing of concurrent reply briefs.[6]

A proposed decision on the Standard Review Projects mailed for comment on March 30, 2018. Parties filed opening comments on April 19, 2018, and reply comments on April 24, 2018. The assigned commissioner convened an All Party Meeting at the Commission's San Francisco office on May 16, 2018. Notice of the All Party Meeting appeared on the Commission's Daily Calendar on May 4, 2018. Parties were provided an agenda and call-in number to participate in the All

[5] PG&E Reply Brief at 6, referencing Exhibit PGE-6.

[6] California Public Utilities Rule of Practice and Procedure 13.13(a).

Party Meeting on May 11, 2018. The All Party Meeting was highly attended, with over 60 people in-person and 90 participants via phone.

1.1. Technical Definitions

Given the technical nature of the utilities' proposals, we have defined a few terms upfront, in addition to the acronym glossary provided in Appendix A.

- **Make-ready:** Service connection and supply infrastructure to support EV charging comprised of the electrical infrastructure from the distribution circuit to the stub of the Electric Vehicle Supply Equipment (EVSE). It can include equipment on the utility-side (e.g. transformer) and customer-side (e.g. electrical panel, conduit, wiring) of the meter.
- **EV Supply Equipment (EVSE):** (1) the equipment that interconnects the AC electricity grid at a site to the EV. 2) Sometimes used more broadly to mean charging station, whether AC or DC, but not including the make-ready infrastructure or other charging infrastructure. Also see charging station/device. May include multiple connectors (called multi-port) to charge several EVs or to serve EVs with different types of connectors (e.g. SAE Combo and CHAdeMO).
- **Level 1 (L1) Charging:** AC Level 1 provides 1 to 5 miles of range per 1 hour of charging using a 120-volt (V) alternating current (AC) plug.
- **Level 2 (L2) Charging:** AC Level 2 provides 10 to 20 miles of range per 1 hour of charging using 240 V or 208 V electrical service.
- **DC Fast Charging:** Charging at 20 kW and higher using direct current. Direct-current (DC) fast charging provides 50 to 70 miles of range per 20 minutes of charging with an electrical output ranging between 50-120 kW. A charging station that rapidly charges a car battery by connecting it directly to a higher power, direct current source.

- **Charge Port:** Generally, refers to the location where the EVSE connector attaches to the vehicle. Not to be confused with port or connector. One EVSE may have multiple charge ports.
- **Site:** the location at which charging infrastructure (EVSE or make-ready) is installed.
- **CHAdeMo:** A connector and communication protocol for vehicle DC charging initially developed in Japan during 2005-2009. It was first adopted into international standards IEC 61851-23/24 and IEC 62196-3 in 2014 and then into USA standard IEEE 2030.1.1 in 2015. Further updates to the protocol are managed by the CHAdeMO Association.
- **Combined Charging System (or Combo/CCS) Connector:** A connector that supports both AC J1772 and DC Charging and created by the Society of Automobile Engineers, which is a standards development organization for vehicle technology.
- **Transportation Electrification:** the use of electricity from external sources of electrical power, including the electrical grid, for all or part of vehicles, vessels, trains, boats, or other equipment that are mobile sources of air pollution and greenhouse gases (GHG) and the related programs and charging and propulsion infrastructure investments to enable and encourage this use of electricity.[7]

2. Statutory and Commission Guidance

In § 740.12(a)(1), the Legislature found, among other things, that widespread TE is needed to achieve the goals set forth in the Charge Ahead California Initiative,[8] and to reduce emissions of GHG "to 40 percent below

[7] Section 237.5.

[8] The goals of the Charge Ahead California Initiative "are to place in service at least 1,000,000 zero-emission and near-zero-emission vehicles by January 1, 2023, to establish a self-sustaining California market for zero-emission and near-zero-emission vehicles in which zero-emission and near-zero-emission vehicles are a viable mainstream option for individual vehicle purchasers, businesses, and public fleets, to increase access for disadvantaged, low-income, and

Footnote continued on next page

1990 levels by 2030 and to 80 percent below 1990 levels by 2050…."[9] The Legislature also found that "[a]dvanced clean vehicles and fuels are needed to reduce petroleum use, to meet air quality standards, to improve public health, and to achieve greenhouse gas emissions reductions goals," and that widespread TE "requires electrical corporations to increase access to the use of electricity as a transportation fuel."

The Legislature recognized the impact of TE, and found at § 740.12(a)(1), in part:

> (C) Widespread transportation electrification requires increased access for disadvantaged communities, low- and moderate-income communities, and other consumers of zero-emission and near-zero-emission vehicles, and increased use of those vehicles in those communities and by other consumers to enhance air quality, lower greenhouse gases emissions, and promote overall benefits to those communities and other consumers.
>
> (F) Widespread transportation electrification should stimulate innovation and competition, enable consumer options in charging equipment and services, attract private capital investments, and create high-quality jobs for Californians, where technologically feasible.
>
> (G) Deploying electric vehicles should assist in grid management, integrating generation from eligible renewable energy resources, and reducing fuel costs for vehicle drivers

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moderate-income communities and consumers to zero-emission and near-zero-emission vehicles, and to increase the placement of those vehicles in those communities and with those consumers to enhance the air quality, lower greenhouse gases, and promote overall benefits for those communities and consumers." (Health and Safety Code § 44258.4.)

[9] The 2030 reductions are mandated in Health and Safety Code § 38566, and the 2050 reductions are set forth in Governor Schwarzenegger's Executive Order S-3-05.

who charge in a manner consistent with electrical grid conditions.

(H) Deploying electric vehicle charging infrastructure should facilitate increased sales of electric vehicles by making charging easily accessible and should provide the opportunity to access electricity as a fuel that is cleaner and less costly than gasoline or other fossil fuels in public and private locations.

The Legislature directed the Commission to consider those findings, among others, set forth by § 740.12(a)(1) when "designing and implementing regulations, guidelines, plans, and funding programs to reduce greenhouse gas emissions."

Pursuant to § 740.12(b):

- The proposed TE programs shall seek to minimize overall costs and maximize overall benefits.
- The Commission shall approve, or modify and approve, TE programs and investments, including those that deploy charging infrastructure, through a reasonable cost recovery mechanism.
- The approval, or modification and approval, of the programs and investments must be consistent with § 740.12, not unfairly compete with nonutility enterprises as required by § 740.3(c), include performance accountability measures, and be in the interests of ratepayers as defined in § 740.8.

Section 740.8 defines the interests of ratepayers as follows:

As used in Section 740.3 or 740.12, "interests" of ratepayers, short- or long-term, mean direct benefits that are specific to ratepayers, consistent with both of the following:

(a) Safer, more reliable, or less costly gas or electrical service, consistent with Section 451, including electrical service that is safer, more reliable, or less costly due to either improved use of the electric system or improved integration of renewable energy generation.

(b) Any one of the following:

(1) Improvement in energy efficiency of travel;

(2) Reduction of health and environmental impacts from air pollution;

(3) Reduction of greenhouse gas emissions related to electricity and natural gas production and use;

(4) Increased use of alternative fuels; and

(5) Creating high-quality jobs or other economic benefits, including in disadvantaged communities identified pursuant to Section 39711 of the Health and Safety Code.

In addition, § 740.3(c) requires the "costs and expenses of those programs are not passed through electric or gas ratepayers unless the commission finds and determines that those programs are in the ratepayers' interest." Furthermore, § 740.12(c) requires that before the Commission can authorize "an electrical corporation to collect new program costs related to transportation electrification in customer rates," the Commission "shall review data concerning current and future electric transportation adoption and charging infrastructure utilization...."[10]

The September 14, 2016 Assigned Commissioner's Ruling in Rulemaking (R.) 13-11-007 (ACR) established a complementary set of principles that guide our review and analysis of the Standard Review Projects. In the ACR, the assigned Commissioner set forth the guidelines on what the TE applications

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[10] Section 740.12(c) also states: "If market barriers unrelated to the investment made by an electric corporation prevent electric transportation from adequately utilizing available charging infrastructure, the commission shall not permit additional investments in transportation electrification without a reasonable showing that the investments would not result in long-term stranded costs recoverable from ratepayers."

should contain, and the criteria the applications would have to meet. In particular, the ACR encouraged projects that:

- Fit with the California Public Utilities Commission (CPUC or Commission) and utility core competencies and capabilities;
- Address the multiple goals of widespread TE;
- Consider Commissioner-identified priority projects;
- Align with Local, Regional and Broader State Policies;
- Promote driver, customer and worker safety;
- Leverage non-utility funding;
- Identify a Vehicle Grid Integration (VGI) Communication Standard;[11]
- Consider utility incentives or other regulatory mechanisms;
- Provide anonymous and aggregated data for evaluation.

The ACR provides guidance about the applications as follows:

- The TE application shall explain how the proposed projects or investments will accelerate the adoption of TE.
- The TE application needs to demonstrate, with specific monitoring and evaluation criteria, how the projects and investments will align with the findings set forth in § 740.12(a)(1).
- The TE application shall describe how each project and investment will minimize overall costs and maximize overall benefits.

[11] The utilities were directed to address whether they intended to adopt standard VGI communications protocols in their applications. Consistent with §§ 740.2, 740.3(a) and 8362, the Commission is cooperating with the CEC, CARB and California Independent System Operator (CAISO) in conducting a working group to determine whether the state should adopt a specific VGI communications protocol. No recommendation has been issued from this working group, so any Commission rulemaking on whether to adopt any specific protocol or protocols or similar requirements will be addressed in a future decision.

- The TE application shall describe the cost recovery mechanism the utility is seeking.
- The TE application shall describe how each proposed project and investment does not unfairly compete with nonutility enterprises.
- Each of the proposed TE projects and investments shall include performance accountability measures.
- The TE application shall describe how each proposed project and investment is in the interests of ratepayers.
- The TE application shall provide testimony about the following: Current and future electric transportation adoption and charging infrastructure utilization; any market barriers that prevent electric transportation from adequately utilizing available charging infrastructure, and a reasonable showing that the investment will not result in long-term stranded costs recoverable from ratepayers.

3. SDG&E's Residential Charging Program

SDG&E's originally filed application presented a Residential Charging Program (RCP) in which SDG&E would own, install, maintain, and operate 90,000 L2 charging stations, including the EVSE and make-ready infrastructure at SDG&E's customers' residences, limited to single-family homes and customers in multi-unit dwellings (MUDs) with four units or less.[12] As defined above, the make-ready infrastructure refers to the service connection and supply infrastructure to support EV charging (i.e. 240-volt outlet) including any distribution system upgrades on the utility side of the meter and panel upgrades (if needed), conduit, and wiring on the customer side of meter. SDG&E designed its RCP to accelerate widespread TE in the light-duty passenger vehicle market.[13]

[12] Exhibit SDGE-04 at RS-2.

[13] Exhibit SDGE-11 at RS-1.

However, due in large part to recommendations of the NRDC, Plug-In America, The Greenlining Institute, CCUE, Sierra Club, and the EDF (collectively, Joint Parties) SDG&E modified its proposal in its rebuttal testimony.[14] SDG&E's modified RCP for which it seeks approval includes:

- Allowing customer choice of either utility-owned or customer-owned EVSE;[15]
- A new allowance cap structure for the EVSE ($500 for single and multi-unit dwellings and $600 for single and multi-family dwellings in DACs) and installation costs ($1425 for single and multi-family dwellings and $1500 for California Alternate Rates for Energy (CARE) and Family Electric Rate Assistance (FERA) Program customers), as well as customers located in DACs (regardless of which ownership model is selected);[16]
- Increasing the number of EVSEs reserved for DACs from 20 percent to 25 percent;[17]
- Replacing the mandatory whole-house grid integrated rate (GIR) with an EV-Only GIR, and allowing customers to choose from two existing electric vehicle time-of-use rates (EV-TOU and EV-TOU-2);[18]
- Requiring networked EVSE;[19]
- Authority to spend $241.8 million, an increase of $16 million from SDG&E's original proposal;[20]

[14] ORA Opening Brief at 55.

[15] Exhibit SDGE-09 at LB-3.

[16] Exhibit SDGE-09 at LB-3.

[17] Exhibit SDGE-11 at RS-3.

[18] Exhibit SDGE-12 at CF-3.

[19] Exhibit SDGE-11 at RS-5.

[20] Exhibit SDGE-13 at MAC-1.

- Incorporate a goal of at least 40 percent of overall program costs to be spent with Diverse Business Enterprise (DBE) firms;[21]
- Use sub-meters for billing purposes at a scale that could be transformative for the electric industry nationwide;[22]
- Set aside $5.5 million for panel upgrades in DACs;[23]
- Adopt measures to ensure both utility-owned and customer-owned EVSE remain in service;[24] and
- Report on relevant metrics for an additional five years.[25]

The Joint Parties suggest the Commission need not rely solely upon the judgement of SDG&E, but can rely upon the collective judgement of a diverse group of stakeholders and experts with deep knowledge of the EV market in concluding that SDG&E's modified program will accelerate transportation electrification consistent with § 740.12.[26]

The chart below outlines SDG&E's RCP as proposed in its rebuttal testimony:[27]

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[21] Exhibit SDGE-11 at RS-8 to RS-9.

[22] Exhibit SDGE-11 at RS-5.

[23] Exhibit SDGE-11 at RS-3.

[24] Exhibit SDGE-11 at RS-7 to RS-8.

[25] Exhibit SDGE-11 at RS-8.

[26] NRDC et al. Opening Brief at 5.

[27] *See* generally, Exhibit SDGE-11.

Table 1. SDG&E Proposed Residential Charging Program

• Install up to 90,000 EVSE in residential customers' homes, with the option of utility or customer EVSE ownership. SDG&E will own all additional infrastructure in both ownership scenarios. The projected budget for 100-percent utility ownership is $241.8 and $239.9 million for 50-percent customer ownership.
• SDG&E would conduct an open Request for Proposals (RFP) to identify eligible EVSE, with a goal of 40 percent spent with diverse businesses. Customer chooses EVSE and Electric Vehicle Service Provider (EVSP); SDG&E installed EVSE in all participants' homes.
• SDG&E would offer an additional $175 in EVSE and installation allowance to customers in DACs or CARE/FERA customers, relative to what other customers would receive. Up to 25 percent of the program funds would be reserved for DACs
• Customers will utilize a "web based portal" to select and purchase an eligible EVSE.
• SDG&E would qualify only networked L2 EVSE that are certified by a Nationally Recognized Testing Laboratory (NRTL) and can connect to SDG&E for billing and receive dynamic pricing signals.
• SDG&E would provide customers with "upfront allowances" toward the cost of the charger through the on-line enrollment process.
• SDG&E will qualify and contract with specific installers through an RFP process.
• SDG&E would require all installers to be IBEW signatory contractors certified through the Electric Vehicle Infrastructure Training Program (EVITP).
• SDG&E would allow any residential customer with an EV to participate.
• Participants must enroll in the proposed Residential GIR or other EV TOU rates.

3.1. Impact on Competition

Sections 740.3(c) and 740.12(b) require the Commission to ensure that the TE programs it approves do not allow the utilities to unfairly compete with nonutility enterprises.[28] In D.11-07-029 and D.14-12-079, the Commission established a "balancing test" that evaluates the benefits of utility ownership of EV charging infrastructure against the competitive limitation that may result

[28] TURN Opening Brief at 123.

from that ownership.[29] Three of the four EVSPs that are parties to this proceeding agree customers should have the option of a utility-owned make-ready infrastructure and EVSE,[30] and SDG&E believes these opinions show that utility involvement will help grow the market and facilitate healthy competition.[31] However, many intervening parties raise anti-competitive concerns with allowing SDG&E to have the potential to own, install and operate up to 90,000 L2 Networked EVSE in SDG&E's service territory. Therefore, it is essential to evaluate the competitive impacts of SDG&E's modified RCP on the EV charging market.

3.1.1. RCP Size

SDG&E sized its RCP based on the assumption that SDG&E would serve 75 percent of the zero-emission vehicles (ZEVs) needed within its service territory to meet the Governor's goal of having 1.5 million ZEVs in California by 2025.[32] To calculate program size, SDG&E assumed that its service territory makes up approximately 10 percent of California's 1.5 million-vehicle goal, narrowing SDG&E's target to 150,000 ZEVs.[33] SDG&E subtracted the projected number of ZEVs in its territory in 2020 (29,691) from 150,000 vehicles to get a remaining market of 120,309 additional ZEVs that need to be on the road in SDG&E's territory by 2025.[34] SDG&E has set the goal of obtaining 75 percent

[29] TURN Opening Brief at 123, citing D.14-12-079 at 5.

[30] SDG&E Opening Brief at 26 referencing Exhibit SDGE-10 at PP-9.

[31] SDG&E Opening Brief at 26, referencing Exhibit SDGE-10 at PP-9.

[32] Exhibit SDGE-04 at RS-6.

[33] Exhibit SDGE-04 at RS-6 to RS-7.

[34] Exhibit SDGE-04 at RS-6 to RS-7.

participation rate through the RCP, which leads to a target of 90,000 customers participating. This implies that drivers who do not participate in SDG&E's RCP will account for the remaining 25 percent of adoption (about 30,000 EVs) within its territory from 2020 to 2025.

ORA is one of the several parties who feel SDG&E's 90,000 deployment goal could create anti-competitive issues within the EVSE and EVSP markets. ORA contends SDG&E's estimate is misleading because the utility ignores the natural progression of EV adoption that would occur from 2020 to 2025 without its proposed RCP.[35] ORA notes the 90,000 figure excludes the 3,000 to 3,500 utility-owned EVSE that were already approved in D.16-01-045.[36] The 90,000 figure additionally omits 14,000 current SDG&E EV drivers not enrolled in EV TOU rates.[37] ORA estimates that by 2025, San Diego's ZEV population, without the RCP, would be approximately 46,000.[38] ORA uses this figure to illustrate that SDG&E's 90,000 L2 EVSE deployment goal actually constitutes 87 percent of the projected vehicles needed to meet the Governor's ZEV goals in SDG&E's territory. ORA opines that SDG&E's potential ownership of 90,000 L2 EVSE, constituting 75 percent of the market share of L2 EVSE in SDG&E's service territory could have significant anti-competitive impacts on the market.[39]

ChargePoint believes that regardless of who "owns" the EVSE, SDG&E's plan to procure and install up to 90,000 EVSE will dominate the market for both

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[35] ORA Opening Brief at 56.

[36] ORA Opening Brief at 57, citing D.16-01-045 at 181.

[37] ORA Opening Brief at 57, citing Exhibit SDGE-15 at JCM-5.

[38] ORA Opening Brief at 57.

[39] ORA Opening Brief at 57.

home L2 EVSE and installation servicers, inalterably changing both markets.[40] This scenario has the potential to provide other charging station providers with little or no opportunity to compete in the EVSE and EVSP markets outside of SDG&E's program.[41]

Electrifying the transportation sector is a critical component to meeting the state's environmental goals, including greenhouse gas emissions reductions and air quality improvements. While we agree with SDG&E's rationale to target the residential market, we also agree with comments from ratepayer advocacy groups that the structure of SDG&E's RCP does not prevent the potential anti-competitive impacts of utility ownership of EV infrastructure.[42] We also find that there are varying methods for calculating the natural adoption of EVs in SDG&E territory and this can impact the overall market penetration of SDG&E's proposed program. Furthermore, as discussed more in Sections 3.2.1 and 3.5, it is unclear if the costs of the program are minimized while maximizing the benefit to all ratepayers.

In that regard, we limit the size of SDG&E's program to an initial, maximum deployment of 60,000[43] EVSE through the RCP, with an option to seek Commission approval to increase the deployment target three years into program implementation (as detailed in Section 3.5). A target of 60,000 participants will enable SDG&E to meet 50 percent of the projected EV adoption need in its service territory, and strikes a balance between the costs to ratepayers

[40] ChargePoint Opening Brief at 59.

[41] ChargePoint Opening Brief at 59-60.

[42] ORA Opening Brief at 85.

[43] Exhibit ORA-3 at 1-11; Exhibit TURN-01 at 1-2.

and the overall benefits of the RCP, in addition to competitive concerns. Furthermore, we make the following supportive modifications:

(1) RCP participants should be limited to new EV drivers[44] (Section 3.2.2);

(2) SDG&E should not own the EVSE or any of the make-ready infrastructure on the customer side of the meter (Section 3.1.2);

(3) any rebates for infrastructure on the customer side of the meter should be treated as an expense (Sections 3.2.1 and 8.1); and

(4) SDG&E should maintain a turn-key offering to the customer by providing rebates for the EVSE and EVSE installation, facilitated through SDG&E's existing Marketplace website (Section 3.5).

These modifications are within the scope of this proceeding, and provide SDG&E the opportunity to provide a turnkey solution to accelerating TE in the light-duty passenger vehicle market while minimizing anti-competitive impacts.

3.1.2. Ownership Structure

SDG&E believes the utility ownership model is reasonable and can maximize benefits and minimize costs. However, in response to recommendations made by the Joint Parties, SDG&E's modified RCP offers customers the choice between the utility owning and maintaining the EVSE or the customer owning and maintaining the EVSE themselves. In either instance, SDG&E still proposes to install, own, and maintain any distribution system upgrades on the utility side of the meter, and the 240-volt circuit from the customer's electric panel to the EVSE, as well as manage the installation of the

[44] TURN Opening Brief at 115.

EVSE by skilled and trained contractors.[45] Regardless of the ownership model, customers will utilize a web-based portal to choose and purchase an EVSE from a predetermined list of qualified EVSE. SDG&E plans to pre-qualify EVSE through an RFP process. During the EVSE purchase process, a monetary allowance will be applied upfront to the transaction. SDG&E requests authority for up to 100 percent utility ownership because SDG&E has no way of accurately predicting which ownership model customers will choose.

Many parties believe SDG&E's proposed EVSE ownership structure does not meet the Commission's "balancing test" that evaluates the benefits of utility ownership and EV charging infrastructure against the competitive limitation that may result from that ownership. ChargePoint acknowledges that although SDG&E amended its original filed application to allow some customers to own the EVSE, the modified RCP fails the anti-competitive balancing test.[46]

In a joint filing, three other EVSE Providers - Siemens, Greenlots, and Electric Motor Werks - contend utility ownership of charging infrastructure will drive the nascent TE market and provide benefits to ratepayers and DACs.[47] Given the evolution of the TE market, these three EVSE providers believe there is an active role for all participants in the TE ecosystem, including utility ownership of EVSE.[48] Siemens, Greenlots and Electric Motor Werks believe in a diverse business model to identify and address different market barriers to enable

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[45] Exhibit SDGE-11 at RS-5.

[46] ChargePoint Opening Brief at 59.

[47] Reply Brief of EVSE Providers at 5.

[48] Reply Brief of EVSE Providers at 5.

widespread TE.[49] To ensure customer exposure to choice and grow the overall EV market, the three EVSE providers support testing various business models.[50]

EDF urges the Commission to maintain SDG&E's ownership option, despite arguments that this may cause anti-competitive concerns.[51] EDF contends even if SDG&E owned all the EVSE in the proposed RCP, the 90,000 figure only represents a fraction of the needed EVs in SDG&E's service territory, diminishing anti-competitive concerns.[52]

Tesla recommends allowing consumers to choose their preferred connection at their residence based on the EV they lease or purchase.[53] Tesla believes mandating any one EVSE connector standard for customer participation in the proposed RCP is unnecessary and restricts customer choice. Tesla contends that customer choice is necessary for EV adoption, a primary goal of SB 350.[54]

Although SDG&E's modified RCP, as described in its rebuttal testimony, presents the options of customer-owned or utility owned EVSE, we agree with ORA that SDG&E fails to establish the benefits under the utility ownership model outweigh the anti-competitive impacts or justify the increased costs to ratepayers.[55] Installing a L2 EVSE at a residential home is not as complicated as the installation of EVSE in other sectors. As ChargePoint notes, "installation of a

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[49] Reply Brief of EVSE Providers at 5.

[50] Reply Brief of EVSE Providers at 6.

[51] EDF Opening Brief at 4.

[52] EDF Opening Brief at 4 to 5.

[53] Tesla Opening Brief at 11.

[54] Tesla Opening Brief at 11.

[55] ORA Opening Brief at 59 to 60.

home charging station is comparable to installation of other home appliances" and further estimates that about 80 percent of home installations are relatively simple and inexpensive and do not require electrical upgrades.[56] As detailed below (Section 3.2.1), TURN argues that utility ownership of the charging infrastructure results in higher, long-term costs to ratepayers, compared to alternative models that can still incentivize EV adoption and L2 EVSE installation in the residential sector. Further, SDG&E did not provide specific rationale or evidence for the need for full utility ownership specific to the single-family residential sector, which currently accounts for the vast majority of EV owners.[57] Given the relative success of EV adoption in the single-family residential sector and the lack of specific rationale from SDG&E on why full utility ownership is necessary for this sector, we question utility ownership in this instance. SDG&E has not presented a convincing case as to why utility ownership of the EVSE and make-ready infrastructure is necessary to improve the delivery of the RCP's objectives in proportion to the higher costs associated with utility ownership.

To test various business models, the Commission has previously authorized SDG&E to install, own, and operate more than $60 million in EV charging infrastructure, including the EVSE, across a variety of sectors.[58] SDG&E stated that in developing its proposed RCP, it did not consider any alternatives

[56] ChargePoint Opening Brief at 40.

[57] TURN cites several studies that show the majority of EV adoption occurs in single family housing, including information from the Center for Sustainable Energy, which shows that 81 percent of early EV adopters live in single-family homes. TURN Opening Brief at 87.

[58] D.16-01-045 authorizes SDG&E to spend $45 million to install, own, and operate up to 3,500 charging stations at workplaces and multiunit dwellings. D.18-01-024 authorizes SDG&E to spend $16 million to install, own, and operate charging equipment in five separate pilot programs.

to full utility ownership.[59] We believe the residential sector provides an opportunity to encourage customer investment in TE, and may not require as much utility intervention on the customer's property to encourage the adoption of EVs.

Denying SDG&E the ability to own any of the charging infrastructure (make-ready or EVSE) on the customer's side of the meter should not hinder SDG&E's ability to offer customers incentives for installing L2 charging stations, encourage the adoption of time-variant rates, and provide the Commission with valuable data to help shape future TE policy. To complement SDG&E's pilots that test full utility ownership of charging infrastructure, t the RCP, as modified by this decision, will test whether a broadly available rebate program that facilitates customer choice of prequalified products and installers is an appropriate use of ratepayer funds to support TE. Moreover, this modification will ensure that SDG&E's share of the EV charging market does not unfairly compete with nonutility enterprises consistent with §§ 740.3(c) and 740.12(b), while still supporting the accelerated adoption of EVs in the residential sector. As discussed further below, SDG&E is encouraged to draw upon the learnings from the RCP to expand on it, or develop other programs that align with the customer and market needs identified during the course of this program.

3.2. Program Specifics

SDG&E designed its RCP to provide consumers a turnkey solution for successful EV adoption amongst the light-duty passenger vehicle sector.[60]

[59] Reporter's Transcript (RT) at 944 to 945.

[60] ORA Opening Brief, citing Exhibit JP-3 at 11.

Although straightforward in theory, SDG&E's modified RCP raises many issues amongst parties, which are addressed below.

3.2.1. Allowance vs. Rebate

SDG&E believes its RCP will achieve California's policy goals by removing one of the key barriers to implementing TE: upfront installation costs.[61] As such, SDG&E provides for allowance(s) for its participants in its RCP. Participants in SDG&E's RCP will receive an allowance toward both the equipment cost and installation of their EVSE.[62]

Table 2. SDG&E RCP Proposed Allowances[63]

Allowance	Networked L2 EVSE	Installation	Total Allowance
Single-Family/MUD (non-DAC)	$500	$1,425	$1,925
Single-Family/MUD (DAC)	$600	$1500*	$2,100

*$1,500 installation allowance also available for CARE and FERA customers.

As reflected above, customers in SDG&E's service territory will receive $500 toward their purchase of a Networked L2 EVSE for single-family and MUDs, and $600 per single-family or MUDs for those individuals living in a DAC. SDG&E supports the use of Networked EVSE to help improve SDG&E's load factor through managed charging.[64] Networked EVSE prices range from

[61] Exhibit SDGE-11 at RS-9, Exhibit SDGE-02 at LB-28.

[62] Exhibit SDGE-11 at RS-3.

[63] Exhibit SDGE-11 at RS-5.

[64] Exhibit SDGE-11 at RS-5.

approximately $600 to $750, depending on cord lengths and power output, making participants responsible for a balance of $100 to $250.[65]

SDG&E proposes to provide an installation allowance up-to and not-to-exceed $1,425 for single-family and MUD customers, based on actual cost.[66] SDG&E suggests this allowance is in alignment with documented historical EV Project residential installation cost data for the San Diego region.[67] SDG&E proposes to offer an allowance of $1,500 for participants living in a DAC or CARE and FERA customers for installation costs.[68] Similar to the EVSE allowance, participants would be responsible for any installation balance.

SDG&E also proposes to include $5.5 million in its RCP budget for those DAC customers that are required to do an electrical panel upgrade before installing their selected Networked L2 EVSE.[69] SDG&E estimates panel upgrades to cost $1,500 to $3,000.[70] SDG&E's proposed installation allowance does not cover panel upgrades for typical residential customers, but these additional funds would help mitigate any excess costs associated with panel upgrades for participants in DACs, who may be living in older buildings with lower panel capacity.

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[65] Exhibit SDGE-11 at RS-5 citing to https://www.amazon/Best-Sellers-Automotive-Electric-Vehicle-Charging-Stations/zgbs/automotive/7427415011.

[66] Exhibit SDGE-11 at RS-6.

[67] Exhibit SDGE-11 at RS-6 referencing https://avt.inl.gov/sites/default/files/pdf/EVProj/HowDoResidentialChargingInstallationCostsVaryByGeographicLocations.pdf.

[68] Exhibit SDGE-11 at RS-6 to RS-7.

[69] SDG&E Opening Brief at 18, referencing Exhibit SDGE-11 at RS-8.

[70] SDG&E Opening Brief at 18.

Joint Parties support the allowance model because it addresses the significant up-front costs (both financial and behavioral) associated with purchasing and installing residential charging equipment, and will lower operational costs by encouraging charging during off-peak and super-off-peak periods when the grid is underutilized.[71] Joint Parties claim, "[e]xisting rebate programs appear to only deliver very modest results, far short of the transformative changes called for by SB 350."[72]

ORA and TURN believe SDG&E can achieve the same goals in its RCP through a straightforward rebate program.[73] TURN and ORA advocate for a rebate model to minimize costs to ratepayers.[74] TURN contends SDG&E's modified RCP will cost between $677 to $750 million (depending on what percentage of customers choose to own their own EVSE); meaning ratepayers would be paying over $7,500 to $8,300 per L2 EVSE installed over the life of the assets.[75] TURN contends these costs are astronomical even when compared to SDG&E's average EVSE allowance ($500) and installation cost estimates ($1,425).[76] TURN suggests "the main reason the cost to ratepayers of this program are approximately four times the actual costs of charging station equipment and installation allowance proposed stem from the fact that SDG&E

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[71] NRDC Opening Brief at 44 to 45.

[72] Exhibit JP-3 at 14.

[73] TURN Opening Brief at 89; ORA Opening Brief at 60 to 61, referencing RT at 1832-1836.

[74] TURN Opening Brief at 89; § 740.12(b).

[75] TURN Opening Brief at 89, citing Exhibit SDGE-13 at MAC-A-1 and MAC-A-2.

[76] TURN Opening Brief at 89.

seeks to capitalize and rate base the installation [of make-ready] infrastructure, installation of labor costs, and the [EVSE] itself."[77]

As noted in UCAN's opening brief and reiterated during hearings, SDG&E requested nearly $100 million in overhead to operate its proposed program. SDG&E contends it would charge a 48.9 percent overhead for the capitalized L2 chargers installed through its RCP.[78] "[T]he 48.9 percent will be charged multiplied times the direct cost of the charger."[79]

TURN acknowledges the upfront costs of purchasing and installing a L2 EVSE may be a barrier for some residential customers, but points to the upfront rebate provided to customers in Sonoma Clean Power's L2 rebate program.[80] Under the Sonoma Clean Power program, customers can go to Sonoma Clean Power's website to order an eligible L2 station; customers are then required to pay the sales tax and a $50 handling fee.[81] TURN suggests SDG&E implement a similar process, whereby eligible customers receive a coupon code to use on SDG&E's Marketplace website to order an eligible L2 charger.[82] The rebate amount would be upfront to reduce the cost of the L2 networked EVSE and any remaining rebate could be sent to the customer via check to cover any installation costs.[83] TURN suggests applying a L2 EVSE and/or installation rebate upfront to

[77] TURN Opening Brief at 89, citing Exhibit SDGE-06 at MAC-4, Table MAC-2.

[78] UCAN Opening Brief at 10, citing Exhibit UCAN-12.

[79] RT at 1151-1152.

[80] TURN Opening Brief at 105.

[81] TURN Opening Brief at 105, referencing Exhibit TURN-04 at Appendix 2.

[82] TURN Opening Brief at 105.

[83] TURN Opening Brief at 105-106.

participants utilizing the Marketplace website, thus reducing the actual upfront purchase cost for customers.[84]

According to SDG&E, "[t]he marketplace is a one-stop-shop for an array of smart appliances, including technology that can respond to price signals and incentivize customers to run the appliances during times of day when electricity is at its lowest price. The SDG&E Marketplace also provides customers information on rebates and energy efficiency scores for products listed throughout the site."[85]

SDG&E believes a rebate approach is flawed, because a rebate model does not promote safety, and has no proven track record for success. SDG&E suggests its allowance model is a more customer-friendly way of managing the program.[86] SDG&E claims installation under its proposed RCP will be safe because "trained and qualified contractors will perform the installation of [EVSE] that will be qualified through a competitive RFP process" and "the installation will be done to SDG&E's electric and safety specifications and managed by SDG&E, so the installations will be high quality and safe."[87] As TURN opines, SDG&E employees will not do any of the actual work associated with EVSE installations, and those same trained and qualified contractors will still perform installations under TURN's rebate proposal, providing the same safety benefits highlighted by SDG&E.[88]

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[84] TURN Opening Brief at 106.

[85] Exhibit SDG&E-4 at RS-26.

[86] TURN Opening Brief at 106.

[87] TURN Opening Brief at 106, citing Exhibit SDGE-11 at RS-13 to RS-14.

[88] TURN Opening Brief at 106, referencing RT at 956.

We agree with TURN that "allowance" or "rebate" is primarily an issue of semantics – the act of providing the credit to customers can be accomplished in the same way under either proposal.[89] We believe a straightforward, upfront-rebate program for the costs of the EVSE and customer-side make-ready infrastructure will work to meet the objectives of SB 350, and SDG&E's deployment goals. Moreover, we require SDG&E to treat the costs of the rebates as expenses, rather than as assets. SDG&E should utilize its current Marketplace website to allow customers to compare prices and read customer reviews when deciding which EVSE they would like to purchase.[90] Moreover, a rebate program that allows the residential customer to select EVSE from any qualified provider creates a good environment for market growth, technical innovation and competition on price, product features and service.[91]

In sum, SDG&E should work with its program administrator cost to design a customer experience that includes an upfront rebate through an enhanced Marketplace site. Once a customer has chosen an EVSE, SDG&E should manage the third-party EVSE installation, as originally proposed by SDG&E, including solicitation and selection of installers and the oversight and verification of the installation. Once the installation is complete, SDG&E should bill the customer directly for any balance above the rebate amount for EVSE and above the rebate amount for the costs of the installation.

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[89] TURN Opening Brief at 106.

[90] TURN Opening Brief at 106, citing Exhibit TURN-21.

[91] TURN Opening Brief at 124, citing Exhibit CP-1 at 11.

3.2.2. Participant Criteria

SDG&E designed its RCP to be open to both current and new EV drivers, a point of contention amongst parties. TURN and ORA advocate limiting RCP participation to only new EV drivers in order to eliminate the scenario of free-riders.[92] Free-riders are those who already own an EV, and any such allowances to those drivers would not result in additional EV adoption.[93] SDG&E does not believe there will be an issue with free-riders participating in the RCP, because of the requirement for participants to enroll in one of SDG&E's EV-TOU rates or its new dynamic rate.[94] SDG&E feels that limiting the RCP to new EV drivers will result in missing the opportunity to incentivize existing EV drivers to switch to a new rate designed to produce managed charging benefits.[95]

TURN recommends the Commission limit RCP participation to recent EV purchasers or lessees.[96] SDG&E claims that even with its proposed allowances participants will still "have skin in the game" because they will be required to either purchase or lease an EV. TURN, however does not feel that this is not enough to avoid free-riders.[97] TURN suggests under the current RCP there is no guarantee that a participant with three months left on their EV-lease will not enroll in the RCP, receive the proposed allowance, and then get an Internal Combustion Engine (ICE) vehicle when their EV lease term ends.[98] Under this

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92 TURN Opening Brief at 95.

93 Exhibit SDGE-15 at JCM-5.

94 Exhibit SDGE-11 at RS-9 to RS-10.

95 Exhibit SDGE-15 at JCM-5.

96 TURN Opening Brief at 115.

97 TURN Opening Brief at 115.

98 TURN Opening Brief at 115.

scenario, ratepayers would continue to pay for the costs of the EVSE and installation and pay SDG&E an annual rate of return.[99] ORA makes a similar showing, saying if a customer enrolled in the RCP moves residences, the EVSE and circuit would stay at the original residence.[100] ORA contends that even if SDG&E knew the RCP customer moved out and the new resident did not have an EV, the original RCP EVSE and circuit would remain in rate base.[101] Similarly, if the same EVSE were relocated to another residence, SDG&E's proposal did not have the utility earning a rate of return on the EVSE itself, but the costs of re-installing the EVSE in a new location would be rate based.[102] To help avoid these scenarios, TURN recommends that lessee participants have a minimum of eighteen months remaining on their lease term to reduce the number of free-riders and risks of stranded costs.[103]

TURN, ORA and NDC additionally question the RCP's openness to customers of all income levels, while SDG&E believes its RCP targets DACs and low-income customers.[104] TURN contends the RCP's failure to have income caps will enable wealthier households to become overwhelming recipients of allowances funded by ratepayer subsidies.[105] A recent survey revealed the majority of EV drivers in California are relatively wealthy, with 76 percent of

[99] TURN Opening Brief at 115.

[100] ORA Opening Brief at 61.

[101] ORA Opening Brief at 61.

[102] ORA Opening Brief at 16 referencing RT at 1834.

[103] TURN Opening Brief 115-116.

[104] TURN Opening Brief at 116; ORA Opening Brief at 71 citing RT at 865; NDC Opening Brief at 16; Exhibit SDGE-11 at RS-9.

[105] Exhibit TURN-04 at 3.

surveyed drivers having a household income of more than $100,000 per year, compared to California's average household income of $65,000.[106] TURN contends these segments will be predominately free-riders who would have bought or leased an EV regardless of the ratepayer subsidy.[107] Alternatively, if the RCP calls for income caps on participation, SDG&E contends the program would not be as effective at accelerating TE in San Diego and at integrating EV charging with the grid.[108] SDG&E believes the addition of an income cap would add an administrative burden and reduce the number of willing EV drivers who would qualify as RCP participants, contrary to the goals of SB 350.[109] SDG&E trusts the RCP will proactively prevent free-ridership from occurring because participants must enroll in an EV rate, in addition to being responsible for any costs over the EVSE and installation allowance.[110] TURN suggests the Commission not accept SDG&E's claims that an income eligibility requirement is unnecessary because residential customers should already be incented to move to a TOU or GIR rate when they acquire an EV.[111] In the alternative, TURN supports enhanced education and outreach or even financial incentives to encourage existing EV drivers to switch to a TOU rate, allowing SDG&E to

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[106] Exhibit TURN-04 at 3, citing CVRP Summary Documentation of the Electric Vehicle Consumer Survey, 2013-2015, at 49. Department of Numbers: http://www.deptofnumbers.com/income/california/.

[107] Exhibit TURN-04 at 3.

[108] Exhibit SDGE-11 at RS-9.

[109] Exhibit SDGE-11 at RS-9.

[110] Exhibit SDGE-11 at RS-9 to RS-10.

[111] TURN Opening Brief at 115.

capture the proposed load management benefits for a fraction of its proposed costs.[112]

TURN also questions SDG&E's focus on single-family residences.[113] TURN contends that 96 percent of proposed RCP funds will benefit what is already the most successful consumer market for EV adoption, single-family residences.[114] A recent report specially commissioned to determine EV adoption found that 81percent of early EV adopters reside in single-family detached homes, while an additional 9 percent are in an attached home (e.g., townhouse).[115] TURN suggests these numbers demonstrate that SDG&E's RCP targets the most successful market for EV adoption, as such, we should ensure any program costs are a reasonable and prudent use of ratepayer funds.[116]

We agree with TURN that RCP participation should be limited to recent EV purchasers or lessees. At the time of program implementation, SDG&E may offer its RCP to those customers who can provide proof of purchase or lease of their EV within 6-months from the time SDG&E implements its RCP. Any lease must have at least eighteen months remaining on the lease term.[117] Modifying SDG&E's RCP to focus on new EV adopters will help achieve one of the primary

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[112] TURN Opening Brief at 115.

[113] TURN Opening Brief at 87.

[114] TURN Opening Brief at 87.

[115] TURN Opening Brief at 87, citing Exhibit TURN-04 at 3, referencing Center for Sustainable Energy, Infographic: What Drives California's Plug-in Electric Vehicle Owners, September, 2016.

[116] TURN Opening Brief at 87.

[117] TURN Opening Brief at 115 to 116.

objectives of SB 350, widespread TE, and facilitate the broader ratepayer benefits associated with widespread TE.

We decline to implement TURN, ORA, and the NDC's recommendation for income caps at this time. We agree with SDG&E that income caps may not be necessary for RCP success, and can result in an additional administrative burden that has yet to be justified. The overall goals of the RCP address several transaction costs, including choosing an EVSE, finding a certified electrician, and coordinating EVSE installation. These barriers persist, albeit to different degrees, across all income classes. Moreover, there is not an immediate concern that less wealthy homeowners will not be able to access SDG&E's proposed incentives. The 60,000 target is scaled to meet a significant portion of residential EV charging need in SDG&E's service territory through 2025. To the extent stakeholders or the Commission identify a need to further target SDG&E's RCP to certain income classes, beyond the 25 percent DAC set-aside,[118] that will be addressed as part of consideration of program expansion via the Advice Letter (AL) process detailed in Section 3.5.

The modifications adopted for RCP participant criteria aim to incentivize drivers to adopt driving an EV. To achieve the state's goal of reducing GHG emissions to 40 percent below 1990 levels by 2030, more customers need to switch from fossil fuel vehicles to EVs; simply incentivizing current EV drivers to upgrade to a L2 charger and enroll in one of SDG&E's proposed rates will not achieve those necessary, incremental EV adoptions.[119]

[118] Exhibit SDGE-11 at RS-3.

[119] Section 740.12(D).

3.2.3. Networked L2 EVSE

SDG&E unequivocally disagrees with parties' contention that L1 charging is sufficient to meet the objectives of SB 350.[120] SDG&E advises L1 charging will not generate the same opportunities for managed charging associated with L2 charging, such as improving SDG&E's load factor, integrating renewables and reducing fuel costs.[121] ORA and TURN do not believe L2 EVSE is required for residential charging, while SDG&E's expert testified that L1 EVSE is simply too slow to meet driving needs while providing load-shifting and managed charging benefits.[122]

SDG&E suggests successfully implementing managed charging requires the increased use of L2 EVSE.[123] Managed charging in the context of this program refers to L2 customers that are incentivized to manage the time and duration of their charge based on their enrollment in a time-variable rate that better reflects grid conditions.[124] Unmanaged charging refers to L1 customers on the standard domestic residential rate that do not receive any incentives to manage their charging.[125] SDG&E's expert testified that unmanaged charging can increase peak net load, potentially leading to the need for additional generation resources and capacity investments.[126] The increased peak net load

[120] Exhibit SDGE-15 at JCM-2.

[121] Exhibit SDGE-15 at JCM-2.

[122] Exhibit SDGE-15 at JCM-2 to JCM-3.

[123] Exhibit SDGE-08 at JCM-19.

[124] Exhibit SDGE-08 at JCM-19.

[125] Exhibit SDGE-08 at JCM-19.

[126] Exhibit SDGE-08 at JCM-19.

can create a steeper afternoon ramp,[127] which may increase the need for additional flexible ramping resources (e.g., gas-fired generation or storage).[128] Managed charging, however, encourages EV charging when net load is lower and discourages EV charging when net load is higher.[129] SDG&E identifies four main benefits of improved net load factor: (1) lower wholesale electricity costs for SDG&E ratepayers; (2) deferral of new generation capacity investments; (3) deferral of distribution infrastructure investments; and (4) spreading fixed costs over more sales, reducing average cost per kilowatt hour (kWh)[130] SDG&E believes its proposed RCP and GIR provides pricing to encourage flexible EV loads to charge at low price hours corresponding to low net load hours.[131] In other words, managed charging has load shifting and load shaping benefits that can reduce upward pressure on rates for all ratepayers.[132] [133]

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[127] In California, solar generation tends to peak midday and wanes in the late afternoon, just as many customers are arriving home and turning on lights and appliances. If residential EV charging also starts at this same time, the difference between available generation and electricity demand will be even larger. *See* https://www.caiso.com/documents/flexibleresourceshelprenewables_fastfacts.pdf for more information.

[128] Exhibit SDGE-08 at JCM-19.

[129] Exhibit SDGE-08 at JCM-19.

[130] Exhibit SDGE-08 at JCM-21 to JCM-22.

[131] Exhibit SDGE-08 at JCM-21.

[132] Managing residential EV charging to occur during times of renewable overgeneration midday or late at night when energy demand is low, it can help prevent transmission and distribution system upgrades that might otherwise be needed to meet increased power demand during times of already high demand.

[133] ORA Opening Brief at 59, citing RT at 1048-1049.

ORA claims the projected grid benefits do not outweigh SDG&E's proposed program costs.[134] ORA highlights that SDG&E did not conduct a load shifting analysis for its modified RCP.[135] ORA does note that under SDG&E's original proposed RCP, SDG&E estimated the load shifting benefits from now to 2039 would be approximately $112 million, significantly less than the original program proposal's $279 million revenue requirement over the same period of time.[136] ORA contends that SDG&E does not opine on whether changing the rate structure in SDG&E's modified RCP will result in greater or less load shifting benefits.[137]

SDG&E suggests that because L1 customers require longer charging durations than L2, L1 charging limits the flexibility to shift charging times to be more beneficial to the grid.[138] Because L2 charging is faster than L1, L2 charging allows EV drivers to get a full charge during super off-peak hours (midnight to 6:00 a.m.).[139] Since L1 charging is slower, EV drivers run the risk of not being able to get a full charge during the super off-peak hours, resulting in possible range anxiety and higher fuel costs due to the inability to fully charge at the lowest electricity prices.[140]

SDG&E designed its RCP with networked L2 EVSE to achieve maximum grid integration benefits. These "smart" or Wi-Fi enabled L2 chargers provide

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[134] ORA Opening Brief at 59.

[135] ORA Opening Brief at 59.

[136] ORA Opening Brief at 50.

[137] ORA Opening Brief at 59 to 60, referencing RT at 1053.

[138] Exhibit SDGE-15 at JCM-3.

[139] Exhibit SDGE-15 at JCM-4.

[140] Exhibit SDGE-15 at JCM-4.

customers with the flexibility to participate in Demand Response programs.[141] Networked L2 EVSE can record interval consumption data enabling drivers to more easily respond to "real time signals" and "EV-only TOU rates."[142]

SDG&E argues the deployment of L2 EVSE is needed to meet the residential charging needs as car manufacturers release more EV models with larger batteries.[143] According to CARB "battery pack capabilities have increased in both battery electric vehicles (BEV) and plug-in hybrid electric vehicles (PHEV), and will likely continue based on manufacturer concerns."[144] SDG&E infers that with larger EV battery capacities comes the capability to accommodate longer travel distances, resulting in the need for greater charging durations.[145] TURN cites to an Applied Energy study that indicates home L1 charging is sufficient for 89 percent of normal daily travel needs on weekdays and 85 percent on weekends.[146] TURN suggests these figures are unsurprising given most drivers travel between 30 to 40 miles per day and park their vehicle overnight.[147] Charging an EV to travel 40 miles per day would take around 8 to 10 hours on a L1 charging port.[148] The Applied Energy study does not address the implications of L1 or L2 charging with larger battery capacities in both current and future EV

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[141] Exhibit SDGE-15 at JCM-4

[142] Exhibit SDGE-15 at JCM-4.

[143] Exhibit SDGE-15 at JCM-4.

[144] Exhibit SDGE-15 at JCM-4.

[145] Exhibit SDGE-15 at JCM-4 to JCM-5.

[146] Exhibit SDGE-15 at JCM-5, referencing Exhibit TURN-04 at 5, footnote 15.

[147] Exhibit TURN-04 at 5.

[148] Exhibit TURN-04 at 5, footnote 16 referencing the National Academy of Sciences, *Overcoming Barriers to Deployment of Plug-in Electric Vehicles* at 2.

models.[149] However, with a 200-mile range vehicle, the EV may not need to be fully recharged each night.[150]

TURN takes issue with the utilization of L2 EVSE stating that SDG&E has not provided any evidence that this will result in EV adoption. In a study cited to in SDG&E's application, 3,881 ZEV respondents (60 percent) responded they were "very influenced" by the subsidy to move to L2 EVSE.[151] TURN suggests these results only show the importance of a subsidy to install a L2 charger, but does not show how this subsidy influences new EV adoption.[152]

In evaluating the positions focused on the use of networked L2 EVSE, the potential benefits of managed charging outweigh TURN and ORA's concerns. Deploying 60,000 L2 EVSE should assist in grid management, a primary objective of SB 350,[153] by encouraging charging during off-peak and super off-peak periods when the grid is underutilized.[154] As NRDC et al. suggest, the L2 charging stations installed through SDG&E's RCP will "allow drivers to take full advantage of the longer ranges of second generation EVs, displacing more petroleum, improving air quality, and reducing emissions of GHGs."[155] We agree with the Joint Parties that qualifying networked L2 EVSE should have

[149] Exhibit SDGE-15 at JCM-5.

[150] Exhibit TURN-04 at 5, footnote 16, referencing the National Academy of Sciences, *Overcoming Barriers to Deployment of Plug-in Electric Vehicles* at 2.

[151] TURN Opening Brief at 87, citing Exhibit SDGE-04 at RS-9.

[152] TURN Opening Brief at 87-88, citing Exhibit TURN-04 at 3, Referencing CVRP, https://cleanvehiclerebate.org/eng/sites/default/files/attachments/California_PEV_Owner_Survey_3.pdf.

[153] Section 740.12(1)(a)(G).

[154] NRDC et al. Opening Brief at 45.

[155] NRDC et al. Opening Brief at 45.

common communication capabilities through WiFi or cellular and be capable of responding to price signals, recording interval energy consumption, allow for accurate billing of EV-only tariffs, and be certified by UL or another Nationally Recognized Testing Laboratory.[156] Networked L2 EVSE will also provide SDG&E and the Commission with valuable data concerning the current and future trends of EV charging patterns and their effect on grid reliability, a necessity in evaluating the success and scalability of SDG&E's RCP.[157]

3.2.4. Proposed Residential Rate

SDG&E proposes to offer a Residential EV-only Grid Integration Rate, in place of its originally proposed whole-house residential GIR.[158] This Residential EV-Only GIR will be applicable only to separately metered residential EV charging, and will consist of: (1) an Hourly Base Rate, which includes the CAISO Day-ahead hourly price; and (2) System and Circuit Hourly Dynamic Adders.[159] The new Residential EV-only GIR includes a two-period hourly base rate, differentiating the super-off peak from all other hours,[160] similar to the current Residential EV TOU rate option, which includes a super off-peak period.[161] The Residential EV-Only GIR will not include a Grid Integration Charge (GIC).[162]

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[156] Exhibit JP-3 at 28.

[157] Pub. Util. Code § 740.12(2) (c).

[158] Exhibit SDGE-12 at CF-2 to CF-3.

[159] Exhibit SDGE-12 at CF-2 to CF-3.

[160] Exhibit SDGE-12 footnote 5: The super off-peak Hourly Base Rate does not include recovery of the Generation Capacity costs not recovered in the C-CPP hourly adder. These will be recovered through the base rate during all other hours.

[161] Exhibit SDGE-12 at CF-3.

[162] Exhibit SDGE-12 at CF-3.

The recovery of distribution costs originally recovered through the GIC are now recovered through the Hourly Base Rate, as recommended by ORA,[163] resulting in higher hourly energy rates.[164] SDG&E proposes that the new Residential EV-Only GIR be optionally available to RCP participants.[165] As such, the following rate options would be available to RCP participants:

- For separately metered EV charging, the Residential EV-only GIR and for their home, any applicable residential rate option;
- For separately metered EV charging, Schedule EV-TOU (SDG&E's existing residential EV schedule for separately metered EV charging) and for their home, an applicable residential rate option; and
- For combined EV charging and home service, Schedule EV-TOU-2 (SDG&E's existing residential whole-house EV schedule).[166]

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[163] Exhibit ORA-3 at 2-10.

[164] Exhibit SDGE-12 at CF-3.

[165] Exhibit SDGE-12 at CF-3.

[166] Exhibit SDGE-12 at CF-3.

Figure 1. SDG&E's Proposed Residential Grid Integration Rate

Hourly Base Rate	
	¢/kWh
Super Off Peak	19.051
Other Times	21.752
+	
CAISO Day Ahead Hourly Price	

+

Dynamic Adders	
	¢/kWh
System Top 150 Hours	69.348
Circuit Top 200 Hours	18.780

SDG&E withdrew its original proposal to make its Residential GIR available more broadly, and now proposes to limit the applicability of its Residential EV-Only GIR to RCP.[167] ORA expressed concerns that including the CAISO day-ahead hourly rate in the hourly base rate is "highly experimental with uncertain outcomes that could hinder customers' acceptance and responsiveness."[168] By withdrawing the requirement that residential participants

[167] Exhibit SDGE-12 at CF-5.

[168] Exhibit SDGE-12 at CF-6, citing Exhibit ORA-3 at 2-11.

must take service on the GIR, SDG&E feels that concerns about including CAISO day-ahead pricing are addressed.[169]

In response to SDG&E's proposed rates, TURN suggests: (1) utilize the submeters embedded in residential EVSE to provide separate meter service to EVs; or (2) add to the baseline allowance of EV users so that reasonable EV charging will not be charged at second tier rates and to redesign SDG&E's existing EV TOU rates so that they contain both a baseline credit and super-off-peak period that is more affordable after the baseline credit.[170] SDG&E suggests its decision to replace the whole-house GIR with an EV-Only GIR, in addition to limiting GIR applicability to program participants, should address TURN's concerns on this issue.[171]

NRDC et al. state that while they appreciate SDG&E's amendments to its GIR, its existing EV TOU rates do not encourage customers to charge during off-peak hours because the delivery component is not time variant.[172] "Unfortunately, SDG&E's existing TOU rates fail to account for the fact delivery charges vary by time-of-use period, and SDG&E's super-off-peak rates are higher than either SCE or PG&E's."[173]

We agree with NRDC et al. that to "comply with ... § 740.12(a)(1)(G) and § 740.12(a)(1)(H), SDG&E's existing TOU EV rates should be redesigned to

[169] Exhibit SDGE-11 at CF-6.

[170] Exhibit TURN-06 at 3.

[171] Exhibit SDGE-12 at CF-6.

[172] NRDC et al. Joint Party Opening Brief at 50.

[173] NRDC et al. Joint Party Opening Brief at 5.

account for the time-differentiated nature of delivery costs."[174] TURN and ORA recommend the super-off-peak pricing should be 12¢-15¢/kWh,[175] which is similar to SCE and PG&E's current off-peak EV TOU rates. We direct SDG&E to submit a Tier 3 Advice Letter updating its existing EV-TOU and EV-TOU-2 rates to ensure the distribution component of the rates is time-differentiated to better incentivize drivers to charge at times when the grid is not constrained. SDG&E's EV-TOU and EV-TOU-2 rates should have super-off peak prices that are substantially lower than prices during other times of the day, to ensure charging during those hours provide cost savings compared to charging at higher-demand hours.

As discussed in more detail in Section 3.5, we approve SDG&E's EV-Only GIR as an optional EV-only tariff in which RCP program participants may choose to enroll.

3.2.5. Customer Marketing Education and Outreach

SDG&E believes education and outreach is important to the success of its RCP. SDG&E intends to leverage SDG&E's Clean Transportation Department's customer engagement efforts to target current and future EV drivers, as well as partner with stakeholders to share information about the RCP.[176]

SDG&E plans to leverage its own market research and existing customer communication channels to reach potential participants to its RCP.[177] SDG&E plans to utilize email campaigns, social media, advertising, non-paid media, its

[174] NRDC et al. Joint Party Opening Brief at 5.

[175] Exhibit TURN-06 at 21; Exhibit ORA-03 at 2-16.

[176] Exhibit SDGE-04 at RS-25.

[177] Exhibit SDGE-04 at RS-25.

company website, and car dealer partnerships in order to market the RCP. SDG&E also proposes to provide education materials on EVSE installation and how customers can effectively use their EV-only GIR.[178]

SDG&E's marketing and outreach plans aim to increase awareness of electric vehicle options for consumers in the light-duty residential vehicle market. SDG&E should work with its PAC to develop program marketing materials that are geared toward both DAC and non-DAC communities.

3.2.6. Data Collection and Program Advisory Council (PAC)

SDG&E designed its monitoring and evaluation plan to align with the commitment to customer service by focusing on evaluating participants' energy usage in conjunction with its approved rates.[179] SDG&E proposes to align its reporting pursuant to the PAC framework outlined in D.16-01-045.[180] SDG&E plans to report on a semi-annual basis on:

- Actual operating costs (i.e., the cost of running the RCP);
- Actual installation costs (total and average per site);
- Actual growth in ZEV by type (i.e., BEV, PHEV); and
- Annual growth of the RCP (by region, including DACs and non-DAC communities).[181]

SDG&E plans to report on these metrics, along with any proposed RCP modifications to the PAC and to monitor its RCP to identify scalability and enhancements to respond to customer needs.[182]

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[178] Exhibit SDGE-04 at RS-25.

[179] Exhibit SDGE-04 at RS-20.

[180] Exhibit SDGE-04 at RS-20, citing D.16-01-045 at 145.

[181] Exhibit SDGE-04 at RS-20 to RS-21.

[182] Exhibit SDGE-04 at RS-21.

In addition to the reporting requirements above, SDG&E agrees to incorporate the Joint Parties' recommendation to report on relevant program metrics for five years after the last EVSE supported by the program is operational.[183] SDG&E believes this additional reporting information will provide valuable information on charging load profiles and EVSE utilization, which complies with § 740.12(c).[184]

We find tremendous value in SDG&E's data collection plans and their work with their PAC. In light of the modifications described in Section 3.5, SDG&E should work with its PAC to ensure it can deliver information on actual RCP operating costs, annual installation costs, growth by vehicle type, and RCP growth in DACs and non-DAC communities. We further address data gathering requirements in Section 10.

3.3. Impact on Transportation Electrification and Emissions Reduction

SDG&E's RCP aims to provide improved air quality and increased use of alternative fuel, while improving the efficient use of the electric grid and increasing integration of renewable energy resources.[185]

SDG&E estimates 90,000 electric vehicles charging on the residential GIR in its service territory will result in the following emissions reductions:

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[183] Exhibit SDGE-11 at RS-8.

[184] Exhibit SDGE-11 at RS-8.

[185] SDG&E Opening Brief at 9, referencing Exhibit SDGE-09 at LB-7, and Exhibit SDGE-10 at PP-8 to PP-11.

Table 3. Air Quality Improvements - Lifetime Impact Estimates[186]

Net Emission Reductions (Metric Tons)			
	CO_2	NOx	VOC[187]
Program Case[188]	1,673,699	217.18	455.47
Reference Case[189]	332,060	43.99	116.86
Net Residential Program Impacts[190]	1,341,609	173.19	338.61
TOTAL:	**1,399,55**	**346.07**	**426.49**

[186] Exhibit SDGE-08 at JCM-5, Table 8-1A.

[187] Exhibit SDGE-08 at JCM-10, VOC stands for Volatile Organic Compounds.

[188] Exhibit SDGE-08 at JCM-2: The Program Case represents the RCP as described in Exhibit SDGE-04 with 90,000 EVs charging on the residential grid-integrated rate using L2 (240-volt) chargers.

[189] Exhibit SDGE-08 at JCM-2: The Reference Case is intended to represent residential charging growth in the absence of the RCP, or the SDG&E service territory EV adoption absent SDG&E's RCP.

[190] Exhibit SDGE-08 at JCM-2: Net Impacts are estimated by subtracting the Reference Case from the Program Case.

Table 4. Air Quality Improvements - 2025 Annual Impact Estimates[191]

Net Emission Reductions (Metric Tons)			
	CO_2	NOx	VOC
Program Case[192]	154,331	20.05	41.83
Reference Case[193]	31,305	4.14	10.87
Net Residential Program Impacts[194]	123,226	15.90	30.96
TOTAL:	**126,445**	**25.25**	**35.18**

SDG&E believes the net air quality benefits of SDG&E's proposed RCP are in line with the goals of SB 350.[195]

In SDG&E's service territory, transportation accounts for approximately 50 percent of all GHG emissions.[196] Light-duty vehicles comprise 97 percent[197] of all registered vehicles in San Diego County and are responsible for approximately 80 percent[198] of combined on-road and off-road GHG emissions.

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[191] Exhibit SDGE-08 at JCM-6, Table 8-1B.

[192] Exhibit SDGE-08 at JCM-2: The Program Case represents the RCP as described in Exhibit SDGE-04 with 90,000 EVs charging on the residential grid-integrated rate using L2 (240-volt) chargers.

[193] Exhibit SDGE-08 at JCM-2: The Reference Case is intended to represent residential charging growth in the absence of the RCP, or the SDG&D service territory EV adoption absent SDG&E's RCP.

[194] Exhibit SDGE-08 at JCM-2: Net Impacts are estimated by subtracting the Reference Case from the Program Case.

[195] Exhibit SDGE-08 at JCM-6.

[196] Exhibit SDGE-09 at LB-6, citing San Diego County Updated Greenhouse Gas Inventory at 3, Energy Policy Initiatives Center, available at http://catcher.sandiego.edu/items/usdlaw/EPIC-GHG-2013.pdf (March 2013).

[197] Exhibit SDGE-09 at LB-6, citing Proprietary IHS/Polk Data (April 2016).

[198] Exhibit SDGE-09 at LB-6, citing EPIC San Diego County Updated GHG Emissions Inventory at 8 (March 2013), *available at*: http://catcher.sandiego.edu/items/usdlaw/EPIC-GHG-2013.pdf.