Evaluation Plan

Reimagine tomorrow.

California Statewide Opt-in Time-of-Use Pricing Pilot Evaluation

October 5, 2016

Prepared for

Southern California Edison Company

Prepared by

Stephen George, Ph.D.
Senior Vice President

Eric Bell, Ph.D.
Managing Consultant

Aimee Savage
Consultant

Trevor Cummings
Senior Analyst

Nexant, Inc.

1 Introduction 1
1.1 Experimental Design 2
1.2 Pilot Evaluation 3

2 SCE Implementation Summary 6
2.1 Recruitment Sample Selection 11
2.2 Pilot Recruitment 13
2.3 Rate Assignment and Enrollment 19
2.4 Notification 24
2.5 Customer Attrition 28
2.6 Pilot Outreach and Education 30
2.7 Regulatory Compliance Assessment 32

3 PG&E Implementation Summary 40
3.1 Recruitment Sample Selection 43
3.2 Pilot Recruitment 45
3.3 Pilot Rate Assignment and Enrollment 50
3.4 Notification 54
3.5 Customer Attrition 61
3.6 Education and Outreach Material 63
3.7 Comparison with Regulatory Guidance 68

4 SDG&E Implementation 75
4.1 Recruitment Sample Selection 80
4.3 Rate Assignment and Enrollment 86
4.4 Notification 89
4.5 Customer Attrition 91
4.6 Pilot Outreach and Education 96
4.7 Regulatory Compliance Assessment 108

5 Methodology 116

5.1 Data Cleaning and Preparation 116

5.2 Load Impact Analysis 118

5.3 Estimating Load Impacts for Rate Treatments 118

5.3.1 Addressing Customer Attrition 119

5.3.2 Reporting Evaluation Results 123

5.3.3 Segmentation Analysis 124

5.4 Estimating Load Impacts for SCE's Smart Thermostat Treatment 128

5.5 Estimating Load Impacts for SDG&E's Usage Alert Treatment 128

5.6 Estimating Load Impacts for PG&E's Smart Phone App 129

5.7 Estimating Impacts for SDG&E's Smart Thermostat Treatment 130

5.8 Bill Impact Analysis 131

5.9 Modeling Opt-out Rates 134

6 Data Validation 137

6.1 SCE 139

6.1.1 Comparison of average values for selected characteristics 139

6.1.2 Comparison of Hourly Load Shapes by Season, Day Type, Rate Period, Segment, and Rate 141

6.2 PG&E 144

6.2.1 Comparison of average values for selected characteristics 144

6.2.2 Comparison of Hourly Load Shapes by Season, Day Type, Rate Period, Segment, and Rate 146

6.3 SDG&E 149

6.3.1 Comparison of average values for selected characteristics 149

6.3.2 Comparison of Hourly Load Shapes by Season, Day Type, Rate Period, Segment, and Rate 150

7 Detailed Work Plan 153

7.1 Task 2a: Data Cleaning and Preparation 153

7.2 Task 2c: Bill Impact Analysis and Reporting 154

7.3 Task 2d: Load Impact Analysis and Reporting 155

8 Deliverables Schedule and Due Dates 157

Appendix A Statewide TOU Pilot Evaluation Data Request 1 159

Appendix B SCE Deliverables and Outcomes from Resolution E-4761.....167

Appendix C PG&E Deliverables and Outcomes from Resolution E-4762 176

Appendix D SDG&E Deliverables and Outcomes from Resolution E-476X ...186

Appendix E SCE Power Analysis Memo 196

Appendix F PG&E Power Analysis Memo 207

Appendix G SDG&E Power Analysis Memo 217

1 Introduction

In Decision 15-07-001, the California Public Utilities Commission (CPUC or the Commission) ordered California's three investor owned utilities (IOUs) to conduct certain "pilot" programs and studies of residential Time-of-Use (TOU) electric rate designs (TOU Pilots and Studies) beginning the summer of 2016, and to file applications no later than January 1, 2018 proposing default TOU rates for residential electric customers. The IOUs were also directed to form a working group (TOU Working Group) to address issues regarding the TOU pilots and to hire one or more qualified independent consultants to assist with the design and implementation of the TOU Pilots and Studies. The TOU Working Group (WG) was comprised of 37 entities and included almost 100 people. Nexant, Inc. was engaged as the independent consultant.

On December 17, 2015, Nexant delivered a detailed report summarizing the design of the proposed opt-in pilots.[1] This report was relied upon by and incorporated into the Advice Letters filed by each IOU requesting approval of and funding for the pilots that each IOU would implement.[2] In February and March 2016 the Commission issued resolutions approving the pilot designs and funding with modifications from the original plan.[3]

At the outset of the WG process, the WG developed the following objectives to help guide pilot design:

- Consider treatment options and pilot designs for 2016/2017 that will provide useful insights for development of the IOU's January 1, 2018 application for default pricing that may begin as early as 2019
- Estimate load impacts by rate period for
    - Different rate structures that vary in terms of the timing and length of rate periods
    - The number of rate periods
    - Changes in rate periods and price ratios across seasons
    - Possible other features such as low or negative prices during excess supply conditions
- Assess customer understanding/acceptance/engagement/satisfaction with various TOU rate options
- Calculate bill impacts for customers on each pilot TOU rate relative to the otherwise applicable tariff (OAT)
- Assess the degree of hardship that might result from default TOU rates on senior citizen households and economically vulnerable customers (and perhaps others) in hot areas as directed by Public Utilities Code Section 745
- Assess the incremental effect of enabling technology on load impacts, bill impacts, and customer satisfaction
- Assess adoption rates for enabling technology for customers on TOU rates
- Assess the effectiveness of alternative information, education, and outreach options.

[1] George, S., Sullivan, M., Potter, J., & Savage, A. (2015). Time-of-Use Pricing Opt-in Pilot Plan. Nexant.

[2] SCE: Advice Letter 3335-E; PG&E: Advice Letter 4764-E; and SDG&E: Advice Letter 2835-E

[3] SCE: Resolution E-4761; PG&E: Resolution E-4762; and SDG&E: Resolution E-4769

Collectively, the pilots implemented across the three IOUs are testing nine different TOU rate options, which vary with respect to TOU rate periods, prices, and seasonality. Recruitment for eight of the rate options has been completed and more than 50,000 households have been enrolled on one of the rate options or retained in the study on the standard tiered rate to act as a control group for those who are placed on the new tariffs. With a scheduled October 1, 2016 launch, the ninth rate option is a complex, dynamic rate that SDG&E will test on a very small group (50 to 200) of customers. Recruitment for this began in late August. The impact of various technologies and information services are also being assessed through the pilots, including estimating TOU load impacts for households with smart thermostats in SCE's service territory, households who download a smart phone app that pushes notifications and displays other energy usage information to their Smartphones in PG&E's service territory, and households that receive usage alerts via email in SDG&E's service territory.

1.1 Experimental Design

A key objective of any pilot or experiment is to establish a causal link between the experimental treatments (e.g., TOU rates, enabling technology, etc.) and the outcomes of interest (e.g., load impacts, changes in bills, customer satisfaction, etc.). The best way to do this is through what is referred to as a randomized control trial (RCT) research design. With this approach, participants are offered a treatment and, after they agree to accept it, are randomly assigned to either the treatment or control condition. This ensures that the treatment and control customers are identical in every way except for exposure to the treatment and any difference that might occur due to random sampling error. As such, any observed difference in load during the peak period between treatment and control customers, for example, is due either to the treatment of interest (e.g., TOU pricing) or random chance.

A key challenge faced by the TOU Working Group was deciding how to gain insights from residential opt-in TOU pilots that might help inform policy decisions for residential default TOU pricing. An important difference between opt-in and default conditions is the mix of customers that are enrolled under each condition. With default enrollment, there are three types of customers who remain on the tariff: those who would enroll on the tariff if it was marketed on an opt-in basis (referred to as "always takers"); those who are unaware that their tariff changed; and those who are aware and would not have enrolled on an opt-in basis but, for a variety of reasons (e.g., inertia, transaction costs associated with switching out, etc.), do not opt out from default enrollment. This latter group—referred to as "complacents"—is likely to be less engaged than the always takers. Unaware customers are, by definition, unengaged. Because of the presence of complacent and unaware customers, average load reductions have been found to be lower under default enrollment compared with opt-in enrollment. However, aggregate load reductions could be much higher under default pricing if the lower average load reduction was offset by much higher enrollment.

In order to better represent the mix of customers that are likely to be enrolled under default conditions, the TOU Working Group decided to implement what is being called a "pay-to-play" (PTP) recruitment strategy. Under this approach, rather than recruit customers onto a specific rate by educating them about the features and potential customer benefits associated with the rate, as would be done for a typical opt-in pilot or program, prospective participants were offered an economic incentive for

agreeing to be in the pilot and were then randomly assigned to one of three[4] rate options or to the control condition after agreeing to participate. Since the primary motivation for enrolling on the study is likely to be the PTP incentive rather than the attractiveness of any particular rate feature, this approach is likely to enroll a reasonable number of participants who would likely be complacents, and even some who might be unaware, under a default enrollment strategy.

1.2 Pilot Evaluation

Evaluation of the opt-in pilots will focus on a number of important research objectives, including:

- Determining the change in electricity use in different time periods for different customer segments from each rate treatment and in response to the various technology and information treatments summarized above;
- Estimating the distribution of bill impacts associated with each rate option both before and after enrolling on the TOU rates;
- Assessing the extent to which the TOU rates cause unreasonable hardship among selected customer segments such as seniors and economically vulnerable customers in hot climate areas; and
- Determining satisfaction with, perceptions about, understanding of, and reported changes in behavior associated with different treatment options.

Nexant was selected as the lead contractor for managing the overall evaluation and for conducting the load and bill impact assessments. Research Into Action (RIA) was chosen to design, implement, and evaluate two customer surveys that will be used to address the latter two research objectives. This evaluation plan focuses on the first two research objectives. RIA is working closely with the TOU WG to design the questionnaire and survey plan for the two customer surveys that will be done, in part, to address the second two research objectives listed above. The first survey will go into the field after the end of summer 2016. RIA is currently working on an analysis plan that will detail how the survey data will be analyzed to address the research questions.

This evaluation plan not only lays out the approach that will be used to estimate load and bill impacts, but also summarizes in some detail the steps and outcomes associated with pilot implementation. For each utility, we describe what has occurred between designing the pilots and where we are in mid-August with more than 50,000 customers enrolled on experimental rates (or participating as a control customer). The key steps in this journey include:

- Screening out customers that, for various reasons, were deemed to be ineligible to participate in the pilot;
- Conducting pretests of different recruitment strategies to determine the most cost-effective means of achieving enrollment targets and to size the sample to the expected rate of acceptance;
- Drawing the recruitment sample;
- Sending out recruitment letters and accepting replies;
- Randomly assigning customers to treatment and control conditions;

[4] For SDG&E, participants were assigned to one of two rate options or the control group.

- Notifying customers of their acceptance into the pilot (or declining customers due to ineligibility or over recruitment);
- Sending welcome packages describing the details of the rates, the requirements of the study, providing tips on how to better manage energy costs through reducing or shifting load and other useful information;
- Sending out ongoing educational material; and
- Monitoring customer attrition.

Sections 2 through 4 provide a detailed summary of how each IOU conducted the above steps and the outcomes of each step (e.g., the number of customers who were recruited and the number who accepted, the number turned away for various reasons, the number assigned to each treatment, etc.). These details will be included in the first interim report, which will be provided in March 2017, and are important so that objective readers have a full understanding of the quality of pilot implementation (e.g., the extent to which implementation adhered rigorously to the experimental design and pilot plan) and also so that insights can be gained about how customers enrolled on TOU rates might behave during full scale roll out of TOU rates.

Another important activity summarized in Sections 2 through 4 concerns the extent to which implementation adhered to the requirements imposed on each IOU in the Commission resolutions approving the pilots. In those resolutions, based on the pilot plan, the Commission specified enrollment targets and levels of precision associated with selected metrics that the pilots are expected to achieve. In subsection 7 of Sections 2 through 4, we provide a detailed assessment of whether or not each Resolution requirement was successfully met.

In nearly all situations, the recruitment process successfully met all of the regulatory requirements laid out in the Commission Resolutions. In a couple of customer segment/treatment cells, enrollment was slightly under what was targeted. However, in these instances, enrollment was above what was needed to meet the requirements for statistical precision for the initial analysis in the summer of 2016. These targets were set based on an assumed attrition rate, including customer churn due to relocation. A preliminary analysis shows that customer churn may be well below the assumed number underlying the targets. As such, it is reasonable to think that the enrolled population in the second summer will still be adequate to meet the desired level of statistical precision.

The one treatment where recruitment was significantly below the target was for smart thermostat owners in SCE's service territory. The target was to recruit 3,750 smart thermostat owners into the study and to assign them randomly to 2 of the 3 rate treatments or to the control condition. Only roughly 600 customers were successfully enrolled. As such, these customers were assigned to only one of the two rates or to the control condition. Nevertheless, the number of customers on the treatment is still much smaller than ideal from a statistical standpoint.

Section 5 of the evaluation plan describes the methodologies that will be used to estimate load and bill impacts for each treatment included in the pilots. It also describes techniques that will be used to better understand the drivers underlying customer attrition. This section also discusses the conditions under which it is appropriate to incorporate selected survey data into the impact evaluation and, importantly, the issues that arise when those conditions are not met.

As discussed above, a key element of the pilot design is the use of a randomized control trial methodology in which participants are randomly assigned to treatment and control conditions after enrolling in the study. This approach ensures that the estimated load impacts are internally valid——that is, that any observed difference in usage between treatment and control customers is due to the treatment itself and not to some exogenous factor or to selection bias. Section 6 contains a detailed assessment of the differences in loads during the pretreatment period and differences in other characteristics across treatment and control customers. These comparisons were done to determine if there is any problem with how the randomization process was implemented. Some differences in these characteristics are to be expected due to random chance and small differences in loads and other variables are observed in about 5% of the pairwise comparisons. This is roughly what would be expected given the sample sizes and level of precision for which the samples were drawn. Importantly, there is no evidence of any problem in the randomized assignment process. Also important is the fact that the basic analysis methodology that will be used to estimate load impacts controls for these small differences.

Sections 7 and 8 present the statement of work and schedule that will govern the remainder of this effort, which will extend into early 2018. The primary deliverables from this evaluation will be documented in an interim report to be completed by the end of March 2017, covering the summer 2016 period, a second interim report covering the first full year of the pilot, to be completed in fall 2017, and a final report documenting all of the analysis to be completed by March 2018.

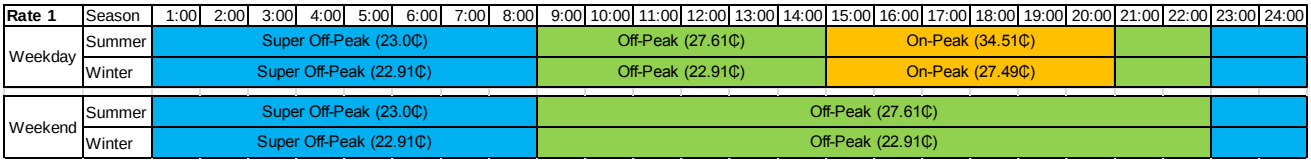
2 SCE Implementation Summary

SCE filed its Time-of-Use (TOU) Pilot Plan advice letter on December 24, 2015, later to be approved with modifications on March 30, 2016.[5] SCE's pilot plan involves testing three tariffs, which vary with respect to the number and timing of rate periods and prices in each period, as summarized in Table 2-1 and Figure 2-1 through Figure 2-3.

Table 2-1: Summary of SCE's TOU Rates

Rate Description		Rate 1	Rate 2	Rate 3
Rate Periods	Summer	3	3	4
	Winter	3	3	3
	Spring	N/A	N/A	4
Highest Price Differential (¢)	Summer	11.5	35.9	20.6
	Winter	4.58	10.5	10.6
	Spring	N/A	N/A	14.9
Peak Period		2-8 PM	5-8 PM	4-9 PM (Super On-Peak)
Duration of Peak		6 Hours	3 Hours	5 Hours
Super Off-Peak?		Yes	Yes	Yes
Super On-Peak?		No	No	Yes

Figure 2-1: SCE Pilot Rate 1



5

Adoption of residential time-of-use pricing pilots pursuant to Decision 15-07-001, Resolution E-4769 (PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA March 17, 2016).

Adoption of time-of-use (TOU) pricing pilots pursuant to Decision (D.) 15-07-001, Resolution E-4761 (PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA February 25, 2016).

George, D. S., Sullivan, D., Potter, J., & Savage, A. (2015). *Time-of-Use Pricing Opt-in Pilot Plan.* Nexant.

Figure 2-2: SCE Pilot Rate 2

Rate 2	Season	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00
Weekday	Summer	Super Off-Peak (17.33¢)								Off-Peak (29.32¢)									On-Peak (53.26¢)						
	Winter	Super Off-Peak (17.41¢)								Off-Peak (26.03¢)									On-Peak (27.91¢)						
Weekend	Summer	Super Off-Peak (17.33¢)								Off-Peak (29.32¢)															
	Winter	Super Off-Peak (17.41¢)								Off-Peak (26.03¢)															

Figure 2-3: SCE Pilot Rate 3

Rate 3	Season	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00
Weekday	Summer	Off-Peak (16.39¢)											On-Peak (22.64¢)					Super On-Peak (37.03¢)							
	Winter	Off-Peak (18.24¢)																Mid-Peak (20.96¢)							
	Spring	Off-Peak (18.24¢)											Super Off-Peak (9.94¢)					On-Peak (24.86¢)							
Weekend	Summer	Off-Peak (16.39¢)																Mid-Peak (18.77¢)							
	Winter	Off-Peak (18.24¢)											Super Off-Peak (10.39¢)					Mid-Peak (20.96¢)							
	Spring	Off-Peak (18.24¢)											Super Off-Peak (9.94¢)					Mid-Peak (20.96¢)							

The prices shown in the above figures do not reflect the baseline credit of 9.87 ¢/kWh for usage below the baseline quantity in each climate zone. This credit significantly reduces average prices, especially for lower usage customers.

Rate 1 has three rate periods on summer weekdays and two on winter weekdays. The peak period on Rate 1 is the same all year long and runs from 2 to 8 PM. The peak to super-off-peak price ratio (ignoring the baseline credit) is 1.5 to 1 in summer in winter. Customers on SCE's Rate 1 will pay off-peak prices on weekends in the winter. In summer, off-peak prices are in effect on weekends from 8 AM to 10 PM, which is the time period covered by the combination of peak and off-peak prices on weekdays.

SCE's Rate 2 has three rate periods on weekdays all year long, and compared with Rate 1, it has a much shorter peak period on weekdays and has significantly higher peak period prices in summer. The peak period runs from 5 to 8 PM. Rate 2 also features a super off-peak price of roughly 17 ¢/kWh between 10 PM and 8 AM on weekdays all year long. The ratio of peak to super-off-peak prices in the summer is roughly 3 to 1. In winter, the peak-to-super off-peak price ratio is roughly 1.6 to 1. On weekends, customers will pay the off-peak price between 8 AM and 10 PM and the super off-peak price during the same overnight hours as on weekdays, from 10 PM to 8 AM.

Rate 3 has a peak-period length of five hours, which is in between the peak-period length for Rates 1 and 2. In addition, the peak period starts later in the day compared with Rate 1, and extends further into the evening (until 9 PM) than either of the other pilot rates. The weekday peak-to-super-off-peak price ratio in the summer on Rate 3 is roughly 2.3 to 1. Another difference between Rate 3 and the other rates is the presence of super off-peak pricing between 11 AM and 4 PM in spring, when excess supply conditions may exist in California. On weekends, Rate 3 has two rate periods in summer and three in spring and winter. The peak period on weekends shown in Figure 2-3 has a different color compared with weekday peak periods because the prices on weekends don't match any of the prices during peak, partial, off-peak, or super-off-peak periods.

In addition to assessing the rate treatments summarized above based on customers recruited from the general residential population, SCE also recruited customers who were known to have purchased and installed a smart thermostat. The objective of this treatment group was to estimate load impacts for smart thermostat owners on TOU rates. The pilot plan called for SCE to partner with a smart thermostat

vendor (in this case, Nest) to recruit smart thermostat owners into the study using the same "pay-to-play" recruitment strategy as was used for the general population. However, because Nest does not know the names or addresses of its owners, recruitment was done via email only (the same communication channel that Nest uses to send out monthly reports to each online Nest owner summarizing equipment run time and other behavioral information). Target enrollment for the technology treatment was 3,750 customers, which were to be randomly assigned to Rates 1 and 3 or to the control condition. As discussed in Section 2.2, enrollment fell well short of this target and those who enrolled were randomly assigned only to Rate 1 and to the control group.

As discussed in the Time-of-Use Pricing Opt-in Pilot Plan[6] and in the IOU Advice Letters, enrollment on each treatment for selected customer segments was designed to address multiple objectives and to provide statistically valid estimates of impacts associated with several different metrics, including load impacts, bill impacts, assessment of hardship, and other survey based information such as reported changes in usage behavior. The enrollment plan called for oversampling low income and senior households in SCE's hot climate zone and oversampling CARE/FERA customers in all climate zones. The enrollment targets were based on an assumed attrition rate (driven mainly by customer churn) of 25% over the course of the pilot and desired levels of accuracy and precision for the various metrics of interest. Table 2-2 shows the target level of enrollment for targeted segments and treatments in SCE's hot climate region and Table 2-3 shows the target for all rate treatments across the three climate zones.

[6] George, D. S., Sullivan, D., Potter, J., & Savage, A. (2015). *Time-of-Use Pricing Opt-in Pilot Plan.* Nexant.

Table 2-2: Target Enrollment for Rate 2 in the Hot Climate Region

Climate Zone	Customer Segment	Sample Size	Non-CARE/FERA	CARE / FERA	Senior	SR < 100% of FPG	CARE / FERA < 100% FPG	<100% FPG	101 to 200% FPG	200 to 250% FPG	> 250% of FPG	Control Group
Hot	SR < 100% FPG	313	152	161	313	313	161	313	0	0	0	313
	Non-SR CARE < 100% FPG	156	0	156	0	0	156	156	0	0	0	156
	SR > 100% FPG	313	232	81	313	0	0	0	65	46	201	313
	Non-SR CARE > 100% FPG	231	0	231	0	0	0	0	89	43	100	231
	General	1,875	1,150	725	502	89	219	374	410	228	862	1,875
	All	2,888	1,533	1,354	1,127	402	536	843	564	317	1,164	2,888
	% In Sample	100%	53%	47%	39%	14%	19%	29%	20%	11%	40%	n/a
	% In Population	100%	61%	39%	27%	5%	12%	20%	22%	12%	46%	n/a

Table 2-3: Target Enrollment by Rate Type, Climate Region and Customer Segment

Climate Zone	Segment	Rate 1	Rate 2	Rate 3	Control	Total
Hot	CARE / FERA	625	1,354	625	1,354	3,958
	Non-CARE / FERA	625	1,533	625	1,533	4,317
	Total	1,250	2,888	1,250	2,888	8,275
Moderate	CARE / FERA	625	625	625	625	2,500
	Non-CARE / FERA	625	625	625	625	2,500
	Total	1,250	1,250	1,250	1,250	5,000
Cool	CARE / FERA	625	625	625	625	2,500
	Non-CARE / FERA	625	625	625	625	2,500
	Total	1,250	1,250	1,250	1,250	5,000
All	CARE / FERA	1,875	2,604	1,875	2,604	8,958
	Non-CARE / FERA	1,875	2,783	1,875	2,783	9,317
	Total	3,750	5,388	3,750	5,388	18,275

In order to avoid significant over or under recruitment and to better manage recruitment costs, SCE did a small pretest in January 2016 to determine how response rates to the pilot solicitation vary across selected customer segments, delivery channels, incentive payments, and with and without the offer of bill protection. Solicitations were sent to 3,200 customers randomly sorted into groups of 200 each. Offers were sent by Federal Express to some customers and by USPS to others. Participation incentive levels varied from $200 to $300, with and without the offer of bill protection. Response rates were tracked separately for CARE and non-CARE customers. Response rates did not vary materially between delivery methods, incentive levels, or with or without bill protection. The overall response rate was roughly 14%. Based on this pretest results, SCE decided to conduct the recruitment based on a $200 incentive using USPS and, for customer service and satisfaction concerns, to include bill protection in the offer.

The remainder of this section summarizes the sampling, recruitment, rate assignment, and enrollment processes that were used by SCE to solicit customers to participate in the pilot and to meet the enrollment targets prescribed in the CPUC resolutions approving the pilot. Section 2.1 describes the customer segments that were, for a variety of reasons, excluded from participation in the pilots and also describes the recruitment sample that was produced by SCE. Section 2.2 discusses the recruitment process and collateral that was used for solicitation. Section 2.3 summarizes the rate assignment and enrollment process while Section 2.4 discusses customer notification. Section 2.5 summarizes customer attrition and Section 2.6 discusses the education and outreach that has occurred since customers were enrolled onto the new rates. Finally, Section 2.7 systematically assesses the extent to which SCE's pilot implementation met the requirements laid out in Resolution E-4769.

2.1 Recruitment Sample Selection

Prior to pulling the recruitment sample, selected customers were screened out from participating in the pilot. Customers with less than 12 months of usage history cannot be defaulted to TOU rates in the future, and were therefore excluded from the pilot.[7]

Public Utilities Code Section 745(c)(1) excludes certain customers from being defaulted onto TOU rates without their affirmative consent. These customers include those who receive a medical baseline allowance, customers requesting third-party notification before disconnection (pursuant to subdivision (c) of Section 779.1), and customers who the California Public Utilities Commission (CPUC) has ordered cannot be disconnected from service without an in-person visit from a utility representative (Decision 12-03-054, March 22, 2012). Although these pilots involved opt-in participation, insights from the pilots are intended to be used for guiding default enrollment. As such, the TOU Working Group involved in designing the pilots decided that customers who would be excluded from being defaulted onto the TOU rates should also be excluded from the opt-in pilots.

SCE databases identify customers with medical baseline allowances, those that require third-party notification, and those that have previously been determined to require an in-person visit prior to disconnection. By agreeing to participate in the pilot the customer agreed that:

- There are no individuals in the home with a medical issue whose health or safety would be at risk due to shifting or reducing electricity use; or
- The household was not enrolled in a medical baseline program and the customer has not requested a third-party notification.

In addition to the statutory exclusions summarized above, a number of other groups were excluded from participating in the pilots for practical or other reasons. The complete list of exclusions includes:

- Direct access customers;
- Critical Peak Pricing;
- Green Rate;
- Medical Baseline;
- Customers requiring a third-party notification;
- Customers requiring an in-person attempt before being disconnected;
- Community choice aggregation customers;
- Net-metered customers;
- Seasonal;
- Sub-metered;
- Multi-family;
- Peak-time rebate customers with enabling technology or direct load control (all other PTR customers were included);
- Level pay plan;
- SmartConnect opt-out;

[7] PG&E and SDG&E elected to not exclude customers from pilot eligibility based on not having a complete 12 months of usage date.

- SCE employees or retirees;
- Customers that are on existing time-varying rates except for participants in SCE's Save Power Days peak time rebate, who will be included in the pilot recruitment sample
    - Seasonal Rates
    - Time-of-Use (pre-existing, non-pilot TOU rates)
    - Multi Affordability Solar Housing (MASH) Program
    - Green Rate
- Customers participating in SCE's load control program—the Summer Discount Plan—have been included in the recruitment sample as have participants in SCE's peak time rebate program known as Save Power Days (except those with smart thermostats, who are excluded). Prior research has shown that participants in load control programs have a higher likelihood of also enrolling on time-varying tariffs and are more engaged in managing their energy use than nonparticipating households. Excluding these households from the pilots could bias downward the average load impacts that would be observed relative to what might occur under future default conditions when such customers will be included.[8]

After the exclusions were applied to the population of roughly 4.3 million residential customers, the eligible population was approximately 3.3 million.

In addition to the above exclusions, SCEs operations department was unable to implement paperless billing for customers on TOU Pilot Rate 3. Unlike Rate 1 and 2, Rate 3's structure was not based on previously implemented rates, so automated billing was not feasible in the short timeframe available. As such, customers assigned to Rate 3 were told in their Welcome Kit materials that they would be receiving a paper bill while participating on the pilot. They were also told that their paperless enrollment would be reactivated at the end of the pilot, whenever they opt out of the pilot, or if they are removed from the pilot. In addition to paperless customers, there were also customers assigned to Rate 3 who view their SCE bill on their bank's website, classified as Check Free customers. Because SCE cannot re-enroll customers into this service, these customers were given the option to lose bill visibility on their bank's website or be removed from the pilot. Of a total 175 Check Free customers assigned Rate 3, 116 elected to remain in the pilot.

In January 2016, after applying the above exclusions, SCE drew a sample from the CARE/Non-CARE strata to offer pretesting to 3,200 customers as summarized above. For SCE's main recruitment campaign, the exclusion criteria were again applied to update customer eligibility status, with pretested candidates among those excluded. SCE resampled customers in the CARE/non-CARE strata that had been partitioned into Hot, Moderate, and Cool Climate Zones. The Hot Climate Zone was sampled with overlapping strata in the following way to maintain proportionality:

- A general sample was drawn from the entire Hot Climate Zone partition;
- The remaining customers were partitioned in CARE and Non-CARE segments, with a sample again drawn; and
- The remaining customers were stratified into groups according to whether they were above or below the federal poverty line (FPL), with a sample then redrawn.

[8] Time-of-Use Pricing Opt-in Pilot Plan, December 17, 2015.

In total, SCE randomly selected 197,214 customers for the recruitment campaign. A breakdown of the total offers made by strata (including the pretest group discussed previously) is shown below in Table 2-4. SCE oversampled CARE/FERA customers for all three rates, households with a senior as the head in the hot climate zone for Rate 2, as well as households with incomes less than or equal to 100% of the Federal Poverty Level (FPL) in accordance with P.U. Code 745(c)(2).

Table 2-4: SCE Offers by Partition and Strata

Category	Hot Climate Zone						
	General	CARE	Non-CARE	Non-Senior CARE		Senior	
				Below 100% of FPL	Above 100% of FPL	Below 100% of FPL	Above 100% of FPL
Offers	37,500	11,458	11,458	5,200	7,700	14,433	10,433

Category	Moderate Climate Zone		Cool Climate Zone		Pre-Test	Total
	CARE	Non-CARE	CARE	Non-CARE		
Offers	23,958	23,958	23,958	23,958	3,200	197,214

2.2 Pilot Recruitment

SCE sent out direct mail offers to participate in the pilot the first week of March 2016. Customers for whom SCE had email addresses (approximately 33% of the sample) also received an email solicitation that contained a link to the enrollment website.[9] Figure 2-4 shows the offer letter and reply enrollment card that was sent to the roughly 197,000[10] customers who were selected for recruitment. As seen in the figure, the solicitation emphasized the importance of the study, the financial incentive participants would receive, what was expected from participants and what they could expect over the course of the pilot, and the fact that participation was risk free in terms of bill impacts due to bill protection. TOU rates were described in very general terms but the specific rates included in the pilot were not described in detail as customers were to be randomly assigned to the rate options after agreeing to be in the study. Participants could enroll online, through the business reply card, or by calling a toll free number. The enrollment survey gathered important data about income, age of household members, email addresses, and a few other variables.

[9] Customers with a valid email received an email invitation as a second touch. Emails were available for approximate 33% of the targeted customers.

[10] 3,200 of the 197,000 customers were part of the pretest.

Figure 2-4: SCE Recruitment Letter and Enrollment Card (front and back)

TOU Pilot Study Letter — Full Launch — March 25, 2016 reply

SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL Company

«Date»

«Customer Name»
«Mail Address 1»
«Mail Address 2»
«City, State Zip+4»
«IMB»

Important:
Enrollment is limited.
Please reply no later than
March 25, 2016.

What's in it for you?

By participating, you'll be helping with future rate design and helping to secure California's energy future. We'll also provide you with a full year of bill protection, and reward you with **$200**.

Re: Rate Plan Change for Account #: «Service Account Number»

Dear «Customer Name»,

You are among a select group of customers invited to participate in an important study with us to test new rate plans. If you choose to participate, you'll also receive **$200** in bill credits, paid out over the course of one year.

We are testing new rate plans as part of a continued effort to better align the prices we charge with the costs incurred. This study will help us to design future rate plans and provide customers like you with the ability to try a new and different rate plan that may assist you with lowering your annual electricity costs — **Risk-Free**.

Why are we testing new rate plans?
A recent decision by the California Public Utilities Commission requires us to test new Time-of-Use (TOU) rate plans under which the price of electricity varies based on the time of day, day of week, and season of the year. The study is being conducted in preparation for the anticipated 2019 transition of residential customers to TOU rate plans.

What is a Time-of-Use rate plan?
TOU rate plans are much different than your current rate plan. Under a TOU rate plan, prices vary according to **how** much and **when** you use electricity. On your current rate plan, the more you use, the higher the price. Under a TOU rate plan, lower prices apply to electricity used during periods of lower demand such as late night, early morning, and weekends. Higher prices are charged when the demand for electricity increases, typically during the mid-afternoon to mid-evening hours. These higher prices are intended to encourage customers to shift their energy usage to lower cost time periods which can result in lower annual electricity bills, reduced demand on the power network, and reduced need for us to secure additional energy resources during more costly time periods.

What is Bill Protection?
We will provide participants with a full year of bill protection — meaning we'll calculate your bills under the new TOU rate plan and under your current rate plan. If you would have paid less under your current rate plan, we will credit back the difference after 12 months of participation. That means you can participate in the study **Risk-Free**.

What happens next?
If you choose to enroll and are selected to participate*:

- You'll be placed in a rate plan that may be similar to your current rate plan, or may be based on TOU in **June 2016**. It's important to know that you will be provided with all the details about your new plan and how best to save energy and money in May 2016, BEFORE your plan is switched in June.
- After receiving your first bill on your new plan, you'll receive a **$100** bill credit as an enrollment reward.
- You'll receive two surveys, one in Fall 2016 and one in Summer 2017. After completing each survey, you'll receive a **$50** bill credit, resulting in a total bill credit of **$200**.
- We will switch you back to your current rate plan in December 2017 when the pilot study rate plan closes. But if at any time you decide that the TOU rate plan is not right for you, you can switch back to your old rate plan and keep any portion of the bill credits received, with no future obligation.

Please help shape California's energy future — and respond before March 25, 2016.
Enrollment in the study is easy — here's how:

- **Go online to enroll at scetoustudy.com and enter participant code XXXXXX, or**
- **Complete and return the attached reply card using the envelope provided, or**
- **Call 1-800-688-5123 Monday-Friday from 8 a.m. to 5 p.m.**

한국어 1-800-628-3061
中文 1-800-843-8343
Tiếng Việt 1-800-327-3031

*Customers enrolled in CARE or FERA will continue to receive their discount if they participate in this study.

FOR OVER 100 YEARS...LIFE. POWERED BY EDISON.

PERF

TOU Pilot Study Enrollment Questions

Please answer all of the questions, sign, date and return this form.
* indicates a required field

☑ **Yes! I agree to have my rate plan switched to a TOU rate in June 2016 so that I may participate in SCE's TOU Pilot Study.**

Service Account Number:
«XXXXXXXXX»

Service Address:
«974 Ximeno Dr XXXXXXXXX
Huntington Beach»

Customer Name: «Customer Name»

* Phone:

* If this is a mobile/cell number, are you the authorized user? ☐ Yes ☐ No

☐ Yes, I would like to receive occasional text messages for tips and reminders during the TOU Pilot Study. Text message alerts may be subject to charges by your wireless carrier.

Email:

☐ Yes, I would like to receive occasional email updates about the TOU Pilot Study including tips and reminders.

* **Language preference:** ☐ English ☐ Spanish ☐ Mandarin ☐ Korean ☐ Vietnamese
* **Including yourself, how many people live in your household?** _____
* **How many people total in your household are 65 years old or older?** _____
* **Is the head of the household 65 years old or older?** ☐ Yes ☐ No
* **Do you rent or own your home?** ☐ Rent ☐ Own
* **What is your total annual household income?**
  - ☐ Less than $12,000
  - ☐ $12,000 - $16,999
  - ☐ $17,000 - $20,999
  - ☐ $21,000 - $24,999
  - ☐ $25,000 - $28,999
  - ☐ $29,000 - $32,999
  - ☐ $33,000 - $40,999
  - ☐ $41,000 - $49,999
  - ☐ $50,000 - $56,999
  - ☐ $57,000 - $99,999
  - ☐ $100,000 or more
  - ☐ Don't know or prefer not to answer

Return in enclosed envelope or mail to:
Southern California Edison
1415 South Acacia Avenue
Fullerton, CA 92831

I agree to the provisions on the back of this card.

Signature Required

Signature _____ Date _____

By agreeing to participate in this Time-of-Use rate study, I am certifying all of the following:

1. I will participate in the rate to the best of my ability, and understand that the incentive payments will be paid out in installments after I complete the surveys.
2. I agree that by enrolling in the pilot that there is no one living in the home who has a medical issue that would put their health or safety at risk by shifting or reducing electricity use.
3. I am not an employee or retiree of SCE.
4. I confirm that the household is not enrolled in the Medical Baseline program, nor does the account require a third-party notification.

In SCE Advice Letter 3335-E/PD1 dated February 25, 2016, SCE proposed to recruit 3,750 customers with smart thermostats to be part of a separate experiment, the results of which will not be directly comparable to the remainder of the pilot. SCE partnered with Nest to tap into customers who already owned smart thermostats. Recruitment was done via email only since Nest does not have names or addresses of households that own Nest thermostats. However, Nest regularly communicates with customers via email when it sends out monthly reports to each online Nest owner summarizing equipment run time and other behavioral information. Nest sent recruitment emails to a little over 51,000 Nest owners. Figure 2-5 shows the email that was sent to each Nest owner to solicit their participation in the pilot. Recipients could click on the "Learn More" button in the email to connect to a microsite where more information could be found and through which customers could enroll online.

Figure 2-5: Solicitation Email Sent to Nest Smart Thermostat Owners

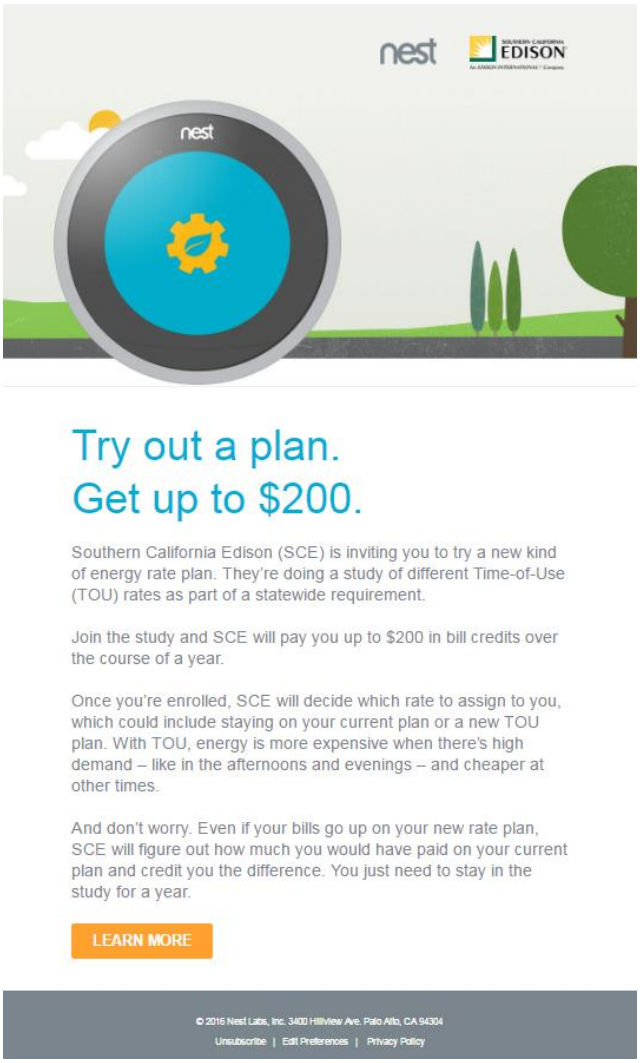


Table 2-5 shows the number of customers that agreed to enroll in the study for each target segment and the acceptance rate for each segment. The overall acceptance rate for the non-smart thermostat treatment groups was 14%, just as it was in the pretest. Acceptance rates for the tariff treatment varied

from a low of 10% for seniors below 100% of the Federal Poverty Guidelines (FPG) to a high of 17% for seniors above 100% of FPG.

Table 2-5: SCE Offers and Acceptances by Partition and Strata

Category	Hot Climate Zone						
	General	CARE	Non-CARE	Non-Senior CARE		Senior	
				Below 100% of FPL	Above 100% of FPL	Below 100% of FPL	Above 100% of FPL
Offers	37,500	11,458	11,458	5,200	7,700	14,433	10,433
Acceptances	4,769	1,690	1,371	713	1,045	1,458	1,764
Acceptance Rate	13%	15%	12%	14%	14%	10%	17%

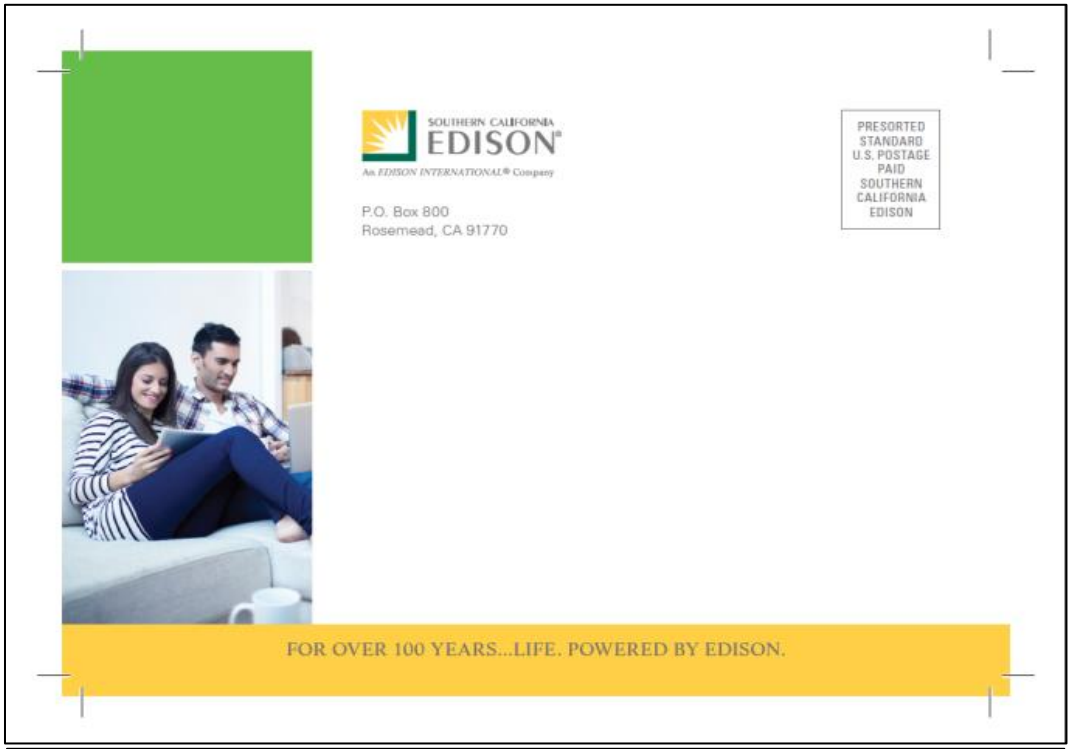
Category	Moderate Climate Zone		Cool Climate Zone		Pre-Test	Total for TOU Rates	Technology
	CARE	Non-CARE	CARE	Non-CARE			
Offers	23,958	23,958	23,958	23,958	3,200	197,214	51,381
Acceptances	3,381	2,609	3,929	3,264	498	27,429	938
Acceptance Rate	14%	11%	16%	14%	16%	14%	2%

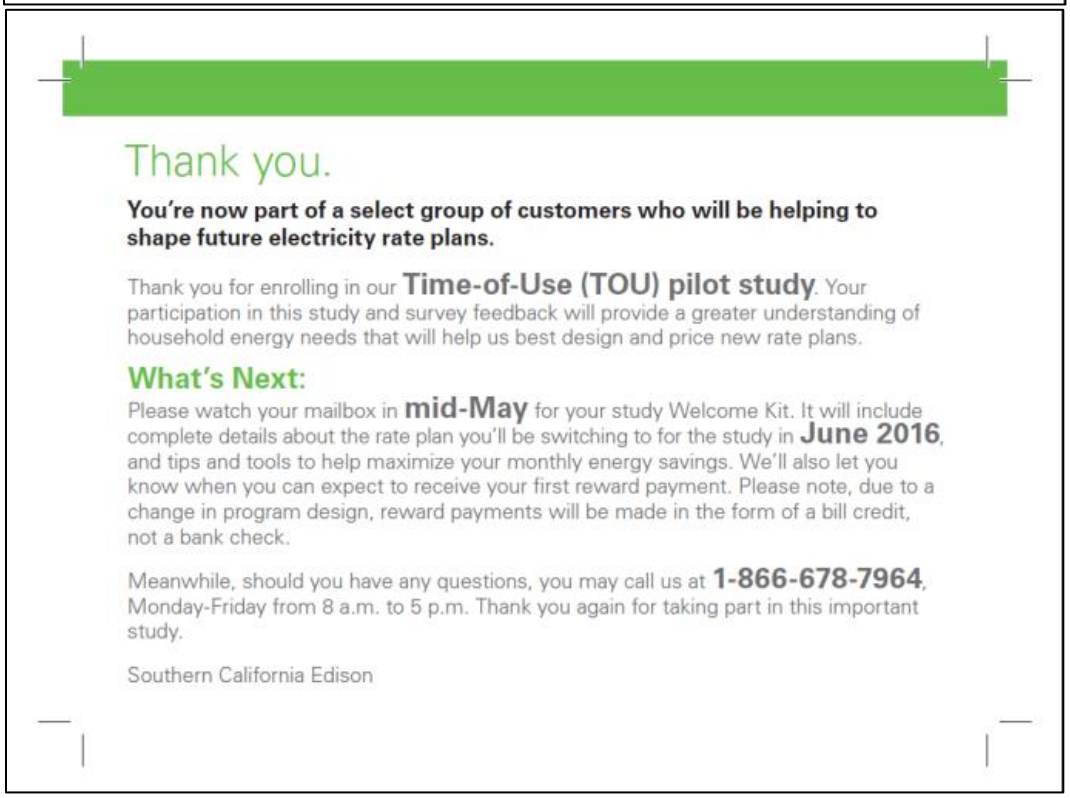
The acceptance rate was much lower among Nest owners, at about 2% of total offers made. 938 accepted the offer to enroll but fewer were accepted for reasons discussed in Section 2.3. There are several possible explanations for this. First, Nest reports that the email open rate for the solicitation was only about 31%. As such, of the roughly 51,000 who were sent an email, only about 16,000 actually read the solicitation. As such, one could argue that the acceptance rate is actually closer to 6% (938/15,928). Of those who opened the email, 2,548 (or 16%) clicked through to the microsite to learn more and to consider more carefully whether or not to enroll in the pilot. Of those who clicked through, more than a third actually completed the enrollment process.

Another possible reason why the overall acceptance rate was lower for this customer segment is that they had already been solicited twice to participate in SCE's Save Power Days demand response program and had declined to do so. As such, this group may be less interested in TOU rates than the general population by virtue of the fact that they had twice declined to participate in a dynamic rate program.

Following acceptance of the pilot offer, customers who enrolled during the pretest were sent a confirmation postcard thanking them for their participation. This was due to the long lag time between their enrollment in Jan/Feb and the Welcome Kit mailing in mid-May. Figure 2-6 shows the postcard, which provided a timeline of further study communications and study commencement, as well as a phone line for inquiries. The confirmation postcard also informed participants of a change in the incentive payment from the bank check described in the solicitation letter to bill credits. The confirmation postcard had messaging that reiterated the exclusivity of the pilot and the idea of helping to influence future rates plans. Postcards were sent in English and Spanish language versions.

Figure 2-6: SCE Confirmation Postcard





2.3 Rate Assignment and Enrollment

Not all customers who agreed to participate in the pilot were actually placed on a TOU tariff or assigned to the control group, thus staying on a tiered rate. There were numerous reasons why customers were not enrolled on a new rate or retained in the study as a control customer. First, their eligibility might have changed between the time they were selected into the recruitment sample and when they accepted the offer, or between the time they were assigned to a treatment condition and when enrollment was scheduled to occur, which was on the first billing cycle date to occur after June 1.[11] For example, a customer might have closed their account, become an NEM customer, or enrolled into the medical baseline program during this period, all of which would lead to being declared ineligible for the study after acceptance occurred.

Another reason why some customers who accepted the offer were not enrolled was because of over recruitment. As indicated in Table 2-6, SCE targeted to enroll 18,275 customers (not counting the Nest treatment group) but more than 27,000 customers accepted the pilot offer. In most cells, SCE accepted more than the target level of enrollees. Prior to enrollment, SCE set a maximum recruitment level at 20% over and above the minimum goal, including attrition, in each cell for Rates 1 and 2. Due to the manual billing constraints, no such over-recruitment for Rate 3 was implemented. Roughly 4,800 customers were declined participation due to over-enrollment above and beyond this level, in individual cells. For each over-subscribed cell, customers who were declined were chosen at random, in order to avoid any bias from only accepting early enrollees. Customers deemed ineligible, or who were declined, received a decline letter that thanked them for their interest in the TOU study. Pretested candidates deemed ineligible as well as non-selected enrollees received a decline letter that included a $5 gift card. Decline letter examples are shown in Figure 2-7. A third reason for a customer not being enrolled onto a rate was if they decided to drop out of the pilot prior to enrollment, although very few did.

Table 2-6 shows the progression of customers from acceptance to enrollment. Once ineligible customers were eliminated and those who were declined due to over recruitment were purged from the population, the remaining customers were randomly assigned to treatment or control conditions. Another change that occurred during this process was that some customers were reassigned to different segments based on data gathered through the enrollment survey. The original sample for targeted segments such as seniors above and below the poverty level was based on information on income and age of the head of household contained in a third party database . If data from the enrollment survey differed from data in the Acxiom database, the enrollment survey data was used to reclassify customers. In addition, customers were reclassified using an alternative definition of senior households from the one used to draw the original sample. The original sample was based on a definition of seniors tied to the age of the customer of record on the account. Subsequently, the Commission directed the IOUs to define senior households as any household where one or more people were aged 65 or older. This change increased the number of senior households in the sample by about 10 percent.

As seen in the table, 1,113 customers, or about 4 percent, were determined to be ineligible after accepting the pilot offer. Roughly 18 percent of those accepting the offer were turned down due to

[11] All Rate 3 and FERA customers were transitioned to their pilot rate starting on June 23 as a result of a July 23 rate implementation for these rates.

over subscription. No one dropped out at this stage prior to receiving a Welcome Kit and learning what rate they were assigned to, which is the next step in the enrollment process. Of the 938 Nest customers who agreed to participate, 250 were deemed ineligible primarily because they were participants in SCE's Save Power Days program and the smart thermostats were used to adjust settings on event days. SCE assigned 20,846[12] customers to one of the three treatments or the control group. The number assigned to Rate 2 was significantly larger than the other rate assignments because Rate 2 was the one chosen to be oversampled in order to assess whether TOU rates cause hardship for targeted customer segments in hot climate zones.

[12] This count does not include the Smart Thermostat customers as they are considered a separate experiment.

Table 2-6: Distribution of Customers from Acceptance to Enrollment

Category	Hot Climate Zone							Moderate Climate Zone		Cool Climate Zone		Pre-Test	Total*
	General	CARE	Non-CARE	Non-Senior CARE		Senior		CARE	Non-CARE	CARE	Non-CARE		
				Below 100% of FPL	Above 100% of FPL	Below 100% of FPL	Above 100% of FPL						
Offers	37,500	11,458	11,458	5,200	7,700	14,433	10,433	23,958	23,958	23,958	23,958	3,200	197,214
Acceptances	4,769	1,690	1,371	713	1,045	1,458	1,764	3,381	2,609	3,929	3,264	498	26,491
Acceptance Rate	13%	15%	12%	14%	14%	10%	17%	14%	11%	16%	14%	16%	13%
Ineligible Prior to Rate Assignment	154	65	53	29	45	70	73	63	68	111	90	42	863
Moved													
Medical		1		2	1			2	2	4	2		14
NEM													
Participation in Rate Program													
Other**	154	64	53	27	44	70	73	61	66	107	88	42	849
Opt-Out Prior to Rate Assignment													
Random Over Enrollment Declines	448	268	46	339	415	454	800	557	67	961	429	7	4,791
Assigned to a Rate or Control (under recruitment segmentation)	4,166	1,358	1,272	347	586	932	891	2,763	2,476	2,861	2,747	447	20,846
Assigned to a Rate or Control (under updated segmentation)	4,491	1,371	1,321	338	493	767	809	2,874	2,637	2,871	2,874		20,846
Rate 1		750	696					749	671	749	750		4,365

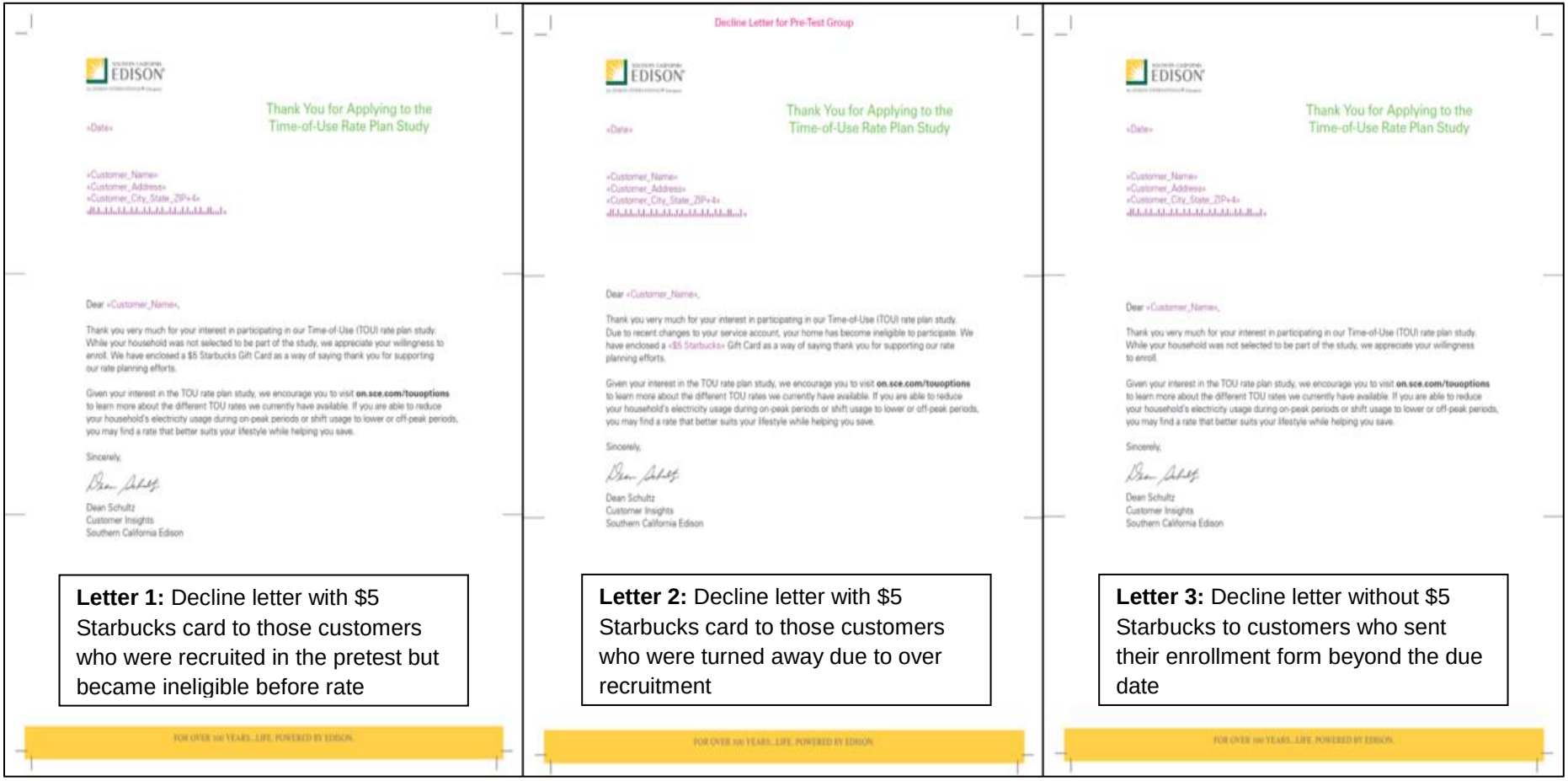
SCE Implementation Summary

Category	Hot Climate Zone							Moderate Climate Zone		Cool Climate Zone		Pre-Test	Total*
	General	CARE	Non-CARE	Non-Senior CARE		Senior		CARE	Non-CARE	CARE	Non-CARE		
				Below 100% of FPL	Above 100% of FPL	Below 100% of FPL	Above 100% of FPL						
Rate 2	2,245			170	238	382	412	750	671	748	749		6,365
Rate 3		621	625					625	625	625	625		3,746
Control	2,246			168	255	385	397	750	670	749	750		6,370
Target Enrollment	3,750	1,250	1,250	312	462	626	626	2,500	2,500	2,500	2,500		18,276
% of Target Achieved	120%	110%	106%	108%	107%	123%	129%	115%	105%	115%	115%		114%
Customers Transitioned to a Pilot Rate	4,416	1,315	1,264	326	478	758	794	2,800	2,580	2,802	2,817		20,350
Difference from Target Enrollment	666	65	14	14	16	132	168	300	80	302	317		2,074

* Totals do not include technology customers

** Other reasons for ineligibility (as described in dataset from SCE) include: Welcome Kit delivery failure, SCE employee, Green Rate, Level Pay Plan, PTR with DLC, as well as "Verification Failures"

Figure 2-7: SCE Decline Letters

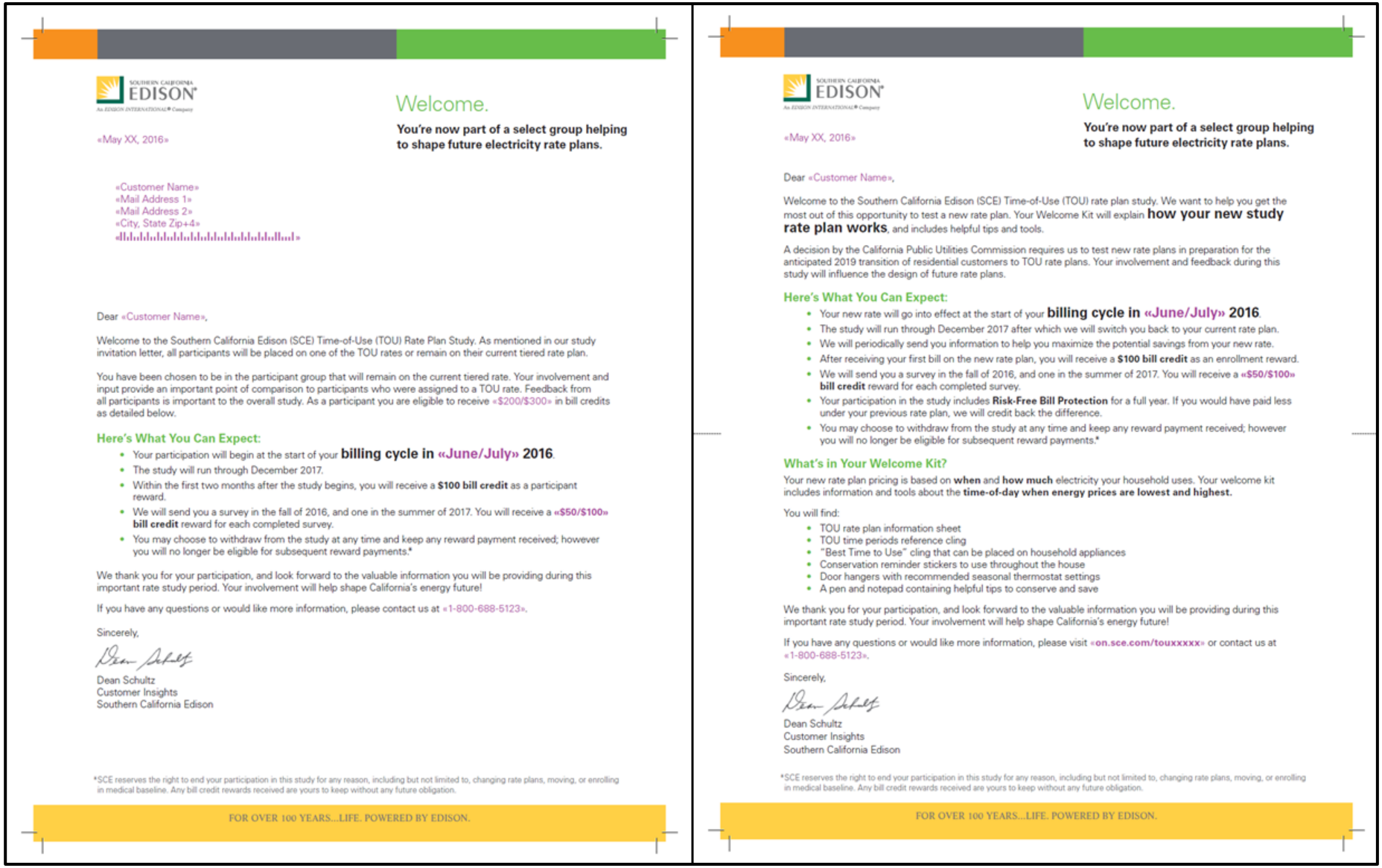


2.4 Notification

Following pilot rate assignment, study participants began receiving Welcome Kits in June 2016. The control group received a Welcome Letter informing them that they were to remain on their current tiered rate along with a timeline of the study that included dates for incentive payments and surveys/bill credits. The treated participants received a similar letter along with information regarding bill protection. Two examples of letters for the treated and control groups are shown in Figure 2-8.

Treated participants also received a TOU rate plan information sheet, TOU time period reference cling, cling for individual appliances, conservation reminder stickers, door hangers with recommended seasonal thermostat settings, as well as a pen and notepad. The TOU rate plan information sheets effectively illustrate Super Off-Peak, Off-Peak, Mid-Peak, On-Peak, and Super On-Peak periods using study-specific seasonal timelines. Examples of TOU Rate information sheets are shown in Figure 2-9 through 2-11. The Welcome Kits provided an effective strategy and tips for study participants to lower or maintain their electricity bills by shifting usage from Peak to Off-Peak times.

Figure 2-8: SCE TOU Pilot Welcome Letter



SOUTHERN CALIFORNIA EDISON®
An EDISON INTERNATIONAL® Company

«May XX, 2016»

«Customer Name»
«Mail Address 1»
«Mail Address 2»
«City, State Zip+4»
«IMB»

Welcome.

You're now part of a select group helping to shape future electricity rate plans.

Dear «Customer Name»,

Welcome to the Southern California Edison (SCE) Time-of-Use (TOU) Rate Plan Study. As mentioned in our study invitation letter, all participants will be placed on one of the TOU rates or remain on their current tiered rate plan.

You have been chosen to be in the participant group that will remain on the current tiered rate. Your involvement and input provide an important point of comparison to participants who were assigned to a TOU rate. Feedback from all participants is important to the overall study. As a participant you are eligible to receive «$200/$300» in bill credits as detailed below.

Here's What You Can Expect:

- Your participation will begin at the start of your **billing cycle in «June/July» 2016**.
- The study will run through December 2017.
- Within the first two months after the study begins, you will receive a **$100 bill credit** as a participant reward.
- We will send you a survey in the fall of 2016, and one in the summer of 2017. You will receive a **«$50/$100» bill credit** reward for each completed survey.
- You may choose to withdraw from the study at any time and keep any reward payment received; however you will no longer be eligible for subsequent reward payments.*

We thank you for your participation, and look forward to the valuable information you will be providing during this important rate study period. Your involvement will help shape California's energy future!

If you have any questions or would like more information, please contact us at «1-800-688-5123».

Sincerely,

Dean Schultz
Customer Insights
Southern California Edison

*SCE reserves the right to end your participation in this study for any reason, including but not limited to, changing rate plans, moving, or enrolling in medical baseline. Any bill credit rewards received are yours to keep without any future obligation.

FOR OVER 100 YEARS...LIFE. POWERED BY EDISON.

SOUTHERN CALIFORNIA EDISON®
An EDISON INTERNATIONAL® Company

«May XX, 2016»

Welcome.

You're now part of a select group helping to shape future electricity rate plans.

Dear «Customer Name»,

Welcome to the Southern California Edison (SCE) Time-of-Use (TOU) rate plan study. We want to help you get the most out of this opportunity to test a new rate plan. Your Welcome Kit will explain **how your new study rate plan works**, and includes helpful tips and tools.

A decision by the California Public Utilities Commission requires us to test new rate plans in preparation for the anticipated 2019 transition of residential customers to TOU rate plans. Your involvement and feedback during this study will influence the design of future rate plans.

Here's What You Can Expect:

- Your new rate will go into effect at the start of your **billing cycle in «June/July» 2016**.
- The study will run through December 2017 after which we will switch you back to your current rate plan.
- We will periodically send you information to help you maximize the potential savings from your new rate.
- After receiving your first bill on the new rate plan, you will receive a **$100 bill credit** as an enrollment reward.
- We will send you a survey in the fall of 2016, and one in the summer of 2017. You will receive a **«$50/$100» bill credit** reward for each completed survey.
- Your participation in the study includes **Risk-Free Bill Protection** for a full year. If you would have paid less under your previous rate plan, we will credit back the difference.
- You may choose to withdraw from the study at any time and keep any reward payment received; however you will no longer be eligible for subsequent reward payments.*

What's in Your Welcome Kit?

Your new rate plan pricing is based on **when** and **how much** electricity your household uses. Your welcome kit includes information and tools about the **time-of-day when energy prices are lowest and highest.**

You will find:

- TOU rate plan information sheet
- TOU time periods reference cling
- "Best Time to Use" cling that can be placed on household appliances
- Conservation reminder stickers to use throughout the house
- Door hangers with recommended seasonal thermostat settings
- A pen and notepad containing helpful tips to conserve and save

We thank you for your participation, and look forward to the valuable information you will be providing during this important rate study period. Your involvement will help shape California's energy future!

If you have any questions or would like more information, please visit **«on.sce.com/touxxxxx»** or contact us at «1-800-688-5123».

Sincerely,

Dean Schultz
Customer Insights
Southern California Edison

*SCE reserves the right to end your participation in this study for any reason, including but not limited to, changing rate plans, moving, or enrolling in medical baseline. Any bill credit rewards received are yours to keep without any future obligation.

FOR OVER 100 YEARS...LIFE. POWERED BY EDISON.

Figure 2-9: SCE TOU Rate 1 Information Sheet

SOUTHERN CALIFORNIA EDISON®
An EDISON INTERNATIONAL® Company

Time-of-Use Rate Plan Overview For Study Participants

The new time-of-use rate plan is about **when** and **how much** electricity you use. With this plan, the price of electricity changes by time of day and with the season. Your new rate plan offers a greater opportunity for you to control your costs by managing how much and when your household uses energy.

The more you can shift your usage to lower cost periods the more you can effectively control your electricity costs. This gives you greater control over your bill.

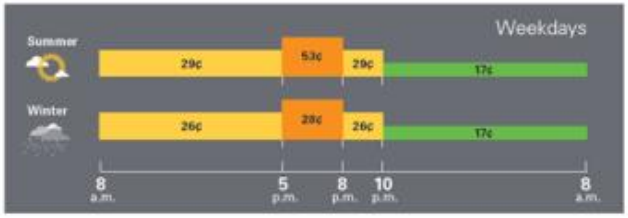
With time-of-use plans, prices may vary throughout the day. In order to take full advantage of these rate plans, it's best to familiarize yourself with how the pricing works.

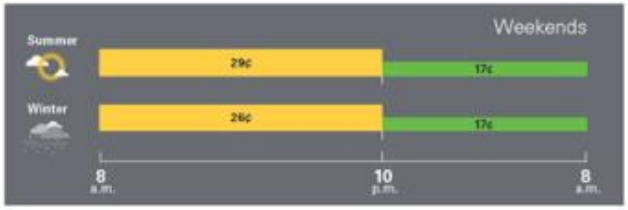
Time-of-Use (TOU) Time Periods

This chart explains costs across time periods and seasons.

Price/kilowatt-hour (kWh):
- Super Off-Peak
- Off-Peak
- On-Peak

Pricing subject to change, current pricing effective as of June 2016. Price/kilowatt-hour is rounded to nearest cent. CARE/FERA customers will continue to receive their discount, which is not reflected in the rate chart. Details on the monthly baseline credit allocation and other information about your TOU study rate plan are available at **on.sce.com/tooshift**.





Summer Rates:
June through September, 4 months

Winter Rates:
October through May, 8 months

FOR OVER 100 YEARS...LIFE. POWERED BY EDISON.

SOUTHERN CALIFORNIA EDISON®
An EDISON INTERNATIONAL® Company

Time-of-Use Rate Plan Overview For Study Participants

Keeping in mind off-peak and super off-peak periods can make shifting the time when a household uses electricity easier than you think. For example, if you are able to move a few tasks, like laundry, running your dishwasher, or electric vehicle charging to the mornings, late evenings, or weekends, then you could reduce your electricity costs. Using ceiling fans when possible instead of air conditioning is another way to control costs.

Energy Management Made Easy

My Account online makes energy management easy. It allows you to quickly view your hourly, daily, and monthly usage, as well as compare year-over-year to better manage your energy consumption. Use it to view projected bills and plan your usage. A free budgeting tool, called Budget Assistant, enables you to set monthly spending goals, track your progress and get automated alerts to stay in control and on budget. To enroll in My Account, go to **sce.com/MyAccount**.

Sharing Smart Energy Ideas

You can find energy saving tips and tools online at **sce.com**.

Tips to Control Your Household Energy Use

Laundry — Shift the time you do laundry to late evenings after 10 p.m. or weekends when rates are lower.

Dishwasher — Run full loads and delay the start time until after 10 p.m.

Cooling — When at home, use your A/C to pre-cool your home during off-peak hours and then switch to low-energy fans to move cool air during the day.

Pool — If you have a pool, set your pool pump to run in the late evening or early morning hours.

Recharging — Recharge your electric vehicle and electronics (phones, batteries) at night to take advantage of lower rates.

SCE reserves the right to end your participation in this study for any reason, including but not limited to, changing rate plans, moving, or enrolling in medical baseline. Any bill credit rewards received are yours to keep without any further obligation.

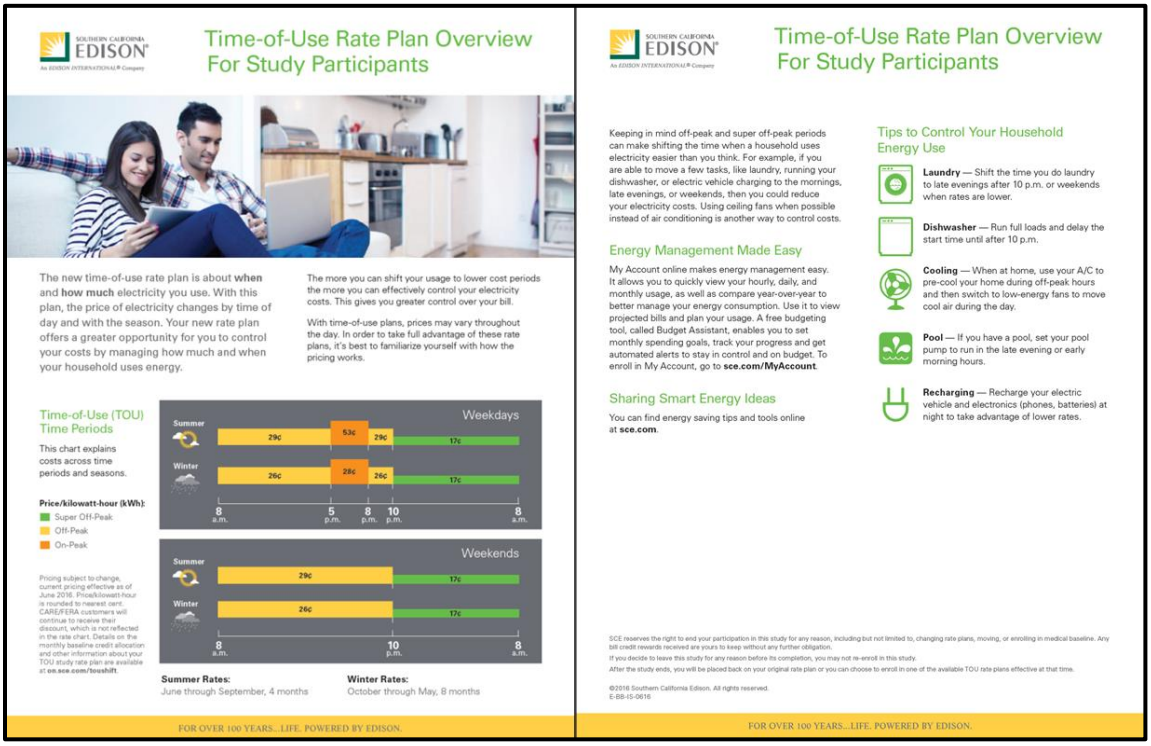
If you decide to leave this study for any reason before its completion, you may not re-enroll in this study.

After the study ends, you will be placed back on your original rate plan or you can choose to enroll in one of the available TOU rate plans effective at that time.

©2016 Southern California Edison. All rights reserved.
E-BB-IS-0616

FOR OVER 100 YEARS...LIFE. POWERED BY EDISON.

Figure 2-10: SCE TOU Rate 2 Information Sheet



Time-of-Use Rate Plan Overview
For Study Participants

The new time-of-use rate plan is about **when** and **how much** electricity you use. With this plan, the price of electricity changes by time of day and with the season. Your new rate plan offers a greater opportunity for you to control your costs by managing how much and when your household uses energy.

The more you can shift your usage to lower cost periods the more you can effectively control your electricity costs. This gives you greater control over your bill.

With time-of-use plans, prices may vary throughout the day. In order to take full advantage of these rate plans, it's best to familiarize yourself with how the pricing works.

Time-of-Use (TOU) Time Periods

This chart explains costs across time periods and seasons.

Price/kilowatt-hour (kWh):
- Super Off-Peak
- Off-Peak
- On-Peak

Pricing subject to change, current pricing effective as of June 2016. Price/kilowatt-hour is rounded to nearest cent. CARE/FERA customers will continue to receive their discount, which is not reflected in the rate chart. Details on the monthly baseline credit allocation and other information about your TOU study rate plan are available at **on.sce.com/toushift**.

Weekdays

	8 a.m.	5 p.m.	8 p.m.	10 p.m.	8 a.m.
Summer	29¢	53¢	29¢	17¢	
Winter	26¢	28¢	26¢	17¢	

Weekends

	8 a.m.	10 p.m.	8 a.m.
Summer	29¢	17¢	
Winter	26¢	17¢	

Summer Rates: June through September, 4 months

Winter Rates: October through May, 8 months

FOR OVER 100 YEARS...LIFE. POWERED BY EDISON.

Time-of-Use Rate Plan Overview
For Study Participants

Keeping in mind off-peak and super off-peak periods can make shifting the time when a household uses electricity easier than you think. For example, if you are able to move a few tasks, like laundry, running your dishwasher, or electric vehicle charging to the mornings, late evenings, or weekends, then you could reduce your electricity costs. Using ceiling fans when possible instead of air conditioning is another way to control costs.

Energy Management Made Easy

My Account online makes energy management easy. It allows you to quickly view your hourly, daily, and monthly usage, as well as compare year-over-year to better manage your energy consumption. Use it to view projected bills and plan your usage. A free budgeting tool, called Budget Assistant, enables you to set monthly spending goals, track your progress and get automated alerts to stay in control and on budget. To enroll in My Account, go to **sce.com/MyAccount**.

Sharing Smart Energy Ideas

You can find energy saving tips and tools online at **sce.com**.

Tips to Control Your Household Energy Use

Laundry — Shift the time you do laundry to late evenings after 10 p.m. or weekends when rates are lower.

Dishwasher — Run full loads and delay the start time until after 10 p.m.

Cooling — When at home, use your A/C to pre-cool your home during off-peak hours and then switch to low-energy fans to move cool air during the day.

Pool — If you have a pool, set your pool pump to run in the late evening or early morning hours.

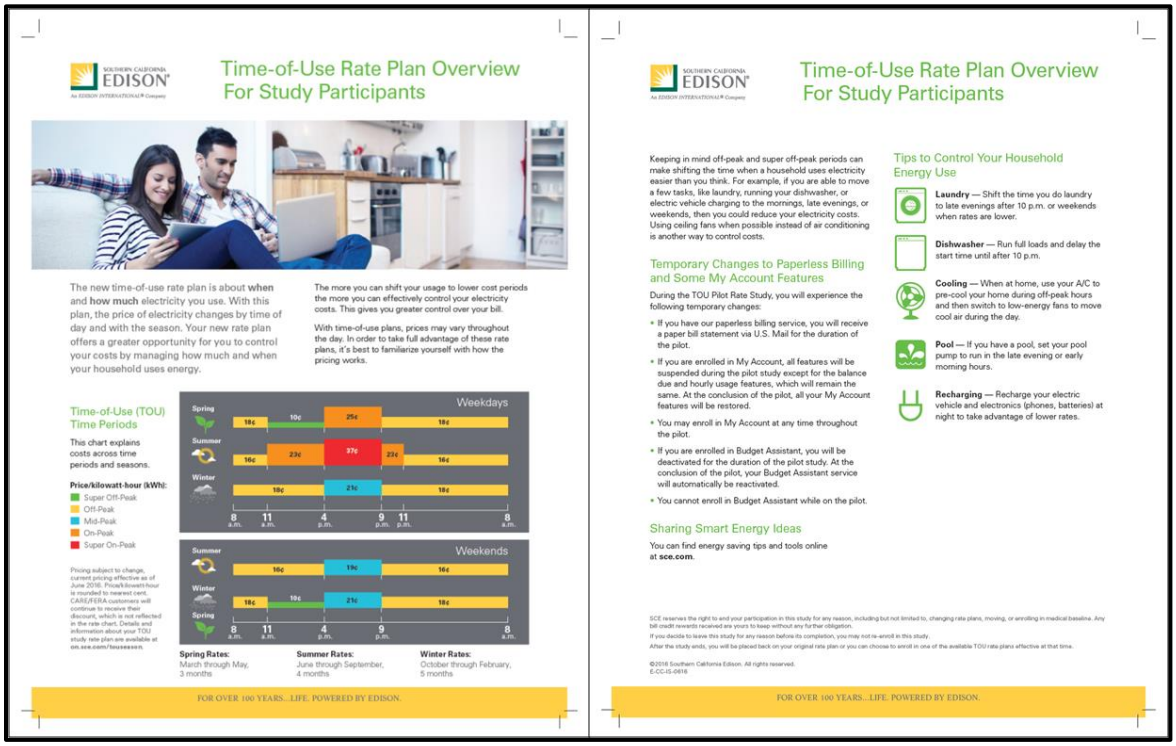
Recharging — Recharge your electric vehicle and electronics (phones, batteries) at night to take advantage of lower rates.

SCE reserves the right to end your participation in this study for any reason, including but not limited to, changing rate plans, moving, or enrolling in medical baseline. Any bill credit rewards received are yours to keep without any further obligation.
If you decide to leave this study for any reason before its completion, you may not re-enroll in this study.
After the study ends, you will be placed back on your original rate plan or you can choose to enroll in one of the available TOU rate plans effective at that time.

©2016 Southern California Edison. All rights reserved.
E-BB-IS-0616

FOR OVER 100 YEARS...LIFE. POWERED BY EDISON.

Figure 2-11: SCE TOU Rate 3 Information Sheet



Time-of-Use Rate Plan Overview
For Study Participants

The new time-of-use rate plan is about **when** and **how much** electricity you use. With this plan, the price of electricity changes by time of day and with the season. Your new rate plan offers a greater opportunity for you to control your costs by managing how much and when your household uses energy.

The more you can shift your usage to lower cost periods the more you can effectively control your electricity costs. This gives you greater control over your bill.

With time-of-use plans, prices may vary throughout the day. In order to take full advantage of these rate plans, it's best to familiarize yourself with how the pricing works.

Time-of-Use (TOU) Time Periods

This chart explains costs across time periods and seasons.

Price/kilowatt-hour (kWh):
- Super Off-Peak
- Off-Peak
- Mid-Peak
- On-Peak
- Super On-Peak

Pricing subject to change, current pricing effective as of June 2016. Price/kilowatt-hour is rounded to nearest cent. CARE/FERA customers will continue to receive their discount, which is not reflected in the rate chart. Details and information about your TOU study rate plan are available at on.sce.com/touseason.

Weekdays

	8 a.m.	11 a.m.	4 p.m.	9 p.m.	11 p.m.	8 a.m.
Spring	18¢	10¢	25¢	18¢		
Summer	16¢	23¢	37¢	23¢	16¢	
Winter	18¢		21¢	18¢		

Weekends

	8 a.m.	11 a.m.	4 p.m.	9 p.m.	8 a.m.
Summer	16¢	19¢	16¢		
Winter	18¢	10¢	21¢	18¢	
Spring					

Spring Rates: March through May, 3 months

Summer Rates: June through September, 4 months

Winter Rates: October through February, 5 months

FOR OVER 100 YEARS...LIFE. POWERED BY EDISON.

Time-of-Use Rate Plan Overview
For Study Participants

Keeping in mind off-peak and super off-peak periods can make shifting the time when a household uses electricity easier than you think. For example, if you are able to move a few tasks, like laundry, running your dishwasher, or electric vehicle charging to the mornings, late evenings, or weekends, then you could reduce your electricity costs. Using ceiling fans when possible instead of air conditioning is another way to control costs.

Temporary Changes to Paperless Billing and Some My Account Features

During the TOU Pilot Rate Study, you will experience the following temporary changes:

- If you have our paperless billing service, you will receive a paper bill statement via U.S. Mail for the duration of the pilot.
- If you are enrolled in My Account, all features will be suspended during the pilot study except for the balance due and hourly usage features, which will remain the same. At the conclusion of the pilot, all your My Account features will be restored.
- You may enroll in My Account at any time throughout the pilot.
- If you are enrolled in Budget Assistant, you will be deactivated for the duration of the pilot study. At the conclusion of the pilot, your Budget Assistant service will automatically be reactivated.
- You cannot enroll in Budget Assistant while on the pilot.

Sharing Smart Energy Ideas

You can find energy saving tips and tools online at **sce.com**.

Tips to Control Your Household Energy Use

Laundry — Shift the time you do laundry to late evenings after 10 p.m. or weekends when rates are lower.

Dishwasher — Run full loads and delay the start time until after 10 p.m.

Cooling — When at home, use your A/C to pre-cool your home during off-peak hours and then switch to low-energy fans to move cool air during the day.

Pool — If you have a pool, set your pool pump to run in the late evening or early morning hours.

Recharging — Recharge your electric vehicle and electronics (phones, batteries) at night to take advantage of lower rates.

SCE reserves the right to end your participation in this study for any reason, including but not limited to, changing rate plans, moving, or enrolling in medical baseline. Any bill credit rewards received are yours to keep without any further obligation.
If you decide to leave this study for any reason before its completion, you may not re-enroll in this study.
After the study ends, you will be placed back on your original rate plan or you can choose to enroll in one of the available TOU rate plans effective at that time.

©2016 Southern California Edison. All rights reserved.
E-CC-IS-0616

FOR OVER 100 YEARS...LIFE. POWERED BY EDISON.

2.5 Customer Attrition

Table 2-7 shows customer attrition from the pilot between when customers were assigned to a rate and when the most recent data update was received by Nexant on August 25, 2016. Attrition over that period was the result of changes in eligibility, customers closing their account due to moving, and customers dropping out of the pilot. Attrition is divided into three periods: the time between rate assignment and when customers were notified of their rate assignment through the Welcome Letter and Information Sheets summarized above; the time between notification and being transferred onto the new rate according to each customer's next billing cycle; and the time between transfer onto the rate and August 25.

Over this period, 1,235 customers left the pilot due either to ineligibility, moving, or proactively dropping out. Of this total, roughly half left because they moved location. Given that this period of time covered roughly four months, this equates to approximately 160 customers moving each month, or an annual churn rate of 1,920, or about 10%. While customers may drop out at a higher rate once they start receiving summer bills, the underlying churn rate suggests that there should be sufficiently large samples in the second summer to meet the design requirements upon which the initial sample sizes were determined.

Only 232 customers actively dropped out of the pilot over this period. As would be expected, the vast majority of these (93%) dropped out after being provided with their rate assignment and the specific information about the peak periods, price ratios, and other rate characteristics associated with the rate to which they were assigned. Most of these dropped out after being transferred onto the rate. It is not known at this time how many of those who dropped off after the rate change left after receiving their first bill under the new rates. Dropout rates may be higher in the future after customers receive several summer bills.

Table 2-7: Customer Attrition

Category	Hot Climate Zone							Moderate Climate Zone		Cool Climate Zone		Total*
	General	CARE	Non-CARE	Non-Senior CARE		Senior		CARE	Non-CARE	CARE	Non-CARE	
				Below 100% of FPL	Above 100% of FPL	Below 100% of FPL	Above 100% of FPL					
Customers assigned to rate treatment or control	4,491	1,371	1,321	338	493	767	809	2,874	2,637	2,871	2,874	20,846
Customers enrolled as of 8-25-2016	4,199	1,271	1,222	312	455	729	751	2,697	2,516	2,739	2,760	19,651
Ineligible Post-Rate Assignment	61	27	39	4	9	13	19	48	49	28	36	333
Ineligibles, Pre-Notification	4	2	5		3	2	4	6	5	7		38
Ineligibles, Pre-Rate Change	10	12	23		1		1	14	25	10	24	120
Ineligibles, Post-Rate Change	47	13	11	4	5	11	14	28	19	11	12	175
Moved Post-Rate assignment	160	53	35	18	21	17	14	105	54	93	63	633
Moves, Pre-Notification	39	8	7	7	5	6	3	22	13	21	13	144
Moves, Pre-Rate Change	12	23	16	4	3	1	2	25	10	18	13	127
Moves, Post-Rate Change	109	22	12	7	13	10	9	58	31	54	37	362
Opt-Out Post-Rate Assignment	71	20	25	4	8	8	25	24	18	11	15	229
Opt-Outs, Pre-Notification	3		2		3		2	1	2		2	15
Opt-Outs, Pre-Rate Change	7	4	4	1			3	1	2	4	4	30
Opt-Outs, Post-Rate Change	61	16	19	3	5	8	20	22	14	7	9	184
Total	292	100	99	26	38	38	58	177	121	132	114	1,195
Attrition rate	5%	4%	3%	4%	5%	4%	5%	4%	2%	3%	2%	3%

* Totals do not include technology customers

2.6 Pilot Outreach and Education

In late July, 2016, treated study participants began receiving Seasonal Newsletters tailored to their individual TOU rate plan, as well as their household psychographic designation. "Green elites" and "connected" customers received a postcard with a link to the online version of the Newsletter. The treatment groups received similar Newsletters that included a welcome message, timeline of the TOU Pilot, On-Peak, Off-Peak, and Super-Off-Peak definitions, as well as tips for reducing electricity usage and bills. All newsletters included customer profiles, stories, and frequently asked questions that were tailored to the household's persona. Customers assigned to Rate 1 and 2 were provided with additional information on the baseline credit for both the postcards and newsletters, while Rate 3 customers were provided with more information on how to manage a three season TOU rate. In addition, all customers in the advanced treatment group received the summer postcard containing tips and reminders about their rate at the end of August.[13]

SCE segmented pilot participants using Acxiom's Energy Customer Dynamics (ECD) segmentation, as well as household demographic, usage, payment, and program behavior data. The ECD assigns households to 1 of 13 segments based on critical household energy buyer capacities, attitudes, and behaviors. SCE used 5 possible segments to categorize residential customers into three combined personas: Green Elites/Connected, Pragmatists/Disengaged, and Constrained. SCE provided definitions of the segments:

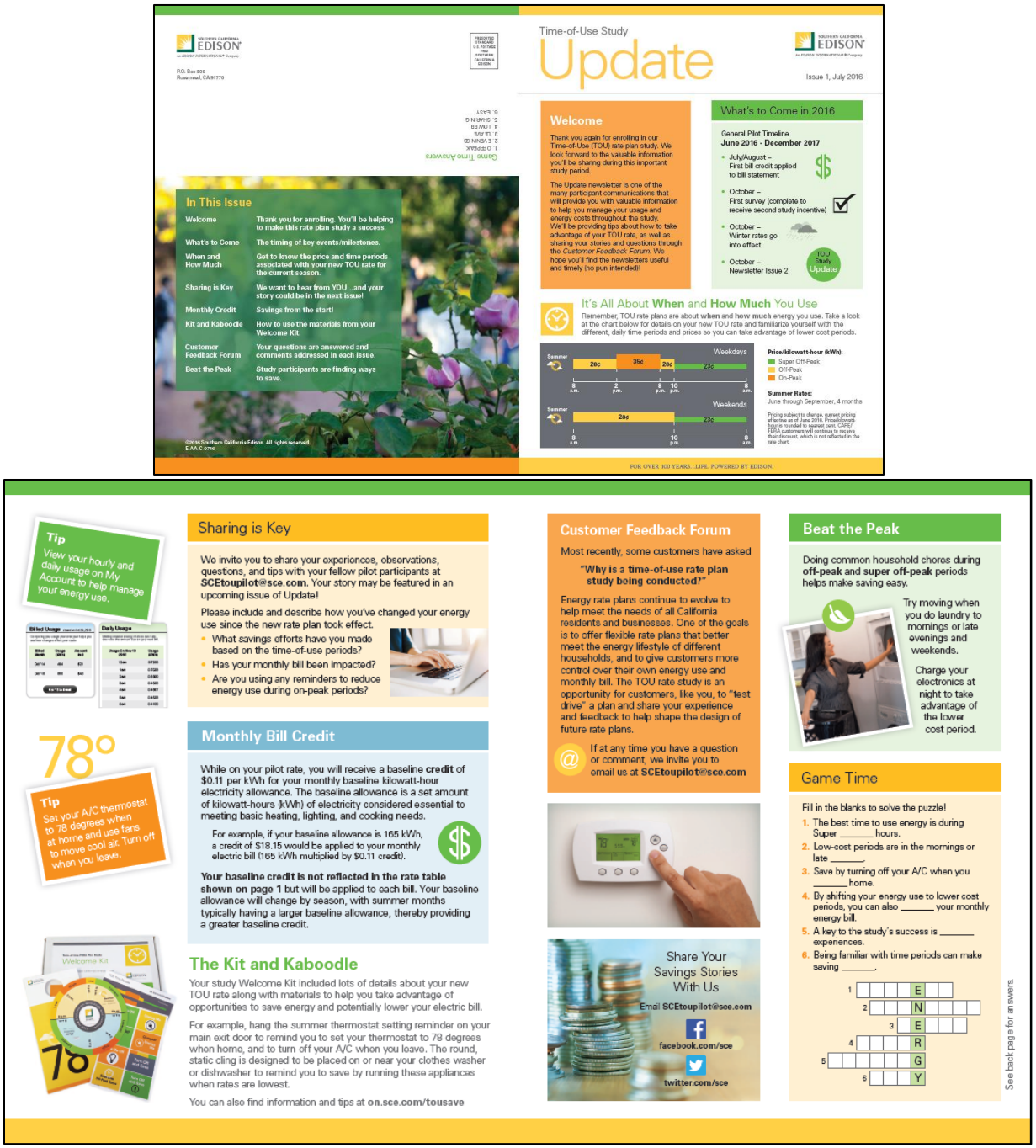
- **Constrained:** customers that have exhibited a pattern of difficulty meeting their energy bill payment.
- **Disengaged:** customers from particular ECD segments (Hands-On Believers, Living in the Now, Tech to Live, Tech Frontiersmen, Unplugged, Creatures of Comfort, and First Coster's), that are not enrolled in My Account or Paperless Billing.
- **Green Elites:** customers identified as having annual income over $80K, and that classified as having high green affinity (including the ECD segments of Green Investors, Green Activists, Payback Investors, and some from Show-Me Participants and Pragmatists).
- **Connected:** customers with high participation in Demand-Side Management (DSM) or self-service programs.
- **Pragmatists:** customers from the remaining segments not otherwise classified (particularly, not exhibiting high green affinity, high participation in DSM / self-service programs, or difficulty meeting monthly bill obligations).

SCE collapsed the five segments into three groups in order to reduce the number of document versions for communication. The Green Elite/Connected segment includes individuals that exhibit a high green affinity, and that are technologically savvy. SCE marketed towards these individuals by focusing their messaging on the potential of technology for long-term sustainability, and the benefit to the environment, while being a part of a movement/something bigger than the individual. Green Elites/Connected households tend to be highly involved in the community and are early adopters of technology. The Pragmatist/Disengaged personas are households with low awareness of energy programming, tend to live within their means, and use technology sparingly. SCE sought to educate

[13] Participants with a Green or Connected persona received a Newsletter postcard directing them to download their newsletter from a landing page. A different postcard, the Summer Postcard, was sent to all advanced group participants regardless of their rate or persona group.

this segment regarding TOU pricing, using straight forward language, that the Pilot would involve minor behavioral changes, but would still allow them to maintain their current lifestyle. The Constrained group includes financially limited, less green-conscious customers. SCE marketed the TOU Pilot to these participants as an opportunity to take advantage of financial gains/savings by modifying electricity usage behavior. An example of a TOU Pilot Newsletter is shown in Figure 2-12.

Figure 2-12: SCE TOU Rate 1 Constrained Newsletter



2.7 Regulatory Compliance Assessment

This section contains a systematic assessment of whether SCE successfully implemented the pilots so as to meet the specific requirements contained in the February 25, 2016 Resolution E-4761 ("the Resolution") approving SCE's pilot. Ordering Paragraph (OP) 11 from the Resolution states the following: "SCE is ordered to ensure that the deliverables as outlined in this Resolution are presented as part of its January 1, 2018 Rate Design Window (RDW) filing for a default TOU rate and menu of TOU rate options."

The deliverables as outlined in the Resolution and their outcomes after implementation of the pilot are summarized in Table 2-10 (which follows Table 2-8 and Table 2-9). The deliverable requirements are expressed either in terms of absolute numbers of participants or in terms of meeting specified levels of statistical confidence (e.g., confidence intervals of ±2 to 3% 90% confidence). When expressed as a minimum number of participants, the outcome column in Table 2-10 shows the current number of participants and reports whether the minimum required number has been exceeded. When the requirement is for a minimum level of statistical confidence, we compare the number of enrolled customers to the values in Table 2-8. These values were based on simulations performed by Nexant for SCE prior to recruitment to determine the required samples sizes for meeting different levels of confidence for load and bill impacts.[14] The survey sample size requirements are based on analysis that was done as part of the pilot planning process.[15]

Table 2-8: Threshold for Minimum Sample Size

	Climate Region	Minimum Threshold	25% Additional for Attrition	Total
Load Impacts: Confidence intervals in the range of ±2-3% with 90% confidence	Hot	500	125	625
	Moderate	750	188	938
	Cool	2,000	500	2,500
Bill Impacts	All	500	125	625
Survey Data	All	250	63	313

Appendix B contains the actual cell counts for each segment and treatment combination, the minimum sample sizes to meet the Resolution requirements, and the difference between these two values. We did not include this level of detail here because of the size of the table. Instead, we provide summary of the conclusions from this detailed analysis in Table 2-10. Table 2-9 provides an excerpt from Appendix B showing the data for the first Resolution shown in Table 2-10. As seen in Table 2-9, meeting the confidence interval minimum requirements for each customer segment covered by requirement 1 in the hot climate zone requires 625 participants. Current enrollment in these three segments ranges from a low of 1,222 to a high of 1,851, which far exceed the minimum requirements. These larger than required sample sizes result from a combination of higher than expected acceptance rates for some segments and the fact that customers in these segments are also used to meet other requirements. As

[14] See Appendix E for the SCE Power Analysis Memo

[15] See Section 3.3.3 of the Nexant report, "*Time-of-Use Pricing Opt-in Pilot Plan*" dated December 17, 2015.

a result of these large sample sizes, the confidence bands on load impact estimates for these segments will be much narrower than required by the Resolution.

Table 2-9: Comparison of Required Sample Sizes and Pilot Participation

Item	Rate	Confidence	Group	Min. Threshold	Actual	Difference
1	2	+/-2-3% @ 90%	CARE/FERA	625	1851	1226
			HH $ < 100% FPG	625	1222	597
			Senior	625	1618	993
		Count	All of Rate 2 in Hot	2888	3359	471
	Control	+/-2-3% @ 90%	CARE/FERA	625	1862	1237
			HH $ < 100% FPG	625	1216	591
			Senior	625	1678	1053
		Count	All Control in Hot	2888	3413	525

As seen in Table 2-10, overall, Deliverables 1 through 8 and 10 have sufficient enrollment to achieve the Resolution requirements. Deliverable 9 was affected by the lower than expected recruitment success rates for Smart Thermostat customers. While more than 900 Nest customers accepted the offer to participate in the pilot, 250 were deemed ineligible because of their participation in SCE's Save Power Days program. As such, only 675 customers were enrolled in the pilot. Given the small sample size, rather than allocate these customers to both Rates 1 and 3 (and the control group) as originally planned and required, SCE chose to put half on Rate 1 and to use the other half as a control group. It is unknown at this time if the Smart Thermostat segment will be large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence.

Table 2-10: Deliverables and Outcomes from Resolution E-4761

Deliverable		Requirement Contained in Resolution E-4761	Outcome	
1	The average change in peak and off-peak energy usage by seniors and customers in hot climate zones as a result of a given TOU rate.	SCE will employ a RCT design and pay-to-play (PTP) recruitment strategy to recruit approximately 2,888 customers onto each of Rate 2 and the control rate (the otherwise applicable tariff (OAT) or tiered rate) in SCE's hot climate region. Sample sizes will be large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence for a variety of customer segments on Rate 2 in SCE's hot climate region, including seniors, CARE/FERA customers, and households with incomes ≤ 100% of the federal poverty guidelines (FPG).	Specific Customer Counts	
			Rate 2 Customers in Hot Climate Region	3,359
			Control Customers in Hot Climate Region	3,413
			Sample Size All customer segments identified in deliverable are large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence.	
			Conclusion All criteria in Resolution E-4761 have been met.	
2	The impact of a given TOU rate on the bills of seniors and economically vulnerable customers in hot climate zones (i.e., the distribution of bill impacts).	Bills will be calculated for both treatment and control customers in two ways; as if their usage were billed on the TOU rate in question, and as if their usage were billed on the OAT. The difference between those two bills will result in a distribution of bill impacts for treatment customers and a distribution of bill impacts for control customers. Comparing the two distributions will illustrate how much of the bill impact results from structural wins and losses and how much results from changes in usage in response to the TOU rate. Sample sizes will be large enough to produce valid bill impact distributions for a variety of customer segments on Rate 2 in SCE's hot climate region, including seniors, CARE/FERA customers, households with incomes ≤ 100% of FPG, and households with incomes between 100 and 200% of FPG.	Sample Size All customer segments identified in deliverable are large enough to produce valid bill impact distributions	
			Conclusion All criteria in Resolution E-4761 have been met.	
3	The impact of a given TOU rate on how seniors and economically vulnerable customers in hot	Surveys will be administered to both treatment and control customers, and will include questions regarding energy usage habits (e.g. the timing of end-use activities,	Sample Size All customer segments identified in deliverable are large enough to produce valid survey data.	

Deliverable		Requirement Contained in Resolution E-4761	Outcome
	climate zones change their energy usage and on these customers' choices regarding other household expenses.	thermostat settings by rate period) and barriers to load shifting or load reduction activities. Questions will also be designed to detect certain forms of hardship (e.g. not paying other bills to pay energy bill). Answers will be compared between treatment and control customers to determine whether certain behaviors or activities are higher among customers on TOU rates relative to customers on the OAT. Sample sizes will be large enough to produce valid survey data for a variety of customer segments in SCE's hot climate region, including CARE/FERA customers on Rate 1; seniors, CARE/FERA customers, households with incomes ≤ 100% of FPG, and households with incomes between 100 and 200% of FPG on Rate 2; and CARE/FERA customers on Rate 3.	Conclusion All criteria in Resolution E-4761 have been met.

Deliverable		Requirement Contained in Resolution E-4761	Outcome	
4	The average change in peak and off-peak energy usage as a result of a given TOU rate for all customers in SCE's service territory, all customers in SCE's hot climate region, and all customers in SCE's moderate climate region.	SCE will employ a RCT design to recruit customers onto the three TOU rates and the control rate. The total number of SCE customers on each of Rates 1 and 3 will be approximately 3,750, and 5,388 on Rate 2. The RCT sampling approach will also be used to create minimum samples of roughly 1,250 customers for each TOU rate in each of SCE's hot, moderate and cool climate regions. Sample sizes will be large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence for all customers for a given TOU rate across SCE's service territory as a whole and for a given TOU rate in each of SCE's hot and moderate climate regions.	**Specific Customer Counts**	
			All Customers on Rate 1	4,266
			All Customers on Rate 2	6,219
			All Customers on Rate 3	3,746
			Hot Climate Zone Customers on Rate 1	1,409
			Hot Climate Zone Customers on Rate 2	3,359
			Hot Climate Zone Customers on Rate 3	1246
			Moderate Climate Zone Customers on Rate 1	1,386
			Moderate Climate Zone Customers on Rate 2	1,383
			Moderate Climate Zone Customers on Rate 3	1250
			Cool Climate Zone Customers on Rate 1	1,471
			Cool Climate Zone Customers on Rate 2	1,477
			Cool Climate Zone Customers on Rate 3	1250
			Sample Size All customer segments identified in deliverable are large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence in the first summer.	
			Conclusion All criteria in Resolution E-4761 have been met.	
5	The average change in peak and off-peak energy usage as a result of a given TOU rate for CARE/FERA and non-CARE/FERA customers across SCE's territory as a whole and in the hot climate region for Rate 2.	The RCT design, PTP recruitment strategy and recruitment targets described above will create sample sizes large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence for CARE/FERA and non-CARE/FERA customers for a given TOU rate across SCE's service territory as a whole and for Rate 2 in SCE's hot climate region.	**Sample Size** All customer segments identified in deliverable are large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence.	
			Conclusion All criteria in Resolution E-4761 have been met.	

Deliverable		Requirement Contained in Resolution E-4761	Outcome
6	The impact of a given TOU rate on the bills of CARE/FERA customers and non-CARE/FERA customers (i.e., the distribution of bill impacts) in SCE's entire territory and in the hot, moderate and cool climate regions separately.	Bills will be calculated for both treatment and control customers in two ways; as if their usage were billed on the TOU rate in question, and as if their usage were billed on the OAT. The difference between those two bills will result in a distribution of bill impacts for treatment customers and a distribution of bill impacts for control customers. Comparing the two distributions will illustrate how much of the bill impact results from structural wins and losses and how much results from changes in usage in response to the TOU rate. Sample sizes will be large enough to produce valid bill impact distributions for CARE/FERA and non-CARE/FERA customers for a given TOU rate across SCE's service territory as a whole and in each of SCE's hot, moderate and cool climate regions.	**Sample Size** All customer segments identified in deliverable are large enough to produce valid bill impact distributions.
			Conclusion All criteria from SCE's proposal on this deliverable have been met. However, the number of customers on Rate 3 do not allow for 25% attrition from the time of being moved to the new rate. The number of customers on Rate 3 can accommodate between 16% and 20% attrition depending on the segment and climate region.
7	The impact of a given TOU rate on how CARE/FERA customers and non-CARE/FERA customers – in SCE's entire territory and in the hot, moderate and cool climate regions separately – change their energy usage and on these customers' choices regarding other household expenses.	Surveys will be administered to both treatment and control customers, and will include questions regarding energy usage habits (e.g. the timing of end-use activities, thermostat settings by rate period) and barriers to load shifting or load reduction activities. Questions will also be designed to detect certain forms of hardship (e.g. not paying other bills to pay energy bill). Answers will be compared between treatment and control customers to determine whether certain behaviors or activities are higher among customers on TOU rates relative to customers on the OAT. Sample sizes will be large enough to produce valid survey data for CARE/FERA and non-CARE/FERA customers for a given TOU rate across SCE's service territory as a whole and in each of SCE's hot, moderate and cool climate regions.	**Sample Size** All customer segments identified in deliverable are large enough to produce valid survey data.
			Conclusion All criteria in Resolution E-4761 have been met.

Deliverable		Requirement Contained in Resolution E-4761	Outcome
8	The level of understanding and acceptance of the TOU pilot rates among various customer segments and how they engage with the rate to potentially lower their energy bills.	The recruitment approach for SCE's TOU pilots does not allow for a direct measure of acceptance rates for each rate option because customers are being paid to participate in the study (and to stay on the rate) and will be randomly assigned to the three different TOU pilot rates. However, surveys will be used to assess customer awareness, understanding, acceptance and satisfaction and these metrics can be compared across rate options as an indirect measure of customer acceptance. Sample sizes will be large enough to produce valid survey data for a variety of customer segments. As part of the end-of-pilot survey in the summer of 2017, customers will be asked whether they would prefer to stay on the TOU rate or return to the OAT. They will also be asked if they would prefer one of the other TOU rates if they had an option. Following payment of the last portion of the incentive, which will be made after completion of the end-of-pilot survey, differential dropout rates will be tracked as an indicator of customer preferences.	**Conclusion** Customer recruitment and enrollment to date is sufficient to allow for the completion of this deliverable at the appropriate time.
9	The impact of PCTs on energy usage and/or customer understanding, acceptance, and engagement while taking service on a given TOU rate.	Using the same RCT design and PTP recruitment strategy described above, SCE will recruit an additional 3,750 customers who have already installed smart thermostats in their homes. These customers will be randomly assigned to either Rate 1, Rate 3 or the control group. Sample sizes will be large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence for Rates 1 and 3 across SCE's service territory as a whole. Answers to survey questions pertaining to customer awareness, understanding, acceptance, and satisfaction and other metrics will be compared between the treatment and control groups to determine whether there are significant differences in these metrics. Sample sizes are large enough to produce valid survey data. As part of the end-of-pilot survey in the summer of 2017, customers will be asked whether they would prefer to stay on the TOU rate or return to the OAT. They will also be asked if they would prefer one of the other TOU rates if they had an option. Following payment of the last portion of the incentive, which will be made after completion of the end-of-pilot survey, differential dropout rates will be tracked as an indicator of customer preferences.	**Specific Customer Counts** Smart Thermostat Customers on Rate 1, 3, or Control: 675 **Sample Size** The Smart Thermostat Customer segment identified in the deliverable may not be large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence. **Conclusion** 334 customers have been assigned to Rate 1, 341 customers to the Control group, and no customers were assigned to Rate 3. It is unknown at this time if the Smart Thermostat segment will be large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence. Possible reasons for the lower than planned participation are discussed in Section 2.

	Deliverable	Requirement Contained in Resolution E-4761	Outcome
10	The impact of education and outreach (E&O) materials that are tailored to various customer segments (including seniors, renters, and non-English speaking customers) and to certain cognitive profiles/customer personas on customer understanding, acceptance, and engagement while taking service on a TOU rate.	Surveys will be used to assess usefulness and preferences for each of the primary types of E&O materials. Responses will be compared across rate options, customer segments and customer personas to determine whether different treatment groups, customer segments or customer personas find some materials more or less useful than others. Answers to survey questions pertaining to customer awareness, understanding, acceptance, and satisfaction and other metrics will also be compared across rate options, customer segments and customer personas to determine whether there are significant differences in these metrics.	**Conclusion** Customer recruitment and enrollment to date is sufficient to allow for the completion of this deliverable at the appropriate time.

3 PG&E Implementation Summary

As did SCE, PG&E filed its Advice Letter (AL) 4764-E on December 24, 2015 describing its plan to implement opt-in TOU pilots as required under Decision 15-07-001. The Commission approved PG&E's AL with some modifications on February 25, 2016 (Resolution 4762-E). PG&E's pilot plan involves testing three TOU rate plans, which vary with respect to the number of rate periods and the prices in each period, as summarized in Table 3-1 and **Error! Reference source not found.** through 3-3.

Table 3-1: Summary of PG&E's TOU Rates

Rate Description		Rate 1	Rate 2	Rate 3
Rate Periods	Summer	2	3	2
	Winter	2	2	2
	Spring	N/A	N/A	3
Highest Price Differential (¢)	Summer	10.3	14.9	28.6
	Winter	1.9	2.6	1.9
	Spring	N/A	N/A	18.0
Peak Period		4-9 PM	6-9 PM	4-9 PM
Duration of Peak		5 Hours	3 Hours	5 Hours
Super Off-Peak?		No	No	Yes
Super On-Peak?		No	No	No

Figure 3-1: TOU Pilot Rate 1 (Hour Ending)

Tariff	Season	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00
Weekday	Summer	Off-Peak (31.67¢)																Peak (41.97¢)							
	Winter	Off-Peak (27.1¢)																Peak (28.98¢)							
	Spring	Off-Peak (27.1¢)																Peak (28.98¢)							
Weekend	Summer	Off-Peak (31.67¢)																							
	Winter	Off-Peak (27.1¢)																							
	Spring	Off-Peak (27.1¢)																							

Figure 3-2: TOU Pilot Rate 2 (Hour Ending)

Tariff	Season	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00
Weekday	Summer	Off Peak (29.59¢)																Partial Peak (39.27¢)		Peak (44.48¢)					
	Winter	Off Peak (26.99¢)																		Peak (29.6¢)					
	Spring	Off Peak (26.99¢)																		Peak (29.6¢)					
Weekend	Summer	Off Peak (29.59¢)																Partial Peak (39.27¢)		Peak (44.48¢)					
	Winter	Off Peak (26.99¢)																		Peak (29.6¢)					
	Spring	Off Peak (26.99¢)																		Peak (29.6¢)					

Figure 3-3: TOU Pilot Rate 3 (Hour Ending)

Tariff	Season	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00
Weekday	Summer	Off-Peak (28.59¢)																Peak (57.19¢)							
	Winter	Off-Peak (27.08¢)																Peak (28.97¢)							
	Spring	Off Peak (26.74¢)										Super Off-Peak (18.02¢)						Peak (36.05¢)							
Weekend	Summer	Off-Peak (28.59¢)																							
	Winter	Off-Peak (27.08¢)																							
	Spring	Off Peak (26.74¢)										Super Off-Peak (18.02¢)													

Note that the prices in the figures do not reflect the baseline credit of 11.71 ¢/kWh. This credit is applied to usage up to 100% of the baseline quantity in each climate zone. The baseline credit significantly reduces average prices, especially for lower usage customers.

Rate 1 is a simple, two-period rate with same weekday peak period from 4 to 9 PM all year long and off-peak prices in effect on weekends. The peak-to-off-peak price ratio in the summer is roughly 1.3 to 1 and is very modest in the winter (non-summer months).

Rate 2 is slightly more complex than Rate 1 as it adds a summer "Partial-Peak" period covering the two hours immediately preceding, and the one hour immediately following the three-hour Peak period that runs from 6 to 9 PM on weekdays and weekends. In order to offset the additional complexity incurred with a third TOU period, PG&E left winter rates unchanged, but kept TOU pricing periods and tariffs uniform over the summer and winter (non-summer months).

Rate 3 is more complex than Rates 1 and 2. It includes TOU pricing in the spring (from March until May) that differs from pricing in the winter in order to allow for lower prices during low-cost hours from 10 AM until 4 PM to be charged in a "Super-Off-Peak" period. The "Super-Off-Peak" period coincides with the period CAISO identifies as being at high risk for oversupply in the future (identified by the so-called "Duck Curve"). TOU Pilot Rate 3 has the same TOU Rate design as TOU Pilot Rate 1 for the summer and winter seasons, with peak times from 4 to 9 PM and all other hours being off-peak. In the spring, the peak hours are also the same as TOU Pilot Rate 1, but the remaining hours are divided into Off-Peak and Super-Off-Peak periods.

For purposes of comparison with the TOU rates summarized above, Table 3-2 shows the tiered rates for PG&E's standard E-1 rate and for EL-1, which is PG&E's CARE rate.

Table 3-2: 2016 Schedule E-1 & Schedule EL-1 Tariffs

Tier	Baseline	E-1	EL-1
1	0-100%	18.21¢	11.93¢
2	100-200%	24.08¢	14.72¢
3	> 200%	39.98¢	21.66¢

In addition to the rate treatments summarized above, PG&E also offered a smartphone app to approximately half of all pilot participants on one of the three pilot TOU rate plans (control group not included). The HomeBeat app by Bidgely provides a means to visualize electricity usage data. It conveys a variety of useful information to TOU participants, including: pricing information; TOU-specific

performance feedback; bill projections; and energy saving tips informed by user specific end use load disaggregation, in order to encourage energy savings.

The objective of this treatment is to understand the impact that the application has on customer acceptance, engagement, satisfaction, and understanding of TOU rates and also to estimate load impacts of the smartphone app if a sufficient number of pilot participants chose to use the app. PG&E implemented the study by randomly assigning customers into two groups, and offering the app to only one of the two groups. As of this writing, roughly 300 customers out of 7,016 who were invited to download the app have successfully downloaded the app, completed registration, and connected the app to their accounts.

As was true for SCE, the sampling plan for PG&E's hot climate zone oversampled selected customer segments such as low income and senior households and oversample CARE/FERA customers in climate regions designated as hot, moderate, and cool. Table 3-3 summarizes the target enrollment for various treatments and customer segments that was designed to meet the requirements in PG&E Resolution E-4762. PG&E's Rate 1 was the rate treatment designated for oversampling in the hot climate zone for purposes of assessing hardship for seniors and low income households. As with SCE, the sampling strategy in the hot climate region involved a combination of recruitment from the general population as well as segment specific targeting of seniors and low income customers based on information contained in PG&E's Experian database. Using the Experian data and assumptions about the incidence rate of customers that meet the various income and age characteristics defined in the resolution, recruiting customers according to the plan in Table 3-3 would result in the distribution of enrolled customers by microsegment as shown in Table 3-4. As seen, this would result in enrollment that exceeds the required sample sizes in all cases. CARE/FERA customers were oversampled in all climate regions.

Table 3-3: PG&E Sampling Plan

		Random Sample				Targeted		
Climate Zone	Segment	Rate 1	Rate 2	Rate 3	Control	Rate 1	Control	Total
Hot	CARE/FERA	725	600	600	725	1,000	1,000	4,650
	Non-CARE/FERA	1,150	600	600	1,150	500	500	4,500
	Total	1,875	1,200	1,200	1,875	1,500	1,500	9,150
Moderate	CARE/FERA	600	600	600	600	-	-	2,400
	Non-CARE/FERA	600	600	600	600	-	-	2,400
	Total	1,200	1,200	1,200	1,200	-	-	4,800
Cool	CARE/FERA	600	600	600	600	-	-	2,400
	Non-CARE/FERA	600	600	600	600	-	-	2,400
	Total	1,200	1,200	1,200	1,200	-	-	4,800
All	CARE/FERA	1,925	1,800	1,800	1,925	1,000	1,000	9,450
	Non-CARE/FERA	2,350	1,800	1,800	2,350	500	500	9,300
	Total	4,275	3,600	3,600	4,275	1,500	1,500	18,750

Table 3-4: Distribution of Enrolled Customers on Rate 1 in PG&E's Hot Climate Zone by Customer Segment

Customer Segment	Count	Requirement
Seniors <100% FPG	335	313
Seniors >100% FPG	1,132	313
CARE/FERA < 100% FPG	507	313
CARE/FERA > 100% FPG	1,218	313
100-200% FPG	790	313
Seniors	1,466	625
CARE/FERA	1,725	625
<100% FPG	633	625
100-200% FPG	790	625

In order to determine the size of the recruitment sample needed to meet the enrollment targets summarized above, and to assess the costs of various recruitment options, PG&E conducted a pretest in January 2016. The pretest varied the delivery mode (FedEx versus USPS), the total incentives paid out, and the timing of the incentive amounts (e.g., more upfront versus more tied to survey completion). Eight different combinations of delivery mode and incentive combinations were tested on a sample of 1,970 customers. Response rates varied from a low of roughly 3% to a high of 13% with the average response rate across all eight options equaling roughly 8%. While response rates for FedEx were more than twice those for USPS, the cost was more than 10 times higher and USPS delivery was chosen for pilot recruitment. Based in part on its own pretest results as well as those of the other two IOUs, PG&E decided to use the USPS option and offer a $200 enrollment incentive for the pay-to-play recruitment, with $75 paid after enrollment, $50 for completion of the first survey in fall 2016, and $75 for completion of the second survey in summer 2017.

The remainder of this section summarizes sampling, recruitment, rate assignment, and enrollment process that was used by PG&E to solicit customers to participate in the pilot and to meet the enrollment targets prescribed in the CPUC resolutions approving the pilot. Section 3.1 describes the customer segments that were, for a variety of reasons, excluded from participation in the pilots and also describes the recruitment sample that was produced by PG&E. Section 3.2 discusses the recruitment process and collateral that was used for solicitation. Section 3.3 summarizes the rate assignment and enrollment process while Section 3.4 discusses customer notification. Section 3.5 summarizes customer attrition and Section 3.6 discusses the education and outreach that has occurred since customers were enrolled onto the new rates. Finally, Section 3.7 systematically assesses the extent to which PG&E's pilot implementation met the requirements laid out in Resolution 4762-E.

3.1 Recruitment Sample Selection

Prior to pulling the recruitment sample, selected customers were screened out from participating in the pilot. Public Utilities Code Section 745(c)(1) excludes certain customers from being defaulted onto TOU rates without their affirmative consent. These customers include those who receive a medical baseline allowance, customers requesting third-party notification (pursuant to subdivision (c) of Section 779.1), and customers who the California Public Utilities Commission (CPUC) has ordered cannot be disconnected from service without an in-person visit from a utility representative (Decision 12-03-054,

March 22, 2012). Although these pilots involved opt-in participation, insights from the pilots are intended to be used for guiding default enrollment. As such, the TOU Working Group involved in designing the pilots decided that customers who would be excluded from being defaulted onto the TOU rates should also be excluded from the opt-in pilots.

PG&E relied on its Customer Care and Billing (CC&B) system to identify and screen out customers with medical baseline allowances, those that require third-party notification, and those that have previously been determined to require an in-person visit prior to disconnection. The enrollment form gave participants the opportunity to indicate whether the household was occupied by disabled persons that were not enrolled in medical baseline or may not be listed as requiring an in-person visit prior to disconnection. These households were allowed to participate in the pilot but the form required them to self-certify at the time of pilot enrollment that losing power due to nonpayment would not put their health or safety at risk.

A list of all statutory exclusions summarized above, as well as a number of other exclusions for practical or other reasons follows:

- All Nonresidential Customers;
- Residential customers on an opt-in TOU rate;
  - Schedules E-6, E-7, E-TOU-A, E-TOU-B, and EV
- Residential customers on a Mastered Metered rate;
  - Schedules ES, ESR, EM, ET[16]
- Customers on Medical Baseline;
- Customers on PG&E's SmartRate™ (critical peak pricing) Program;
- Direct Access and Community Aggregation customers;
- Net Energy Metering Customers;
- Customers without a SmartMeter™;
- Customers with a SmartMeter™ whose interval reads are not yet of billing quality;
- Customers who have a Home Area Network device;
- PG&E employees and retirees;
- Customers who have requested third-party notification;
- Customers who have stated that they are eligible for an in-person visit from a utility representative before they can be disconnected from service;
- Solar Choice program; and
- Those who intend to move, or install a solar system in the 18 months following enrollment.

Due to the fact that some of the data required to apply the screens above resided in different internal systems, PG&E employed a two-stage sampling process. After applying the screens, PG&E drew a sample 348,750 customers from the main customer information system. When the pretest sample was added to this total, the sample is distributed across various strata as shown in Table 3-5.

[16] To summarize, to be eligible for the Opt-in TOU Pilot, a customer must be on PG&E's standard, tiered E-1 rate at the time of pilot recruitment.

Table 3-5: PG&E Offers by Partition and Strata

Category	Hot Climate Zone			
	Non-Targeted		Targeted	
	CARE	Non-CARE	CARE	Non-CARE
Offers	66,534	87,890	49,999	25,000

Category	Moderate Climate Zone		Cool Climate Zone		Pre-Test	Total
	CARE	Non-CARE	CARE	Non-CARE		
Offers	30,164	30,601	30,119	30,413	1,972	350,720

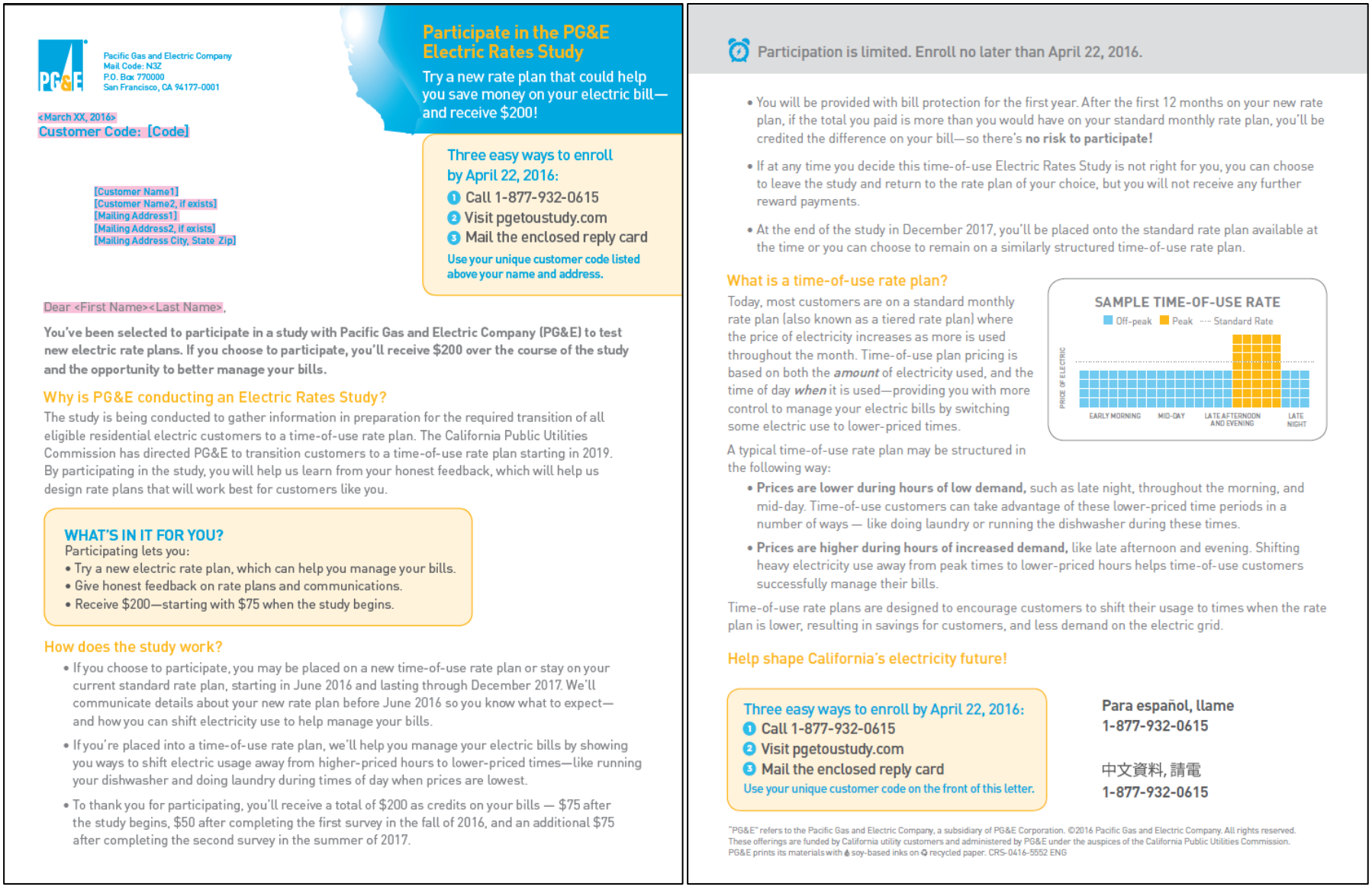
3.2 Pilot Recruitment

PG&E mailed out roughly 350,000 invitation letters over a four days starting April 1. As seen in Figure 3-4, the solicitation emphasized the importance of the study, the financial incentive participants would receive, what was expected from participants, and what they could expect over the course of the pilot, and the fact that participation was risk free due to bill protection. It also set a cutoff date for enrollment of April 22. TOU rates were described in very general terms but the specific rates included in the pilot were not described in detail as customers were to be randomly assigned to the rate options after agreeing to be in the study.

The engagement letter provided a toll free phone number, link to the PG&E TOU website, as well as a postage paid enrollment card/form (as shown in Figure 3-5) for the customer to fill out and return to PG&E. The enrollment form acted as a survey aimed at gathering important data regarding income, senior status, email addresses, and a few other variables. Customers for whom PG&E had email addresses (approximately 1/3 of the sample) also received the email solicitation in Figure 3-6 about a week after the letter was sent. The recruitment email conveyed the same messaging as the solicitation letter, and included a link to the PG&E TOU website, as well as a Pilot hotline for enrollment.

In July 2016, roughly 50% of all treated customers received an invitation to download the HomeBeat app by Bidgely. The invitation outlined the app's functionality, step-by-step instructions for download, as well as contact information for Bidgely and the TOU study phone line. The invitation was sent by both email and mail, with very similar designs. The mail version is shown in Figure 3-7.

Figure 3-4: PG&E Recruitment Invitation Letter



Pacific Gas and Electric Company
Mail Code: N3Z
P.O. Box 770000
San Francisco, CA 94177-0001

<March XX, 2016>
Customer Code: [Code]

[Customer Name1]
[Customer Name2, if exists]
[Mailing Address1]
[Mailing Address2, if exists]
[Mailing Address City, State Zip]

Participate in the PG&E Electric Rates Study

Try a new rate plan that could help you save money on your electric bill—and receive $200!

Three easy ways to enroll by April 22, 2016:
1. Call 1-877-932-0615
2. Visit pgetoustudy.com
3. Mail the enclosed reply card

Use your unique customer code listed above your name and address.

Dear <First Name><Last Name>,

You've been selected to participate in a study with Pacific Gas and Electric Company (PG&E) to test new electric rate plans. If you choose to participate, you'll receive $200 over the course of the study and the opportunity to better manage your bills.

Why is PG&E conducting an Electric Rates Study?

The study is being conducted to gather information in preparation for the required transition of all eligible residential electric customers to a time-of-use rate plan. The California Public Utilities Commission has directed PG&E to transition customers to a time-of-use rate plan starting in 2019. By participating in the study, you will help us learn from your honest feedback, which will help us design rate plans that will work best for customers like you.

WHAT'S IN IT FOR YOU?

Participating lets you:
- Try a new electric rate plan, which can help you manage your bills.
- Give honest feedback on rate plans and communications.
- Receive $200—starting with $75 when the study begins.

How does the study work?

- If you choose to participate, you may be placed on a new time-of-use rate plan or stay on your current standard rate plan, starting in June 2016 and lasting through December 2017. We'll communicate details about your new rate plan before June 2016 so you know what to expect—and how you can shift electricity use to help manage your bills.
- If you're placed into a time-of-use rate plan, we'll help you manage your electric bills by showing you ways to shift electric usage away from higher-priced hours to lower-priced times—like running your dishwasher and doing laundry during times of day when prices are lowest.
- To thank you for participating, you'll receive a total of $200 as credits on your bills — $75 after the study begins, $50 after completing the first survey in the fall of 2016, and an additional $75 after completing the second survey in the summer of 2017.

Participation is limited. Enroll no later than April 22, 2016.

- You will be provided with bill protection for the first year. After the first 12 months on your new rate plan, if the total you paid is more than you would have on your standard monthly rate plan, you'll be credited the difference on your bill—so there's **no risk to participate!**
- If at any time you decide this time-of-use Electric Rates Study is not right for you, you can choose to leave the study and return to the rate plan of your choice, but you will not receive any further reward payments.
- At the end of the study in December 2017, you'll be placed onto the standard rate plan available at the time or you can choose to remain on a similarly structured time-of-use rate plan.

What is a time-of-use rate plan?

Today, most customers are on a standard monthly rate plan (also known as a tiered rate plan) where the price of electricity increases as more is used throughout the month. Time-of-use plan pricing is based on both the ***amount*** of electricity used, and the time of day ***when*** it is used—providing you with more control to manage your electric bills by switching some electric use to lower-priced times.

SAMPLE TIME-OF-USE RATE
Off-peak Peak Standard Rate
PRICE OF ELECTRIC
EARLY MORNING MID-DAY LATE AFTERNOON AND EVENING LATE NIGHT

A typical time-of-use rate plan may be structured in the following way:

- **Prices are lower during hours of low demand,** such as late night, throughout the morning, and mid-day. Time-of-use customers can take advantage of these lower-priced time periods in a number of ways — like doing laundry or running the dishwasher during these times.
- **Prices are higher during hours of increased demand,** like late afternoon and evening. Shifting heavy electricity use away from peak times to lower-priced hours helps time-of-use customers successfully manage their bills.

Time-of-use rate plans are designed to encourage customers to shift their usage to times when the rate plan is lower, resulting in savings for customers, and less demand on the electric grid.

Help shape California's electricity future!

Three easy ways to enroll by April 22, 2016:
1. Call 1-877-932-0615
2. Visit pgetoustudy.com
3. Mail the enclosed reply card

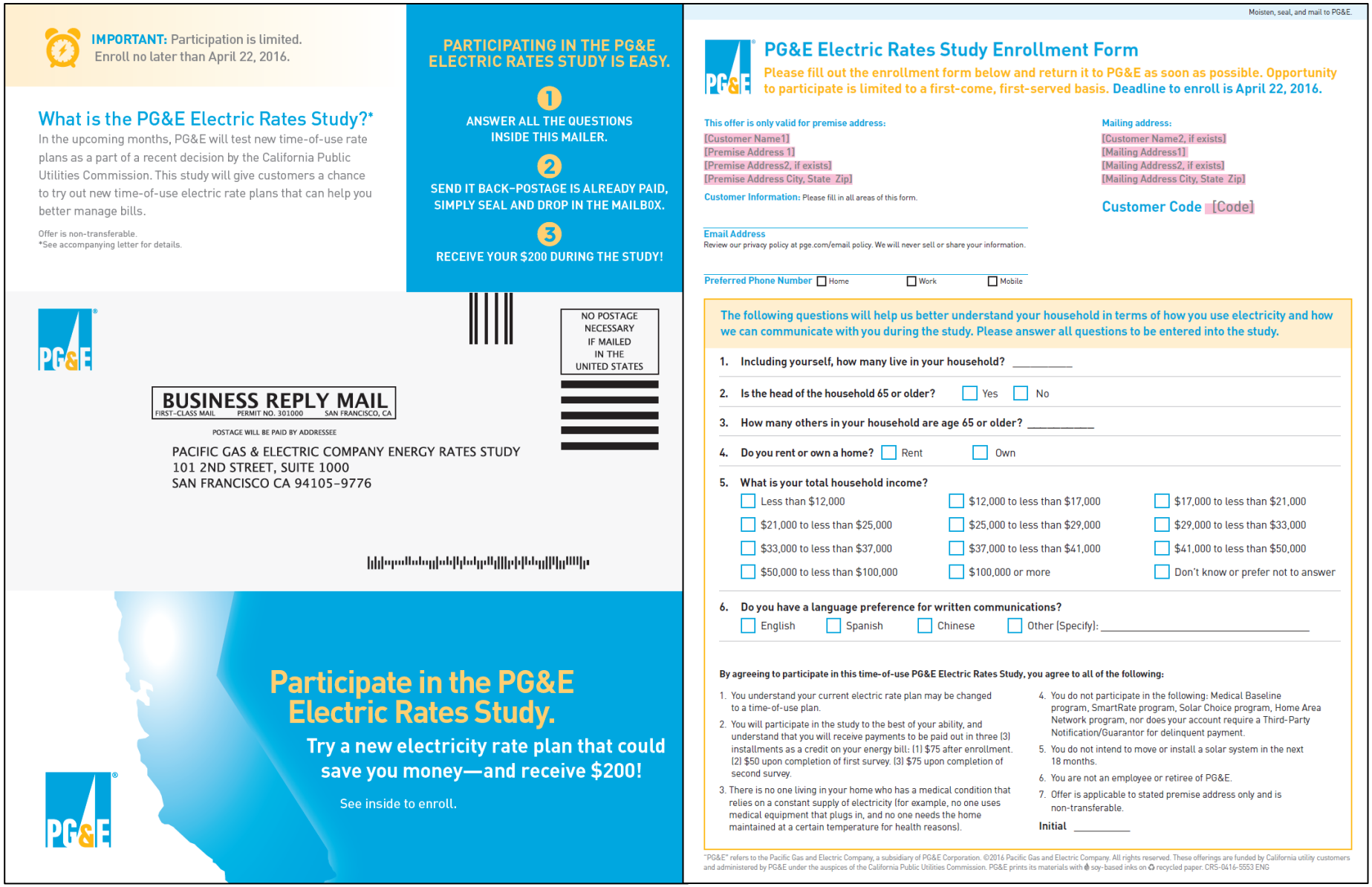
Use your unique customer code on the front of this letter.

Para español, llame
1-877-932-0615

中文資料, 請電
1-877-932-0615

"PG&E" refers to the Pacific Gas and Electric Company, a subsidiary of PG&E Corporation. ©2016 Pacific Gas and Electric Company. All rights reserved.
These offerings are funded by California utility customers and administered by PG&E under the auspices of the California Public Utilities Commission.
PG&E prints its materials with soy-based inks on recycled paper. CRS-0416-5552 ENG

Figure 3-5: PG&E Enrollment Form



IMPORTANT: Participation is limited.
Enroll no later than April 22, 2016.

What is the PG&E Electric Rates Study?*

In the upcoming months, PG&E will test new time-of-use rate plans as a part of a recent decision by the California Public Utilities Commission. This study will give customers a chance to try out new time-of-use electric rate plans that can help you better manage bills.

Offer is non-transferable.
*See accompanying letter for details.

PARTICIPATING IN THE PG&E ELECTRIC RATES STUDY IS EASY.

1. ANSWER ALL THE QUESTIONS INSIDE THIS MAILER.
2. SEND IT BACK–POSTAGE IS ALREADY PAID, SIMPLY SEAL AND DROP IN THE MAILBOX.
3. RECEIVE YOUR $200 DURING THE STUDY!

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

BUSINESS REPLY MAIL
FIRST-CLASS MAIL PERMIT NO. 301000 SAN FRANCISCO, CA

POSTAGE WILL BE PAID BY ADDRESSEE

PACIFIC GAS & ELECTRIC COMPANY ENERGY RATES STUDY
101 2ND STREET, SUITE 1000
SAN FRANCISCO CA 94105-9776

Participate in the PG&E Electric Rates Study.

Try a new electricity rate plan that could save you money—and receive $200!

See inside to enroll.

Moisten, seal, and mail to PG&E.

PG&E Electric Rates Study Enrollment Form

Please fill out the enrollment form below and return it to PG&E as soon as possible. Opportunity to participate is limited to a first-come, first-served basis. **Deadline to enroll is April 22, 2016.**

This offer is only valid for premise address:
[Customer Name1]
[Premise Address 1]
[Premise Address2, if exists]
[Premise Address City, State Zip]

Mailing address:
[Customer Name2, if exists]
[Mailing Address1]
[Mailing Address2, if exists]
[Mailing Address City, State Zip]

Customer Information: Please fill in all areas of this form.

Customer Code [Code]

Email Address
Review our privacy policy at pge.com/email policy. We will never sell or share your information.

Preferred Phone Number ☐ Home ☐ Work ☐ Mobile

The following questions will help us better understand your household in terms of how you use electricity and how we can communicate with you during the study. Please answer all questions to be entered into the study.

1. **Including yourself, how many live in your household?** _____
2. **Is the head of the household 65 or older?** ☐ Yes ☐ No
3. **How many others in your household are age 65 or older?** _____
4. **Do you rent or own a home?** ☐ Rent ☐ Own
5. **What is your total household income?**
   - ☐ Less than $12,000
   - ☐ $12,000 to less than $17,000
   - ☐ $17,000 to less than $21,000
   - ☐ $21,000 to less than $25,000
   - ☐ $25,000 to less than $29,000
   - ☐ $29,000 to less than $33,000
   - ☐ $33,000 to less than $37,000
   - ☐ $37,000 to less than $41,000
   - ☐ $41,000 to less than $50,000
   - ☐ $50,000 to less than $100,000
   - ☐ $100,000 or more
   - ☐ Don't know or prefer not to answer
6. **Do you have a language preference for written communications?**
   ☐ English ☐ Spanish ☐ Chinese ☐ Other (Specify): _____

By agreeing to participate in this time-of-use PG&E Electric Rates Study, you agree to all of the following:

1. You understand your current electric rate plan may be changed to a time-of-use plan.
2. You will participate in the study to the best of your ability, and understand that you will receive payments to be paid out in three (3) installments as a credit on your energy bill: (1) $75 after enrollment. (2) $50 upon completion of first survey. (3) $75 upon completion of second survey.
3. There is no one living in your home who has a medical condition that relies on a constant supply of electricity (for example, no one uses medical equipment that plugs in, and no one needs the home maintained at a certain temperature for health reasons).
4. You do not participate in the following: Medical Baseline program, SmartRate program, Solar Choice program, Home Area Network program, nor does your account require a Third-Party Notification/Guarantor for delinquent payment.
5. You do not intend to move or install a solar system in the next 18 months.
6. You are not an employee or retiree of PG&E.
7. Offer is applicable to stated premise address only and is non-transferable.

Initial _____

"PG&E" refers to the Pacific Gas and Electric Company, a subsidiary of PG&E Corporation. ©2016 Pacific Gas and Electric Company. All rights reserved. These offerings are funded by California utility customers and administered by PG&E under the auspices of the California Public Utilities Commission. PG&E prints its materials with soy-based inks on recycled paper. CRS-0416-5553 ENG

Figure 3-6: PG&E Recruitment Invitation Email

VER EN ESPAÑOL

PG&E

You're invited to help shape California's energy future—and receive $200!

Dear <First Name> <Last Name>,

You've been selected to participate in a study with Pacific Gas and Electric Company (PG&E) to test new electric rate plans. If you choose to participate, you'll receive $200 over the course of the study and the opportunity to better manage your bills.

ENROLL TODAY

Or call 1-877-932-0615
to participate in the PG&E Electric Rates Study

Why is PG&E conducting an Electric Rates Study?

The study is being conducted to gather information in preparation for the required transition of all eligible residential electric customers to a time-of-use rate plan. The California Public Utilities Commission has directed PG&E to transition customers to a time-of-use rate plan starting in 2019. By participating in the study, you will help us learn from your honest feedback, which will help us design rate plans that will work best for customers like you.

WHAT'S IN IT FOR YOU?

Participating lets you:

- **Try a new electric rate plan, which can help you manage your bills.**
- **Give honest feedback on rate plans and communications.**
- **Receive $200—starting with $75 when the study begins.**

How does the study work?

- If you choose to participate, you may be placed on a new time-of-use rate plan or stay on your current standard rate plan, starting in June 2016 and lasting through December 2017. We'll communicate details about your new rate plan before June 2016 so you know what to expect—and how you can shift electricity use to help manage your bills.
- If you're placed into a time-of-use rate plan, we'll help you manage your electric bills by showing you ways to shift energy usage away from higher-priced hours to lower-priced times—like running your dishwasher and doing laundry during times of day when prices are lowest.
- To thank you for participating, you'll receive a total of $200 as credits on your statements—$75 after the study begins, $50 after completing the first survey in the fall of 2016, and an additional $75 after completing the second survey in the summer of 2017.
- You will be provided with bill protection for the first year. After the first 12 months on your new rate plan, if the total you paid is more than you would have on your standard monthly rate plan, you'll be credited the difference on your statement—so there's **no risk to participate!**
- If at any time you decide this time-of-use Electric Rates Study is not right for you, you can choose to leave the study and return to the rate plan of your choice, but you will not receive any further reward payments.
- At the end of the study in December 2017, you'll be placed onto the standard rate plan available at the time or you can choose to remain on a similarly structured time-of-use rate plan.

What is a time-of-use rate plan?

Today, most customers are on a standard monthly rate plan (also known as a tiered rate plan) where the price of electricity increases as more is used throughout the month. Time-of-use plan pricing is based on both the ***amount*** of electricity used, and the time of day ***when*** it is used—providing you with more control to manage your electric bills by switching some electric use to lower-priced times.

A typical time-of-use rate plan may be structured in the following way:

- **Prices are lower during hours of low demand,** such as late night, throughout the morning, and mid-day. Time-of-use customers can take advantage of these lower-priced time periods in a number of ways — like doing laundry or running the dishwasher during these times.
- **Prices are higher during hours of increased demand,** like late afternoon and evening. Shifting heavy electricity use away from peak times to lower-priced hours helps time-of-use customers successfully manage their bills.

Time-of-use rate plans are designed to encourage customers to shift their usage to times when the rate plan is lower, resulting in savings for customers, and less demand on the electric grid.

Help shape California's electricity future!

ENROLL TODAY

Or call 1-877-932-0615
to participate in the PG&E Electric Rates Study

Participation is limited. Enroll no later than April 22, 2016.

Figure 3-7: PG&E HomeBeat™ app by Bridgely Recruitment

Stay connected to your electricity use on your Time-of-Day Study rate plan with the HomeBeat™ app by Bidgely

If you have a smartphone, you can download the **HomeBeat** app to connect with your electricity usage data. Here's how the app may help you on your rate plan:

- Stay informed about rate plan peak and off-peak periods with alerts and notifications.
- Discover how to shift and reduce energy on your new Time-of-Day Study rate plan with personalized, appliance-level tips and recommendations.
- Track energy use and monitor electricity costs for peak and off-peak times.
- Monitor your own peak usage periods to see how you're saving electricity over time.

As part of the Electric Rates Study, PG&E is interested in your feedback on whether using an app similar to **HomeBeat** increases your satisfaction with your Time-of-Day Study rate plan and helps you shift and save energy. We'll ask you about this during seasonal research.

HomeBeat is not a PG&E endorsed product or service and is not required for your participation in the PG&E Electric Rates Study.

How to download the **HomeBeat** app:

- Search for **'HomeBeat'** in the App Store or in Google Play.
- Download and open the app.
- Enter your ZIP code and choose your utility provider: **Pacific Gas and Electric Company**.
- Sign up for a **HomeBeat** account by entering your name, desired username and password.
- At the next screen, you will have two choices:
  - If you have a PG&E My Account already, select "I have an online account" and log in with your username and password.
  - If you do not already have a PG&E My Account, select "I need to create an online account" and please follow the instruction prompts on creating one. You will need your 11-digit account number to do this (e.g., 1234567890-2). You can find it on your bill.
- Once you are logged in, follow the prompts to authorize the **HomeBeat** app to connect with your energy usage data by selecting the orange "Quick Authorization" button. Once the connection is authorized and complete, you can begin to explore your energy use information, personalized tips, tools and notifications.

Have questions about the **HomeBeat** app? Contact Bidgely customer support at **hbpilot-support@bidgely.com**.

Have questions about your PG&E bill, electricity usage, Time-of-Day Study rate plan or PG&E's Electric Rates Study in general? Contact PG&E at **1-855-223-3710**.

此手機應用程式只有英文版本。

Esta aplicación para teléfonos inteligentes está disponible sólo en inglés.

Download **HomeBeat** today.

ANDROID APP ON Google play

Available on the App Store

"PG&E" refers to the Pacific Gas and Electric Company, a subsidiary of PG&E Corporation. ©2016 Pacific Gas and Electric Company. All rights reserved. These offerings are funded by California utility customers and administered by PG&E under the auspices of the California Public Utilities Commission. PG&E prints its materials with soy-based inks on recycled paper. CRS-0716-6198

Bidgely, HomeBeat, and the Bidgely LOGO are trademarks of Bidgely in the United States. Other marks belong to their respective holders.

Table 3-6 shows the number of customers that agreed to enroll in the study for each target segment and the acceptance rate for each segment. The overall acceptance rate for the non-App treatment groups was 7%. Acceptance rates for the tariff treatment varied from a low of 5% for non-targeted, non-CARE individuals in hot climate zones, to a high of 11% for CARE individuals in cool climate zones. Importantly, these acceptance rates across groups are not directly comparable. For some sub-segments that were under the target level by the April 22 close date, PG&E allowed enrollment to extend beyond that date while cutting off those that exceeded the enrollment target. For one group, non-CARE customers in the moderate climate zone, recruitment was far enough below the target level that PG&E conducted outbound calling to meet the enrollment requirements. As such, the acceptance rates for each group reflect a combination of different time periods and, in one case, a mixed mode recruitment process near the end of the recruitment period.

Table 3-6: PG&E Offers and Acceptances by Partition and Strata

Category	Hot Climate Zone				Pre-Test
	Non-Targeted		Targeted		
	CARE	Non-CARE	CARE	Non-CARE	
Offers	66,534	87,890	49,999	25,000	1,972
Acceptances	4,393	4,144	4,442	1,815	191
Acceptance Rate	7%	5%	9%	7%	10%

Category	Moderate Climate Zone		Cool Climate Zone		Total
	CARE	Non-CARE	CARE	Non-CARE	
Offers	30,164	30,601	30,119	30,413	350,720
Acceptances	2,866	2,434	3,204	2,644	25,942
Acceptance rate	10%	8%	11%	9%	7%

3.3 Pilot Rate Assignment and Enrollment

Not all customers who agreed to participate in the pilot were actually placed on a TOU tariff or assigned to the control group, thus staying on a tiered rate. There were numerous reasons why customers were not enrolled on a new rate or retained in the study as a control customer. First, their eligibility might have changed between the time they were selected into the recruitment sample and when they accepted the offer, or between the time they were assigned to a treatment condition and when enrollment was schedule to occur, which was on the first billing cycle date to occur after June 1. For example, a customer might have closed their account, become a net metered customer, or enrolled into the medical baseline program during this period; all of which would lead to being declared ineligible for the study.

Another reason why some customers who accepted the offer were not enrolled was due to over recruitment. As indicated in Table 3-7, PG&E targeted to enroll 18,750 customers, but almost 26,000

customers accepted the pilot offer. In most strata, save for Non-CARE individuals in moderate climate zones (which had a lower acceptance rate and proved difficult to meet the target), PG&E accepted more than the target level of enrollees. Overall, PG&E accepted almost 21,000 customers into the pilot and turned away 4,600 customers due to over enrollment. Additional customers were turned away due to a change in their eligibility. Those who were declined due to over enrollment or due to a change in eligibility were sent a decline notice and were offered a four-pack of LED light bulbs as recompense. Figure 3-8 contains copies of the decline letter for both groups.

Table 3-7 shows the progression of customers from acceptance to enrollment. Once ineligible customers were eliminated and those who were declined due to over recruitment were purged from the population, the remaining customers were randomly assigned to treatment or control conditions. Another change that occurred during this process was that some customers were reassigned to segments based on data gathered through the enrollment survey. The original sample for targeted segments—such as seniors above and below the poverty level—was based on information on income and the age of the PG&E accountholder contained in PG&E's Experian database. However, the enrollment survey data was ultimately used first to classify customers, with the Experian data only used in the rare instances when the respondent did not provide demographic data in their enrollment survey. In addition, customers were reclassified using an alternative definition of senior households from the one used to draw the original sample. The original sample was based on a definition of seniors tied to the age of the customer of record on the account. Subsequently, the Commission directed the IOUs to define senior households as any household where one or more people were age 65 or older. This change increased the number of senior households in the sample by about 10%.

Table 3-7: Distribution of Customers from Acceptance to Enrollment

Category	Hot Climate Zones, CARE Customers	Hot Climate Zones, Non-CARE Customers	Hot Targeted Climate Zones, CARE Customers	Hot Targeted Climate Zones, Non-CARE Customers	Moderate Climate Zones, CARE Customers	Moderate Climate Zones, Non-CARE Customers	Cool Climate Zones, CARE Customers	Cool Climate Zones, Non-CARE Customers	Total
Offers	66,534	87,890	49,999	25,000	30,164	30,601	30,119	30,413	350,720
Acceptances	4,393	4,144	4,442	1,815	2,866	2,434	3,204	2,644	25,942
Acceptance rate	7%	5%	9%	7%	10%	8%	11%	9%	7%
Ineligible Prior to Rate Assignment	53	50	35	8	21	31	23	27	248
Moved	43	36	20	7	19	29	17	25	196
Medical	0	0	0	0	0	0	0	0	0
NEM	0	0	0	0	0	0	0	0	0
Participation in Rate Program	3	8	6	0	0	1	5	1	24
Other	7	6	9	1	2	1	1	1	28
Opt-Out Prior to Rate Assignment	1	2	0	0	0	0	1	0	4
Random Over Enrollment Declines	1,316	319	1,486	662	192	28	643	44	4,690
Assigned to a Rate or Control (under updated segmentation)	3,023	3,773	2,921	1,145	2,653	2,375	2,537	2,573	21,000
Rate 1	827	1,239	1,461	573	664	595	635	644	6,638
Rate 2	685	648	0	0	664	594	634	643	3,868
Rate 3	685	648	0	0	663	593	634	643	3,866
Control	826	1,238	1,460	572	662	593	634	643	6,628
Target enrollment	2,650	3,500	2,000	1,000	2,400	2,400	2,400	2,400	18,750
% of Target achieved	114%	108%	146%	115%	111%	99%	106%	107%	112%
Customers Sent to Rate Transition Process	3,007	3,746	2,909	1,138	2,645	2,370	2,528	2,566	20,909
Customers Successfully Transitioned to a Pilot Rate	2,980	3,710	2,897	1,130	2,626	2,356	2,514	2,546	20,759

Figure 3-8: PG&E Ineligibility & Decline Letter

Pacific Gas and Electric Company
Mail Code: N3Z
P.O. Box 770000
San Francisco, CA 94177-0001

<June XX, 2016>
CODE: <<Customer Code>>

Thank you for your interest in the PG&E Electric Rates Study

You have not been placed into the study. Please visit **pge.com/freeled** to claim your free LED light bulbs.

[Customer Name1]
[Mailing Address1]
[Mailing Address2, if exists]
[Mailing Address City, State Zip]

Dear <First Name><Last Name>,

Thank you for your interest in participating in the PG&E Electric Rates Study. While your household was unfortunately **not selected** to be part of the study due to ineligibility*, we appreciate your willingness to enroll. To **thank you** for your support and to help you save energy, we are offering you a free **4-pack of LED light bulbs** — a $34 value. LED light bulbs are an easy way to quickly reduce the electric usage in your home.

Getting your LED light bulbs is easy:

Step 1: Visit **pge.com/freeled**
Step 2: Enter your preferred shipping information
Step 3: Enter your promotional code (the unique customer code listed above your name)

This is a limited-time offer, **so act by August 31, 2016.**

In addition, given your interest in time-of-use rate plans, we encourage you to visit **pge.com/learnaboutrates** to learn more about the time-of-use rate plans currently available, and explore which rate plan option best suits your lifestyle. If you are able to reduce your household's electricity usage during peak periods or shift some of your usage into the 19 hours a day with lower off-peak prices, you may find that one of our current time-of-use rates can work for you and help you manage your electric bills.

Whether or not you decide to change your rate plan, there are easy ways to reduce energy use around your home that can help you manage bills. For year-round money and energy-saving tips, visit **pge.com/savingstips.**

If you have any follow-up questions about this letter, please contact us at **1-877-932-0615.**

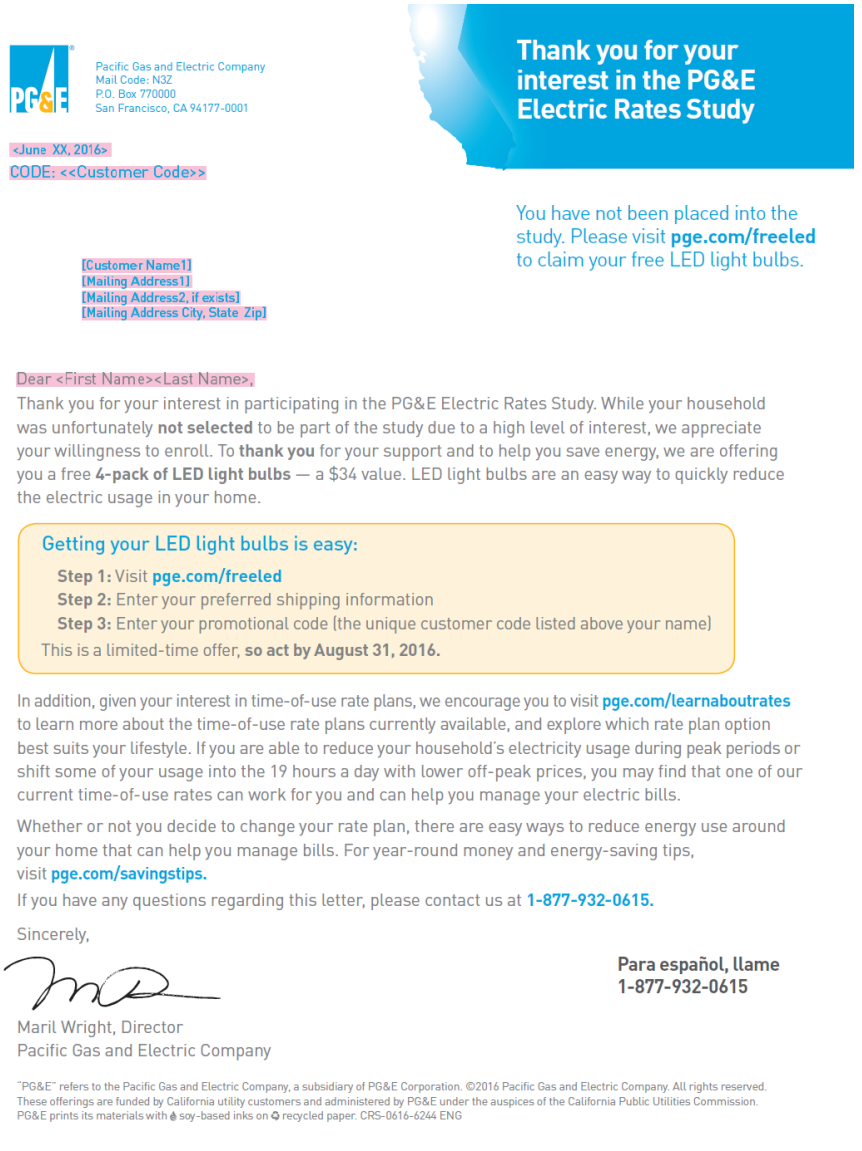
Sincerely,

Para español, llame 1-877-932-0615

Maril Wright, Director,
Pacific Gas and Electric Company

*Your PG&E account may not be eligible for participation in the study due to one or more disqualifying factors:
- Participation in Medical Baseline, SmartRate™, Solar, SolarChoice, and/or Home Area Network Programs
- Account requires a Third Party Notification/Guarantor for delinquent payment
- Moved or stopped service; Changed service to one of the following: Changed rate plan; Community Choice Aggregation; Electric Direct Access; Transitional Bundled Service; SmartMeter™ opt-out
- Employee or retiree of PG&E

"PG&E" refers to the Pacific Gas and Electric Company, a subsidiary of PG&E Corporation. ©2016 Pacific Gas and Electric Company. All rights reserved.
These offerings are funded by California utility customers and administered by PG&E under the auspices of the California Public Utilities Commission.
PG&E prints its materials with soy-based inks on recycled paper. CRS-0616-6245 ENG



Pacific Gas and Electric Company
Mail Code: N3Z
P.O. Box 770000
San Francisco, CA 94177-0001

<June XX, 2016>
CODE: <<Customer Code>>

Thank you for your interest in the PG&E Electric Rates Study

You have not been placed into the study. Please visit **pge.com/freeled** to claim your free LED light bulbs.

[Customer Name1]
[Mailing Address1]
[Mailing Address2, if exists]
[Mailing Address City, State Zip]

Dear <First Name><Last Name>,

Thank you for your interest in participating in the PG&E Electric Rates Study. While your household was unfortunately **not selected** to be part of the study due to a high level of interest, we appreciate your willingness to enroll. To **thank you** for your support and to help you save energy, we are offering you a free **4-pack of LED light bulbs** — a $34 value. LED light bulbs are an easy way to quickly reduce the electric usage in your home.

Getting your LED light bulbs is easy:

Step 1: Visit **pge.com/freeled**
Step 2: Enter your preferred shipping information
Step 3: Enter your promotional code (the unique customer code listed above your name)

This is a limited-time offer, **so act by August 31, 2016.**

In addition, given your interest in time-of-use rate plans, we encourage you to visit **pge.com/learnaboutrates** to learn more about the time-of-use rate plans currently available, and explore which rate plan option best suits your lifestyle. If you are able to reduce your household's electricity usage during peak periods or shift some of your usage into the 19 hours a day with lower off-peak prices, you may find that one of our current time-of-use rates can work for you and can help you manage your electric bills.

Whether or not you decide to change your rate plan, there are easy ways to reduce energy use around your home that can help you manage bills. For year-round money and energy-saving tips, visit **pge.com/savingstips.**

If you have any questions regarding this letter, please contact us at **1-877-932-0615.**

Sincerely,

Para español, llame 1-877-932-0615

Maril Wright, Director
Pacific Gas and Electric Company

"PG&E" refers to the Pacific Gas and Electric Company, a subsidiary of PG&E Corporation. ©2016 Pacific Gas and Electric Company. All rights reserved.
These offerings are funded by California utility customers and administered by PG&E under the auspices of the California Public Utilities Commission.
PG&E prints its materials with soy-based inks on recycled paper. CRS-0616-6244 ENG

3.4 Notification

Unlike SCE, which sent out a brief confirmation letter once customers were selected into the pilot (and then later received a Welcome Package), PG&E's customers were notified of their acceptance into the pilot through the Welcome Package that was sent to customers. Following pilot rate assignment, study participants began receiving Welcome Kits in mid-May, 2016 dependent on their individual treatment status. The treatment groups (designated as, Time-of-day Study 4 to 9 PM, Time-of-day Study 6 to 9 PM and Time-of-day Study Three Seasons for Rates 1, 2, and 3 respectively) received similar Welcome Kits outlining the entire study timeframe, incentive requirements, schedules, bill protection, a telephone number, and a treatment specific website for any inquiries. The Welcome Kit effectively illustrated Peak, Partial Peak, Off-Peak, and Super-Off-Peak periods using study-specific infographics, color-coded clocks, and seasonal timelines. The Welcome Kits outlined an effective strategy for study participants to lower or maintain their electricity bills by shifting usage from Peak to Off-Peak times. The Time-of-Day study, Three Seasons Welcome Kit, which covers the most complex rate, is shown in Figure 3-9. The Time-of-Day study from 4 to 9 PM, and Time-of-Day study 6 to 9 PM.

The control group also received a Welcome Kit explaining that they were to remain on their current monthly rate plan throughout the study. The mailer included an outline of the entire study timeframe, incentive requirements and schedules, as well as a telephone line for study inquires. Energy conservation tips were also included in the mailer alongside a website for further information.

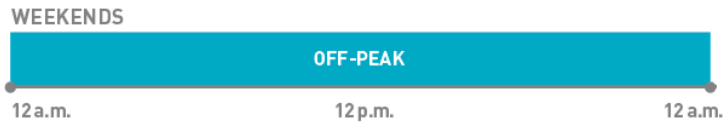
Figure 3-9: Three Seasons Welcome Kit

Time-of-Day Study: Three Seasons

Differently priced time periods apply to certain parts of the day, which vary slightly from season to season.

Summer, Fall and Winter (June through February)

Peak time is 4 p.m. to 9 p.m., Monday through Friday only. All other times are off-peak. Prices in the summer are higher overall than in winter and spring.



Spring (March through May)

Peak time is 4 p.m. to 9 p.m., Monday through Friday only. Super off-peak hours from 10 a.m. to 4 p.m. in spring only—prices are the lowest of the year. This is the best time to save money on electric use. Prices are lower overall in the spring than in the summer.

The total amount of electricity you use also plays a role in your Time-of-Day rate plan.

Each month, you're given an initial kilowatt hour (kWh) electricity allowance. Electricity you use up to this amount each month is charged at a lower price. Your initial allowance (also known as baseline allowance) is based on where you live. To find the initial allowance/baseline for your area, visit **pge.com/baseline**.

Once you've used your initial electricity allowance, pricing switches to over-allowance pricing, which is a higher kWh price across all times of day and seasons.

Your initial allowance is the same as on the standard tiered rate plan. If your household can reduce total electric use in addition to shifting away from peak hours, this can help you save money on your bills.

Time-of-Day Study: Three Seasons prices per kWh*

Summer
June-September

Initial allowance
Peak: $0.46/kWh
Off-peak: $0.17/kWh

After allowance
Peak: $0.57/kWh
Off-peak: $0.29/kWh

Fall and Winter
October-February

Initial allowance
Peak: $0.17/kWh
Off-peak: $0.16/kWh

After allowance
Peak: $0.29/kWh
Off-peak: $0.27/kWh

Spring
March-May

Initial allowance
Peak: $0.25/kWh
Off-peak: $0.15/kWh
Super off-peak: $0.06/kWh

After allowance
Peak: $0.36/kWh
Off-peak: $0.27/kWh
Super off-peak: $0.18/kWh

*Prices per kilowatt hour are rounded to the nearest cent.

If you are a CARE customer, you will continue to receive a discount on all energy use.

Prices per kWh on all PG&E rate plans may change over time due to California Public Utility Commission rulings and decisions.

Reminder: Peak time is 4 p.m. to 9 p.m., Monday through Friday, year-round.

Easy ways to shift your electric use.

Use these easy tips to help shift usage and manage your bills on your new Time-of-Day rate plan.

- **Run higher electric use appliances during off-peak periods,** such as overnight, in the morning, and early afternoon.
- **Run the dishwasher and start loads of laundry** when you wake up in the morning, or before going to sleep at night, after 9 p.m.
- **Pre-cool your home in the summer** by running the air conditioner or fans prior to the 4 p.m. peak period; try to limit use of these items during peak periods, health permitting.
- **Turn off lights and entertainment items** such as TVs, computers, and gaming consoles when not in use—all the time, and especially from 4 p.m. to 9 p.m.
- **Try to use one TV instead of several.**

Top Electricity-Hungry Appliances

To maximize savings on your new rate plan, try using the following appliances during lower-priced times of day:

Visit **pge.com/savingstips** for more ways to save energy and money.

Time-of-Day Study: Three Seasons
pgestudythreeseasons.com

Time-of-Day Study: Three Seasons

pgestudythreeseasons.com

Only select customers have been invited to participate in this study. If you decide to leave this study before its completion, you cannot return to the study rate.

You may become ineligible for this study and your Time-of-Day rate plan if you enroll in certain other PG&E programs. For more information on this and other terms and conditions, visit **pgestudythreeseasons.com**.

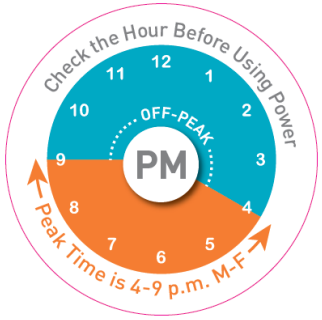
After the study ends, you will be placed back onto the standard rate plan available at that time or you can choose to move to a similarly structured Time-of-Day rate plan.

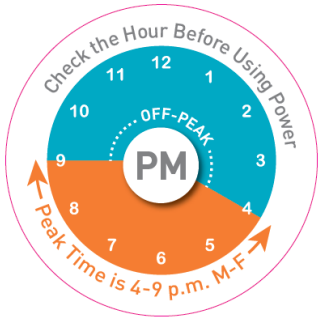
"PG&E" refers to the Pacific Gas and Electric Company, a subsidiary of PG&E Corporation. ©2016 Pacific Gas and Electric Company. All rights reserved. These offerings are funded by California utility customers and administered by PG&E under the auspices of the California Public Utilities Commission. PG&E prints its materials with soy-based inks on recycled paper. CRS-0416-5846

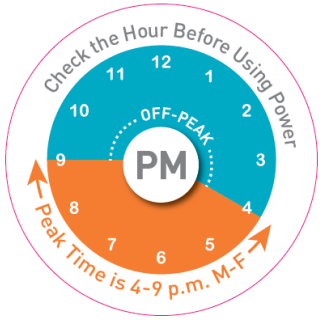
Check the hour before using power.

Time-of-Day Study: Three Seasons

Easy ways to shift and save. Place these decals on major appliances to help your household remember the best times to use energy, and when you may want to wait a while. When you're done using them, they will pull off of your appliances easily without leaving marks.







Tips to help you shift electric use away from peak hours:

- Run higher electric use appliances, like your air conditioner, washer and dryer during off-peak periods.
- Run your AC unit or fan prior to the late afternoon peak period (4 p.m.). (health permitting)
- Unplug appliances and other items not in constant use.
- Turn off lights that aren't in use.
- Try to use one TV instead of several.
- Run dishwasher only when full and after 9 p.m.

Visit **pge.com/savingstips** for more ways to save energy and money.

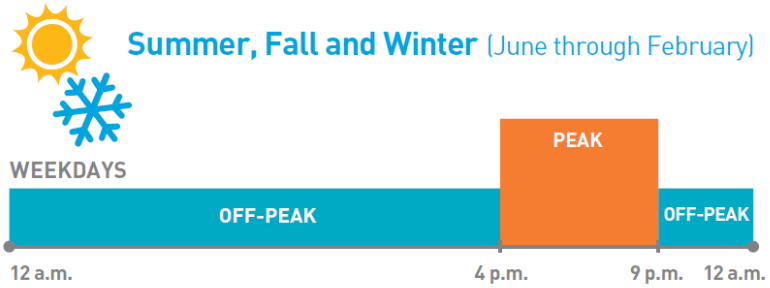
CRS-0416-XXXX

Check the hour before using power.

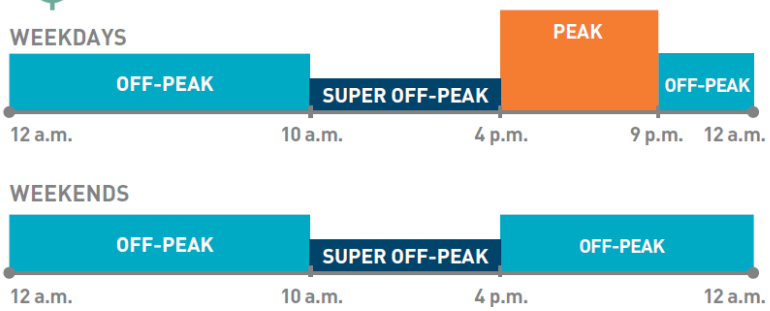
Time-of-Day Study: Three Seasons

Easy ways to shift and save. Place these decals on major appliances to help your household remember the best times to use energy from season to season. These decals contain peak and off-peak hours, as well as special time periods that are only available during certain seasons. When you're done using them, they will pull off of your appliances easily without leaving marks.

Summer, Fall and Winter (June through February)



Spring (March through May)



PG&E®

CRS-0416-XXXX

3.5 Customer Attrition

Table 3-8 shows customer attrition from the pilot between when customers were assigned to a rate and when the most recent data update was received by Nexant on August 3, 2016. Attrition over that period was the result of changes in eligibility, customers closing their account due to moving, and customers dropping out of the pilot. Attrition is divided into three periods: the time between rate assignment/notification and when customers were sent for a rate change; the time during the rate transition process; and the time between transfer onto the rate and August 3.

Over this period, 439 customers left the pilot due either to ineligibility, moving or proactively dropping out. Of this total, roughly 40% left because they moved location. Given that this period of time covered roughly three months (mid-May through early August), this equates to approximately 60 customers moving each month, or an annual churn rate of 720, or less than 4%. This is significantly less than the assumed churn rate underlying the sampling plan, which was in the 15% to 20% range. While customers may drop out at a higher rate once they start receiving summer bills, at least the underlying churn rate suggests that there should be sufficiently large samples in the second summer to meet the design requirements upon which the initial sample sizes were determined.

Only 164 customers actively dropped out of the pilot over this period. Of these, about 40% dropped out prior to rate assignment and notification, and another 40% dropped out after enrollment on the rate. The remainder dropped out between notification and enrollment.

Table 3-8: PG&E Customer Attrition

Category	Hot Climate Zone						Moderate Climate Zone		Cool Climate Zone		Total
	CARE	Non-CARE	Senior		Non-Senior		CARE	Non-CARE	CARE	Non-CARE	
			Below 100% of FPL	Above 100% of FPL	Below 100% of FPL	Above 100% of FPL					
Customers assigned to rate treatment or control	3,023	3,773	398	306	745	2,580	2,653	2,375	2,537	2,573	20,963
Customers enrolled as of 8-3-2016	2,935	3,668	383	302	730	2,535	2,601	2,337	2,493	2,520	20,504
Ineligible Post-Rate Assignment	**15**	**17**		**1**	**7**	**8**	**12**	**8**	**9**	**18**	**95**
Ineligibles, Prior to Rate Change Process	2					1		1			4
Ineligibles, During Rate Change Process	12	15			4	5	6	8	6	11	67
Ineligibles, Post-Rate Change	6	8		1	4	3	7	3	4	10	46
Moved Post-Rate assignment	**44**	**23**	**10**	**3**	**4**	**9**	**28**	**13**	**24**	**23**	**181**
Moves, Prior to Rate Change Process	5	3	2				3		5	1	19
Moves, During Rate Change Process	11	9		2		3	12	4	7	8	56
Moves, Post-Rate Change	28	11	8	1	4	6	13	9	12	14	106
Opt-Out Post-Rate Assignment	**26**	**59**	**5**		**3**	**27**	**11**	**13**	**10**	**9**	**163**
Opt-Outs, Prior to Rate Change Process	9	24	1		2	11	5	4	4	6	66
Opt-Outs, During Rate Change Process	4	12	2			4	1	2	1	1	27
Opt-Outs, Post-Rate Change	12	23	2		1	12	5	7	5	2	69
Total	85	99	15	4	14	44	51	34	43	50	439
Attrition rate	3%	3%	4%	1%	2%	2%	2%	1%	2%	2%	2%

3.6 Education and Outreach Material

Study participants received Education and Outreach materials tailored to their individual treatment. The treatment groups (Three Seasons, 4 to 9 PM, and 6 to 9 PM) received similar outreach materials that reiterated the energy reduction tips, incentive requirements and schedules, Peak and Off-Peak period definitions, and general usage shifting strategy that was presented in the Welcome Kits. Customers in each treatment group received outreach material entitled, “Careful Consideration” and “Convenience Control” depending on their customer segment as shown in Figure 3-10 and 3-11, respectively. The materials differed in their message regarding the participant’s attitude toward the study. The Careful Consideration material was entitled, “This summer, become a part of California’s cleaner energy future” whereas the Convenience Control material was entitled, “This summer, you have the control to shift your electricity usage and manage bills.” The tone of the Careful Consideration leads the reader to believe they are involved in a larger effort to reduce emissions, whereas the Convenience Control material evokes a very practical or utilitarian message.

Figure 3-10: Three Seasons Careful Consideration E&O

This summer's forecast: a cleaner, more sustainable energy future for all Californians.

Your new **Time-of-Day Study: Three Seasons** rate plan isn't just an opportunity to better manage your electricity bills. As part of a select group of customers participating in the PG&E Electric Rates Study, your experience and feedback will help shape California's energy future.

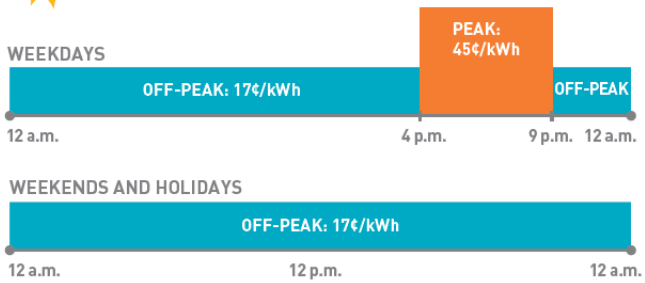
Your **Time-of-Day Study: Three Seasons** rate plan has two time periods in the summer.

Off-Peak $
19 hours

Peak $$
5 hours

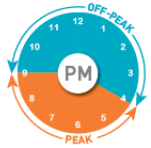
Summer (June through September)*

Peak time is 4 p.m. to 9 p.m., Monday through Friday only.
All other times are off-peak.



You can save money by shifting electricity use to **off-peak**, lower-priced times of day.

*In October, your Time-of-Day rate plan will switch to fall/winter time periods and pricing. You will be sent another mailer around that time to remind you of the seasonal change. Summer pricing listed above displays initial allowance pricing only. Refer to your **Time-of-Day Study: Three Seasons** Welcome Kit or **pgestudythreeseasons.com** at any time for all initial allowance, after allowance and seasonal pricing for this rate plan.



Check the hour before using power.

It's the easy way to shift electricity use on your Time-of-Day Study rate plan.

Use these easy summer tips to help shift electric use and manage your energy statements on your new Time-of-Day Study rate plan.

- When possible, delay chores such as dishwashing, laundering, and cooking until before or after peak time.
- Allow cooler air from the morning and nights to flow into your home. As the temperature rises, close the windows and draw the shades to keep pre-cooled air inside.
- Discover additional ways you can save energy around your home with Home Energy Checkup. Visit **pge.com/homeenergycheckup**.

If you have an air conditioner, these tips can help you use your AC as efficiently as possible.

- Set your air conditioning thermostat to 75-78ºF (health permitting) when you're at home and to 85ºF when you're away.
- Check the filter on your ventilation and air conditioning system. A dirty filter can cause your system to work harder to keep you cool, wasting energy.
- To help keep your air conditioner fit for summer, check out the AC Quality Care program. Find a contractor and see if you qualify for rebates at **pge.com/acqualitycare**.

Visit **pge.com/savingstips** for more ways to save energy.

Figure 3-11: Three Seasons Convenience Control E&O

This summer's forecast: greater ability to manage your electric bills.

With your **Time-of-Day Study: Three Seasons** rate plan, you have the opportunity to shift your electricity use to lower-priced times of day, giving you more control of your electric bills.

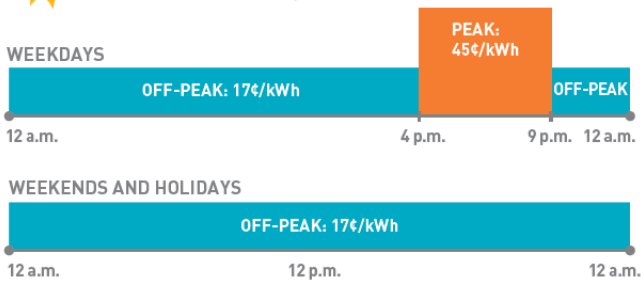
By being part of a select group of customers participating in the PG&E Electric Rates Study, you'll have a direct impact on the future of California's electric rates by providing valuable input on the rate plans that work best for all customers.

Your **Time-of-Day Study: Three Seasons** rate plan has two time periods in the summer.

Off-Peak $
19 hours

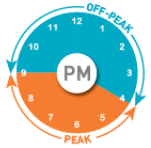
Peak $$
5 hours

Summer (June through September)*
Peak time is 4 p.m. to 9 p.m., Monday through Friday only.
All other times are off-peak.



You can save money by shifting electricity use to **off-peak**, lower-priced times of day.

*In October, your Time-of-Day rate plan will switch to fall/winter time periods and pricing. You will be sent another mailer around that time to remind you of the seasonal change. Summer pricing listed above displays initial allowance pricing only. Refer to your **Time-of-Day Study: Three Seasons** Welcome Kit or **pgestudythreeseasons.com** at any time for all initial allowance, after allowance and seasonal pricing for this rate plan.



Check the hour before using power.

It's the easy way to shift electricity use on your Time-of-Day Study rate plan.

Use these easy summer tips to help shift electric use and manage your energy statements on your new Time-of-Day Study rate plan.

- When possible, delay chores such as dishwashing, laundering, and cooking until before or after peak time.
- Allow cooler air from the morning and nights to flow into your home. As the temperature rises, close the windows and draw the shades to keep pre-cooled air inside.
- Discover additional ways you can save energy around your home with Home Energy Checkup. Visit **pge.com/homeenergycheckup**.

If you have an air conditioner, these tips can help you use your AC as efficiently as possible.

- Set your air conditioning thermostat to 75-78°F (health permitting) when you're at home and to 85°F when you're away.
- Check the filter on your ventilation and air conditioning system. A dirty filter can cause your system to work harder to keep you cool, wasting energy.
- To help keep your air conditioner fit for summer, check out the AC Quality Care program. Find a contractor and see if you qualify for rebates at **pge.com/acqualitycare**.

Visit **pge.com/savingstips** for more ways to save energy.

3.7 Comparison with Regulatory Guidance

As discussed in Section 2.7 for SCE, this section contains a systematic assessment of whether PG&E successfully implemented the pilots so as to meet the specific requirements contained in the February 25, 2016 Resolution E-4762 ("the Resolution") approving PG&E's pilot. The deliverables, as outlined in the Resolution, and their outcomes after implementation of the pilot are summarized in Table 3-11 (which follows Table 3-9 and Table 3-10). When deliverable requirements are expressed as a minimum number of participants, the Outcome column in Table 3-11 shows the current number of participants and reports whether the minimum required number has been exceeded. When the requirement is for a minimum level of statistical confidence, we compare the number of enrolled customers to the values in Table 3-9. These values were based on simulations performed by Nexant for PG&E prior to recruitment to determine the required samples sizes for meeting different levels of confidence for load and bill impacts.[17] The survey sample size requirements are based on analysis that was done as part of the pilot planning process.[18]

Table 3-9: Threshold for Minimum Sample Size

	Climate Region	Minimum Threshold	25% Additional for Attrition	Total
Load Impacts: Confidence intervals in the range of ±2-3% with 90% confidence	Hot	500	125	625
	Moderate	500	125	625
	Cool	750	188	938
Bill Impacts	All	500	125	625
	Hot: CARE/FERA	100	25	125
	Hot: Non-CARE/FERA	250	63	313
	Moderate: CARE/FERA	100	25	125
	Moderate: Non-CARE/FERA	250	63	313
	Cool: CARE/FERA	100	25	125
	Cool: Non-CARE/FERA	100	25	125
Survey Data	All	250	63	313

Appendix C contains the actual cell counts for each segment and treatment combination, the minimum sample sizes to meet the Resolution requirements, and the difference between these two values. We did not include this level of detail here because of the size of the table. Instead, we provide a summary of the conclusions from this detailed analysis in Table 3-11. Table 3-10 provides an excerpt from Appendix C showing the data for the first Resolution shown in Table 3-11. As seen in Table 3-10, meeting the confidence interval minimum requirements for each customer segment covered by requirement 1 in the hot climate region requires 625 participants. Current enrollment in these three segments ranges from a low of 1,034 to a high of 2,489, which far exceed the minimum requirements. These larger than required sample sizes result from a combination of higher than expected acceptance

[17] See Appendix F for the PG&E Power Analysis Memo

[18] See Section 3.3.3 of the Nexant report, "*Time-of-Use Pricing Opt-in Pilot Plan*" dated December 17, 2015.

rates for some segments and the fact that customers in these segments are also used to meet other requirements. As a result of these large sample sizes, the confidence bands on load impact estimates for these segments will be much narrower than required by the Resolution.

Table 3-10: Comparison of Required Sample Sizes and Pilot Participation

Item	Rate	Confidence	Group	Min. Threshold	Actual	Difference
1	1	+/-2-3% @ 90%	CARE/FERA	625	2244	1619
			HH $ < 100% FPG	625	1034	409
			Senior	625	2489	1864
		Count	All of Rate 1 in Hot	3000	4011	1011
	Control	+/-2-3% @ 90%	CARE/FERA	625	2283	1658
			HH $ < 100% FPG	625	1053	428
			Senior	625	2527	1902
		Count	All Control in Hot	3000	4090	1090

As seen in Table 3-11, overall, Deliverables 1 through 8 and 10 have sufficient enrollment to achieve the Resolution requirements. Deliverable 9 was affected by the low recruitment success rates for the Smartphone application. While 5,300 customers were targeted via email and 7,300 customers were targeted via a mailer, only 302 customers were ultimately recruited. Given the small sample size, statistical matching will be used to develop a control group for estimating load impacts. It is unknown at this time if the Smartphone application segment will be large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence.

Table 3-11: Deliverables and Outcomes from Resolution E-47612

Deliverable		Requirement Contained in Resolution E-4762	Outcome	
1	The average peak and off-peak change in energy usage (or lack thereof) by seniors and economically vulnerable customers in hot climate zones as a result of a given TOU rate.	PG&E will employ a RCT design and pay-to-play (PTP) recruitment strategy to recruit approximately 3,000 customers onto each of Rate 1 and the control rate (the otherwise applicable tariff (OAT) or tiered rate) in PG&E's hot climate region. Sample sizes will be large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence for a variety of customer segments on Rate 1 in PG&E's hot climate region, including seniors, CARE/FERA customers, and households with incomes ≤ 100% of the Federal Poverty Guideline (FPG).	Specific Customer Counts	
			Rate 1 Customers in Hot Climate Region	4,011
			Control Customers in Hot Climate Region	4,090
			Sample Size All customer segments identified in deliverable are large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence.	
			Conclusion All criteria in Resolution E-4761 have been met.	
2	The impact of a given TOU rate on the bills of seniors and economically vulnerable customers in hot climate zones (i.e., the distribution of bill impacts).	Bills will be calculated for both treatment and control customers in two ways; as if their usage were billed on the TOU rate in question, and as if their usage were billed on the OAT. The difference between those two bills will result in a distribution of bill impacts for treatment customers and a distribution of bill impacts for control customers. Comparing the two distributions will illustrate how much of the bill impact results from structural wins and losses and how much results from changes in usage in response to the TOU rate. Sample sizes will be large enough to produce valid bill impact distributions for a variety of customer segments on Rate 1 in PG&E's hot climate region, including seniors, CARE/FERA customers, households with incomes ≤ 100% of FPG, and households with incomes between 100 and 200% of FPG.	Sample Size All customer segments identified in deliverable are large enough to produce valid bill impact distributions	
			Conclusion All criteria in Resolution E-4761 have been met.	
3	The impact of a given TOU rate on how seniors and economically vulnerable customers in hot climate zones change their energy usage and on these customers'	Surveys will be administered to both treatment and control customers, and will include questions regarding energy usage habits (e.g. the timing of end-use activities, thermostat settings by rate period) and barriers to load shifting or load reduction activities. Questions will also be	Sample Size All customer segments identified in deliverable are large enough to produce valid survey data.	

<table>
<tr><th colspan="2">Deliverable</th><th>Requirement Contained in Resolution E-4762</th><th colspan="2">Outcome</th></tr>
<tr><td></td><td>choices regarding other household expenses.</td><td>designed to detect certain forms of hardship (e.g. not paying other bills to pay energy bill). Answers will be compared between treatment and control customers to determine whether certain behaviors or activities are higher among customers on TOU rates relative to customers on the OAT. Sample sizes will be large enough to produce valid survey data for a variety of customer segments in PG&E's hot climate region, including seniors, CARE/FERA customers, households with incomes ≤ 100% of FPG, and households with incomes between 100 and 200% of FPG on Rate 1; and CARE/FERA customers on Rates 2 and 3.</td><td colspan="2">Conclusion
All criteria in Resolution E-4761 have been met.</td></tr>
<tr><td rowspan="13">4</td><td rowspan="13">The average peak and off-peak change in energy usage as a result of a given TOU rate for all customers in PG&E's service territory, all customers in PG&E's hot climate region, and all customers in PG&E's moderate climate region.</td><td rowspan="13">PG&E will employ a RCT design to recruit customers onto the three TOU rates and the control rate. The total number of PG&E customers on each of Rates 2 and 3 will be approximately 3,750, and 5,500 on Rate 1. The RCT sampling approach will also be used to create minimum samples of roughly 1,250 customers for each TOU rate in each of PG&E's hot, moderate and cool climate regions. Sample sizes will be large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence for all customers for a given TOU rate across PG&E's service territory as a whole and for a given TOU rate in each of PG&E's hot and moderate climate regions.</td><td colspan="2">Specific Customer Counts</td></tr>
<tr><td>All Customers on Rate 1</td><td>6,516</td></tr>
<tr><td>All Customers on Rate 2</td><td>3,809</td></tr>
<tr><td>All Customers on Rate 3</td><td>3,814</td></tr>
<tr><td>Hot Climate Zone Customers on Rate 1</td><td>4,011</td></tr>
<tr><td>Hot Climate Zone Customers on Rate 2</td><td>1,303</td></tr>
<tr><td>Hot Climate Zone Customers on Rate 3</td><td>1,313</td></tr>
<tr><td>Moderate Climate Zone Customers on Rate 1</td><td>1,243</td></tr>
<tr><td>Moderate Climate Zone Customers on Rate 2</td><td>1,245</td></tr>
<tr><td>Moderate Climate Zone Customers on Rate 3</td><td>1,240</td></tr>
<tr><td>Cool Climate Zone Customers on Rate 1</td><td>1,262</td></tr>
<tr><td>Cool Climate Zone Customers on Rate 2</td><td>1,261</td></tr>
<tr><td>Cool Climate Zone Customers on Rate 3</td><td>1,261</td></tr>
</table>

Deliverable		Requirement Contained in Resolution E-4762	Outcome
			Sample Size All customer segments identified in deliverable are large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence.
			Conclusion All criteria in Resolution E-4761 have been met.
5	The average peak and off-peak change in energy usage as a result of a given TOU rate for CARE/FERA and non-CARE/FERA customers across PG&E's territory as a whole and in the hot climate region for Rate 1.	The RCT design, PTP recruitment strategy and recruitment targets described above will create sample sizes large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence for CARE/FERA and non-CARE/FERA customers for a given TOU rate across PG&E's service territory as a whole and for Rate 1 in PG&E's hot climate region.	Sample Size All customer segments identified in deliverable are large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence.
			Conclusion All criteria in Resolution E-4761 have been met.
6	The impact of a given TOU rate on the bills of CARE/FERA customers and non-CARE/FERA customers (i.e., the distribution of bill impacts) in PG&E's entire territory and in the hot, moderate and cool climate regions separately.	Bills will be calculated for both treatment and control customers in two ways; as if their usage were billed on the TOU rate in question, and as if their usage were billed on the OAT. The difference between those two bills will result in a distribution of bill impacts for treatment customers and a distribution of bill impacts for control customers. Comparing the two distributions will illustrate how much of the bill impact results from structural wins and losses and how much results from changes in usage in response to the TOU rate. Sample sizes will be large enough to produce valid bill impact distributions for CARE/FERA and non-CARE/FERA customers for a given TOU rate across PG&E's service territory as a whole and in each of PG&E's hot, moderate and cool climate regions.	Sample Size All customer segments identified in deliverable are large enough to produce valid bill impact distributions.
			Conclusion All criteria in Resolution E-4761 have been met.

Deliverable		Requirement Contained in Resolution E-4762	Outcome
7	The impact of a given TOU rate on how CARE/FERA customers and non-CARE/FERA customers – in PG&E's entire territory and in the hot, moderate and cool climate regions separately – change their energy usage and on these customers' choices regarding other household expenses.	Surveys will be administered to both treatment and control customers, and will include questions regarding energy usage habits (e.g. the timing of end-use activities, thermostat settings by rate period) and barriers to load shifting or load reduction activities. Questions will also be designed to detect certain forms of hardship (e.g. not paying other bills to pay energy bill). Answers will be compared between treatment and control customers to determine whether certain behaviors or activities are higher among customers on TOU rates relative to customers on the OAT. Sample sizes will be large enough to produce valid survey data for CARE/FERA and non-CARE/FERA customers for a given TOU rate across PG&E's service territory as a whole and in each of PG&E's hot, moderate and cool climate regions.	Sample Size All customer segments identified in deliverable are large enough to produce valid survey data. Conclusion All criteria in Resolution E-4761 have been met.
8	The level of customer understanding, acceptance, and engagement while taking service on a given TOU rates among various customer segments.	The recruitment approach for PG&E's TOU pilots does not allow for a direct measure of acceptance rates for each rate option because customers are being paid to participate in the study (and to stay on the rate) and will be randomly assigned to the three different TOU pilot rates. However, surveys will be used to assess customer awareness, understanding, and satisfaction and these metrics can be compared across rate options as an indirect measure of customer acceptance. Sample sizes will be large enough to produce valid survey data for a variety of customer segments. As part of the end-of-pilot survey in the summer of 2017, customers will be asked whether they would prefer to stay on the TOU rate or return to the OAT. They will also be asked if they would prefer one of the other TOU rates if they had an option. Following payment of the last portion of the incentive, which will be made after completion of the end-of-pilot survey, differential dropout rates will be tracked as an indicator of customer preferences.	Conclusion Customer recruitment and enrollment to date is sufficient to allow for the completion of this deliverable at the appropriate time.
9	The impact of smartphone	PG&E will divide pilot participants in half and offer the	Specific Customer Counts

	Deliverable	Requirement Contained in Resolution E-4762	Outcome	
	applications on energy usage and/or customer understanding, acceptance, and engagement while taking service on a given TOU rate.	smartphone application to one group and not to the other. If acceptance of the application is great enough, an impact assessment will be conducted to determine whether the information provided through the application increased load response for rate participants who receive it. If application acceptance is too low, statistical matching will be used to develop a control group for estimating load impacts. Answers to survey questions pertaining to customer awareness, understanding and satisfaction, and other metrics will be compared between those who download the application and those who don't to determine whether there are significant differences in these metrics. Application acceptance rates will also be reported and compared across rate options and customer segments.	Smartphone application offers made: Email	5,300
			Smartphone application offers made: Mail	7,300
			Smartphone application customers recruited	302
			Sample Size The Smartphone application customer segment identified in the deliverable may not be large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence even through statistical matching. It may be possible to reach other conclusions about impacts on acceptance and satisfaction using attrition rates and survey responses.	
			Conclusion It is unknown at this time if the Smartphone application segment will be large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence. Details regarding the Smartphone application treatment are in Section 3.	
10	The impact of education and outreach (E&O) materials that are tailored to various customer segments (including seniors, renters, and non-English speaking customers) and to certain cognitive profiles/customer personas on customer understanding of, acceptance of, and engagement with a TOU rate.	Surveys will be used to assess usefulness and preferences for each of the primary types of E&O materials. Responses will be compared across rate options, customer segments and customer personas to determine whether different treatment groups, customer segments or customer personas find some materials more or less useful than others. Answers to survey questions pertaining to customer awareness, understanding, and satisfaction, and other metrics will also be compared across rate options, customer segments and customer personas to determine whether there are significant differences in these metrics.	Conclusion Customer recruitment and enrollment to date is sufficient to allow for the completion of this deliverable at the appropriate time.	

4 SDG&E Implementation

SDG&E filed its TOU Pilot Plan advice letter on December 30, 2015.[19] In order to address some concerns raised by Energy Division and to clarify items contained in the initial plan, SDG&E filed a revised plan in an advice letter filed on January 22, 2016.[20] SDG&E's pilot plan was approved with modifications on March 17, 2016.[21]

SDG&E's pilot plan involved recruiting customers onto one of two rate options, depicted in Table 4-1 and Figures 4-1 and 4-2. SDG&E also proposed offering a third, dynamic rate option starting in fall 2016. Rate 1 has three rate periods in all seasons and all days of the week. The peak period, from 4 to 9 PM, is constant across all days of the week and seasons. The timing and length of the Off-Peak and Super-Off-Peak periods are also constant across seasons but differ on weekdays and weekends. The Peak to Super-Off-Peak price ratio (without the baseline credit) is roughly 1.9 to 1 in summer and a very modest 1.06 to 1 in spring and winter. The summer Peak to Off-Peak price ratio is roughly 1.6 to 1.

Table 4-1: Summary of SDG&E's TOU Rates

Rate Description		Rate 1	Rate 2
Rate Periods	Summer	3	2
	Winter	3	2
Highest Price Differential (¢)	Summer	26.9	23.6
	Winter	2.2	1.5
Peak Period		4-9 PM	4-9 PM
Duration of Peak		5 Hours	5 Hours
Super Off-Peak?		Yes	No
Super On-Peak?		No	No

Figure 4-1: SDG&E Pilot Rate 1

Tariff	Season	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00
Weekday	Summer	Super Off Peak (29.71¢)						Off Peak (34.91¢)										Peak (56.57¢)					Off Peak (34.91¢)		
	Winter	Super Off Peak (35.12¢)						Off Peak (36.2¢)										Peak (37.31¢)					Off Peak (36.2¢)		
Weekend	Summer	Super Off Peak (29.71¢)														Off Peak (34.91¢)		Peak (56.57¢)					Off Peak (34.91¢)		
	Winter	Super Off Peak (35.12¢)														Off Peak (36.2¢)		Peak (37.31¢)					Off Peak (36.2¢)		

[19] Advice Letter 2835-E

[20] Advice Letter 2835-E-A.

[21] Adoption of residential time-of-use pricing pilots pursuant to Decision 15-07-001, Resolution E-4769 (PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA March 17, 2016).

Figure 4-2: SDG&E Pilot Rate 2

Tariff	Season	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00
Weekday	Summer	Off Peak (32.94¢)																Peak (56.57¢)					Off Peak (32.94¢)		
	Winter	Off Peak (35.77¢)																Peak (37.31¢)					Off Peak (35.77¢)		
Weekend	Summer	Off Peak (32.94¢)																Peak (56.57¢)					Off Peak (32.94¢)		
	Winter	Off Peak (35.77¢)																Peak (37.31¢)					Off Peak (35.77¢)		

The primary difference between SDG&E's Rate 2 and Rate 1 is that Rate 2 has only two rate periods whereas Rate 1 has three rate periods. Rate 2 has the same Peak period from 4 to 9 PM in effect all days of the year and is the same period as for Rate 1. In summer, the Peak-to-Off-Peak price ratio for Rate 2 is roughly 1.7 to 1.

Rates 1 and 2 have baseline credits to reflect the tiered structure of the standard rate. The credits for up to 130% of baseline are 20.32 ¢ and 18.64 ¢ for the summer and winter seasons respectively. This credit significantly reduces average prices, especially for lower usage customers.

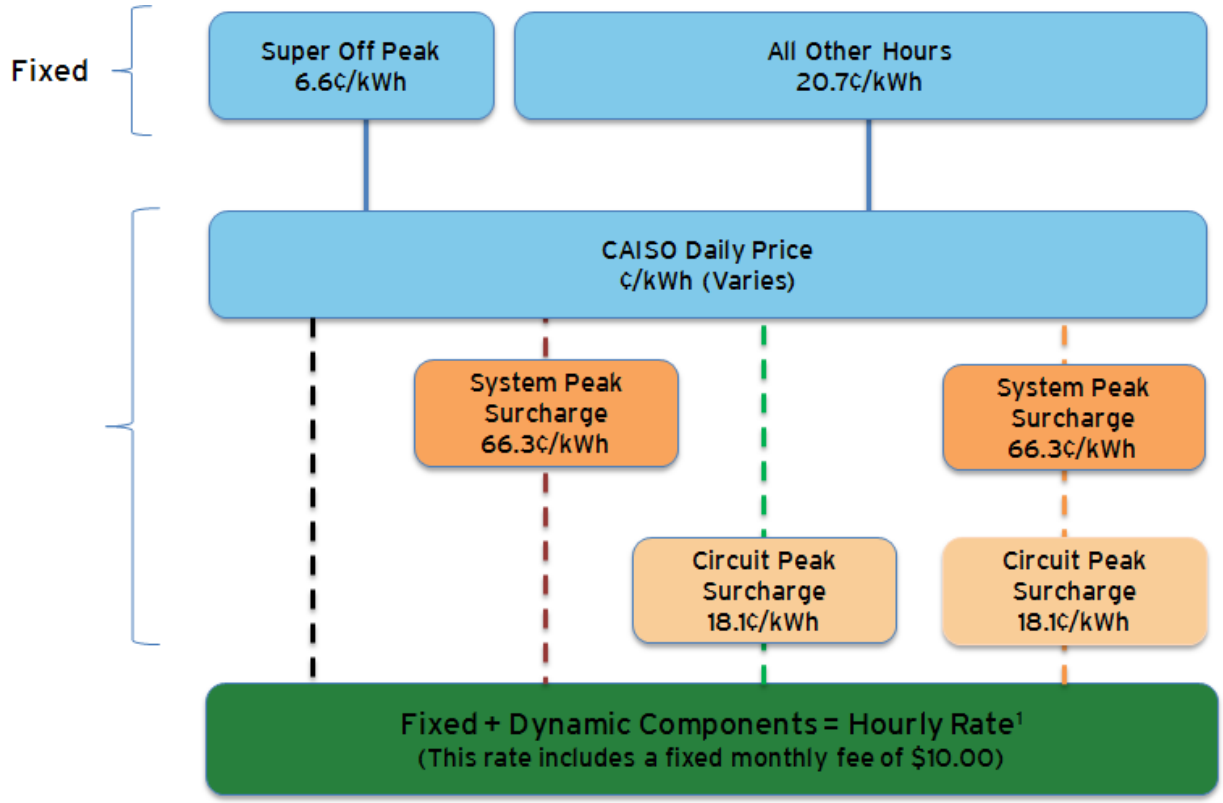
For reference, Table 4-2 shows the tiered rate that control customers were placed on.

Table 4-2: 2016 Schedule DR & Schedule DR-LI Tariffs

Tier	Baseline	Summer		Winter	
		DR	DR-LI	DR	DR-LI
1	0-130%	19.13¢	18.34¢	17.55¢	16.76¢
2	> 130%	39.46¢	38.67¢	36.19¢	35.39¢

SDG&E's pilot plan also calls for testing a third dynamic hourly rate option that is much more complex than Rates 1 and 2. This rate is intended for customers who adopt innovative technology and have an understanding of their energy usage. Figure 4-3 shows the different components of the rate, which consist of a fixed monthly service fee, energy usage charges, hourly prices tied to the CAISO wholesale market, and two hourly adders; one tied to system peak and the other tied to local circuit peaks. These hourly adders are called *day ahead*. Credits can also be applied to encourage increased usage on surplus energy days. Given the complexity of this rate and the narrow, specialized population to which it is targeted, at this stage, this rate should be thought of as more of a proof of concept than as a rate that would be applicable to a broad cross section of customers.

Figure 4-3: SDG&E Rate 3



SDG&E's goal for Rate 3, which is being called Whenergy HourX, is to enroll a minimum of 50 customers and a maximum of 200. Recruitment for Rate 3 officially began on September 2, with a targeted group of approximately 300 Sempra employees. These employees are a mix of EV owners as well as solar customers. On September 12, a recruitment email was sent to a randomly selected sample of 100 SDG&E customers. The sample of 100, nonemployee, customers included those who have a smart thermostat installed, have previously participated in SDG&E energy efficiency programs, are on a residential rate, and have a valid email address on file. A concurrent, nonrelated, effort around enabling technology is being conducted by a third party and has contributed an additional number of HourX participants. To be eligible for HourX, all customers must currently have AC with a smart thermostat installed on or before October 1, 2016. HourX includes pilot bill protection, three rebate offerings, as well as the $200 in bill credits for responding to a series of surveys as a participant in the pilot (Pay-to Play).[22] Due to the complexity of HourX, a dedicated phone line and dedicated email inbox have been set up for customer inquiries. Similar to Rates 1 and 2, HourX will have a microsite and smart app feature that provide HourX specific information. It will include the day ahead forecasted pricing, and tips and tools to help save energy while on the dynamic rate.

In addition to the above rate options, SDG&E's pilot is testing the impact of weekly usage alerts on demand response under TOU rates and is also testing the impact of TOU rates on the uptake of smart thermostats. The current usage alert provides weekly emails to participants that report the prior week's

[22] Note that SDG&E employees that go onto its Rate 3 (HourX) are not eligible for the $200 PTP incentive.

electricity usage by rate period. A future release, scheduled for mid-October, will include a bill-to date forecast, an updated usage chart displaying usage by peak period, along with a doughnut chart illustrating the total amount of usage by peak period for the billing period. Figure 4- shows samples of the current and future usage alert.

These alerts are being offered on a default basis for a random sample of 2,500 customers on Rate 2 in the moderate and cool climate zones. SDG&E has just over 70% of its pilot customers' email addresses, which translates to approximately 1,775 customers that will get the weekly email alert.

The smart thermostat pilot treatment will test the take rate for smart thermostats by customers who are already on a TOU rate. SDG&E will offer two different rebates, $100 and $200, to customers who purchase a smart thermostat. Marketing for this treatment will begin November 1, 2016 and will last through December 31. The original plan for this treatment was to randomly divide all customers on Rates 1 and 2 into two groups and offer one group the $100 rebate and the second group the $200 rebate. Based on a recommendation from Nexant, SDG&E will modify this initial plan and make the offer to its control group customers as well. This would allow for determination of the incremental acceptance rate of smart thermostats for TOU customers compared with customers on a standard tiered rate.

The targeting and sampling plan for SDG&E's pilots differs from that of PG&E and SCE in that there is no oversampling of selected customer segments in the hot climate region for purposes of assessing hardship. Over sampling was not possible in SDG&E's service territory because the population in the hot climate region is so small. SDG&E only has about 16,000 accounts in total in its hot climate region, which drops to less than 10,000 when all relevant exclusions are applied. The number of accounts that are senior households or CARE customers above and below 100% of the Federal Poverty Guideline (FPG) are much fewer. It is not feasible to obtain large enough enrollment among these small populations to meet targets for statistical accuracy. As such, no specific targets were set for overall enrollment or for any subpopulations in SDG&E's hot climate zone.

Table 4-3 shows the targeted enrollment for SDG&E's pilot rates, including oversampling for usage alerts for Rate 2. An extra 2,500 participants were recruited for the usage alert treatment track and placed on Rate 2 in the moderate and cool climate zones. The target enrollment numbers for SDG&E's moderate and cool climate regions for CARE and non-CARE customers are larger than they were for PG&E and SCE because the power analysis done by Nexant for SDG&E showed that larger samples would be needed to obtain the same level of statistical confidence for load impact estimates.[23]

[23] See power analysis memo in Appendix G. The request to approve the larger sample sizes was made in a letter from SDG&E to Energy Division dated April 1. This letter did not include a request for additional funding for the pilots. Permission was granted by the Commission in a letter from the Energy Division to SDG&E dated April 8, 2016.

Table 4-3: Target Enrollment for SDG&E Pilots

Approved High Scenario All					
Climate Zone	**Segment**	**Rate 1**	**Rate 2**	**Control**	**Total**
Hot	Total	0	1250	0	1250
Moderate	non-care	938	1563	938	3439
	care	938	1563	938	3439
	total	1876	3126	1876	6878
Cool	non-care	938	1563	938	3439
	care	938	1563	938	3439
	total	1876	3126	1876	6878
All	total	3752	7502	3752	15006

As did SCE and PG&E, SDG&E did a pretest to determine expected acceptance rates under different marketing materials, incentive levels, delivery channels, and with and without bill protection. Three marketing formats were tested, one with graphics (Letter 1), one with similar content but without graphics (Letter 2), and one without graphics but with a larger font size (Letter 3). Incentive levels of $200 and $300 were tested and the $200 incentive level was tested with and without bill protection. The pretest design is shown in Table 4-4 along with the response rates for each test cell. These response rates were recorded on April 13. The email solicitations were sent on March 11 and the direct mail solicitations were sent on March 25. Based in part on the pretest and in part on conforming to what the other utilities were doing, SDG&E based it's recruitment on a $200 incentive with pilot bill protection. SDG&E also concluded from the pretest that it would be cost effective to initially use email solicitation for the customers for whom SDG&E had email addresses and to use direct mail as a follow up to those who did not open or click through the email solicitation.

Table 4-4: SDG&E Pretest Results

Incentive Level	Direct mail			Email Population		
	Letter 1 (Marketing) (A)	**Letter 2 (Solicitation) (B)**	**Letter 3 (Large Print) (C)**	**Letter 2 Sent via USPS (D) and email (E)**	**Letter 1 sent via email (F)**	**Letter 3 sent via email (G)**
$200	1.6% (4)	2.0% (5)	3.1% (8)	9.4% (24)	8.2% (21)	5.9% (15)
$200 with Bill Protection	3.9% (10)	2.0% (5)	3.5% (9)	11.8% (30)	5.5% (14)	6.3% (16)
$300	4.3% (11)	3.1% (8)	4.7% (12)	10.2% (26)	7.5% (19)	7.8% (20)

The remainder of this section summarizes the sampling, recruitment, rate assignment, and enrollment processes that were used by SDG&E to solicit customers to participate in the pilot and to meet the enrollment targets prescribed in the CPUC resolutions approving the pilot. Section 2.1 describes the customer segments that were, for a variety of reasons, excluded from participation in the pilots and also describes the recruitment sample that was produced by SDG&E. Section 4.2 discusses the recruitment process and collateral that was used for solicitation. Section 4.3 summarizes the rate assignment and enrollment process while Section 4.4 discusses customer notification. Section 4.5

summarizes customer attrition and Section 4.6 discusses the education and outreach that has occurred since customers were enrolled onto the new rates. Finally, Section 4.7 systematically assesses the extent to which SDG&E pilot implementation met the requirements laid out in Resolution E-4769.

4.1 Recruitment Sample Selection

Prior to pulling the recruitment sample for Pilot Rates 1 and 2, selected customers were screened out from participating in the pilot.[24] Public Utilities Code Section 745(c)(1) excludes certain customers from being defaulted onto TOU rates without their affirmative consent. These customers include those who receive a medical baseline allowance, customers requesting third-party notification (pursuant to subdivision (c) of Section 779.1), and customers who the California Public Utilities Commission (CPUC) has ordered cannot be disconnected from service without an in-person visit from a utility representative (Decision 12-03-054, March 22, 2012). Although these pilots involved opt-in participation, insights from the pilots are intended to be used for guiding default enrollment. As such, the TOU Working Group involved in designing the pilots decided that customers who would be excluded from being defaulted onto the TOU rates should also be excluded from the opt-in pilots.

SDG&E databases identify customers with medical baseline allowances, those that require third-party notification, and those that have previously been determined to require an in-person visit prior to disconnection. Language was included in the TOU pilot enrollment form asking whether there was anyone in the household that had a serious medical condition that required a constant daily supply of electricity for electrical equipment.

SDG&E identified customers on the Medical Baseline Program using their Customer Care and Billing system. Additionally, SDG&E's system identifies the following customer groups that require an in-person visit by SDG&E before disconnection as being a "vulnerable" segment. Some of these customers are also on medical baseline; however, the majority of the vulnerable group are not:

- Life Support;
- Medical Baseline;
- Hearing Impaired;
- Visually Impaired;
- Disabled; or
- Elderly.

These customers were excluded from the pilot recruitment sample and will also become ineligible if they fall into one of the above categories over the course of the pilot. Additional exclusions included:

- All nonresidential accounts;
- Employees;
- NEM customers;
- Direct access customers;
- Accounts on the do not contact list;

[24] SDG&E did not initially screen out "vulnerable" customers (those requiring an in-home visit prior to disconnection) from its first wave recruiting list. That screen was performed after the first wave went out. Vulnerable customers were excluded from the recruiting lists for the second wave.

- Accounts without a smart meter;
- Customers with more than one account (in part to screen out seasonal homes); and
- Customers on opt-in TOU or CPP tariffs.

After applying the above exclusions, the eligible population equaled roughly 820,000, or about 64% of SDG&E's 1.3 million residential customers. Table 4-5 shows the recruitment sample sizes that were drawn from the eligible population by CARE status and climate zone.

Table 4-5: SDG&E Offers by Partition and Strata

Category	Hot Climate Zone	Moderate Climate Zones		Cool Climate Zones		Total
	General	CARE	Non-CARE	CARE	Non-CARE	
Offers	9,444	83,552	125,038	86,060	119,555	423,649

4.2 Pilot Recruitment

Recruitment for SDG&E's pilot began on April 19 with email sent out to all those in the sample for whom SDG&E had email addresses. Customers who had not opened the email or clicked through to view the content were sent a second email solicitation on April 22 and those who did not open or click through the second email were sent a letter solicitation on May 3. The first tranche of customers for whom SDG&E did not have email addresses received a recruitment letter on April 20 and a second tranche of customers were sent a letter on April 25. These letters included a link to the online enrollment form as well as a business reply card. Follow up letters were sent to both groups on April 27.

Figure 4-4 shows a copy of the initial recruitment letter that was sent to SDG&E customers. The email solicitation had similar content. As seen, the letter prominently displayed the $200 incentive that participants could earn by being in the study. It also explained what is meant by TOU rates, without providing specific prices, summarized the requirements of the study, and provided instructions on how to participate and what would happen next if they were accepted into the pilot. The fact that bill protection makes this a no risk offer is also discussed.

Figure 4-4: Initial Recruitment Letter

SDGE
A Sempra Energy utility®

Details as of:
04/08/2016

For service at:
123 Any Street
Anytown, US 12345-6789

April 20, 2016

John Q. Sample
SDG&E
8306 Century Park Ct # CP41F
San Diego, CA 92123-1530

Account number: 9999999999

Dear John,

Sometimes small steps can have a big, positive effect. You can take a small step right now that will affect electricity consumers across California. And, you can get up to **$200** for helping.

You're one of a select number of households chosen for an opportunity to participate in a study exploring new electricity pricing based on *when* energy is used (referred to as *Time of Use* rates). This study will also help determine new rates that will be introduced throughout the state in 2019. By participating you'll:

- Help California and the city of San Diego meet their energy goals
- Provide feedback on the new rate that will help determine future electric rates in California
- Have an opportunity to save on your energy costs over 18 months, while participating in the new rates

What are Time of Use rates?

In an effort to meet California's energy goals, public utilities are offering new *Time of Use* rates. By enrolling in these rates, not only will you play a pivotal role in California's future, but you can also help reduce the need for new power plants and even help the environment. With *Time of Use* rates, electricity prices vary depending on the time of day energy is used. Compared with the standard electric rate, prices are **lower most of the time** but higher during peak hours. If you reduce your electricity use when prices are higher—by shifting when you use major appliances, for example—you can better manage your energy costs. By better understanding your energy use, and shifting it during peak periods, you can help lower electricity prices not just for you but for all consumers.

What's in it for you?

In addition to helping the state and learning more about your energy use, you'll receive up to **$200** for participating after completing several short surveys over the course of the study.

Regardless of any fluctuation in your bill, you'll also be covered by what is called pilot bill protection. This means that at the end of your first 12 months on the study we'll compare your costs on the standard residential rate to the study rate that you'll be assigned to, and if the standard rate has lower costs, you'll get a credit back on your bill.

Figure 4-5: Initial Recruitment Letter (continued)

How long is the study?

The study runs 18 months, from June 2016 through the end of 2017. We're testing several different rates in this study, and you'll be placed randomly on one of the *Time of Use* rates or on a rate similar to our standard residential rate. You're free to drop out of the study at any time and return to the standard non-*Time of Use* rate when you leave the study. You can keep any reward payments you've received up to that time, but you'll become ineligible to receive any further payments.

How do I enroll?

To enroll, please either return the enclosed questionnaire or complete the online enrollment form at sdge.com/TOUstudy. You can also learn more by calling 1-800-411-7343. After agreeing to enroll, you'll stay on your current rate until your June billing date, at which time you'll be switched to the new rate. We'll provide you with detailed information about your new rate after it's assigned. You'll also receive tips on how to reduce your energy costs by managing when you use electricity.

Take a small step and sign up today.

Sincerely,

Amy Jauert
Smart Pricing Project Manager

Figure 4-6 shows the enrollment card that was included with the recruitment letter. As seen, the enrollment card gathered a variety of useful information, including language and communication channel preferences, the number of people in the household, the number of seniors in the household, and income. Enrollees were also asked to confirm their understanding that the incentive payments will be paid out in installments after completing the surveys, that no one in the household has a serious medical condition that requires the constant supply of electricity, that they are not planning to install solar panels during the study period, and that they are not an employee or retiree of SDG&E.

Figure 4-6: Enrollment Card and Survey

Time of Use Pilot Study Enrollment Questionnaire

Thank you for your interest in our *Time of Use* study. Your involvement will help shape new rates that will be introduced in 2019.

To enroll your household in the study, please take a few minutes to fill out the form below. All of the information you provide will be confidential and only used for the purpose of the pilot study.

Name on the SDG&E® account | **Service account number** *(listed on SDG&E bill)*

Service Address

Phone Number

( ) _____ Is this a mobile number? ☐ Yes ☐ No

If it is acceptable for us to contact you via this number (call or text), please sign and check the box next to the statement below.

☐ *I acknowledge that it would be acceptable for SDG&E to contact me via call or text at the number listed above.*

Signature _____ Date _____

What is your preference to receive information about the pilot study? *(Please check all that apply)*

☐ Email: _____
☐ Direct Mail
☐ Phone

Do you have a language preference other than English?

☐ Spanish ☐ Vietnamese ☐ Other *(please specify)*: _____ ☐ No

How old is the Head of Household? _____ **How many people are there in your household?** _____ **How many seniors (65 years or older) live in the household?** _____

Annual household income

☐ Less than $12,000
☐ $12,000 to less than $17,000
☐ $17,000 to less than $21,000
☐ $21,000 to less than $25,000
☐ $25,000 to less than $29,000
☐ $29,000 to less than $33,000
☐ $33,000 to less than $37,000
☐ $37,000 to less than $41,000
☐ $41,000 to less than $50,000
☐ $50,000 to less than $100,000
☐ $100,000 or more
☐ Don't know or prefer not to answer

☐ **I confirm that the statements below are true.**

- I understand that the incentive payments will be paid out in installments after I complete several surveys.
- No one in my household currently has a serious medical condition that requires a constant daily supply of electricity or electrical equipment.
- I'm not currently considering installing solar panels within the next 18 months.
- I'm not an employee or retiree of SDG&E.

☐ **Yes, I agree to have my rate plan switched** in June 2016 to a *Time of Use* rate or one that is similar to my current rate, so that I may participate in SDG&E's *Time of Use* pilot study.

Signature _____ Date _____

Table 4-6 shows the number of customers that agreed to enroll in the study for each target segment and the acceptance rate for each segment. The overall acceptance rate was 7%. The acceptance rate for CARE customers was twice the rate for non-CARE customers. Acceptance rates did not vary across

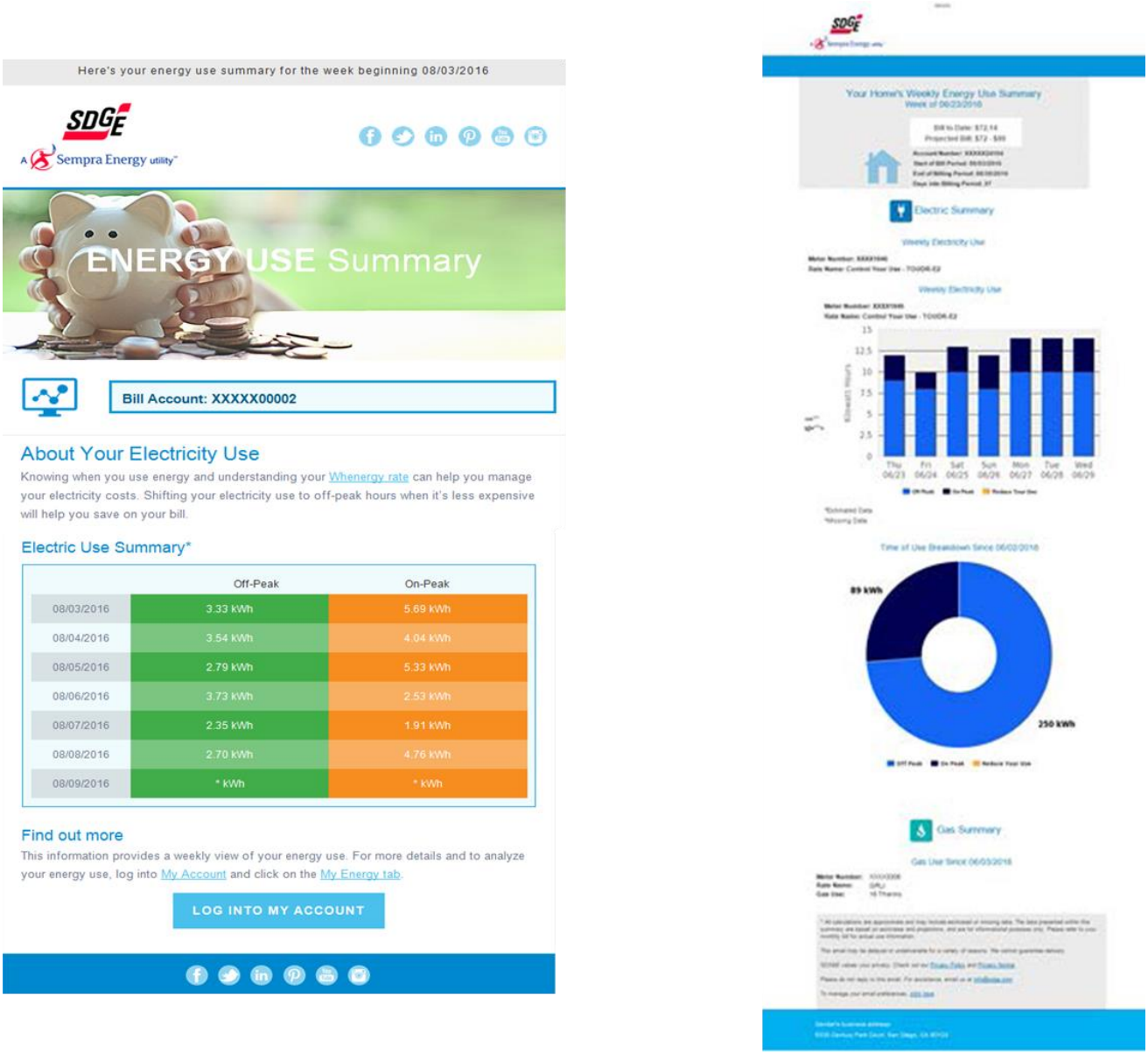
the moderate and cool climate zones. The acceptance rate in the hot climate zone, 9%, was actually higher than in the other two climate zones.

Table 4-6: SDG&E Offers and Acceptances by Partition and Strata

Category	Hot Climate Zone	Moderate Climate Zones		Cool Climate Zones		Total
	General	CARE	Non-CARE	CARE	Non-CARE	
Offers	9,444	83,552	125,038	86,060	119,555	423,649
Acceptances	865	8,417	6,322	8,817	6,483	30,904
Acceptance Rate	9%	10%	5%	10%	5%	7%

The first usage alerts were sent to customers who were recruited for that treatment on August 12. Due to system issues and rate changes, this was launched slightly later than originally planned. After assigning customers to the control group, alerts went to roughly 1,800 or 72% of the 2,500 randomly selected customers for whom SDG&E had email addresses that were obtained either through the normal course of business or through the enrollment survey. To date, usage alert opt out rates have been minimal (<10). A sample of the August and October usage alerts can be seen in Figure 4-.

Figure 4-7: Sample of the August and October Usage Alerts



4.3 Rate Assignment and Enrollment

Not all customers who agreed to participate in the pilot were actually enrolled in the pilot study, thus staying on a tiered rate. There were several reasons why customers were not enrolled on a new rate or retained in the study as a control customer. Table 4-7 summarizes the reasons why roughly half of those who accepted the offer were not enrolled in the study.

One reason why some customers were not enrolled was because they became ineligible between when they were selected into the recruitment sample and when they accepted the offer, or between the time they were assigned to a treatment condition and when enrollment was scheduled to occur. For example, a customer might have closed their account, become a net metered customer, or enrolled

into the medical baseline program during this period, all of which would lead to being declared ineligible for the study after acceptance occurred. As seen in Table 4-7, almost a thousand customers were deemed to be ineligible after accepting the recruitment offer but before being assigned to a treatment. This high concentration of households consisted of customers that had self-certified as seniors/disabled, thus requiring an in-person visit prior to electricity being shut off. The intent was to screen these customers out prior to sending out recruitment letters, thereby avoiding this exclusion post acceptance. However, during the recruitment process, it was realized this screen did not occur in the first recruiting wave, thus resulting in the high number of ineligibilities due to self-certification. Prior to sending the second wave of recruitment letters, SDG&E did screen for self-certified seniors/disabled.

By far the most significant reason why customers were not enrolled in the study was due to over recruitment. As seen in Table 4-7, SDG&E targeted to enroll roughly 15,000 customers but had almost 31,000 accept the offer. Due to the compressed recruitment schedule, a large number of reply cards had not been received and processed prior to the determination to sending a second tranche of recruitment letters. Given the impending launch date, once all target cells were exceeded, SDG&E chose a cutoff date after which all enrollees were declined. This cutoff was imposed in all treatment cells and climate regions. Given the very small number of customers in SDG&E's hot climate zone, SDG&E's original pilot plan was to accept all customers in the hot region, assign all to Rate 2, and then create a statistically matched control group from those who did not enroll for purposes of estimating load impacts. Reply cards for roughly half of the hot climate zone customers were received and processed after the enrollment cut-off date, resulting in their being declined participation in the study. After confirming that the pretreatment load shapes for both the accepted and declined groups were nearly identical, Nexant determined that this group could be used as a control for estimating load impacts. However, due to the small sample size and amount of load shift/reduction, it still may not be possible to estimate a statistically significant load reduction. Customers who were declined participation in the study were sent a letter thanking them for their interest and directing them to SDG&E's website where they could learn more about TOU pricing plans that were available outside of the pilot.

Table 4-7: Distribution of Customers from Acceptance to Enrollment

Category	Hot Climate Zones, General	Moderate Climate Zones, CARE Customers	Moderate Climate Zones, Non-CARE Customers	Cool Climate Zones, CARE Customers	Cool Climate Zones, Non-CARE Customers	Total
Offers	9,444	83,552	125,038	86,060	119,555	423,649
Acceptances	865	8,418	6,323	8,817	6,483	30,906
Acceptance Rate	9%	10%	5%	10%	5%	7%
Ineligible Prior to Rate Assignment	35	426	68	394	55	978
Medical	30	392	35	369	27	853
NEM	0	2	5	1	5	13
Other	5	32	28	24	23	112
Opt-Out Prior to Rate Assignment	0	0	0	0	0	0
Number of customers whose acceptance cards were received after enrollment deadline	398	4,382	2,309	4,615	2,420	14,124
Customers Assigned to a Pilot Rate	432	3,610	3,946	3,808	4,008	15,804
Rate 1	0	977	1,064	1,029	1,084	4,154
Rate 2	432	1,659	1,817	1,750	1,843	7,501
Control	0	974	1,065	1,029	1,081	4,149
Target Enrollment	1,250	3,439	3,439	3,439	3,439	15,006
% of Target Achieved	35%	105%	115%	111%	117%	105%
Customers Transitioned to a Pilot Rate	423	3,470	3,856	3,680	3,911	15,340

4.4 Notification

The roughly 15,800 customers who were accepted into SDG&E's rate pilot were notified and informed about their rate assignment through a multi-step process that resulted from several pricing changes for the pilot tariffs. Prior to the June 1 launch, SDG&E filed and received approval for its pilot tariffs. After further review and discussion with ORA and Energy Division, it was determined that SDG&E would make adjustments to its previously approved tariffs. The new pricing became effective June 23, 2016. At the same time, SDG&E was also implementing its next step in the tier collapse component of rate reform, moving from three tiers to two tiers. This created an additional pricing change beginning July 1, 2016.[25]

As a result of these price changes, customers were informed about their rate assignment and provided with detailed information through a three step process. Between May 16 and June 2, customers received a letter welcoming them to the study, indicating their treatment assignment (e.g., Rate 1, Rate 2, or control) and informing them of the timing associated with the Peak rate period. Examples of this Welcome Letter for Rate 1 customers and for the control group are shown in Figure 4-8. The letters also indicated that more details would follow and reminded them of some of the requirements and features of the study, including the incentive amount they would receive if they stayed in the pilot over the course of the study.

The welcome packages were originally planned to be sent out in mid-June but because of the multiple rate changes in June, they were put on hold and, instead, customers were sent another communication on July 5 indicating the prices being charged in each rate period. Figure 4-9 contains copies of the information that was sent out to Rate 1 and Rate 2 customers in this pricing communication. The letters indicate that Welcome Kits would be arriving soon.

Figure 4-10 shows a copy of the Welcome Kit material for Rate 2 customers. English versions of the Welcome Kits were sent out starting on July 29 and most had been distributed by August 15. Spanish version Welcome Kits were sent on September 9. As of this writing, all customers have received Welcome Kits.

[25] 1 SDG&E AL 2890-E-D; SDG&E AL 2861-E-A

Figure 4-8: SDG&E TOU Pilot Welcome Letter

Rate 1

SDGE
A Sempra Energy utility

May 20, 2016

John Q. Sample
8306 Century Park Ct # Cp41F
San Diego, CA 92123-1530

Dear John:

Your new rate is "Study Rate 1."

Congratulations, you've been selected to participate in our *Time of Use* study that begins on June 1, 2016, and runs through the end of 2017. We appreciate your interest and are excited to work with you to help determine new rates that will be introduced statewide in 2019.

You've been selected to be placed on "Study Rate 1" during the study period. Your new rate will begin with your June billing cycle. This rate has a summer season and a winter season, as well as three *Time of Use* periods (on-peak, off-peak, and super off-peak). The daily on-peak period runs from 4:00 p.m. to 9:00 p.m. and applies to both summer (May through October) and winter (November through April).

Be on the lookout for your Welcome Kit delivery! It will include information about your rate, ways to adjust your energy use to different times of the day, along with answers to your questions.

In addition to helping conserve energy and learning more about your energy use, you'll receive up to $200 in bill credits for your participation. This is based on your completion of several short surveys over the course of the study. After you complete each survey, a credit will be applied to your bill.

You're free to drop out of the study at any time and return to the standard non-*Time of Use* rate. You keep any bill credits you've received up to that time, but you'll become ineligible to receive any further credits. Pilot Bill Protection will also go into effect for the first 12 months of the study—we'll compare the charges you would have incurred on the standard residential rate to the study rate that you're assigned, and if the standard rate has lower costs, you'll get a credit back on your bill.

Thank you again for your participation in our study. Your contribution and feedback are greatly appreciated and will help determine future *Time of Use* electric rates in California.

Sincerely,

Amy Jauert
Smart Pricing Project Manager

EI_013557

Control Group

SDGE
A Sempra Energy utility

May 20, 2016

John Q. Sample
8306 Century Park Ct # Cp41F
San Diego, CA 92123-1530

Dear John:

Congratulations, you've been selected to participate in our *Time of Use* study that begins on June 1, 2016, and runs through the end of 2017. We appreciate your interest and are excited to work with you to help determine new rates that will be introduced statewide in 2019.

You've been selected to be part of the control group during the study period, which means you will remain on your current electric rate. However, you'll still receive the same incentives as the other study participants. While you won't yet be on a *Time of Use* rate, you are encouraged to decrease your daily energy use during the peak hours of 4:00 p.m. to 9:00 p.m. We'll be providing you with additional detailed information in the coming weeks.

You can also learn more about *Time of Use* at sdge.com/Whenergy. Please note that the peak periods listed on that site may differ slightly from the peak periods associated with this *Time of Use* study.

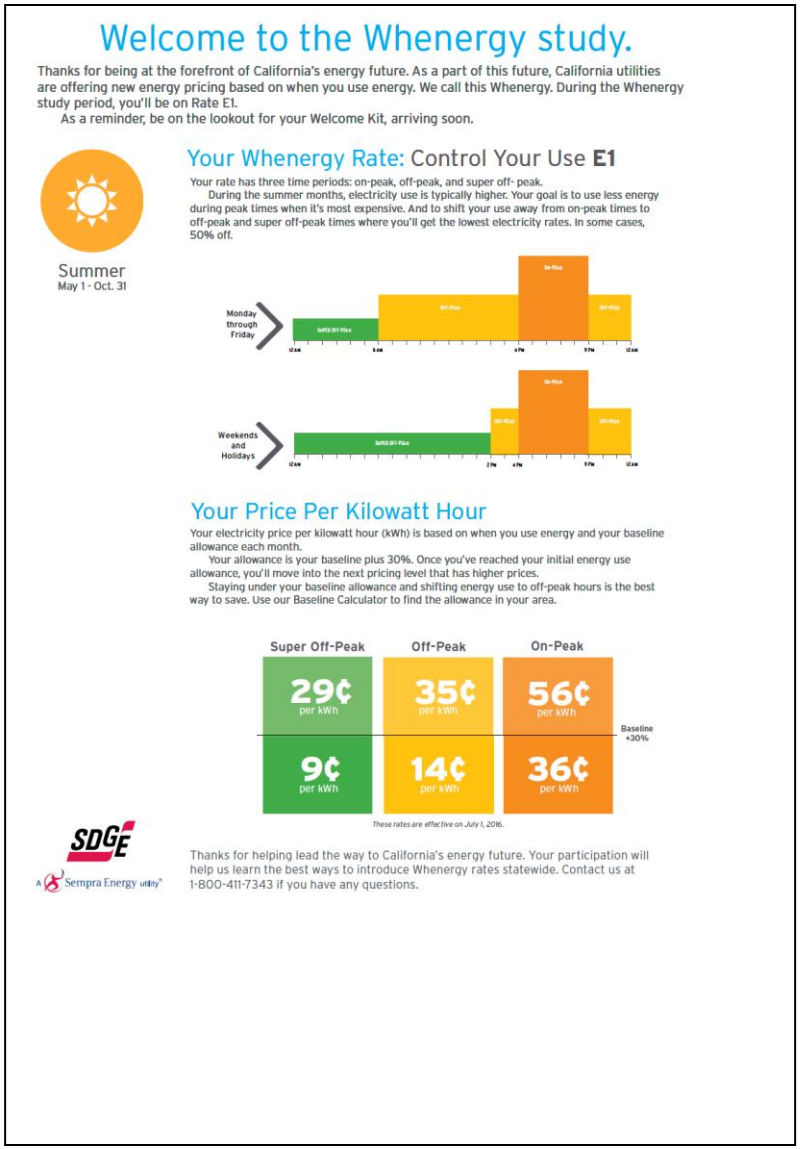
In addition to helping conserve energy and learning more about your energy use, you'll receive up to $200 in bill credits for your participation. This is based on your completion of several short surveys over the course of the study. After you complete each survey, a credit will be applied to your bill. You're free to drop out of the study at any time.

Thank you again for your participation in our study. Your contribution and feedback are greatly appreciated and will help determine future *Time of Use* electric rates in California.

Sincerely,

Amy Jauert
Smart Pricing Project Manager

Figure 4-9: Pricing Communication Letter



Welcome to the Whenergy study.

Thanks for being at the forefront of California's energy future. As a part of this future, California utilities are offering new energy pricing based on when you use energy. We call this Whenergy. During the Whenergy study period, you'll be on Rate E1.

As a reminder, be on the lookout for your Welcome Kit, arriving soon.

Summer
May 1 - Oct. 31

Your Whenergy Rate: Control Your Use **E1**

Your rate has three time periods: on-peak, off-peak, and super off- peak.

During the summer months, electricity use is typically higher. Your goal is to use less energy during peak times when it's most expensive. And to shift your use away from on-peak times to off-peak and super off-peak times where you'll get the lowest electricity rates. In some cases, 50% off.

Your Price Per Kilowatt Hour

Your electricity price per kilowatt hour (kWh) is based on when you use energy and your baseline allowance each month.

Your allowance is your baseline plus 30%. Once you've reached your initial energy use allowance, you'll move into the next pricing level that has higher prices.

Staying under your baseline allowance and shifting energy use to off-peak hours is the best way to save. Use our Baseline Calculator to find the allowance in your area.

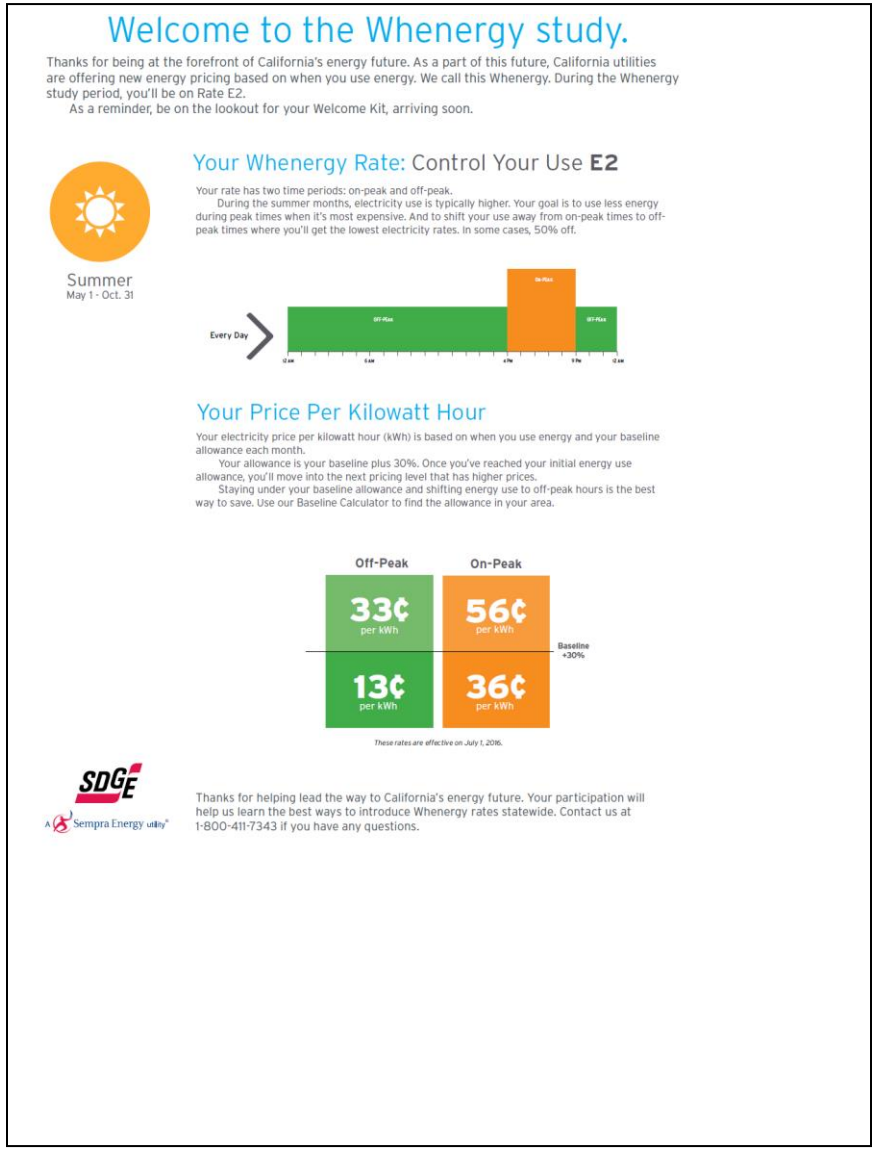
Super Off-Peak	Off-Peak	On-Peak
29¢ per kWh	35¢ per kWh	56¢ per kWh
9¢ per kWh	14¢ per kWh	36¢ per kWh

Baseline +30%

These rates are effective on July 1, 2016.

SDGE
A Sempra Energy utility®

Thanks for helping lead the way to California's energy future. Your participation will help us learn the best ways to introduce Whenergy rates statewide. Contact us at 1-800-411-7343 if you have any questions.



Welcome to the Whenergy study.

Thanks for being at the forefront of California's energy future. As a part of this future, California utilities are offering new energy pricing based on when you use energy. We call this Whenergy. During the Whenergy study period, you'll be on Rate E2.

As a reminder, be on the lookout for your Welcome Kit, arriving soon.

Summer
May 1 - Oct. 31

Your Whenergy Rate: Control Your Use **E2**

Your rate has two time periods: on-peak and off-peak.

During the summer months, electricity use is typically higher. Your goal is to use less energy during peak times when it's most expensive. And to shift your use away from on-peak times to off-peak times where you'll get the lowest electricity rates. In some cases, 50% off.

Your Price Per Kilowatt Hour

Your electricity price per kilowatt hour (kWh) is based on when you use energy and your baseline allowance each month.

Your allowance is your baseline plus 30%. Once you've reached your initial energy use allowance, you'll move into the next pricing level that has higher prices.

Staying under your baseline allowance and shifting energy use to off-peak hours is the best way to save. Use our Baseline Calculator to find the allowance in your area.

Off-Peak	On-Peak
33¢ per kWh	56¢ per kWh
13¢ per kWh	36¢ per kWh

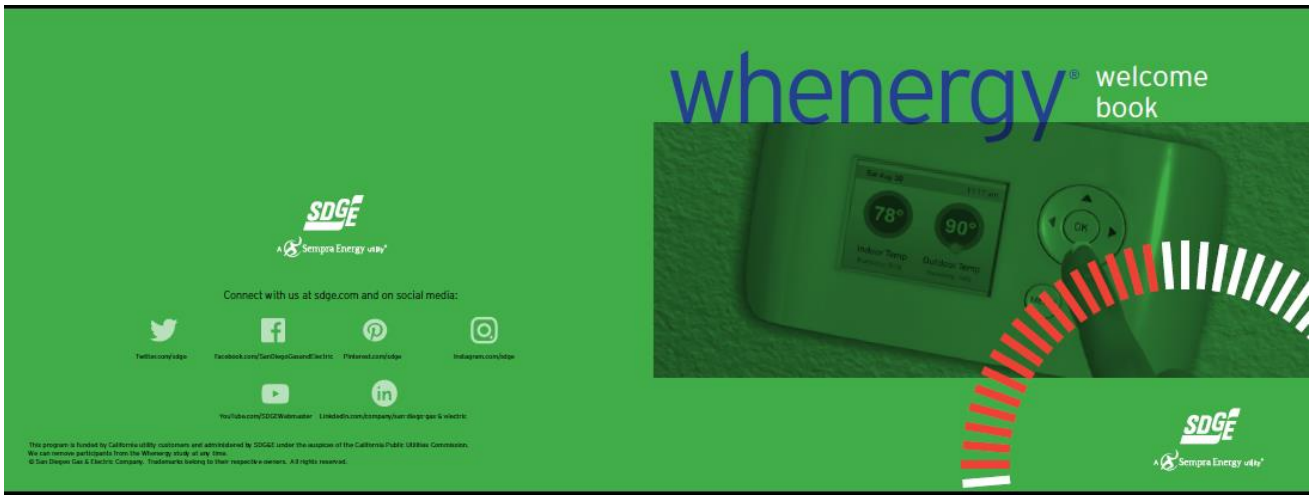
Baseline +30%

These rates are effective on July 1, 2016.

SDGE
A Sempra Energy utility®

Thanks for helping lead the way to California's energy future. Your participation will help us learn the best ways to introduce Whenergy rates statewide. Contact us at 1-800-411-7343 if you have any questions.

Figure 4-10: SDG&E Rate 2 Welcome Kit



Thanks for being a part of our study.

The idea behind the Whenergy study is to learn from you. We'll use your performance and feedback to help us improve the program for everyone. We'll be checking with you regularly through emails and other communications. And be sure to look out for exciting new tools and updates. We're happy to have you along on our journey to California's energy future.

Whenergy study basics.

Study timing
- June 2016 through December 2017.
- Look for updates about your new pricing plan and saving ideas.

Compensation
- You'll complete three surveys (Fall 2016, Spring 2017 and Winter 2017)
- Your $200 bill credit will be in three payments - August, late Fall, end of 2017.
- If you leave the study early you won't receive further compensation/bill credits.

Bill Protection
- Regardless of any fluctuation on your bill, you'll be covered by Pilot Bill Protection.
- At the end of your first year, if you could have saved money by staying on a standard rate, you'll get a credit back on your bill.

Questions? Talk with us at 1-800-411-7343.

What is Whenergy?

For decades, Californians have paid for energy based mostly on the amount they use every month. But the true cost of electricity changes dramatically based on the **time of day.** During the peak demand periods of 4pm to 9pm, the cost of delivering electricity can go up 200% or more. Whenergy rates are closer to the real costs of supplying electricity. They encourage everyone to save electricity **when** it matters most. That's good for the electric grid, our state and the environment.

Today's rates
Two pricing levels where electricity costs rise the more you use.

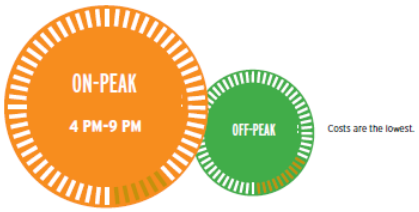
Whenergy rates
Prices based on **when** you use energy. Higher prices during peak periods. Lower prices at off-peak times.

WHENERGY TIP:
Shift your electric use to Off-Peak time periods when rates are at their lowest.

Figure 4-10: SDG&E Rate 2 Welcome Kit (continued)

Know the Whenergy time periods.

Whenergy rates use time of day periods that reflect electricity demand levels throughout the year. There are two periods: On-Peak, Off-Peak and Super Off-Peak. It's important to know that during the Pilot, the **On-Peak period is always 4pm to 9pm throughout the year.** Off-Peak and Super Off-Peak periods vary during the week and in Summer and Winter.



Electricity costs are at their highest. Save money by using less electricity or by shifting use to the lower-cost times.

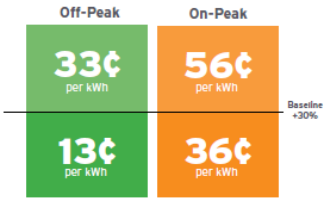
WHENERGY TIP:
In Winter, replace incandescent holiday lights with low energy LED's.

Your Whenergy Rate: E2

When you use electricity. Your rate has **two** time periods: On-Peak and Off-Peak. During Summer, electricity use is at its highest level all year. Your goal is to use less energy during peak times when it's most expensive. And to shift your use away from On-Peak times to Off-Peak times where you'll get the lowest electricity rates. In some cases, 50% off.

Summer
May 1 - Oct. 31

How much electricity you use: Your electricity (kWh) price is based on how much total electricity you use each month. You'll start with a lower-priced monthly allowance - based on where you live. Once you've reached your initial allowance, you'll move into the second pricing level with higher prices. Staying within your initial allowance is the best way to save. Visit sdge.com/baseline to find the allowance in your area.



Summer
May 1 - Oct. 31

WHENERGY TIP:
During Summer, pre-cool your home by running the A/C before Peak periods.

You want to save. We want to help.

To be succesful, you'll need to really take charge of your electricity use. Managing you energy life has become easier thanks to new tools and technology. We encourage you to take advantage of these free programs and tools.

Mobile App
Monitor your energy use, access your smart appliances, pay your bill and more - from your desktop, tablet or phone. Download at *sdge.com/mobileapps.*

Free Energy Survey
Take our online home energy-efficiency survey at *sdge.com/survey.* This tool shows you ways to save that are personalized based on how you use energy at home.

marketplace.sdge.com
A one-stop shop for energy saving appliance and rebate deals. Browse the best local retailers and factor energy savings into your purchases.

Top 10 Whenergy saving ideas.

1. Run your higher electric use appliances during off-peak periods.
2. Pre-Cool your home by running AC before the afternoon Peak period.
3. Unplug appliances and other items not in constant use.
4. Turn off your dishwasher after the wash cycle – and let your dishes air-dry.
5. Install aerating, low-flow faucets and showerheads to reduce hot water use.
6. Turn off lights when possible, especially during peak periods.
7. Get out of the house during peak times. Visit a park, see a movie . . .
8. Grill dinner outside to avoid heating up your home and using more AC
9. Use microwaves and toaster ovens to cook or warm leftovers.
10. Run your washer/dryer during Off Peak periods and do multiple loads.

WHENERGY TIP:
Use less energy during Peak times. Shift your use to less-expensive Off-Peak times.

4.5 Customer Attrition

Table 4-8 shows customer attrition from the SDG&E pilot between when customers were assigned to a rate and when the most recent data update was received by Nexant on August 18, 2016. Attrition over that period was the result of changes in eligibility, customers closing their account due to moving, and customers dropping out of the pilot. Attrition is divided into three periods: the time between rate assignment and when customers were notified of their rate assignment; the time between notification and being transferred onto the new rate according to each customer's next billing cycle; and the time between transfer onto the rate and August 18, 2016.

Over this period, 853 customers left the pilot due either to ineligibility, moving, or proactively dropping out. Of this total, roughly 75% left because they moved location. Only 148 customers, or roughly 1%, actively dropped out of the pilot over this period. Dropout rates may be higher in the future once customers have received several summer bills. Due to some billing issues, many SDG&E customers had their initial bills delayed so dropout rates may rise.

Table 4-8: Customer Attrition

Attrition Reason	Hot Climate Zones, General	Moderate Climate Zones, CARE Customers	Moderate Climate Zones, Non-CARE Customers	Cool Climate Zones, CARE Customers	Cool Climate Zones, Non-CARE Customers	Total
Customers assigned to rate treatment or control	432	3,610	3,946	3,808	4,008	15,804
Customers transitioned to pilot rate (or control customers)	423	3,470	3,856	3,680	3,911	15,340
Customers enrolled as of 8-18-2016	412	3,376	3,732	3,612	3,819	14,951
Ineligible Post-Rate Assignment	**1**	**12**	**28**	**2**	**19**	**62**
Ineligibles, Pre-Notification	0	7	13	0	14	34
Ineligibles, Pre-Rate Change	1	2	9	1	2	15
Ineligibles, Post-Rate Change	0	3	6	1	3	13
Moved Post-Rate assignment	**8**	**191**	**128**	**176**	**140**	**643**
Moves, Pre-Notification	8	109	91	98	108	414
Moves, Pre-Rate Change	0	26	1	29	1	57
Moves, Post-Rate Change	0	56	36	49	31	172
Opt-Out Post-Rate Assignment	**11**	**31**	**58**	**18**	**30**	**148**
Opt-Outs, Pre-Notification	8	30	46	16	25	125
Opt-Outs, Pre-Rate Change	0	0	2	0	0	2
Opt-Outs, Post-Rate Change	3	1	10	2	5	21
Total	**20**	**234**	**214**	**196**	**189**	**853**
Attrition rate	5%	6%	5%	5%	5%	5%

4.6 Pilot Outreach and Education

Whether in person, over the phone, via the microsite, smartphone app, email, or direct mail—messaging that clearly explains the pilot and its purpose, the specific pilot rates, possible behavior modifications that can ultimately lead to bill savings opportunities is critical to customer acceptance not only of the pilot, but of time-of-use in general. In addition to the notification and Welcome Kit information (June/July) that was sent to pilot customers, SDG&E has utilized a variety of communication methods to date. Once the pilot customers have received their Welcome Kits, it is SDG&E's intent to communicate with its pilot customers every six to eight weeks in what is called Whenergy Updates. These updates can be email, direct mail, or both.

As smartphones are a key communication channel, SDG&E implemented an option for pilot customers to subscribe to receive push notifications to remind them of TOU period changes. In their August Whenegy Update, customers received a personalized PIN so they would receive notifications and information specific to their assigned pilot rate. In addition to these notifications, app users can also go to their MyAccount to review their energy usage and pay their bill online. Figure 4-5 and 4-12 provide email and direct mail examples of the Whenergy Smart Phone App recruitment and show an example of the actual notifications.

Figure 4-5: Whenergy Smart Phone App Recruitment—Email

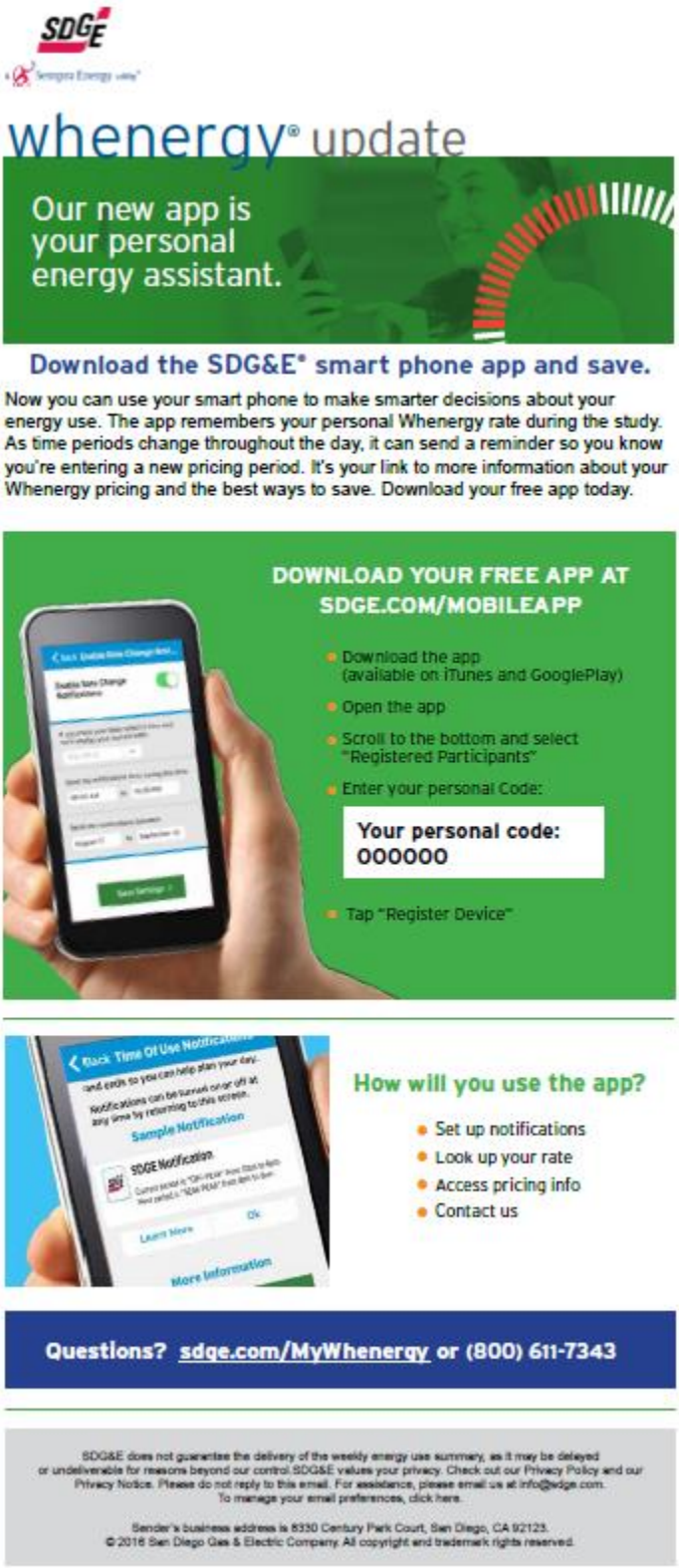
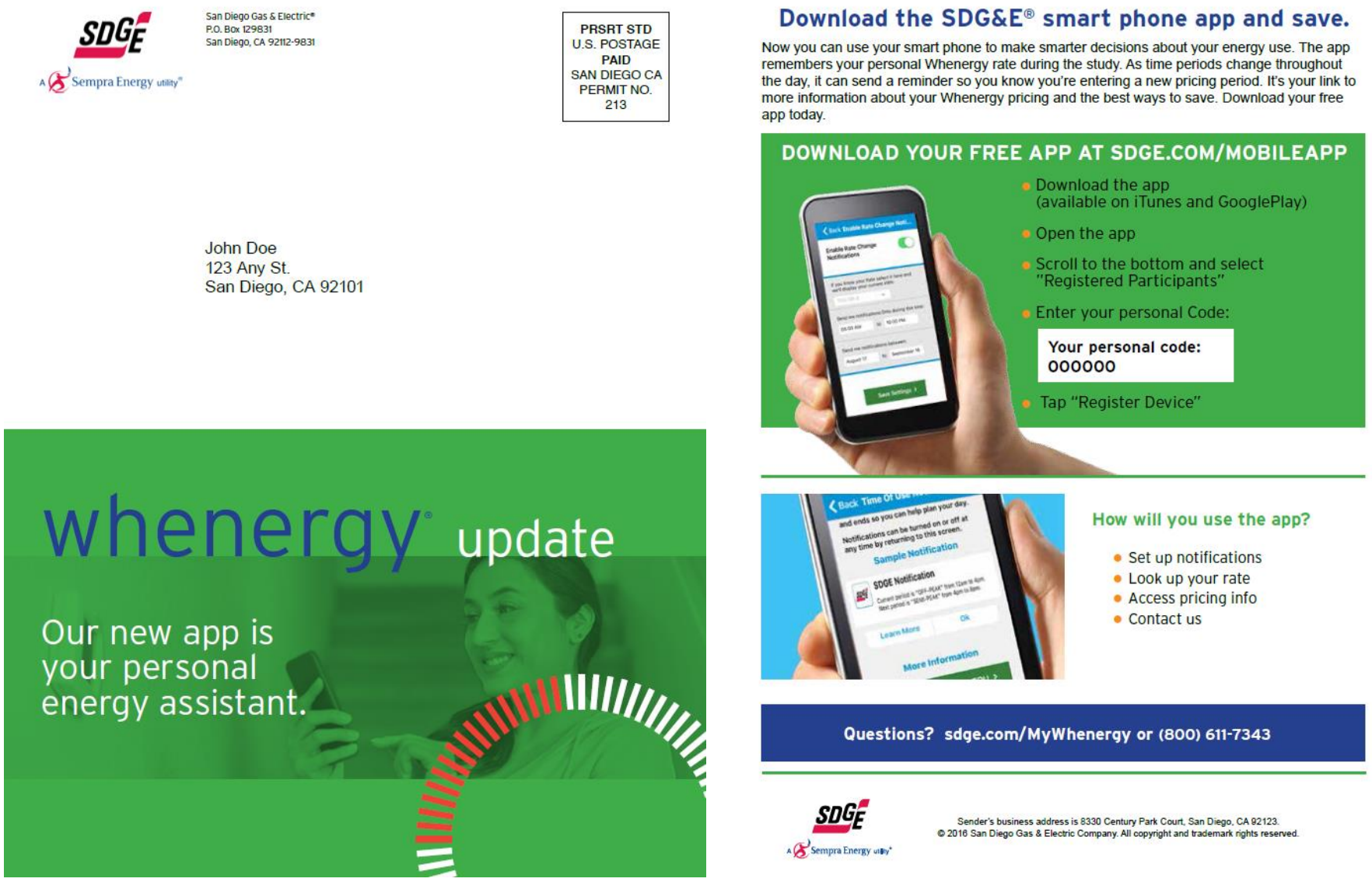


Figure 4-6: Whenergy Smart Phone App Recruitment—Direct Mail



SDG&E's microsite is another avenue for pilot customers to receive information related to their pilot participation. Each pilot participant was given their rate specific URL in the welcome information. The microsite can be accessed via any device with an internet connection. The Whenergy HourX microsite is scheduled to launch October 1. Figure 4-7 through 4-17 show samples of: the HourX recruitment email; the Whenergy HourX welcome email; the actual Whenergy HourX microsite; and an example of the day-ahead price forecasting chart, along with additional ways for customers to engage.

Figure 4-7: HourX Recruitment Email Sample

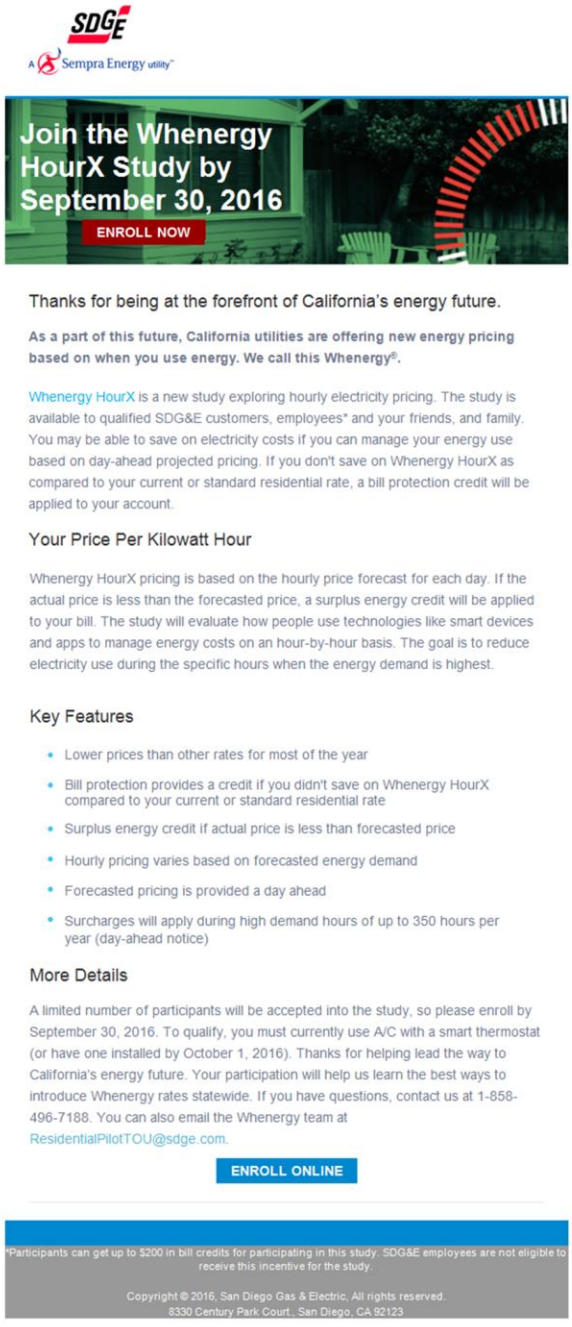
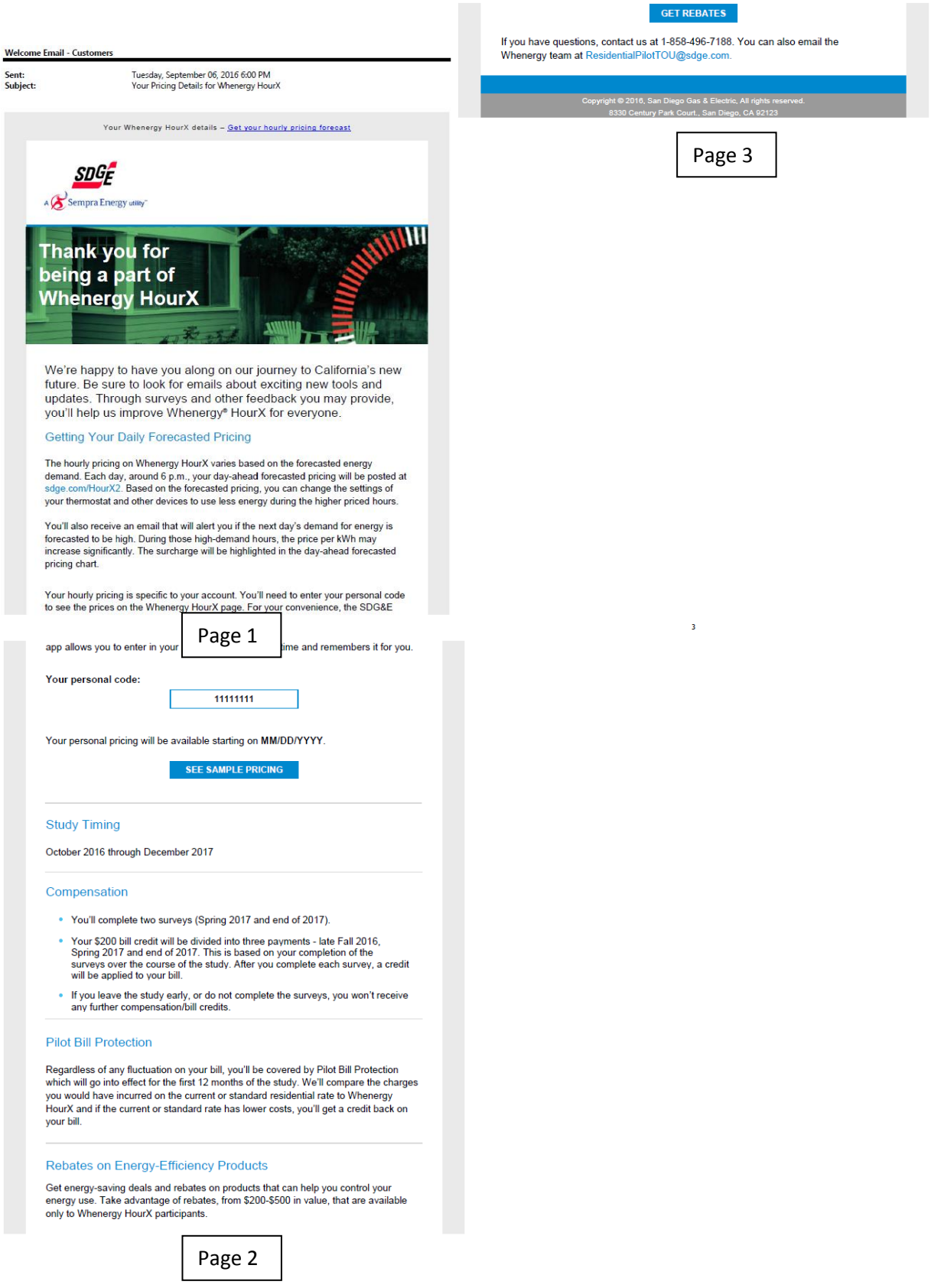


Figure 4-8: Whenergy HourX Welcome Email



Welcome Email - Customers

Sent: Tuesday, September 06, 2016 6:00 PM
Subject: Your Pricing Details for Whenergy HourX

Your Whenergy HourX details – Get your hourly pricing forecast

SDGE
A Sempra Energy utility

Thank you for being a part of Whenergy HourX

We're happy to have you along on our journey to California's new future. Be sure to look for emails about exciting new tools and updates. Through surveys and other feedback you may provide, you'll help us improve Whenergy® HourX for everyone.

Getting Your Daily Forecasted Pricing

The hourly pricing on Whenergy HourX varies based on the forecasted energy demand. Each day, around 6 p.m., your day-ahead forecasted pricing will be posted at sdge.com/HourX2. Based on the forecasted pricing, you can change the settings of your thermostat and other devices to use less energy during the higher priced hours.

You'll also receive an email that will alert you if the next day's demand for energy is forecasted to be high. During those high-demand hours, the price per kWh may increase significantly. The surcharge will be highlighted in the day-ahead forecasted pricing chart.

Your hourly pricing is specific to your account. You'll need to enter your personal code to see the prices on the Whenergy HourX page. For your convenience, the SDG&E

Page 1

app allows you to enter in your ime and remembers it for you.

Your personal code:

11111111

Your personal pricing will be available starting on **MM/DD/YYYY**.

SEE SAMPLE PRICING

Study Timing

October 2016 through December 2017

Compensation

- You'll complete two surveys (Spring 2017 and end of 2017).
- Your $200 bill credit will be divided into three payments - late Fall 2016, Spring 2017 and end of 2017. This is based on your completion of the surveys over the course of the study. After you complete each survey, a credit will be applied to your bill.
- If you leave the study early, or do not complete the surveys, you won't receive any further compensation/bill credits.

Pilot Bill Protection

Regardless of any fluctuation on your bill, you'll be covered by Pilot Bill Protection which will go into effect for the first 12 months of the study. We'll compare the charges you would have incurred on the current or standard residential rate to Whenergy HourX and if the current or standard rate has lower costs, you'll get a credit back on your bill.

Rebates on Energy-Efficiency Products

Get energy-saving deals and rebates on products that can help you control your energy use. Take advantage of rebates, from $200-$500 in value, that are available only to Whenergy HourX participants.

Page 2

3

GET REBATES

If you have questions, contact us at 1-858-496-7188. You can also email the Whenergy team at ResidentialPilotTOU@sdge.com.

Copyright © 2016, San Diego Gas & Electric, All rights reserved.
8330 Century Park Court., San Diego, CA 92123

Page 3

Figure 4-9: Whenergy HourX Daily Reminder Email

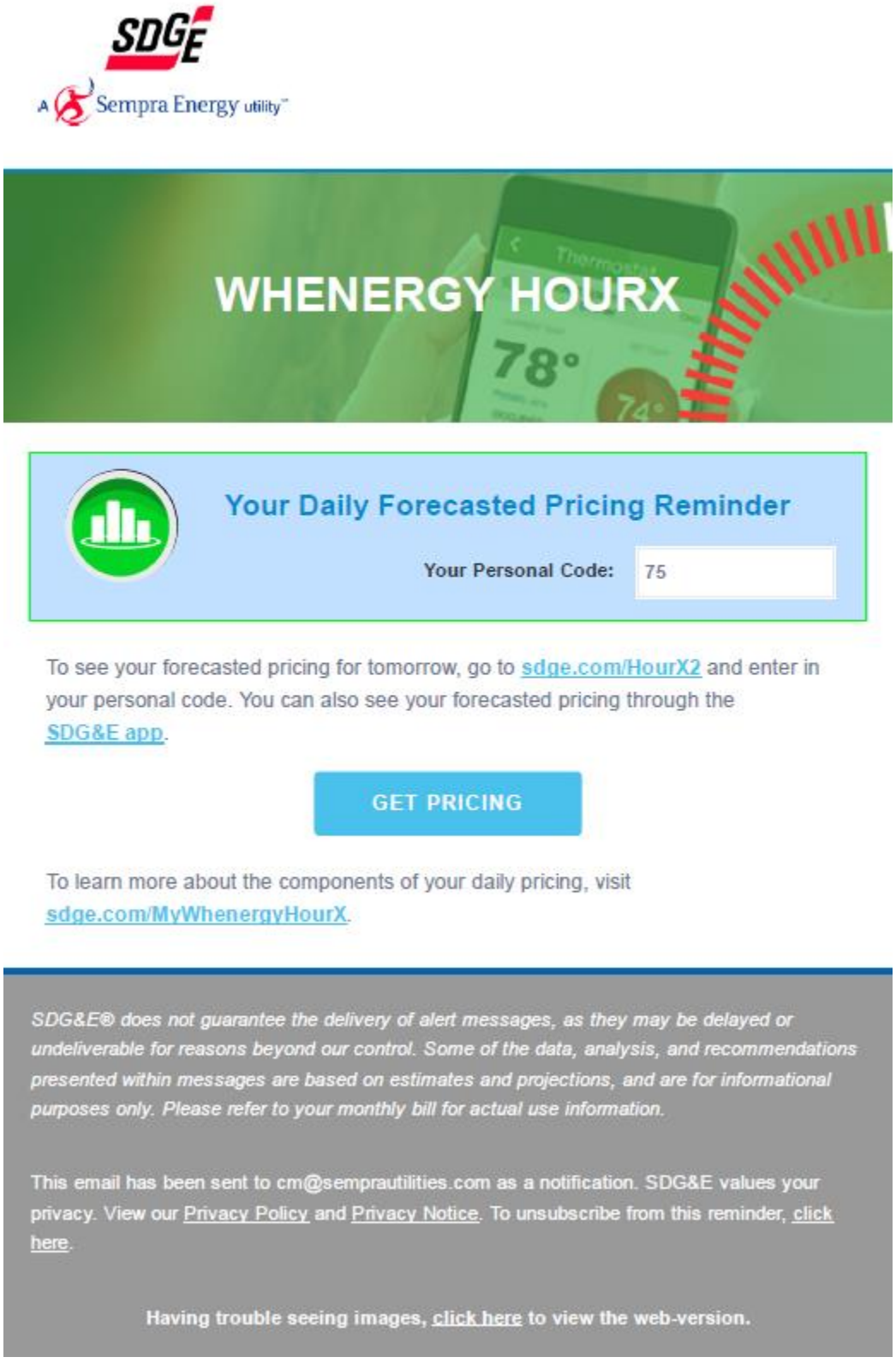


Figure 4-10: Whenergy HourX Web Page

Languages ▾ Careers Contact Us Outage Map

SDGE A Sempra Energy utility

Search

My Account | Customer Service | Residential | Business | In the Community | Environment | Rebates

Whenergy Study on Hourly Rate

Thanks for being at the forefront of California's energy future. As a part of this future, California utilities are offering new energy pricing based on when you use energy. We call this Whenergy®.

Already Enrolled?

If you are already enrolled:

Enter here

Your Whenergy Rate: HourX

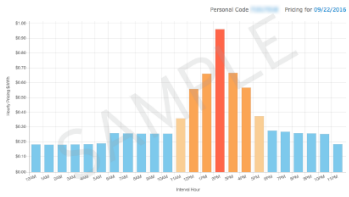
Whenergy HourX is a new study exploring hourly electricity pricing. The study will evaluate how people use technologies like smart devices and apps to manage energy costs on an hour-by-hour basis. Participants can get up to $200 in bill credits for participating in this study. They may also be able to save on electricity costs if they can manage their energy use with day-ahead projected pricing. If they don't save on Whenergy HourX as compared to their current or standard residential rate, a bill protection credit will be applied to their account.

Page 1

The goal is to reduce electricity use during the specific hours when the energy demand is highest.

Your Price Per Kilowatt Hour

Whenergy HourX pricing is based on the hourly price forecast for each day. The pricing will be provided the day before so that you can plan your energy use for the next day. Surcharges may apply during high system demand hours (up to 350 hours per year) and will also be published in the day-ahead pricing. If the actual price is less than the forecasted price, a surplus energy credit will be applied to your bill.



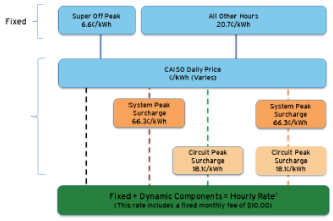
The blue bars indicate forecasted prices without surcharges. The orange bars indicate surcharges due to forecasted high-demand hours. The forecasted pricing on the chart is based on estimates and projections, and is for informational purposes only. All calculations are approximate and may include estimated or missing data. Please refer to your monthly bill for actual use information.

Key Features of Whenergy HourX

Page 2

- Lower prices than other rates for most of the year
- Bill protection provides a credit if you didn't save on Whenergy HourX compared to your current or standard residential rate
- Surplus energy credit if actual price is less than forecasted price
- Hourly pricing varies based on forecasted energy demand
- Forecasted pricing is provided a day ahead
- Surcharges will apply during high demand hours of up to 350 hours per year (day-ahead notice)

Pricing Components



Thanks for helping lead the way to California's energy future. Your participation will help us learn the best ways to introduce Whenergy rates statewide. If you have any questions, contact us at 1-858-496-7188. You can also email the Whenergy team at ResidentialPilotTOU@sdge.com.

Page 3

[1]Rates are effective as of October 1, 2016. All prices (rates) are subject to the supervision and regulation of the California Public Utilities Commission (CPUC) and are subject to change by CPUC order.

Resources	Tools	Our Company	Doing Business with Us
Brochures & Fact Sheets	Energy Efficiency Survey	About Us	Customer Choice
Rates & Regulations	kWickview®	Accessibility	Customer Generation
FERC Standards of Conduct and OASIS	Energy Waves	Major Projects	Energy Service Providers
CPUC Postings	Energy Management Tool	Newsroom	Procurement
Safety	Home Area Network	Privacy Policy	RFPs and RFOs
Energy Innovation Center	Green Button	Privacy Notice	Supplier Diversity
Additional Languages	Energy Data Request	Terms & Conditions	Supplier Documents
Total Electric Rates			Vendor Portal

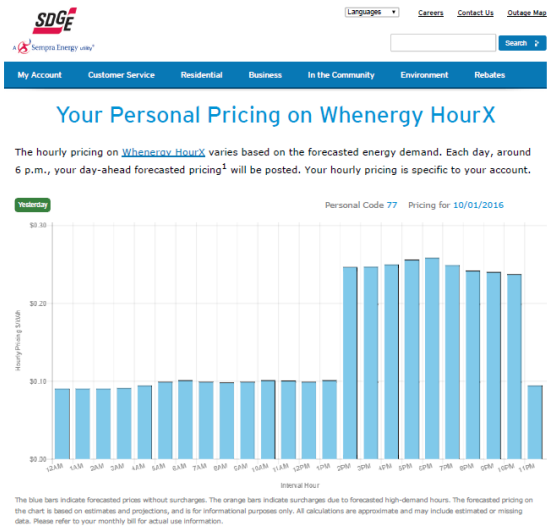
SDG&E®, San Diego Gas & Electric® and kWickview® are registered trademarks of San Diego Gas & Electric Company. © 1998-2016 San Diego Gas & Electric Company. The trademarks used herein are the property of their respective owners. All rights reserved.

Privacy Policy | Privacy Notice | Terms and Conditions

SDGE A Sempra Energy utility

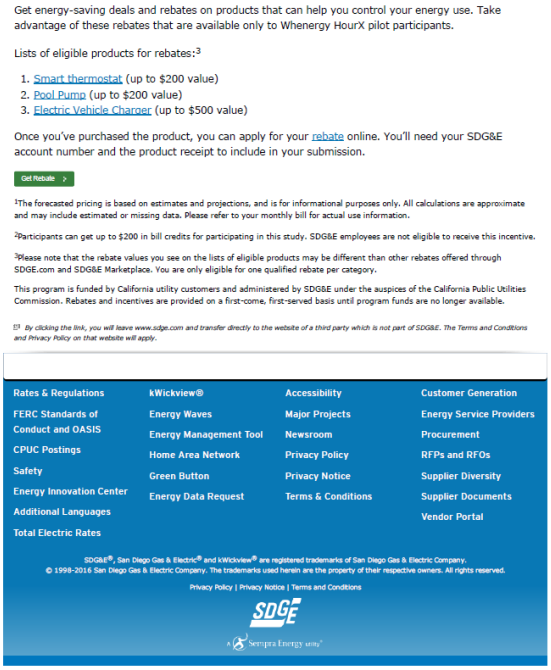
Page 4

Figure 4-11: Whenergy HourX Chart from Web Page



Page 1

Page 2



Page 3

SDG&E is undergoing a refresh of its residential segmentation—due out late 2016. In the interim, in order to tailor communications to its pilot customers, an interim segmentation methodology has been implemented. Using load research data, along with predictive tools, SDG&E developed twelve (12) interim segmentation categories as shown in Table 4-9.

Table 4-9: Interim Segmentation Categories

Segment	Summer	AC Prediction	Tech Prediction
1	Higher Use	AC	Higher Tech
2	Higher Use	AC	Low/Avg Tech
3	Higher Use	No AC	Higher Tech
4	Higher Use	No AC	Low/Avg Tech
5	Medium Use	AC	Higher Tech
6	Medium Use	AC	Low/Avg Tech
7	Medium Use	No AC	Higher Tech
8	Medium Use	No AC	Low/Avg Tech
9	Low Use	AC	Higher Tech
10	Low Use	AC	Low/Avg Tech
11	Low Use	No AC	Higher Tech
12	Low Use	No AC	Low/Avg Tech

Splitting customers between the high and low usage groups, SDG&E was able to create three communication segments—High Usage, Low Usage, and Techie. The September Whenergy update will focus on Ways to Save on TOU. There are different versions of the message for each of the three segment groups as shown in Figure 4-12 through 4-20. Based on customer preference, this communication is sent via email or direct mail.

Figure 4-12: Whenergy Update—High Usage Customers

SDGE
A Sempra Energy utility

San Diego Gas & Electric®
P.O. Box 129831
San Diego, CA 92112-9831

PRSRT STD
U.S. POSTAGE
PAID
SAN DIEGO CA
PERMIT NO.
213

John Doe
123 Any St.
San Diego, CA 92101

Shifting to off-peak times can save you the most.

When the temperature changes, so do energy costs - dramatically. Keeping your home comfortable is the highest expense and managing your A/C use can help. Sign up for free Whenergy Alerts to see where your energy use stands. And to know if you've exceeded your usage and cost goals.

AVOID THE PEAK
4 PM-9 PM

TOP 5 A/C SAVING TIPS

- Avoid peak hour use between 4 p.m. and 9 p.m.
- Set thermostat to 78°+
- Use fans instead of A/C
- Replace A/C filters
- Pre-cool before 11 a.m.

More Whenergy saving ideas.

- Block direct sunlight by closing window coverings and using solar shades
- Pre-cool your home by running A/C before the afternoon peak period
- Unplug appliances and other items not in constant use
- Save water and energy with our no-cost Water and Energy Savings Kit
- Use a swimming pool or spa cover and use a variable speed pool pump
- Get out of the house during peak times. Visit a park, see a movie . . . .
- Grill dinner outside to avoid heating up your home and using more A/C
- Use the online energy management tools you'll find at sdge.com/MyEnergyTool

Questions? sdge.com/MyWhenergy2 or (800) 411-7343

SDGE
A Sempra Energy utility

© 2016 San Diego Gas & Electric Company. All copyright and trademark rights reserved.
Printed on recycled paper.

Figure 4-13: Whenergy Update—Low Usage Customers

SDGE
A Sempra Energy utility®

San Diego Gas & Electric®
P.O. Box 129831
San Diego, CA 92112-9831

PRSRT STD
U.S. POSTAGE
PAID
SAN DIEGO CA
PERMIT NO.
213

John Doe
123 Any St.
San Diego, CA 92101

Lower your use during the 4 p.m. to 9 p.m. peak.

As the temperature changes, keeping your home comfortable can affect your energy costs too. During the Whenergy Study your ability to shift your electricity to off-peak hours is the key to saving. Sign up for free Whenergy Alerts to see where your energy use stands. And to know if you've exceeded your usage and cost goals.

TOP 5 COOLING TIPS

- Avoid peak hour use between 4 p.m. to 9 p.m.
- Set thermostat to 78˚+
- Use fans instead of A/C
- Shade or block windows
- Get Whenergy Alerts

More Whenergy saving ideas.

- Block direct sunlight by closing window coverings and using solar shades
- Pre-cool your home by running A/C before the afternoon peak period
- Unplug appliances and other items not in constant use
- Save water and energy with our no-cost Water and Energy Savings Kit
- Use a swimming pool or spa cover and use a variable speed pool pump
- Get out of the house during peak times. Visit a park, see a movie . . . .
- Grill dinner outside to avoid heating up your home and using more A/C
- Use the online energy management tools you'll find at sdge.com/MyEnergyTool

Questions? sdge.com/MyWhenergy1 or (800) 411-7343

SDGE
A Sempra Energy utility®

© 2016 San Diego Gas & Electric Company. All copyright and trademark rights reserved.
Printed on recycled paper.

Figure 4-14: Whenergy Update—Techie Customers

SDGE
A Sempra Energy utility®

San Diego Gas & Electric®
P.O. Box 129831
San Diego, CA 92112-9831

PRSRT STD
U.S. POSTAGE
PAID
SAN DIEGO CA
PERMIT NO.
213

John Doe
123 Any St.
San Diego, CA 92101

Tech tools can help you save.

As the temperature changes, keeping your home comfortable can affect your energy costs too. During the Whenergy Study your ability to shift your electricity to off-peak hours is the key to saving. Using Whenergy tools like smart thermostats, the SDG&E® app and Whenergy alerts can help you avoid the peak. Whenergy alerts can also help you see where your energy use stands and if you've exceeded your usage and cost goals.

AVOID THE PEAK
4 PM-9 PM

WHERE TO GET YOUR WHENERGY TOOLS

- Free SDG&E App download at iTunes or GooglePlay
- Smart Thermostat shop now @sdge.com/marketplace
- Whenergy Alerts sdge.com/MyAccount

More Whenergy saving ideas.

- Block direct sunlight by closing window coverings and using solar shades
- Pre-cool your home by running A/C before the afternoon peak period
- Unplug appliances and other items not in constant use
- Save water and energy with our no-cost Water and Energy Savings Kit
- Use a swimming pool or spa cover and use a variable speed pool pump
- Get out of the house during peak times. Visit a park, see a movie . . . .
- Grill dinner outside to avoid heating up your home and using more A/C
- Use the online energy management tools you'll find at sdge.com/MyEnergyTool

Questions? sdge.com/MyWhenergy1 or (800) 411-7343

SDGE
A Sempra Energy utility®

© 2016 San Diego Gas & Electric Company. All copyright and trademark rights reserved.
Printed on recycled paper.

4.7 Regulatory Compliance Assessment

This section contains a systematic assessment of whether SDG&E successfully implemented the pilots so as to meet the specific requirements contained in the March 17, 2016 Resolution E-4769 ("the Resolution") approving SDG&E's pilot. Ordering Paragraph (OP) 8 from the Resolution states the following: "SDG&E is ordered to ensure that the deliverables as outlined in this Resolution are presented as part of its January 1, 2018 Rate Design Window (RDW) filing for a default TOU rate and menu of TOU rate options."

The deliverables as outlined in the Resolution and their outcomes after implementation of the pilot are summarized in Table 4-11 (which follows Table 4-9 and Table 4-10). The deliverable requirements are expressed either in terms of absolute numbers of participants or in terms of meeting specified levels of statistical confidence (e.g., confidence intervals of ±2 to 3% 90% confidence). When expressed as a minimum number of participants, the outcome column in Table 4-10 shows the current number of participants and reports whether the minimum required number has been exceeded. When the requirement is for a minimum level of statistical confidence, we compare the number of enrolled customers to the values in Table 4-9. These values were based on simulations performed by Nexant for SCE prior to recruitment to determine the required samples sizes for meeting different levels of confidence for load and bill impacts.[26] The survey sample size requirements are based on analysis that was done as part of the pilot planning process.[27]

Table 4-9: Threshold for Minimum Sample Size

	Climate Region	Minimum Threshold	25% Additional for Attrition	Total
Load Impacts: Confidence intervals in the range of ±2-3% with 90% confidence	Moderate	1,000	250	1,250
	Cool	1,250	313	1,563
Bill Impacts	All	500	125	625
Survey Data	All	250	63	313

Appendix D contains the actual cell counts for each segment and treatment combination, the minimum sample sizes to meet the Resolution requirements, and the difference between these two values. We did not include this level of detail here because of the size of the table. Instead, we provide a summary of the conclusions from this detailed analysis in Table 4-11. Table 4-10 provides an excerpt from Appendix B showing the data for the first Resolution shown in Table 4-11. As seen in Table 4-9, the target enrollment in the Hot climate region for Rate 2 was 1,250. Current enrollment in this segment is 423, which is below the target. There were 398 customers whose reply cards to participate in the pilot were received after the cut-off date that can be used as a control group.

[26] See Appendix E for the SCE Power Analysis Memo.

[27] See Section 3.3.3 of the Nexant report, "*Time-of-Use Pricing Opt-in Pilot Plan*" dated December 17, 2015.

Table 4-10: Comparison of Required Sample Sizes and Pilot Participation

Item	Rate	Confidence	Group	Min. Threshold	Actual	Difference
1	2	Count	All of Rate 2 in Hot	1250	423	-827

As seen in Table 4-11, overall, Deliverables 2 through 12 have either achieved sufficient enrollment to achieve the Resolution requirements or are still forthcoming. The target enrollment for Deliverable 1 was 1,250 customers from the Hot climate region. Ultimately, only 423 were enrolled on a rate. 398 customers whose reply cards to participate in the pilot were received after the cut-off date can be used as a control group. Ultimately, it is unknown if statistically significant load impacts can be estimated for this segment. Deliverables 2 and 3 each refer to the enrollment target of Deliverable 1; while not ideal, it is possible each may still be completed with the lower enrollment given neither require a formal estimation of bill impacts or survey comparison.

Table 4-11: Deliverables and Outcomes from Resolution E-4769

Deliverable		Requirement Contained in Resolution E-4769	Outcome
1	The average peak and off-peak change in energy usage by seniors and economically vulnerable customers in the hot climate region as a result of pilot rate 2.	SDG&E will employ a RCT design and pay-to-play (PTP) recruitment strategy to recruit approximately 1,250 customers onto pilot rate 2 in SDG&E's hot climate region. It is not expected that load impacts will be formally estimated but they may become available if a control group can be formed used statistical matching in the ex post analysis phase.	Specific Customer Counts Rate 2 Customers in Hot Climate Region 423
			Conclusion This criterion in Resolution E-4769 will not be met. 398 customers whose reply cards to participate in the pilot were received after the cutoff date can be used as a control group.
2	The impact of pilot rate 2 on the bills of seniors and economically vulnerable customers in the hot climate region (i.e., the distribution of bill impacts).	SDG&E will reach out to all CARE/FERA households in the hot climate region and all households with incomes below $40,000 and will then recruit from the remaining population to bring the total number of pilot rate 2 enrolled customers in the hot climate region to 1,250. There will not be a formal control group due to the small size of the customer base in SDG&E's hot climate region. Normally, bill impacts would be determined by calculating bills for both treatment and control customers in two ways; as if their usage were billed on the TOU rate in question, and as if their usage were billed on the otherwise applicable tariff (OAT). The difference between those two bills will result in a distribution of bill impacts for treatment customers and a distribution of bill impacts for control customers. Comparing the two distributions will illustrate how much of the bill impact results from structural wins and losses and how much results from changes in usage in response to the TOU rate. Due to the lack of a control group in SDG&E's hot climate region, it is not expected that bill impacts will be formally estimated. They may become available if a control group can be formed used statistical matching in the ex post analysis phase.	Specific Customer Recruitment All customer recruitment completed as required.
			Conclusion All criteria in Resolution E-4769 have been met.

Deliverable		Requirement Contained in Resolution E-4769	Outcome	
3	The impact of pilot rate 2 on how seniors and economically vulnerable customers in the hot climate region change their energy usage and on these customers' choices regarding other household expenses.	Normally, surveys would be administered to both treatment and control customers, and include questions regarding energy usage habits (e.g. the timing of end-use activities, thermostat settings by rate period) and barriers to load shifting or load reduction activities. Questions will also be designed to detect certain forms of hardship (e.g. not paying other bills to pay energy bill). Answers would be compared between treatment and control customers to determine whether certain behaviors or activities are higher among customers on TOU rates relative to customers on the OAT. Due to the lack of a control group in SDG&E's hot climate region, this process of formal comparison cannot be followed. Survey results of the 1,250 estimated hot climate region participants in rate 2 will still be collected and reviewed.	Survey Implementation Survey data can be collected from all customers in the climate region.	
			Conclusion All criteria in Resolution E-4761 can be met to the extent possible given the outcome from Deliverable 1.	
4	The average peak and off-peak change in energy usage as a result of pilot rates 1 and 2 for all customers in SDG&E's service territory, all customers in SDG&E's moderate climate region, and all customers in SDG&E's cool climate region.	SDG&E will employ a RCT design to recruit customers onto pilot rates 1 and 2, and the control rate. The total number of SDG&E customers on pilot rate 1 will be approximately 2,500 (1,250 in each of the moderate and cool regions) and on pilot rate 2 approximately 6,250 (2,500 in each of the moderate and cool regions). Sample sizes will be large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence for all customers for pilot rates 1 and 2 across SDG&E's service territory as a whole and in each of SDG&E's moderate and cool climate regions. It is noted that the territory-wide load impacts for pilot rate 1 are not affected by the lack of hot climate region sampling for that rate as hot climate region customers make up such a small proportion of SDG&E's total customer base.	Specific Customer Counts	
			All Customers on Rate 1	4,036
			All Customers on Rate 2	6,870
			Moderate Climate Zone Customers on Rate 1	1,984
			Moderate Climate Zone Customers on Rate 2	3,368
			Cool Climate Zone Customers on Rate 1	2,052
			Cool Climate Zone Customers on Rate 2	3,502
			Sample Size All customer segments identified in deliverable are large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence.	
			Conclusion All criteria in Resolution E-4761 have been met.	

Deliverable		Requirement Contained in Resolution E-4769	Outcome
5	The average peak and off-peak change in energy usage as a result of pilot rates 1 and 2 for CARE/FERA and non-CARE/FERA customers across SDG&E's territory as a whole.	The RCT design, PTP recruitment strategy and recruitment targets described above will create sample sizes large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence for CARE/FERA and non-CARE/FERA customers for pilot rates 1 and 2 across SDG&E's service territory as a whole. As noted above, the territory-wide load impacts for pilot rate 1 are not affected by the lack of hot climate region sampling for that rate as hot climate region customers make up such a small proportion of SDG&E's total customer base.	Sample Size All customer segments identified in deliverable are large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence. Conclusion All criteria in Resolution E-4761 have been met.
6	The impact of pilot rates 1 and 2 on the bills of CARE/FERA customers and non-CARE/FERA customers (i.e., the distribution of bill impacts) in SDG&E's entire territory and in the moderate and cool climate regions separately.	Bills will be calculated for both treatment and control customers in two ways; as if their usage were billed on the TOU rate in question, and as if their usage were billed on the OAT. The difference between those two bills will result in a distribution of bill impacts for treatment customers and a distribution of bill impacts for control customers. Comparing the two distributions will illustrate how much of the bill impact results from structural wins and losses and how much results from changes in usage in response to the TOU rate. Sample sizes will be large enough to produce valid bill impact distributions for CARE/FERA and non-CARE/FERA customers for pilot rates 1 and 2 across SDG&E's service territory as a whole and in each of SDG&E's moderate and cool climate regions.	Sample Size All customer segments identified in deliverable are large enough to produce valid bill impact distributions. Conclusion All criteria in Resolution E-4769 have been met.
7	The impact of pilot rates 1 and 2 on how CARE/FERA customers and non-CARE/FERA customers – in SDG&E's entire territory and in the	Surveys will be administered to both treatment and control customers, and will include questions regarding energy usage habits (e.g. the timing of end-use activities, thermostat settings by rate period) and barriers to load	Sample Size All customer segments identified in deliverable are large enough to produce valid survey data.

Deliverable		Requirement Contained in Resolution E-4769	Outcome
	moderate and cool climate regions separately – change their energy usage and on these customers' choices regarding other household expenses.	shifting or load reduction activities. Questions will also be designed to detect certain forms of hardship (e.g. not paying other bills to pay energy bill). Answers will be compared between treatment and control customers to determine whether certain behaviors or activities are higher among customers on TOU rates relative to customers on the OAT. Sample sizes will be large enough to produce valid survey data for CARE/FERA and non-CARE/FERA customers for pilot rates 1 and 2 across SDG&E's service territory as a whole and in each of SDG&E's moderate and cool climate regions.	Conclusion All criteria in Resolution E-4761 have been met.
8	The level of customer understanding, acceptance, and engagement while taking service on a given TOU rate among various customer segments.	The recruitment approach for SDG&E's TOU pilots does not allow for a direct measure of acceptance rates for each rate option because customers are being paid to participate in the study (and to stay on the rate) and will be randomly assigned to pilot rates 1 or 2. Instead, surveys will be used to assess customer awareness, understanding, and satisfaction and these metrics can be compared across rate options as an indirect measure of customer acceptance. Sample sizes will be large enough to produce valid survey data for a variety of customer segments. As part of the end-of-pilot survey in the summer of 2017, customers will be asked whether they would prefer to stay on the TOU rate or return to the OAT. They will also be asked if they would prefer one of the other TOU rates if they had an option. Following payment of the last portion of the incentive, which will be made after completion of the end-of-pilot survey, differential dropout rates will be tracked as an indicator of customer preferences.	Conclusion Customer recruitment and enrollment to date is sufficient to allow for the completion of this deliverable at the appropriate time.

Deliverable		Requirement Contained in Resolution E-4769	Outcome
9	The impact of usage alerts and/or other technology on energy usage and/or customer understanding, acceptance, and engagement while taking service on a given rate.	SDG&E will double the number of cool and moderate climate region customers on pilot rate 2 and automatically enroll half of the participants in each climate region in the usage alert system that SDG&E is developing for the TOU pilots. Incremental load impacts will be estimated for participants who receive the alerts and SDG&E will also assess customer interest in, satisfaction with, and use of the usage alert through customer surveys. SDG&E plans to make the tips and tools information on their TOU pilot microwebsite available to pilot participants through a smartphone application. Users of the app would also be able to receive push notifications containing reminders of TOU period rate changes. As with other outreach materials, SDG&E will assess the impact of the app on customer understanding, acceptance and engagement using customer surveys.	Conclusion Half of participants on Rate 2 have been enrolled in the usage alert system. Customer enrollment to date is sufficient to allow for the completion of this deliverable at the appropriate time.
10	For participants on pilot rates 1 and 2, evaluate the take rates for smart thermostats at two different rebate levels and qualitatively assess their usefulness to households that accept them. If possible, estimate load impacts of smart thermostat usage.	For the purposes of this pilot, SDG&E defines a smart thermostat as a device that is internet-connected and capable of receiving and responding to real-time information or equipped with the sensors and software necessary to automatically adjust to customer behavior. SDG&E's technology treatment will attempt to increase the purchase rate of smart thermostats by offering two different rebate amounts for the purchase of a smart thermostat. One of these offers will be made to all customers enrolled in SDG&E's pilot rates 1 and 2. If a sufficiently large number of customers purchase smart thermostats through the subsidies that will be offered, SDG&E will estimate load impacts for the purchasing households using a pseudo-control group developed using ex post statistical matching. The smart thermostat offer will be made after the first summer of the TOU pilot.	Conclusion This deliverable is forthcoming.

Deliverable		Requirement Contained in Resolution E-4769	Outcome
11	For participants on pilot rate 3, assess customer interest, acceptance and understanding of the hourly rate; identify what strategies customers use to respond to hourly prices; identify what strategies customers use to respond to an over-generation credit; and assess the effectiveness of enabling technologies in conjunction with an hourly rate.	SDG&E's pilot rate 3 will test a proof of concept with regard to customer interaction with advanced technologies. Customers must have or purchase a smart programmable thermostat that is installed and operating at the onset of the pilot. Although there are many enabling technology options, SDG&E will be offering all pilot rate 3 customers rebates for the purchase of a new smart thermostat, installation or replacement of existing pool pump and motor or upgrade of electric vehicle charging equipment. Surveys of pilot rate 3 customers will presumably be used to conduct this assessment.	Conclusion This deliverable is forthcoming.
12	The impact of education and outreach (E&O) materials that are tailored to various customer segments (including seniors, renters, and non-English speaking customers) and to certain cognitive profiles/customer personas on customer understanding, acceptance, and engagement while on a TOU rate.	Surveys will be used to assess usefulness and preferences for each of the primary types of E&O materials. Responses will be compared across rate options, customer segments and customer personas to determine whether different treatment groups, customer segments or customer personas find some materials more or less useful than others. Answers to survey questions pertaining to customer awareness, understanding, and satisfaction, and other metrics will also be compared across rate options, customer segments and customer personas to determine whether there are significant differences in these metrics.	Conclusion Customer recruitment and enrollment to date is sufficient to allow for the completion of this deliverable at the appropriate time.

5 Methodology

The quantitative analysis to be conducted includes estimation of energy and load impacts for each treatment for a variety of customer segments and climate regions as well as the estimation of bill impacts for selected segments. We also plan to analyze opt-out rates for each tariff. Treatments include TOU rates for all three IOUs as well as usage alerts for SDG&E, smart thermostats for SCE and SDG&E, and a smartphone app for PG&E. For bill impacts, relevant customer segments include CARE/FERA and non-CARE/FERA customers in all climate regions, and senior households and CARE/FERA customers categorized by selected income strata within the hot climate regions of SCE and PG&E. For SDG&E, which only has about 16,000 households in its hot climate region, only 432 customers were enrolled in the pilot and all were assigned to Rate 2. There were 398 customers whose reply cards to participate in the pilot were received after the cut-off date. SDG&E plans to utilize these customers as a control group.

The remainder of this subsection summarizes the approach to the following four tasks:

- Data cleaning and preparation;
- Load impact analysis;
- Bill impact analysis; and
- Customer attrition.

5.1 Data Cleaning and Preparation

The billing and load impact analysis for the TOU pilots will involve acquiring and analyzing a large amount of interval data and a wide variety of data from all three IOUs. A key to minimizing data problems and project inefficiencies is providing a clear and detailed data request.

The initial data request was submitted to the IOUs on June 8, 2016 and included requests for the following data:

- Dataset of offer recipients;
- Dataset of customers who accepted offer to participate;
- Enrollment survey data;
- Customer contact information for survey deployment;
- Pilot implementation documentation;
- All ME&O documents and implementation plans;
- Pilot opt-outs; and
- Interval data.

The data request is included in Appendix A.

Importantly, it will be useful to have most of the data not just for customers who enroll in the pilot but also for those who did not respond. While the pilots are designed to eliminate selection bias associated with rate or treatment selection once enrollment occurs, there may still be differences in the characteristics of customers who enroll in the study and those who don't. It will be important to understand these differences so the pilot results can be put into the proper perspective with regard to external validity (e.g., the ability to extrapolate the findings outside the study population).

Nexant will prepare at least two more data requests in the near future, including:

- Delivery of interval data as well as billing data in October 2017 so that impact analysis for the second summer can be conducted as input to the final report; and
- Potentially, regular (perhaps monthly) updates of enrollment/attrition activity over the entire course of the project.

In addition to the variables above, other data may be useful for analysis if it is made available. For example, for the SCE smart thermostat treatment, data that thermostat vendors have regarding temperature settings by time of day, duty cycle for air conditioners, hours of the day when thermostats are set in "away mode" and many other variables could provide useful insights about customer behavior. Nexant is working with SCE and Nest to determine what data will be made available to produce alternative metrics for the impact of smart thermostats on usage behavior for customers on TOU rates.

Another example of additional data that might be useful pertains to PG&E's smartphone app treatment. If the vendor tracks the particular features of the app that customers engage with, or frequency of interaction, that data could be quite useful for determining whether the smartphone app, or something similar, should be offered as a key educational element for default pricing or, at the very least, whether it should be studied further in the default pilots to be implemented in 2018.

Data from the enrollment survey will also be requested and merged with the data listed above. Unlike survey data to be collected in fall 2016 and in late spring/early summer 2017, where there may be differential response rates or item nonresponse across treatment options, treatment assignment occurs after the enrollment survey data is collected. As such, any nonresponse bias should be equally present across all treatment and control conditions, which makes using this data to compare the characteristics of the populations across treatment conditions valid. The data being gathered at the time of enrollment is: income; number of persons per household by senior and non-senior status; and age of head of household, etc. Comparing average values for these key variables across rate and other treatment assignments and between treatment and control conditions is a useful validation of the random assignment of participants to these conditions. This validation will also be done using some of the data, including overall usage; load shape; participation in EE, DR, and behavioral conservation programs; psychographic assignment; and any other characteristics that are available for all customers.

A key deliverable from the project will be a database that provides each IOU and the CPUC with all of the relevant data collected or developed over the course of the project. It will be important to discuss at the outset of the project the specific content and desired format of this data and whether this deliverable needs to include all interim data sets that may be developed in order to produce the analysis data set, or whether just the final analysis data set will be sufficient. This is still an open issue and needs to be decided. It will also be important to discuss the format of the dataset and the type of data dictionary that will be needed. Agreeing on these issues upfront will minimize the cost of producing and delivering the data at the end of the project as it will allow Nexant to efficiently track and document everything along the way.

5.2 Load Impact Analysis

The estimation of load impacts by rate period and changes in annual and seasonal energy use for each pilot rate are key pilot objectives. Examining load impacts for customers with smart thermostats in SCE's service territory, for customers receiving usage alerts in SDG&E's service territory and for customers receiving information via a smartphone app in PG&E's service territory are also important objectives. The approach used to estimate load impacts differs somewhat for the rate treatments as a whole and for the technology and information treatment options summarized earlier due to differences in the experimental design and participant sample sizes for these opt-in treatments. Also of interest is how load impacts vary across customer segments, both those that were incorporated into the pilot design and sampling plan (e.g., impacts for CARE/FERA and non-CARE/FERA customers and for seniors and others in the hot climate zone) as well as segments that weren't built into the pilot plan but that can be identified through surveys or from IOU databases. A key challenge when exploring how impacts vary across segments identified after the fact as opposed to those incorporated into the experimental plan is to ensure that the internal validity provided through the rigorous adherence to the RCT/RED design of the pilots is not violated. This issue is discussed further in the following section.

5.3 Estimating Load Impacts for Rate Treatments

The proposed approach to estimating load impacts for the eight rate treatments spread across the three IOUs and for each customer segment that was oversampled is to rigorously adhere to the RCT design that ensures that the impacts are internally valid. Internally valid means that the treatments being studied (e.g., TOU rates) are the cause of any observed difference in loads by rate period between the treatment and control conditions.

The analysis method to be used is referred to as a difference-in-differences (DiD) analysis. This method estimates impacts by subtracting treatment customers' loads from control customers' loads in each hour or rate period after the treatments are in place and subtracts from this value the difference in loads between treatment and control customers for the same time period in the pretreatment period. With random assignment to treatment and control conditions, this straightforward analysis ensures that any estimated impacts are internally valid. Subtracting any difference between treatment and control customers prior to the treatment going into effect adjusts for any difference between the two groups that might occur due to random chance.

The DiD calculation can be done by hand using simple averages or by using regression analysis. Customer fixed effects regression analysis allows each customer's mean usage to be modeled separately, which reduces the standard error of the impact estimates without changing their magnitude. Additionally, standard regression software allows for the calculation of standard errors, confidence intervals, and significance tests for load impact estimates that correctly account for the correlation in customer loads over time.[28] Implementing a DiD through simple arithmetic would yield the same point estimate but it would not generate confidence intervals. A typical regression specification for estimating impacts using an RCT design is shown in Equation 1.

[28] More accurately, they account for the correlation in regression errors within customers over time.

$$kW_{i,t} = \alpha_i + \delta \text{treat}_i + \gamma \text{post}_t + \beta(\text{treatpost})_{i,t} + v_i + \varepsilon_{i,t} \quad \text{Equation 1}$$

In Equation 1, the variable $kW_{i,t}$ equals electricity usage during the time period of interest, which might be each hour of the day, Peak or Off-Peak rate periods, daily usage, or some other period. The index *i* refers to customers and the index *t* refers to the time period of interest. The estimating database would contain electricity usage data during both the pretreatment and post-treatment periods for both treatment and control group customers. The variable *treat* is equal to 1 for treatment customers and 0 for control customers, while the variable *post* is equal to 1 for days after the TOU rate has been implemented and a value of 0 for days during the pretreatment period. The *treatpost* term is the interaction of *treat* and *post* and its coefficient β is a difference-in-differences estimator of the treatment effect that makes use of the pretreatment data. The primary parameter of interest is β, which provides the estimated demand impact of TOU during the relevant period. The parameter a_i is equal to mean usage for each customer for the relevant time period (e.g., hourly, peak period, etc.). The v_i term is the customer fixed effects variable that controls for unobserved factors that are time-invariant and unique to each customer. In the evaluation, Equation 1 will be estimated using ordinary least squares regression (or weighted least squares in situations where oversampled cells are combined with random samples so that the estimated impacts represent the relevant populations) with clustered robust standard errors to account for serial correlation that is likely to be present in the data.[29]

5.3.1 Addressing Customer Attrition

Customer attrition is an important factor to address in the load impact analysis methodology. We expect that the number of customers who move should be evenly distributed between the treatment and control groups. As such, excluding movers from the estimation database for both groups will have no adverse effect on the internal validity of the experimental design and will be done. However, control group customers aren't expected to opt-out of the pilot at the same rate as treatment customers. Aside from completing a few surveys, there is no real reason for a control customer to drop off the pilot. On the other hand, we have already seen treatment customers requesting to be removed from the pilot for a variety of reasons related to the treatment itself (e.g., high summer bills). If treatment group customers who opted out were dropped from the estimation database, the initial randomization of the treatment and control groups would no longer be valid, as the treatment group would only contain those who haven't self-selected out while the control group would still contain customers who would have self-selected out, but haven't because they weren't affected by the treatment.

In order to address the differential opt-out rates between the treatment and control group, the load impact analysis will be conducted as a Randomized Encouragement Design (RED). Typically, with a RED design, the behavior of two randomly-chosen groups of customers who were subjected to different levels of encouragement to take up a treatment is observed. In this case, we are able to use the fundamental design of the RED analysis approach to facilitate load impact estimation accounting for customer attrition. In a typical RED design, the treatment customers are encouraged to enroll in a pilot, and only a certain percentage of customers actually sign up. In this case, all of the treatment group

[29] Serial correlation certainly exists in the variable of interest (*treatpost*) and is very likely to be present in the dependent variable (period average load). If unaddressed, serial correlation will lead to standard errors that are systematically too small. This results in overstating the precision of the impact estimate and misleading inference. To adjust for serial correlation, we follow the best practices described by Bertrand, et al. (2002), Wooldridge (2003), and Cameron (2010).

customers were enrolled on a TOU rate, but some chose to drop out after some period of time. In both cases, the end result is a portion of customers originally assigned to the treatment group who do not actually receive the treatment in some periods. However, in order to maintain the initial randomization and internal validity, all customers assigned to the treatment group must be retained as treatment customers for purposes of the analysis. This ensures that the treatment and control groups still have the same expected characteristics prior to the experiment and allows for estimation of the effect of the treatment on customers who were affected by the encouragement, as summarized next.

One fundamental difference between the analyses used for RCTs and for REDs is that with RCTs, all customers in the treatment group are enrolled and therefore are assumed to be affected by the treatment and none in the control group are affected. In contrast, for REDs, the treatment group consists of all customers who received some form of encouragement toward a treatment (in this case customers who were enrolled on a TOU rate) and the control group consists of customers who received less encouragement or no encouragement (in this case these are the control group customers who were not enrolled on a TOU rate). This means the RED treatment group will potentially contain many customers who are assumed to be unaffected by the treatment because they declined, or in this case, opted out of the treatment. This introduces the potential for confusion in terminology when discussing REDs because it is often convenient to consider the treatment group of an experiment to be the group of all customers who are directly affected by the treatment of interest (e.g., all customers who actually enrolled in the TOU pilot).

For an RED there are two treatments of interest, each vital to producing the final treatment impact estimate. First, there is the encouragement treatment, which gives an RED its name. In this case, that treatment consists of a customer being enrolled on a TOU rate. Second, there is the impact of the treatment itself. That is, the impact for those who do not opt-out (i.e., accept the treatment).

The same regression specification shown in Equation 1 for an RCT design can be used to estimate the first stage impact, which estimates the impact of the encouragement. The estimating database would include all customers who were offered the treatment, whether or not they accepted it—meaning it includes those who ultimately opt-out at some point.[30] It also includes the control group. The impact in this case represents the average for all customers that received an offer (were enrolled onto a TOU rate), not the average for customers who accepted the offer (customers who stayed on the TOU rate). This initial load impact estimate is often referred to as the intention-to-treat (ITT) effect. Under the reasonable assumption that non-compliers were unaffected by the offer, the intention-to-treat estimate can be transformed into the effect of the treatment on compliers by dividing the intention-to-treat estimate by the fraction of the population enrolled on the pricing plan in that period. This scaled up effect is often referred to as the local average treatment effect (LATE) or, alternatively, the treatment effect on the treated.

Through the research plan review process we received a suggestion that rather than using the RED analysis approach as described earlier, "opt-outs could be included in the analysis dataset, but set *treatpost* to 0 once a customer had exited the pilot." It was suggested that this would "eliminate the issue of participants self-selecting out of the treatment group (they remain as part of the analysis), but

[30] As indicated above, movers will be removed from the estimation database for both treatment and control customers.

allows the β from Equation 1 to model what we've intuitively come to expect in terms of the impact of the TOU rates."

To address what would happen if the *treatpost* variable was set to 0 once a customer had exited the pilot, we conducted several different simulations. A dataset of customer load was generated to represent a treatment group and control group average hourly load in a pretreatment and post-treatment period. 2 kW was used as a base, and a random number generator was used to apply variability to the load. A known load impact of 0.4 kW plus or minus minor random variation (averaging out to 0.4 kW across the treatment group) was applied to the treatment group in the treatment period, allowing us to test an RCT based off Equation 1 with no attrition, the RED method with attrition based off Equation 1, and then setting the *treatpost* variable to 0 for customers who opted out. Given this was intended to be a simple diagnostic test, customer fixed effects were not used. Identical underlying datasets were used across all three models, with load for customers who opted out not including the approximately 0.4 kW load impact applied to the other treatment customers in the treatment period. This resulted in the post-treatment load for the opt-out customers approximating the pretreatment load for both the treatment and control group, and the post-treatment load for the control group.

The actual average treatment effect after the random variation was applied was 0.396 kW. The *treatpost* β coefficient from the RCT approach with no attrition was 0.416 kW; a difference of about 5%. This difference should not reflect on any issues with the RCT approach, as the sample size, level of random variation applied to the load, and the random number generator used all influenced the difference. To test how the RED and other model work in a situation with attrition, 25% of the treatment customers were opted-out as described earlier. The new actual average treatment value for the remaining customers was only slightly different at 0.395 kW. The ITT (β coefficient) from the RED analysis was 0.317 kW, which resulted in 0.423 kW once it was divided by 0.75 (the fraction of the treatment population enrolled on a TOU rate). The model with *treatpost* set to 0 for opt-outs resulted in a β coefficient for *treatpost* of 0.420. Ultimately, both showed very similar results and a difference of approximately 6% compared to the actual average treatment. These are very much in line with the results from the RCT with no attrition and can all be interpreted as the average treatment effect on the treated.

Based on these findings, it would appear that in a situation with customer attrition, setting the *treatpost* variable to 0 may yield similar results as the RED. However, the RED approach is widely accepted and has been thoroughly vetted and implemented across a wide range of studies. While the *treatpost* method may have merit, it has not been thoroughly vetted—nor is conducting additional analysis to further test it within the scope for this evaluation. Based on there not being a significant difference in the ultimate outcome, and the RED being the widely accepted approach, we plan to move forward using the RED analysis methodology.

This model is a simple and transparent specification and will produce unbiased impact estimates with precise standard errors. The RFP for this project indicated that the impact models should incorporate variables such as weather, time, day of week, customer segment variables, and other factors that can influence hourly loads. Unlike within-subjects analysis that relies on incorporating such variables into the model and on accurate model specification to control for exogenous factors and produce unbiased impact estimates, a major advantage of an RCT/RED design is that a very simple model such as the one

summarized earlier will produce unbiased estimates. Adding additional variables that reduce variation in loads over time can increase the precision of the estimated impacts and can also be used to determine whether impacts vary across customer characteristics by using interaction terms and observing whether the estimated coefficients are statistically significant. However, we do not recommend taking this approach for several reasons.

- **Lack of transparency:** The simple DiD model summarized in Equation 1 is very easy to understand and quite transparent compared with a model that incorporates multiple interaction terms. Given the keen interest of many stakeholders in the results from these pilots, we believe the transparency and simplicity of the proposed model is important.
- **Sample size determination was based on the same simple model:** As such, given that the target sample sizes were met, the target level of precision can be achieved without adding variables to the model to try and improve precision. While greater precision is always desirable, the potential errors that could be introduced by specification error (see next bullet) must be considered.
- **Potential specification error:** Introducing additional terms in the model in order to improve precision can lead to specification error and potential bias. For example, if the relationship between interaction terms and load is nonlinear but a linear specification is used, the estimated coefficients would be biased and potentially misleading, especially across values at the extremes of the distribution.
- **The correlation between impacts and customer characteristics can be determined differently while maintaining transparency and avoiding specification error:** This can be done by partitioning the data for treatment and control customers into segments (e.g., AC owners, usage stratum, pretreatment load shapes, etc.) and then using the simple DiD regression to the segmented data (assuming the segments of interest are large enough).

For these reasons, we propose to rely on the simple model described earlier for estimating load impacts for all eight rate treatments as well as for estimating impacts for selected customer segments.

As discussed in Sections **Error! Reference source not found.** and 3, for both SCE and PG&E, a complex targeting scheme was used to meet the minimum requirements for enrollment in selected segments in hot climate regions. As such, depending on the segments being examined, weighted regressions will be run so that the load impacts represent the population of enrolled customers within those segments. The weights will be based on the enrollment rates for each segment as determined from the general population sample within the hot climate zones. Table 5-1 shows the enrollment for each of the targeted segments in SCE's service territory that came in through the general hot population recruitment track and the total that were enrolled in each segment when those that were targeted were combined with the general population group. When load impacts are being estimated for the enrolled population on Rate 2 in the hot climate zone for SCE and all observations are being used, the weights in the last column of the table will be applied to customers that came in through the targeted track so that the impacts represent the general population of enrolled customers. Note that we are not trying to produce impacts for the general population of customers in the hot climate zone in SCE's service territory but rather for the general population of enrolled customers in the pilot, which reflects differential acceptance rates for the targeted customer segments.

Table 5-1: Customer Segment Weights for SCE's Hot Climate Zone Participants on Rate 2

Analysis Group		In "Hot, General Population"		In Hot Climate Zone		Analysis Weight
Non-Senior CARE Customers	above FPL	292	13%	522	16%	0.86
	below FPL	377	17%	538	16%	1.07
Senior Customers	above FPL	665	30%	1,064	32%	0.96
	below FPL	178	8%	554	16%	0.49
Other		681	31%	681	20%	1.53
Total		2,193	100%	3,359	100%	-

5.3.2 Reporting Evaluation Results

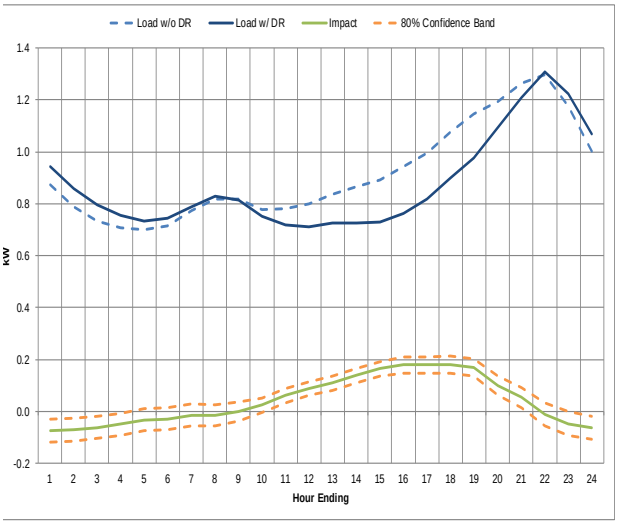
Nexant will produce load impact estimates that conform to the requirements for ex post evaluation of nonevent based demand response resources as indicated in California's Demand Response Load Impact protocols. These protocols require that load impacts in each hour be developed for the average weekday and monthly system peak days for each month of the year. Although not explicitly required by the protocols, load impacts for the average weekend day will also be developed for each month of the year given that the TOU rates are also effective on the weekends. As this is an ex post evaluation, average weekday impacts will be based on the observed customer load pooled across the weekdays in each month, and similarly for weekend days. Monthly system peak day impacts will be estimated based on load data observed on the historical monthly system peak days. Weather normalized results, such as those conducted for demand response ex ante load impacts, are not currently in scope for this evaluation. Load impacts will be presented in both nominal (kWh) and proportional (%) terms as shown in **Error! Not a valid bookmark self-reference.**.

In recent years, there has been growing interest in knowing what impacts are on weekends as well, especially in SDG&E's service territory where high demand days are increasingly common on weekends, especially in September and early October when the offshore flow typically produces the warmest temperatures in the highly populated coast region. As such, we plan to provide impact estimates for weekends as well. We also propose to produce and deliver the electronic load impact tables that are provided to the IOUs and the Commission in conjunction with the annual load impact evaluations for demand response and rate programs each year. These Excel tables have pull down menus that allow users to select from among a large number of day types, seasons, customer segments, etc. **Error! Not a valid bookmark self-reference.** contains an example of the output from these electronic tables for PG&E's E6 TOU rate. This was taken from Nexant's impact evaluation of PG&E's residential time-varying rates for 2014.

Figure 5-1: Average Hourly Load Impact Estimates for PG&E's E6 Customers for Average July 2014 Weekday

Menu Options	
Result Type	Individual Customer
Customer Type	E6
LCA	All
Day Type	Average Weekday
Month	July

Day Information	
Peak Period Start	1 PM
Peak Period End	7 PM
Average Temp. for Peak Hours	78
Reference Load for Peak Hours	0.99
Load Reduction for Peak Hours	0.17
% Load Reduction for Peak Hours	17%
Population Size	8,644



Hour	Load w/o DR (kW)	Load w/ DR (kW)	Impact (kW)	% Load Impact (%)	Temp. (°F)	Uncertainty Adjusted Impact - Percentiles				
						10th	30th	50th	70th	90th
12 AM - 1 AM	0.87	0.94	-0.07	-8.3%	64.3	-0.12	-0.09	-0.07	-0.05	-0.03
1 AM - 2 AM	0.79	0.86	-0.07	-8.8%	63.6	-0.11	-0.09	-0.07	-0.05	-0.03
2 AM - 3 AM	0.73	0.79	-0.06	-8.3%	63.0	-0.10	-0.08	-0.06	-0.04	-0.02 *
3 AM - 4 AM	0.71	0.76	-0.05	-6.9%	62.4	-0.09	-0.07	-0.05	-0.03	-0.01 *
4 AM - 5 AM	0.70	0.73	-0.03	-4.5%	62.0	-0.07	-0.05	-0.03	-0.01	0.01 *
5 AM - 6 AM	0.72	0.74	-0.03	-4.0%	61.7	-0.07	-0.05	-0.03	-0.01	0.01 *
6 AM - 7 AM	0.77	0.79	-0.01	-1.8%	61.7	-0.06	-0.03	-0.01	0.00	0.03 *
7 AM - 8 AM	0.82	0.83	-0.01	-1.7%	63.3	-0.05	-0.03	-0.01	0.00	0.03 *
8 AM - 9 AM	0.82	0.82	0.00	0.1%	65.6	-0.04	-0.01	0.00	0.02	0.04 *
9 AM - 10 AM	0.78	0.75	0.03	3.3%	68.5	0.00	0.01	0.03	0.04	0.05 *
10 AM - 11 AM	0.78	0.72	0.06	7.9%	71.4	0.04	0.05	0.06	0.07	0.09
11 AM - 12 PM	0.80	0.71	0.09	11.1%	74.3	0.06	0.08	0.09	0.10	0.11
12 PM - 1 PM	0.84	0.73	0.11	13.0%	76.7	0.08	0.10	0.11	0.12	0.14
1 PM - 2 PM	0.86	0.73	0.14	16.0%	78.3	0.11	0.13	0.14	0.15	0.17
2 PM - 3 PM	0.89	0.73	0.16	18.4%	79.1	0.14	0.15	0.16	0.18	0.19
3 PM - 4 PM	0.94	0.76	0.18	19.0%	79.3	0.15	0.17	0.18	0.19	0.21
4 PM - 5 PM	1.00	0.82	0.18	18.0%	78.8	0.15	0.17	0.18	0.19	0.21
5 PM - 6 PM	1.08	0.90	0.18	16.7%	77.7	0.15	0.17	0.18	0.19	0.21
6 PM - 7 PM	1.15	0.98	0.17	14.8%	75.6	0.13	0.16	0.17	0.18	0.20
7 PM - 8 PM	1.19	1.09	0.10	8.4%	72.9	0.06	0.09	0.10	0.12	0.14
8 PM - 9 PM	1.26	1.21	0.05	4.3%	69.7	0.02	0.04	0.05	0.07	0.09 *
9 PM - 10 PM	1.30	1.31	-0.01	-0.8%	67.4	-0.06	-0.03	-0.01	0.01	0.03 *
10 PM - 11 PM	1.18	1.22	-0.05	-4.0%	66.0	-0.09	-0.07	-0.05	-0.03	0.00 *
11 PM - 12 AM	1.00	1.07	-0.06	-6.3%	65.0	-0.11	-0.08	-0.06	-0.05	-0.02 *
Entire Peak	**0.99**	**0.82**	**0.17**	**17.1%**	**78.1**	**0.96**	**0.16**	**0.17**	**0.18**	**0.20**
Entire Day	**21.97**	**20.98**	**0.99**	**4.5%**	**69.5**	**0.95**	**0.98**	**0.99**	**1.01**	**1.03**

** The impact percentiles indicate that it is uncertain whether the impact is positive or negative in this hour*

Load impact estimates for each tariff will be produced for three different time periods. The first period will cover summer 2016 which, for SCE and PG&E, runs from June 1 through September 30 and for SDG&E runs from May 1 through October 30. Since many customers were not enrolled until mid to late June, and the Rate 3 group was not enrolled until July, this first analysis will not cover a full summer. The second period is intended to cover the first full year on the rate and will end at the start of the second summer rate period[31] which, for PG&E and SCE, would be June 1, 2017 and for SDG&E would be May 1, 2017. The third evaluation period will cover the second summer period.

A useful focus of investigation for the final analysis will be whether impacts persist across the two summers. To investigate this properly, it will be necessary to conduct the analysis for the subset of customers that have stayed on the rates the entire time, rather than compare the impacts in the first summer with impacts in the second summer for the population of customers enrolled in each summer. This second comparison is not valid if the question of interest is whether customers who stay on the tariffs continue to reduce peak demand at the same rate over time or, alternatively, show a decline or increase in load response over time.

5.3.3 Segmentation Analysis

There is significant interest in understanding how load impacts vary across customer segments and characteristics. Indeed, the pilot plan was influenced significantly by the desire to understand how

[31] Some customers may not have a full year of data at this point. However, delaying the analysis to allow for all customers to have 12 months of data would lead to a delay in release of the second interim report.

impacts vary across selected customer segments such as CARE/FERA and non-CARE/FERA customers, customers in different climate zones, and seniors and households with incomes below 100% of the FPG in hot climate zones on selected rates. As discussed above, for these segments around which the pilots were designed, load impacts will be estimated using the model represented in Equation 1 for the data partitioned by segment (for both treatment and control customers). These estimates are internally valid by virtue of the RCT/RED design and DiD analysis.

However, there is also interest in knowing whether load impacts might vary across numerous other customer segments. Characteristics of interest might include personas, load shape (e.g., peaky versus non-peaky loads), usage stratum (e.g., high and low usage customers), whether or not a customer was a structural benefiter or non-benefiter, whether or not a customer owns central air conditioning, senior households in cooler climate regions, customers who do and don't experience economic hardship based on survey questions, highly satisfied or less satisfied customers and others.

Whether or not a DiD RCT analysis can be used to produce unbiased, internally valid load impact estimates for these ex post customer segments depends on several factors. One of the most important is sample size. Sample sizes need to be large enough to estimate load impacts with reasonable levels of precision and confidence. As seen in the pilot design document and in subsequent power analysis done by Nexant for each IOU,[32] the required sample sizes to obtain a 90% confidence band of ±2 to 3% vary by climate region, with as few as 500 treatment customers (and an equal number of control customers) needed in SCE's hot climate region and as many as 2,000 needed in the cool region. If there is interest in determining the differential impacts for a segment that constitutes, say, half of the population and the focus is on the service territory as a whole rather than on a specific climate zone, the existing sample sizes would be more than sufficient. On the other hand, if the interest is for a segment that has about a 5 or 10% representation in the population and load impacts are needed for each climate zone, the sample sizes may be too small to detect statistically significant differences.

Regardless of how large the sample, a key issue concerning whether or not differential impacts can be estimated for segments of interest is whether customers in the segment are randomly distributed across the treatment and control conditions. If they are, load impacts can be developed using the DiD RCT/RED analysis. If they are not, estimated impacts could be biased. The following examples indicate situations in which segmentation is appropriate (assuming adequate sample sizes) and situations where it is not.

Any situation in which the characteristic of interest is based on pretreatment data and the data exists for all customers will allow for internally valid estimates to be developed using a DiD RCT analysis.[33] Among the many examples of this situation are examining load impacts (in both percentage and absolute terms) by usage stratum, load shape clusters, whether or not a customer is a structural winner or loser, personas, whether or not a customer participates in an IOU's EE programs, and others. Another example would be determining if load impacts differ for participants in an IOU's home energy reports (HERs) program, assuming (as is typically the case) that a randomly selected control group was held out in order to estimate load impacts for HER customers. Characteristics identified through surveys

[32] See Appendix E, F, and G

[33] In all of these examples, the implicit assumption is that the sample is large enough to estimate impacts on data partitioned by the characteristic of interest using a DiD analysis.

that were administered prior to assignment to treatment and control conditions also fall into this category because any survey non-response (either to the whole survey or to selected questions) will be randomly distributed across treatment and control customers. As such, while non-response may diminish the sample sizes used for estimation, it will not introduce any response bias.

On the other hand, if a characteristic of interest is obtained through a survey that was conducted after assignment to treatment and control conditions, there is a danger that response bias could be introduced since prior studies have shown that treatment customers may respond at a higher rate and differently than control customers. For example, in Nexant's evaluation of SMUD's SPO pilot, non-response was much higher among control customers than treatment customers and, more importantly, very engaged treatment customers appeared to respond at much higher rates compared with less engaged treatment customers or the control group. As such, very different results for selected impacts of interest were obtained when survey data was incorporated into the analysis than when those variables were excluded in favor of using only variables for which data existed for all treatment and control customers.

In the current context, we do not expect differential response rates between treatment and control customers to be particularly large since both groups are being paid to respond to the surveys and response rates are expected to be high across the board. Furthermore, differences in response rates per se do not necessarily introduce bias in the load impact estimates. For example, if the response rate for treatment customers was 80% and for control customers was 60%, and survey data was used to partition customers according to some characteristic of interest (e.g., air conditioning ownership), the level of precision of the impact estimates would be impacted due to the smaller sample sizes. However, as long as there is no reason to believe that the distribution of households according to air conditioning ownership was different across the two groups, this difference should not produce any bias into the estimation of load impacts.

On the other hand, if there is reason to believe that response rates for treatment and control customers, or for one group of interest and another, are correlated with usage behavior, the estimated impact is almost certainly biased. Suppose, as was true in the SMUD example, highly engaged customers had very different load shapes prior to treatment compared with non-engaged customers and they were also more likely to respond to the survey. Under these conditions, estimating load impacts by partitioning the treatment and control groups based on a survey question (air conditioning ownership for example) and estimating impacts based on differences in loads between the two groups will produce a biased estimate. Put another way, you can no longer claim that the treatment and control groups used in the analysis represent the same underlying populations. While a DiD analysis can be used to correct for the pretreatment bias in the load shapes in this example, the more highly engaged treatment group of survey respondents could be taking other actions over the analysis period unrelated to the TOU rates that would lead to changes in usage behavior that is different from the control group over the same period. In other words, once randomization of assignment to treatment and control conditions is violated because of the desire to use survey data as a conditioning variable, the internal validity of the load impacts is called into question.

A very similar problem occurs even if you have the same response rates between treatment and control customers but a conditioning variable of interest is caused by the treatment itself. A very important

example of this situation is if you wanted to know whether participants who experience hardship, with hardship determined based on responses to survey questions, have different load impacts than those who do not experience hardship. Ignore for the moment the problem that what constitutes a hardship has not been decided and, indeed, will be decided based on the survey data. Instead, suppose that for purposes of this analysis we simply agree to define hardship based on one or more of the questions in the survey. Suppose also that TOU rates actually do increase the incidence of hardship. Finally, suppose that one of the primary reasons that TOU rates increase the incidence of hardship is not that customers who experience hardship under TOU rates respond more or less than those who don't, but that they just start out with much larger structural losses than those who don't experience hardship. Under these assumptions, if you partition treatment and control customers based on their hardship and then estimate load impacts by taking the difference in loads between the groups, you no longer have the same underlying population of customers in the treatment and control groups—you have more structural losers in the treatment group than in the control group and very different pretreatment load shapes between the two. While you may be able to correct for this pretreatment difference using the DiD analysis, this pretreatment difference is not due to random chance as is assumed with an RCT, but due to a fundamental difference in the populations, which undercuts the internal validity of the analysis.

Given these issues, Nexant plans to use the following principles to guide decisions about ex post segmentation analysis:

- Segmentation based on data that exists for all customers is favored over segmentation based on data obtained from the pilot surveys done following assignment to treatment and control conditions—this not only preserves the magnitude of the estimation samples, it also avoids any potential bias that might arise from differential response rates between treatment and control customers. Variables that fall into this category include usage stratum, pretreatment load shape (as determined by statistical analysis such as k-means clustering), participation in an IOU's DR and EE programs (including HER programs), personas, and household characteristics from the IOU commercial databases.
- Segmentation based on survey data that is factual and is not tied to or the result of being on the TOU rate will be considered—examples include household characteristics such as air conditioning ownership, housing type, income, etc. Creating segments based on survey responses that may result from being on the TOU rate, such as hardship, customer satisfaction, etc., violate the internal validity of the experiment and are not appropriate candidates for segmentation for purposes of estimating load impacts (but are very important inputs to decision making).
- Regardless of the source of data used for segmentation, sample sizes must be large enough to produce impact estimates with reasonable statistical precision.
- Although, for these reasons, we do not believe it is valid to estimate load impacts using the RCT/RED analysis when selection effects are present, as they are for hardship customers and potentially other customer segments, we understand the interest in doing so. In these instances, statistical matching (explained in Section 5.6), may be more appropriate and we will apply this method where necessary assuming sample sizes for the groups of interest are large enough to justify such exploration.

5.4 Estimating Load Impacts for SCE's Smart Thermostat Treatment

As described in Section **Error! Reference source not found.**, SCE partnered with Nest to recruit people who already owned Nest thermostats into the rate pilot. The plan called for recruiting 3,750 Nest owners and randomly assigning them to Rates 1 and 3 or to the control condition. For reasons previously discussed, participation was significantly below the target. Indeed, as of this writing, roughly 688 Nest thermostat owners are enrolled in the pilot. Half of these households were enrolled on Rate 1 and the other half were retained as a control group on the non-TOU tariff. With this RCT/RED design, load impacts will be estimated using the same approach as described earlier for all rate treatments. The load impacts will represent changes in behavior for Nest thermostat owners who are on SCE's Rate 1. Given the very small sample sizes for this treatment, no customer segmentation of any kind will be performed for Nest owners for purposes of estimating load impacts.

In addition to estimating load impacts based on whole house load data, we plan to work with SCE and Nest to analyze data obtained by Nest from the smart thermostats, such as temperature settings and run-time data. Exactly what data will be available and at what level of aggregation is still being discussed. At a minimum, it should be possible to compare average temperature settings and run-time data between those on the TOU rate and those in the control group. Thus, even if the small sample sizes don't allow for statistically valid estimates of load impacts to be produced from whole house data, it may be possible to use these other metrics to determine whether households with smart thermostats behave differently on TOU rates compared with households who are on the tiered rate.

5.5 Estimating Load Impacts for SDG&E's Usage Alert Treatment

As described in Section 4, SDG&E began sending TOU usage alerts to half of their Rate 2 customers for which they had email addresses on a default basis in August 2016. Email addresses obtained through the enrollment survey as well as through the normal course of business (e.g., MyAccount customers) were used. To date, roughly 1,800 TOU participants have received one or more usage alerts on a default basis and very few if any have contacted SDG&E to stop receiving the alerts. The incremental load impact for TOU rate participants who receive usage alerts over customers on TOU rates who do not receive usage alerts will be estimated using an RED analysis.[34] In this example, one group—the control group[35]—is not encouraged and the treatment group is. The treatment group consists of all customers who received some form of encouragement toward a treatment (in this case SDG&E's randomly assigned 2,500 who are designated to receive usage alerts, of which 1,800 have email addresses, from its 5,000 Rate 2 treatment group customers) and the control group consists of customers who received less encouragement or no encouragement (in this case these are the remaining Rate 2 customers that will not receive usage alerts). Since it is expected that SDG&E has email addresses on the same proportion of customers in the treatment and control groups, those without email addresses can be dropped from both groups without introducing any selection effects, which will significantly increase the precision of the load impact estimates for the ITT stage of the analysis compared with the

[34] Given how few dropouts have occurred, as a practical matter, this is essentially an RCT design rather than an RED design.

[35] In this instance, the control group is not the rate treatment control group (e.g., those who stay on a non-TOU rate) but TOU participants who don't get usage alerts. As such, the estimated impact for the treatment group represents the incremental impact of usage alerts for customers on TOU rates.

diluted impact estimates that would result if the email customers remained in the encouraged and control groups.

5.6 Estimating Load Impacts for PG&E's Smartphone App

As discussed in Section 3, participation in PG&E's smart phone app treatment has been limited. As of this writing, roughly 300 customers have signed up and successfully downloaded the app. Had the sign up rate been much higher, it would have been possible to use an RED analysis to estimate the incremental load impact associated with the smartphone app compared with customers on the TOU rate who did not download the app. Instead, statistical matching will be used to estimate incremental load impacts. The control group will be chosen from among those who are on TOU rates who were not offered the smartphone app.

Statistical matching is commonly used when RCT or RED designs are not an option and has been shown to be superior to within-subjects analysis, especially for evaluating impacts for TOU programs or behavioral programs where observed changes in usage over time are subject to influence from exogenous factors that are hard to control for. Nexant commonly uses matching for many impact evaluations of existing programs and has developed systematic methods for obtaining the best matches.

There are various methods that can be used to select a suitable control group. One common method that we have used numerous times is propensity score matching.[36] With this approach, model specification affects both the quality of the match and the number of participants matched given some threshold for the acceptable quality of a match. To identify the best model, Nexant first develops a set of candidate models to test. A candidate model could vary based on its specification, its *hard match* criteria, and its caliper. A hard match is when a different probit model is estimated for each value of a categorical variable (e.g., customer segment, climate region, etc.) and matches are constrained within that value. This ensures that customers in a certain segment, such as CARE/FERA, are only matched to control group customers in that same segment. The *caliper* is a constraint placed on the maximum proximity of a potential control group match. A caliper of 0.05, for example, restricts potential matches to be within 0.05 of a customer's propensity score.

The set of candidate models and their associated control groups are evaluated using a cross-validation process that assesses the quality of the match based on how well they predict for excluded days that are not used to estimate the model. The rationale for such a strategy is that, if a probit model yields a control group that accurately predicts treatment load on excluded days, it is expected to provide an accurate counterfactual for event day load. A good control group's load can be said to predict that of the treatment group accurately if it yields an unbiased and precise fit to that of the treatment group.

While propensity score matching has worked well in numerous evaluations, Nexant is currently exploring further advances in matching techniques and will consider alternative methods that may be superior to the commonly used propensity score approach. Among the most promising of recently

[36] For a discussion of the use of propensity score matching to identify control groups, see Imbens, Guido W. and Woolridge, Jeffrey M. "Recent Developments in the Econometrics of Program Evaluation." *Journal of Economic Literature* 47.1 (2009): 5-86.

developed approaches is Genetic Matching,[37] which uses a genetic machine learning algorithm to determine the optimal distance metric for matching, whether it is a propensity score, as described above, or an alternative metric such as Mahalanobis distance. This approach is generalizable to all cases where matching is possible, and it is designed such that it always performs at least as well or better than matching on a propensity score or Mahalanobis distance alone.

Another promising new approach is referred to as the *Synthetic Control Method*.[38] This method uses pretreatment data to construct a weighted average of non-treated units such that their behavior most closely represents each treated unit. This approach can be generalized to multiple treated units for a program-level impact analysis, and can be flexibly implemented to deal with a slow ramp up in program enrollment. Nexant has recently tested this method as a technique for studying changes in energy consumption induced by the installation of an advanced thermostat.

These advanced methods may be particularly suitable for analyzing load impacts that are expected to be quite small, such as might be the case with PG&E's smartphone app. With small expected impacts, even small differences in loads between the treatment and control groups can produce relatively large errors in the estimated impacts; so, precise matching is essential to producing the best possible impact estimates. Ultimately, should the sample size be too small to estimate statistically significant load impacts, it may be possible to arrive at insights by looking at effects of the app on customer attrition and satisfaction.

In addition to estimating load impacts associated with the app, other insights may be gained through analysis of customer interaction with the app as reported by the app vendor. The nature and availability of data from the vendor is currently unclear but we will pursue and analyze whatever data is made available. Furthermore, additional insights will be reported from the survey of app participants that is being conducted in conjunction with the RIA survey that is summarized in a separate evaluation plan.

5.7 Estimating Impacts for SDG&E's Smart Thermostat Treatment

As discussed in Section 4, SDG&E will be offering differing rebate amounts of $100 and $200 to all of its pilot participants to encourage them to purchase a smart thermostat. The offer started November 1, 2016 and was extended through the end of December 2016. The primary focus of this treatment was to assess differential take rates for each rebate amount for both TOU rate and control customers. However, acceptance rates are not expected to be large enough to estimate load impacts for smart thermostat owners using an RED analysis; an RCT recruit-and-deny design was considered but not chosen. Instead, assuming a sufficiently large number of customers will accept the incentive offers, statistical matching will be used to develop a suitable control group after the fact and the load impact analysis will be conducted using the matched control group's load as the reference load. This analysis will be done following the 2017 summer period.

[37] see "Genetic Matching for Estimating Causal Effects: A General Multivariate Matching Method for Achieving Balance in Observational Studies" by Alexis Diamond and Jasjeet Sekhon for an explication of the Genetic Matching approach.

[38] see "Synthetic Control Methods for Comparative Case Studies: Estimating the Effect of California's Tobacco Control Program" by Alberto Abadie et. al. for an explication of the Synthetic Control Method.

5.8 Bill Impact Analysis

The impact of TOU rates on customers' bills is an important metric of interest to multiple stakeholders. A key design requirement for the TOU pilots and one of the primary objectives delineated in the Advice Letters and the Commission resolutions is to estimate bill impacts based on both pre and post-treatment usage for a variety of customer segments. In hot climate zones, these segments include: seniors; CARE/FERA customers; households with incomes less than 100% of Federal Poverty Guidelines (FPG); and households with incomes between 100% and 200% of FPG. The bill impacts of TOU rates on CARE/FERA and non-CARE/FERA households in the moderate and cool climate regions is also of interest.

From a policy standpoint, what is of primary interest is how much individual customers' bills change as a result of being placed on a TOU rate after they adjust their behavior (or choose not to) in response to the time-varying price signals associated with the rate. However, it is not valid to compare an individual's bill before and after they are placed on a TOU rate because there are a myriad of reasons why such bills might change that have nothing to do with the new rate. A specific household might have gained or lost a household member, had a teenager go away to (or return from) college, made an addition to the house, purchased an electric vehicle, changed one of more appliances, or made any of a number of other changes that could cause very significant changes to usage and bills that have nothing to do with the rate change. As such, the primary challenge in this task is determining how best to answer the key policy questions associated with bill impacts without relying on "before-and-after" comparisons of bills for individual customers.

The basic approach is to examine the distribution of bill impacts for both treatment and control customers based on both pre and post-treatment usage. By estimating bill impacts based on pretreatment usage, it is possible to identify the percent of customers in segments of interest that are structural benefiters and non-benefiters. It is also possible to determine, for example, what percent of customers in each segment will see bill increases of, say, 10% or more or $20 dollars or more, if they don't change their usage in response to the new rate. However, as indicated above, comparing this distribution based on pretreatment usage with a similar distribution or metric based on post-treatment usage for participants does not produce a valid estimate of the impact of a price-induced change in behavior on bill impacts because some or all of the observed change could result from some exogenous factors, such as differences in weather or a slowdown in the economy, or a change in the number of people in the household. Put another way, if we found that 25% of customers would see bill impacts greater than $20 based on pretreatment usage but only 20% would see a bill impact of $20 or more based on post-treatment usage, we wouldn't know if some of that observed reduction in the percent of customers experiencing high bill impacts resulted from a cooler than normal summer period with less load used during high priced periods.

To address this issue, we can compare the change in the bill distribution and other metrics for treatment and control customers to determine how much of the observed change in the distribution was driven by price-induced behavior change and how much was driven by exogenous factors. Suppose, for example, we found that the percent of control group customers experiencing a bill impact greater than $20 was the same if calculated based on usage in both the pre and post-treatment periods. Given this, we could say with confidence that the drop from 25% to 20% in the percent of customers in the treatment group experiencing bill impacts above $20 was due to a change in behavior for these customers in response to

the TOU pricing and not due to some exogenous factor. Alternatively, if we found that the percent of control customers experiencing a bill increase based on post-treatment usage was down from 25% to 23%, then we could attribute 3 percentage points (60%) of the observed 5 percentage point change in the percent of treatment customers experiencing a $20 or more bill impact to a change in usage behavior and the remaining 2 percentage points (40%) to some exogenous factor such as weather. Conceptually, this approach is equivalent to a difference-in-differences calculation. Bill impacts based on the DiD approach as defined above will be conducted for a set of metrics such as bill increases greater than $10, $20, $30, etc. The distribution of bill impacts from the pretreatment billing analysis will help to inform the thresholds that are ultimately used.

Nexant has already worked with data on bill impacts for all three IOUs. Following completion of the Nexant report in December, each IOU contracted separately with Nexant to conduct simulations designed to determine the sample sizes required to characterize the distribution of bill impacts for the various customer segments with reasonable precision. Figure 5-2 and Figure 5-3 are from that analysis and show the distribution of annual bill impacts for SCE's Rate 2 and PG&E's Rate 1 as a percent of the monthly bill by climate region for CARE and non-CARE customers based on pretreatment usage. Several things are obvious from these figures: the distributions and magnitude of bill impacts vary by customer segment, climate region, and rate type. We also produced the same distributions separately for summer bills and winter bills and found that bills increased for nearly everyone in the summer and were lower for nearly everyone in the winter.

This work illustrates how much bill impacts are likely to vary across rates and customer segments. As seen in the figures, almost no one on PG&E's Rate 1 would see a bill increase exceeding 20% and very few would see an annual bill increase of 10% except in the hot climate zone. For SCE's Rate 2, quite a few customers would see rate increases exceeding 20% and a relatively large share of customers would see increases greater than 10%, especially in the hot climate region.

Figure 5-2: Annual Bill Impacts for SCE Rate 2 as a Percent of Monthly Bill

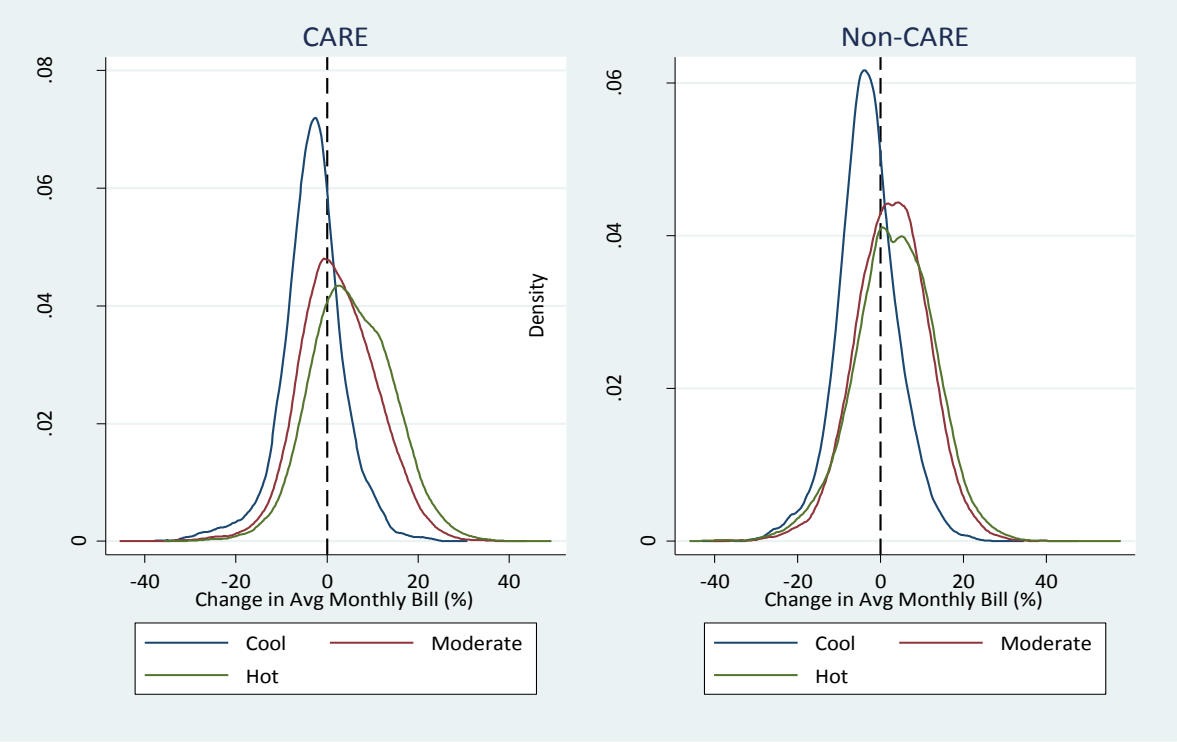
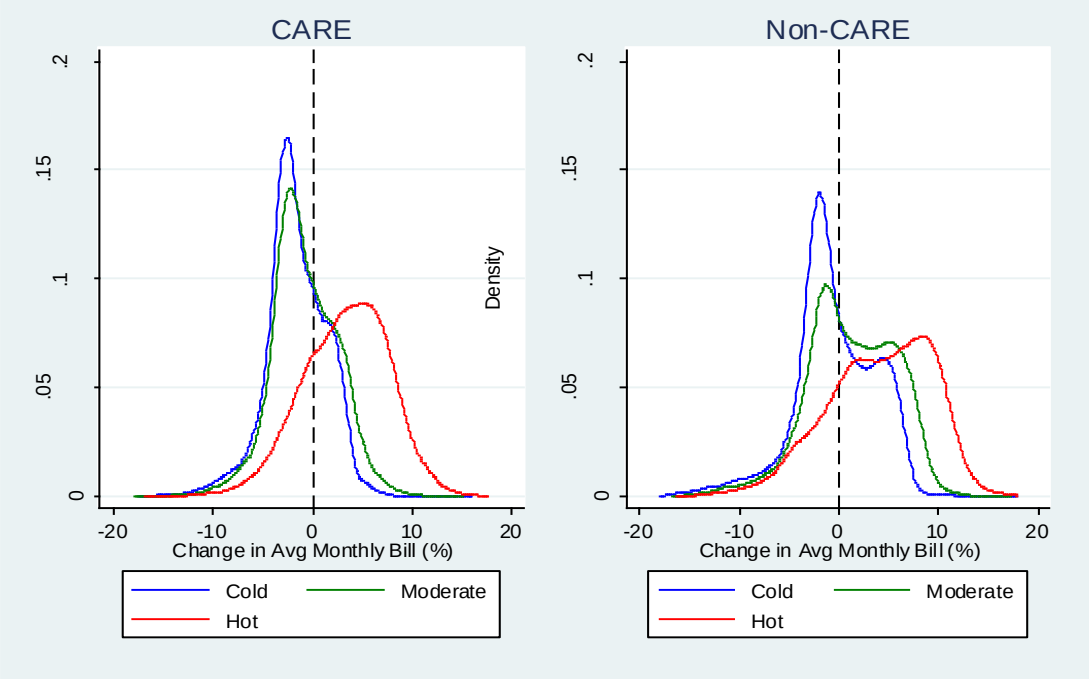


Figure 5-3: Annual Bill Impact Distributions for PG&E Rate 1 as a Percent of Monthly Bill



The calculation of bill impacts is quite straightforward. Nexant often calculates bills and bill impacts under various, complex rate structures as input to impact evaluations and pilot designs. The primary

challenge in this instance will be to determine the best way to present the analysis so that it clearly answers the policy questions of interest. A number of options exist, including:

- Displaying the full distribution of bill impacts (as in Figures 5-2 and 5-3) for each relevant customer segment based on pretreatment data (showing both percentage changes and absolute changes in separate graphs) so as to highlight the structural winners and non-winners in each segment;
- Displaying the same curves for the post-treatment period, with control and treatment customer distributions included in the same graph to illustrate if the distribution for participants shifts to the left or changes shape compared with the distribution for control customers; and
- Tables showing the percent of customers with bill impacts greater than or less than various percentage or absolute values—e.g., percent that have bill impacts between 0 and $10, $10 and $20, greater than $20, etc.—in these tables, we would propose to use the difference-in-differences analysis summarized above to adjust these values for the participant population based on changes in bill impacts over time in the control group due to exogenous factors.

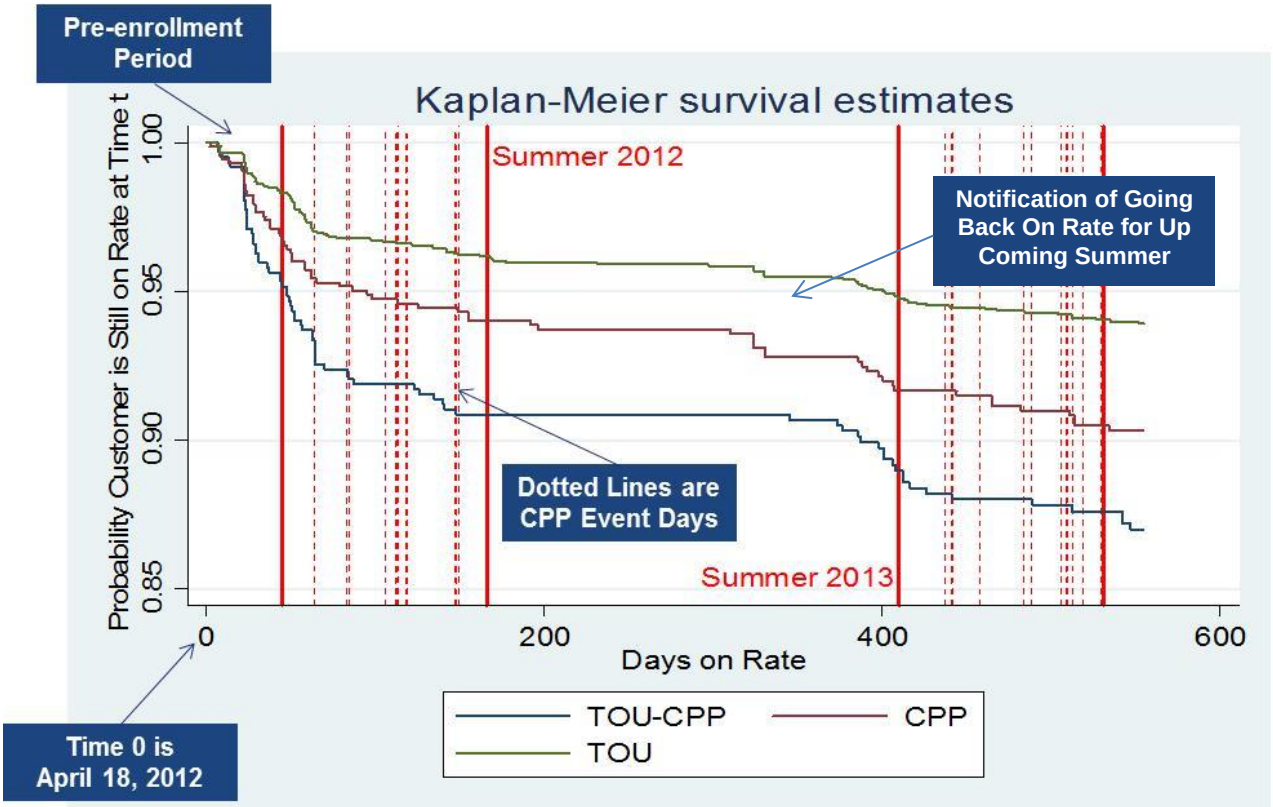
5.9 Modeling Opt-out Rates

Although the primary objective of the impact evaluation is to estimate load impacts for the various rate options, and the pilots have been designed to retain as many customers as possible onto the rates, it will nevertheless be useful to examine how opt-out rates vary across rate treatments and to determine the variables that are correlated with opt-outs (such as bill impacts, load shape, etc.). Such analysis may provide useful insights concerning relative customer preferences among the various rate options and may also help predict what opt-out rates might be under full scale roll out of default TOU pricing. There are two approaches to modeling opt-out rates that will be used.

The first approach involves a Kaplan-Meier survival function for the opt-in TOU and CPP pricing plans. This function displays the likelihood of staying on a pricing plan as a function of time. Figure 5-4 shows an example of a Kaplan-Meier survival function that Nexant produced as part of the evaluation of SMUD's Smart Pricing Options (SPO) pilot. The data underlying this analysis would represent only active de-enrollment, not customers who left the plan because they moved. The advantage of this function is that you can easily compare opt-out rates for multiple rate options to determine, for example, whether customers opt-out at a greater rate from Rate 3 compared with Rates 1 or 2. You can also easily see how opt-out rates vary during selected periods of time (e.g., post notification but pre-enrollment versus post-enrollment) and also as a function of selected events, such as receipt of their first bill[39] or notification of a switch in prices across seasons. As seen in the example from the SMUD pilot, opt-out rates were highest for the TOU-CPP pricing plan and lowest for the TOU plan. Also, there was an uptick in opt-outs when notifications went out prior to the second summer about the summer rates kicking in.

[39] In comments received it was noted: "The timing of the first bill varies widely, in particular for SCE's rate 3 (delays in receiving first bill). Can you discuss if/how this approach can account for different event timing? Is it still a valid comparison of treatment timing differs?" Response: Delayed bills are a problem for the K-M model, so it may not be appropriate to use for SCE's rate 3. In the Cox Hazard model it is possible to implement a variable unique to each customer, which allows for variation in bill timing.

Figure 5-4: Kaplan-Meyer Survival Function for Opt-in Pricing Plans



A second approach to modeling opt-out rates involves estimating the likelihood of dropping off each rate as a function of customer characteristics. A Cox Proportional Hazard (Cox PH) model provides estimates of the hazard ratio, which is defined as the instantaneous probability of a customer dropping off a plan at time *t* given that they have not dropped prior to that time:

$$\text{HR} = \frac{\textit{Probability that customers with characteristic X drop out}}{\textit{Baseline probability of dropping out that depends only on time}}$$

The hazard ratio is interpreted as follows:

- A HR equal to 1 means that the characteristic of interest has no impact on the likelihood of dropping out;
- A HR > 1 means that a characteristic increases the likelihood of dropping out (e.g., a HR of 1.1 on a CARE variable, for example, would mean that CARE customers are 10% more likely to drop out at any given time than non-CARE customers); and
- A HR < 1 means that a characteristic decreases the likelihood of dropping out (e.g., a HR of 0.9 for a CARE variable would mean CARE customers are 10% less likely to drop out than non-CARE customers).

Table 5-2 shows the results of the Cox PH model estimation for opt-in pricing plans from SMUD's SPO and contains notes about the interpretation of each model coefficient. We plan to estimate such models for each rate and each utility using customer characteristics data such as usage stratum, load shape variables, bill impacts, and selected survey data.

Table 5-2: Cox PH Model Results for Opt-in Pricing Plans from SMUD's SPO Pilot

Variable	Hazard Ratio Estimates	Interpretation
EAPR status	0.84	EAPR customers are less likely to drop out than non-EAPR customers but the impact is not statistically significant
CPP	1.79**	Customers who opt-in to the CPP pricing plan are 80% more likely to drop out than those who opt-in to the TOU pricing plan (but opt-out rates are low for both plans)
2011 Summer Savings as a % of Summer Bill	0.03**	A 10% savings on summer bills reduces the likelihood of an opt-in customer dropping out by 30%.
Carbon Offsets program	0.21	Enrollment in the Carbon Offsets program reduces the likelihood of dropping out, but is not statistically significant
Received EE loan or rebate	1.30*	Customers who received an EE loan or rebate are 30% more likely to drop out
EnergyHelp program	0.64	Customers enrolled in the EnergyHelp program are more likely to drop out, but the impact is not statistically significant
Green Energy program	0.99	Enrollment in the Green Energy program has essentially no impact on dropout rates
Customer enrolled in MyAccount	1.01	MyAccount has no impact on dropout rates for opt-in customers

**p<0.01; *p<0.05; +p<0.1

Note: The interpretation of the summer savings coefficient differs from the others due to the structure of the Cox PH model. The initial estimate of 0.03 represents the impact of saving 100% of summer bills and was converted to a more easily interpretable impact of 10% savings.

6 Data Validation

The TOU Pilot's RCT experimental design relies on randomization of customers across the three treatment groups and the control group within each customer segment to ensure the RCT maintains internal validity. With proper randomization, post-treatment differences between the treatment groups and control group can be assumed to be caused by the treatment (or random chance), not by some preexisting difference between the two groups. If not identified, any preexisting differences between the groups could be misinterpreted as differences due to the TOU treatments once the treatment is implemented. In order to confirm that there were not any issues with the randomization, and that there weren't any pre-existing differences, several validation checks were conducted for each IOU.

Comparisons for validations conducted in steps 1 and 2 below were completed across the three rate assignments and the control group for the following customer segments at each IOU:[40]

- Hot, General Population
- Hot, CARE
- Hot, Non-CARE
- Hot, Non-Senior, CARE, Above 100% FPG
- Hot, Non-Senior, CARE, Below 100% FPG
- Hot, Senior, Above 100% FPG
- Hot, Senior, Below 100% FPG
- Moderate, CARE
- Moderate, Non-CARE
- Cool, CARE
- Cool, Non-CARE

The validations conducted for each IOU consisted of the following steps:

1. Comparison of average values for selected characteristics for treatment and control groups including the following variables:[41]
    a. Geographic location (LCA)
    b. Rent or own home
    c. Household Size
    d. All electric or dual fuel
    e. CARE/FERA or non-CARE/FERA
    f. Senior or non-Senior
    g. Persona
        i. SCE: Connected, Constrained, Disengaged, Green, Elites, Pragmatists

[40] SDG&E did not have segmentation within the Hot Climate Region.

[41] Enrollment survey data was used unless it was unavailable, in which case the existing third-party data was used.

ii. PG&E: Beyond Their Means, Eco Active Go Getter, Gadget Family, Geo Centric Basics, Geo Centric Digitals, Geo Centric Discounters, Heart and Home, Living for Today, Stable Living, Style Seeker, Way Wired

iii. SDG&E: Higher Tech, Low/Avg Tech

h. Federal Poverty Guideline (FPG) status

i. <100%, 100-200%, 200-250%, >250%, N/A

i. Participation in behavioral program

i. SCE: Energy Pledge, HEES Enhancement, Opower

ii. PG&E: Opower

iii. SDG&E: Home Energy Reports (HERs)

j. DR program participation

i. SCE: Save Power Days (SPD), SPD with Direct Load Control (DLC),Summer Discount Program

ii. PG&E: SmartAC

iii. SDG&E: PSH, Summer Saver, Reduce Your Use, Small Customer Technology Deployment Program

k. Energy usage

i. Peak kW, Off Peak kW, and Average Daily kWh by month

2. Comparisons of hourly load shapes were conducted for the following combinations of time of year, day type, and period by segment and rate:

a. Time of year

i. Season: Summer, Winter, Spring

b. Day type

i. Weekday, Weekend

c. Period

i. Peak, Partial-Peak, Off-Peak, Super Off-Peak

Comparisons across key variables between the treatment and control groups within customer segments as noted in step 1 were completed by using Chi-Squared and T-tests in order to determine if there were statistically significant differences between groups. Chi-Squared tests were used to identify differences between categorical variables such as Senior or Non-senior households and T-tests were used to examine differences across continuous variables such as Household Size or Average Daily kWh. The outcome from the Chi-Squared and T-tests is the p-value, which in practical terms identifies the likelihood that the difference between the two groups being tested is significantly different from zero. In this case, a p-value of 0.05 is generally interpreted to mean that there is a 1-p (0.95 or 95%) chance that the true difference between groups in the population is not equal to zero. Based on this definition, a p-value closer to 1 means there is a low likelihood that a difference exists between the two groups being tested, and that the randomization was effective in eliminating any pretreatment differences between the two populations. If a p-value is close to zero, especially if it is less than .1 or .05, there is a greater likelihood that there may be preexisting differences between two groups in the full population; which could affect the results if not properly accounted for.

For estimating load impacts due to the TOU rates, the most important pre-existing difference is in the average loads of the treatment and control groups. T-tests were used to identify any statistically significant pretreatment differences in load across groups in step 2. Similarly to step 1, the p-value was used to identify any statistically significant differences in load between groups. The interpretation of the p-value remains the same as in step 1, with a high p-value (closer to one) indicating there is a low likelihood of any preexisting differences between the treatment and control groups in the full population. As discussed in Section 5.2, any minor pretreatment differences are automatically addressed by using a difference-in-differences calculation where the first difference accounts for any pretreatment difference, and the second difference accounts for the post-treatment difference. The result is the difference between the treatment and the control group, net of any pretreatment differences.

With these definitions in mind, the following sections detail the findings from the validation tests for each IOU. Given the large number of combinations of variables and segments tested, a few examples will be provided for context from steps 1 and 2 for each IOU, and then only situations where statistically significant differences were observed are summarized. Dynamic tables containing all validation outcomes will be provided as appendices.

6.1 SCE

The combination of the low incidence rates of statistically significant differences in both the customer characteristics data and load data indicate the randomization was successfully implemented. Leveraging the DiD approach accounts for any of the preexisting differences identified through the validation analysis, and, ultimately, results in identifying the difference between the treatment and control groups as the result of the TOU treatment, net of any preexisting differences. In summary, there are no currently identifiable issues related to the randomization that will inhibit the estimation of load impacts attributable to TOU rates; details are provided in the following section.

6.1.1 Comparison of Average Values for Selected Characteristics

The Excel table shown in Table 6-1 lists all instances where the treatment and control group customers within a segment had preexisting differences. In the workbook, users are able to select a specific customer segment, as identified in Section 6, and view the distribution of values of the customer characteristics across the treatment rates and control group, along with the p-values to identify any variables with statistically significant differences. Cells in the table highlighted in orange indicate that there is a p-value of less than 0.05—in this instance, for Rate 1 and 3 for the FPG variable. This means there is at least a 95% chance that the allocation of customers by FPG type are different between Rate 1 and the Control group, and Rate 3 and the control group within the Hot, CARE/FERA group. The Chi-Squared test evaluates differences across the combination of FPG sub-variables between each rate and the control group. For example: <100% FPG customers are 50% of the Hot, CARE/FERA customers on Rate 1 and similarly, 50% of the control group. However, the 100 to 200% group makes up 35% of Rate 1 and 39% of the control group. The small differences combined across each of the FPG related sub-variables are enough to indicate that the distribution of customers across various levels of FPG are statistically different between Rate 1 and the control group. The complete list of variables, segments, and rates with significant differences will be discussed next along with any implications.

Table 6-1: Example of Customer Characteristics Validation Output: Hot Climate Region, CARE/FERA

Select Segment:	Hot, CARE		Original Segment		1,315			
Rate 1	733		From HG		1,992			
Rate 2	1,000		From HC		0			
Rate 3	582		From HN		0			
Control	992							
Total	**3,307**							
* Enrollments as of rate-change								

Test		Rate 1	Rate 2	Rate 3	Control	P-Values		
						Rate 1 & Control	Rate 2 & Control	Rate 3 & Control
LCA	LA Basin	19%	21%	20%	21%	0.12	0.89	0.67
	Outside LA Basin	33%	37%	38%	36%			
	Ventura/Big Creek	48%	42%	41%	43%			
Rent or Own	Rent	46%	50%	51%	49%	0.18	0.72	0.53
	Own	54%	50%	49%	51%			
Household Size		3.20	3.22	3.06	3.14	0.66	0.44	0.48
Fuel Type	Dual Fuel	92%	91%	92%	91%	0.48	0.86	0.59
	All Electric	8%	9%	8%	9%			
CARE	Y	100%	100%	100%	100%	0.00	0.00	0.00
	N							
Senior	Y	35%	33%	37%	35%	0.97	0.31	0.55
	N	65%	67%	63%	65%			
Persona	Connected	20%	21%	19%	23%	0.29	0.93	0.07
	Constrained	41%	39%	41%	38%			
	Disengaged	25%	22%	26%	22%			
	Green Elites	3%	4%	2%	4%			
	Pragmatists	11%	14%	11%	13%			
FPG	<100%	50%	50%	54%	50%	0.00	0.64	0.00
	100-200%	35%	39%	33%	39%			
	200-250%	6%	6%	6%	5%			
	>250%	6%	5%	6%	6%			
	N/A	2%	0%	1%	0%			
Behavior Program	Energy Pledge	2%	4%	3%	4%	0.17	0.68	0.79
	HEES Enhancement	1%	1%	2%	1%			
	Opower 1							
	Opower 2							
	Opower 3	5%	5%	4%	4%			
	Opower 4	11%	12%	12%	14%			
	None	81%	78%	79%	77%			
DR Program	Y	34%	31%	30%	31%	0.20	0.83	0.53
	N	66%	69%	70%	69%			

Table 6-2 contains the list of customer characteristic variables with statistically significant differences between the treatment and control group by rate and segment. As noted above, T-tests were conducted focusing at the 0.95 level, so a rate of around 5% of statistically significant tests is completely expected. Overall, seven different customer characteristic variables had at least one rate and segment combination with a significant difference. The FPG distribution contained the most rate-segment combinations with seven, followed by the distribution of DR Program participants with three rate-segment combinations. Fuel Type and Household Size each had two, and LCA, Rent or Own, and Senior each had one rate-segment combination with a significant difference resulting in a total of 16 significant differences across all rate-segment-characteristic combinations.

Table 6-2: Customer Characteristic Variables with Statistically Significant Differences between Treatment & Control Group by Rate and Segment

Characteristic	Rate	Segment
DR Program	1	Hot, Non-CARE
	2	Hot, Non-Senior, CARE, Above 100% FPG
	2	Hot, Senior, Below 100% FPG
FPG	1, 3	Hot, CARE
	3	Hot, Non-CARE
	1, 3	Hot, Non-Senior, CARE, Above 100% FPG
	3	Hot, Senior, Above 100% FPG
Fuel Type	2	Hot, Non-CARE
	2	Moderate, Non-CARE
Household Size	1	Hot, Non-CARE
	3	Hot, Senior, Below 100% FPG
LCA	3	Hot, Senior, Below 100% FPG
Rent or Own	2	Hot, Non-Senior, CARE, Above 100% FPG
Senior	3	Moderate, Non-CARE

While 16 statistically significant differences were observed, 372 different rate-segment-characteristic combinations were tested. This results in an overall rate of only 4.3% of those combinations exhibiting statistically significant differences. A few of the statistically significant differences fall within segments that will not be directly used for the load impact analysis, so they are not cause for concern. In a sample drawn to facilitate estimations of load impacts at a 90% confidence level, there is always a chance of observing some statistically significant differences just by random chance. Based on these observations, the number of statistically significant differences observed falls within the range that should be expected from a properly implemented randomization.

6.1.2 Comparison of Hourly Load Shapes by Season, Day Type, Rate Period, Segment, and Rate

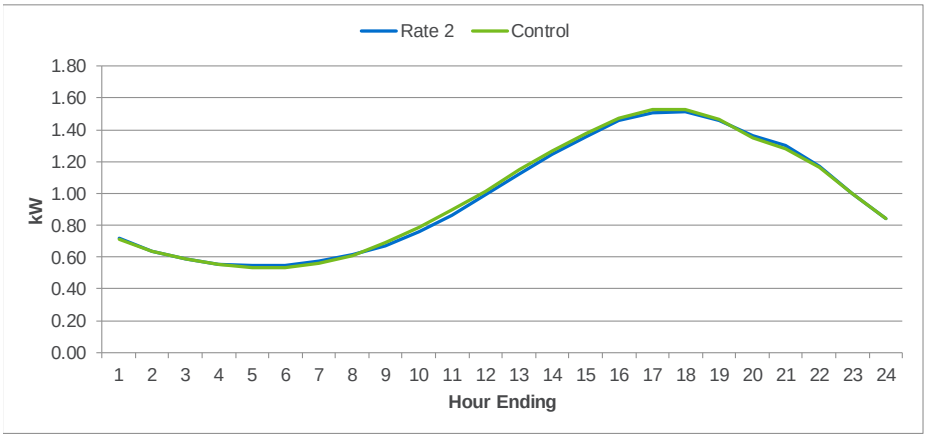
The Excel table shown in Table 6-3 was developed to identify any instances where the treatment and control group customers within a segment had preexisting differences in hourly load shapes. In the workbook, users are able to select a specific customer segment, season, day type, and rate and view the hourly load shapes for the treatment and control group along with counts showing the number of

customers by treatment and control group. The example shows the hourly load shapes for Seniors below 100% of FPG in the Hot Climate Region on a Summer Weekday on Rate 2 or the Control group. The lines are visually very close together and there is not a statistically significant difference in hourly load between the treatment and control groups for this segment on this particular day type.

Figure 6-1: Comparison of Hourly Load Shapes by Season, Day Type, Rate Period, Segment, and Rate

Segment	Hot, Senior, Below 100% FPG
FPG	All
CARE	All
Senior	All
Season	Summer
Weekday	Weekday
Rate	Rate 2

Assignment	# of Customers
Rate 2	554
Control	571



Hour	Rate 2	Control
1	0.72	0.71
2	0.64	0.64
3	0.59	0.59
4	0.55	0.55
5	0.55	0.54
6	0.55	0.54
7	0.57	0.56
8	0.61	0.61
9	0.67	0.69
10	0.76	0.78
11	0.86	0.89
12	0.99	1.01
13	1.12	1.15
14	1.24	1.27
15	1.36	1.38
16	1.46	1.47
17	1.51	1.53
18	1.52	1.53
19	1.46	1.47
20	1.36	1.35
21	1.30	1.28
22	1.17	1.17
23	1.00	1.00
24	0.84	0.84

In order to efficiently evaluate all 300 combinations of Rate Type, Segment, Season, Day Type, and TOU Period, a program was written in Stata to systematically iterate through all of the different combinations and conduct T-tests to identify any combinations with a statistically significant difference in load. Ultimately, 13 instances out of the 300 combinations tested (4.3%) were found to have statistically significant differences in load—these are listed in Table 6-3. Several of these cases are in segments for which load impacts will not be directly estimated, so they are not worrisome.

Table 6-3: Statistically Significant Differences in Hourly Load between Treatment & Control Group by Segment, Rate, Season, Day Type, and Rate Period

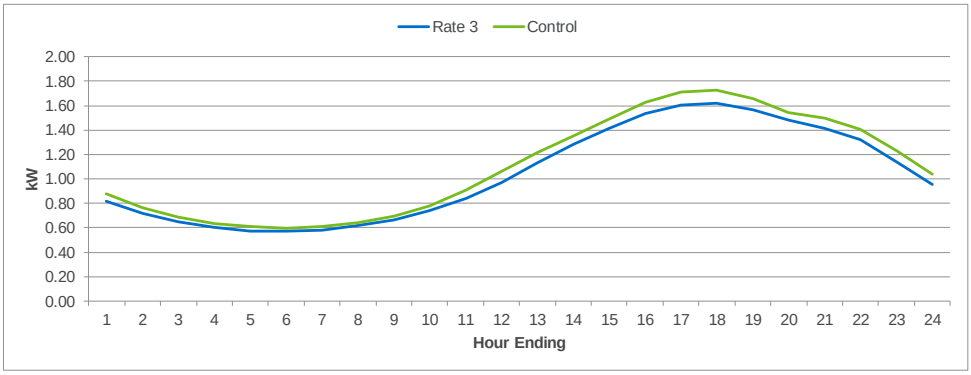
Issue	Segment	Rate	Season	Weekday/ Weekend	Rate Period	P-Value
1	Hot, CARE	Rate 1	Winter	Weekday	Peak	0.043
2	Hot, CARE	Rate 3	Spring	Weekend	Off-Peak	0.024
3	Hot, CARE	Rate 3	Summer	Weekday	Off-Peak	0.030
4	Hot, CARE	Rate 3	Summer	Weekday	Peak	0.039
5	Hot, CARE	Rate 3	Summer	Weekend	Off-Peak	0.015
6	Hot, Non-CARE	Rate 3	Spring	Weekday	Peak	0.014
7	Hot, Non-CARE	Rate 3	Spring	Weekday	Super Off-Peak	0.017
8	Hot, Non-CARE	Rate 3	Spring	Weekend	Super Off-Peak	0.010
9	Hot, Non-CARE	Rate 3	Winter	Weekend	Super Off-Peak	0.022
10	Hot, Non-Senior, CARE, Above 100% FPG	Rate 3	Spring	Weekday	Peak	0.043
11	Hot, Non-Senior, CARE, Above 100% FPG	Rate 3	Spring	Weekend	Off-Peak	0.036
12	Moderate, Non-CARE	Rate 2	Summer	Weekday	Super Off-Peak	0.035
13	Moderate, Non-CARE	Rate 2	Summer	Weekend	Super Off-Peak	0.025

Figure 6-1 provides an example of a Segment-Rate-Season-Day Type- Rate Period combination with a statistically significant difference in hourly load. In this example, there is an approximately 6% difference in load during the peak period for CARE/FERA customers in the Hot Climate Region on Summer Weekdays on Rate 3 compared to the Control group.

Figure 6-1: Example of Statistically Significant Difference in Hourly Load

Issue	4
Segment	Hot, CARE
Season	Summer
Weekday	Weekday
Rate	Rate 3
Treatment Customers	582
Control Customers	992

Period	Peak
Treatment Mean kW during Peak	1.26
Control Mean kW during Peak	1.34
% Difference	6%
P-value	0.039



Hour	Rate 3	Control
1	0.81	0.88
2	0.71	0.76
3	0.65	0.69
4	0.60	0.63
5	0.57	0.61
6	0.57	0.60
7	0.58	0.61
8	0.62	0.64
9	0.66	0.69
10	0.74	0.78
11	0.84	0.91
12	0.97	1.06
13	1.13	1.22
14	1.28	1.35
15	1.41	1.49
16	1.53	1.63
17	1.61	1.71
18	1.62	1.73
19	1.57	1.66
20	1.48	1.55
21	1.42	1.50
22	1.32	1.41
23	1.14	1.23
24	0.96	1.04

In any randomization there is likely to be various correlations or statistical anomalies that occur purely by chance. The key to validating the randomization is to identify if these incidents occur at a high enough frequency that the randomization process may have been flawed. In this case, finding 4.3% of the combinations tested having statistically significant differences is well within the expected range.

Additionally, given there is generally some small level of differences expected to occur even with proper randomization, a difference-in-differences (DiD) analysis approach, as discussed in Section 5.2, is used for the load impact evaluation to allow for the correction of any preexisting differences between the treatment group and the control group.

The combination of the low incidence rates of statistically significant differences in both the customer characteristics data and load data indicate the randomization was successfully implemented. Leveraging the DiD approach accounts for any of the preexisting differences identified through the validation analysis, and, ultimately, results in identifying the difference between the treatment and control groups as the result of the TOU treatment, net of any preexisting differences. In summary, there are no currently identifiable issues related to the randomization that will inhibit the estimation of load impacts attributable to TOU rates.

6.2 PG&E

6.2.1 Comparison of Average Values for Selected Characteristics

Table 6-4 lists all instances where the treatment and control group customers within a segment had preexisting differences. As in the SCE Excel table, cells in the table highlighted in orange indicate that there is a p-value of less than 0.05—in this instance, for Rate 2 for the DR Program variable. This means there is at least a 95% chance that the percentage of customers on DR programs are different between Rate 2 and the Control group within the Moderate, Non-CARE/FERA group. The Chi-Squared test evaluates differences in DR participation between each rate and the control group. For example: 9% of Rate 2 customers in the Moderate, Non-CARE segment are enrolled in SmartAC while only 4% of control customers in the same segment are SmartAC participants. This difference in SmartAC participation is large enough to be statistically different between Rate 2 and the control group. The complete list of variables, segments, and rates with significant differences is discussed next along with any implications.

Table 6-4: Example of Customer Characteristics Validation Output: Hot Climate Region, CARE/FERA

Select Segment:	Moderate, Non-CARE							
Rate 1	589							
Rate 2	588							
Rate 3	587							
Control	592							
Total	**2,356**							
*Enrollments as of a rate-change								

Table 6-5: Example of Customer Characteristics Validation Output: Hot Climate Region, CARE/FERA (continued)

Test		Rate 1	Rate 2	Rate 3	Control	P-Values		
						Rate 1 & Control	Rate 2 & Control	Rate 3 & Control
LCA	Greater Bay Area	83.8%	84.0%	84.4%	84.6%	0.71	0.96	0.92
	Greater Fresno Area	0.0%	0.2%	0.0%	0.2%			
	Humboldt	1.2%	0.9%	1.5%	1.0%			
	Kern							
	North Coast and North Bay	6.5%	6.8%	6.5%	6.3%			
	Other	6.8%	6.5%	5.7%	6.1%			
	Sierra	0.9%	0.7%	0.5%	0.3%			
	Stockton	0.9%	1.0%	1.4%	1.5%			
Rent or Own	Rent	28%	21%	27%	25%	0.21	0.11	0.45
	Own	72%	79%	73%	75%			
Household Size		2.57	2.62	2.65	2.58	0.92	0.58	0.34
Fuel Type	Dual Fuel	79%	82%	81%	81%	0.53	0.49	1.00
	All Electric	21%	18%	19%	19%			
CARE	Y							
	N	100%	100%	100%	100%			
Senior	Y	35%	34%	35%	38%	0.23	0.15	0.18
	N	65%	66%	65%	62%			
Persona	Beyond Their Means	2%	2%	1%	2%	0.46	0.75	0.46
	Eco Active Go Getter	23%	21%	23%	22%			
	Gadget Family	7%	9%	5%	8%			
	Geo Centric Basics							
	Geo Centric Digitals	0%	0%	0%	0%			
	Geo Centric Discounters							
	Heart and Home	11%	12%	13%	12%			
	Living for Today	6%	4%	4%	5%			
	Stable Living	14%	12%	12%	11%			
	Style Seeker	5%	6%	6%	6%			
	Way Wired	31%	33%	34%	35%			
FPG	<100%	4%	4%	5%	5%	0.39	0.32	0.40
	100-200%	9%	9%	9%	7%			
	>200%	87%	87%	86%	88%			
Behavior Program	Opower HER	53%	62%	57%	59%	0.03	0.30	0.48
	None	47%	38%	43%	41%			
DR Program	SmartAC	4%	9%	6%	4%	0.87	0.00	0.09
	None	96%	91%	94%	96%			

Table 6-6 contains the list of customer characteristic variables with statistically significant differences between the treatment and control group by rate and segment. Overall, eight different customer

characteristic variables had at least one rate and segment combination with a significant difference. The Rent vs. Own and Household Size distributions contained the most rate-segment combinations with seven, followed by the distribution FPG levels with six rate-segment combinations. CARE had four, LCA had three, Persona had two, and DR Program and Behavior Program each had one rate-segment combination with a significant difference resulting in a total of 31 significant differences across all rate-segment-characteristic combinations.

Table 6-6: Customer Characteristic Variables with Statistically Significant Differences between Treatment & Control Group by Rate and Segment

Characteristic	Rate	Segment
Behavior Program	1	Moderate, Non-CARE
DR Program	2	Moderate, Non-CARE
FPG	3	Hot, CARE
	2, 3	Hot, General Population
	1	Hot, Non-Senior, CARE, Above 100% FPG
	2, 3	Hot, Senior, Above 100% FPG
Household Size	3	Cool, CARE
	2	Hot, Non-Senior, CARE, Above 100% FPG
	1, 2, 3	Hot, Senior, Above 100% FPG
	1, 2	Hot, Senior, Below 100% FPG
LCA	3	Cool, Non-CARE
	2	Hot, General Population
	2	Hot, Non-CARE
Persona	3	Hot, General Population
	3	Hot, Senior, Above 100% FPG
Rent or Own	1, 3	Cool, Non-CARE
	1	Hot, CARE
	3	Hot, General Population
	2	Hot, Non-CARE
	1, 2	Hot, Senior, Above 100% FPG

While 29 statistically significant differences were observed, 396 different rate-segment-characteristic combinations were tested. This results in an overall rate of 7.3% of those combinations exhibiting statistically significant differences. A few of the statistically significant differences fall within segments that will not be used for the load impact analysis, so they are not cause for concern. For example, load impacts are not required to be estimated for customers in the Hot, Senior, Below 100% FPG segment for Rate 2. In a sample drawn to facilitate estimations of load impacts at a 90% confidence level, there is always a chance of observing some statistically significant differences just by random chance. Based on these observations, the number of statistically significant differences observed falls within the range that should be expected from a properly implemented randomization.

6.2.2 Comparison of Hourly Load Shapes by Season, Day Type, Rate Period, Segment, and Rate

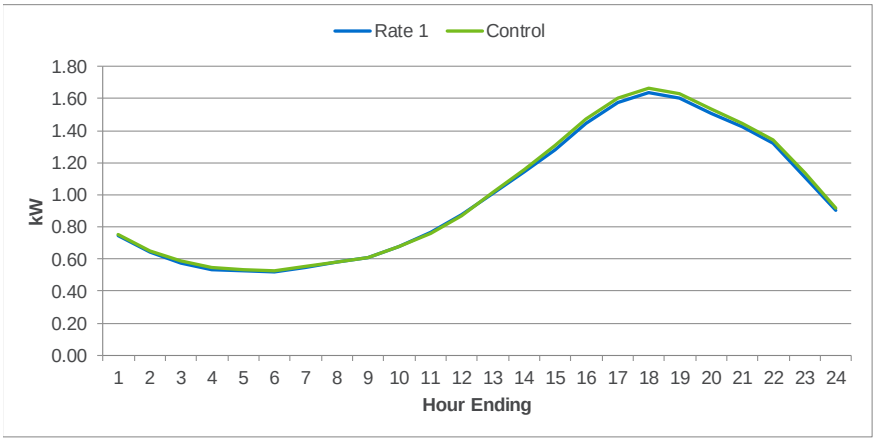
Figure 6-2 was developed to identify any instances where the treatment and control group customers within a segment had preexisting differences in hourly load shapes. In the workbook, users are able to

select a specific customer segment, season, day type, and rate and view the hourly load shapes for the treatment and control group along with counts showing the number of customers by treatment and control group. The example shows the hourly load shapes for CARE customers in the Hot Climate Region on a Summer Weekday on Rate 1 or the Control group. The lines are visually very close together and there is not a statistically significant difference in hourly load between the treatment and control groups for this segment on this particular day type.

Figure 6-2: Comparison of Hourly Load Shapes by Season, Day Type, Rate Period, Segment, and Rate

Segment	Hot, CARE
FPG	All
CARE	All
Senior	All
Season	Summer
Weekday	Weekday
Rate	Rate 1

Assignment	# of Customers
Rate 1	768
Control	785



Hour	Rate 1	Control
1	0.75	0.76
2	0.64	0.65
3	0.58	0.59
4	0.53	0.55
5	0.53	0.53
6	0.52	0.53
7	0.55	0.55
8	0.58	0.58
9	0.61	0.61
10	0.68	0.67
11	0.77	0.76
12	0.88	0.87
13	1.01	1.01
14	1.14	1.16
15	1.28	1.31
16	1.45	1.47
17	1.58	1.60
18	1.64	1.66
19	1.61	1.63
20	1.51	1.53
21	1.43	1.45
22	1.32	1.34
23	1.11	1.14
24	0.90	0.92

In order to efficiently evaluate all 297 combinations of Rate Type, Segment, Season, Day Type, and TOU Period; a program was written in Stata to systematically iterate through all of the different combinations and conduct T-tests to identify any combinations with a statistically significant difference in load. Ultimately, 18 instances out of the 297 combinations tested (6%) were found to have statistically significant differences in load—these are listed in Table 6-7.

Table 6-7: Statistically Significant Differences in Hourly Load between Treatment & Control Group by Segment, Rate, Season, Day Type, and Rate Period

Issue	Segment	Rate	Season	Weekday/ Weekend	Rate Period	P-Value
1	Hot, CARE	Rate 1	Winter	Weekday	Peak	0.03
2	Hot, CARE	Rate 1	Winter	Weekend	Off-Peak	0.04
3	Hot, Non-CARE	Rate 1	Summer	Weekday	Peak	0.02
4	Hot, Non-CARE	Rate 2	Summer	Weekday	Partial-Peak	0.04
5	Hot, Non-CARE	Rate 3	Summer	Weekday	Peak	0.04
6	Hot, Non-CARE	Rate 3	Summer	Weekend	Off-Peak	0.04
7	Hot, Non-Senior, CARE, Above 100% FPG	Rate 2	Winter	Weekday	Peak	0.03

Issue	Segment	Rate	Season	Weekday/ Weekend	Rate Period	P-Value
8	Hot, Non-Senior, CARE, Above 100% FPG	Rate 3	Spring	Weekday	Super Off-Peak	0.04
9	Hot, Senior, Above 100% FPG	Rate 3	Summer	Weekend	Off-Peak	0.03
10	Hot, Senior, Below 100% FPG	Rate 2	Summer	Weekday	Partial-Peak	0.04
11	Hot, Senior, Below 100% FPG	Rate 2	Summer	Weekday	Peak	0.04
12	Hot, Senior, Below 100% FPG	Rate 2	Summer	Weekend	Off-Peak	0.04
13	Hot, Senior, Below 100% FPG	Rate 2	Summer	Weekend	Partial-Peak	0.04
14	Hot, Senior, Below 100% FPG	Rate 2	Summer	Weekend	Peak	0.03
15	Moderate, CARE	Rate 3	Spring	Weekday	Super Off-Peak	0.00
16	Moderate, CARE	Rate 3	Spring	Weekend	Super Off-Peak	0.05
17	Moderate, Non-CARE	Rate 3	Summer	Weekday	Off-Peak	0.03
18	Moderate, Non-CARE	Rate 3	Summer	Weekday	Peak	0.03

Figure 6-3 provides an example of a Segment-Rate-Season-Day Type-Rate Period combination with a statistically significant difference in hourly load. In this example, there is an approximately 7% difference in load during the peak period for Non-CARE/FERA customers in the Hot Climate Region on Summer Weekdays on Rate 3 compared to the Control group.

Figure 6-3: Example of Statistically Significant Difference in Hourly Load

Issue	5
Segment	Hot, Non-CARE
Season	Summer
Weekday	Weekday
Rate	Rate 3
Treatment Customers	601
Control Customers	1,189

Period	Peak
Treatment Mean kW during Peak	1.71
Control Mean kW during Peak	1.61
% Difference	-7%
P-value	0.042

Hour	Rate 3	Control
1	0.72	0.70
2	0.63	0.62
3	0.57	0.57
4	0.54	0.54
5	0.54	0.54
6	0.58	0.58
7	0.65	0.66
8	0.71	0.72
9	0.72	0.72
10	0.74	0.74
11	0.80	0.80
12	0.88	0.87
13	0.99	0.98
14	1.12	1.10
15	1.28	1.24
16	1.48	1.42
17	1.67	1.58
18	1.82	1.70
19	1.81	1.71
20	1.70	1.62
21	1.55	1.49
22	1.36	1.32
23	1.11	1.08
24	0.88	0.86

In any randomization there is likely to be various correlations or statistical anomalies that occur purely by chance. The key to validating the randomization is to identify if these incidents occur at a high enough frequency that the randomization process may have been flawed. In this case, finding 6% of the combinations tested having statistically significant differences in hourly load is within the acceptable range. Again, many of the comparisons are within segments that do not require load impact estimates and these cases are not cause for concern.

6.3 SDG&E

6.3.1 Comparison of Average Values for Selected Characteristics

Table 6-8 lists all instances where the treatment and control group customers within a segment had preexisting differences. In the workbook, users are able to select a specific customer segment to identify any variables with statistically significant differences. Cells in the table highlighted in orange indicate that there is a p-value of less than 0.05—in this instance, for Rate 1 for the household size variable. This means there is at least a 95% chance that the household sizes are different between Rate 1 and the Control group within the Cool, Non-CARE/FERA group. The complete list of variables, segments, and rates with significant differences will be discussed next along with any implications.

Table 6-8: Example of Customer Characteristics Validation Output: Hot Climate Region, CARE/FERA

Select Segment:	Cool, Non-CARE
Rate 1	1,059
Rate 2	1,802
Control	1,050
Total	**3,911**

*Enrollments as of a rate-change

Test		Rate 1	Rate 2	Control	P-Values	
					Rate 1 & Control	Rate 2 & Control
Heat Type	None	80%	79%	80%	0.59	0.86
	Space Heat	16%	17%	16%		
	Space and Water	4%	3%	3%		
	Water Heat	0%	1%	1%		
Household Size		2.42	2.33	2.29	0.01	0.36
MyAccount	Y	65%	64%	65%	0.90	0.61
	N	35%	36%	35%		
CARE	Y					
	N	100%	100%	100%		
Senior	Y	28%	28%	28%	0.98	0.74
	N	72%	72%	72%		
Persona	Low/Avg Tech	46%	44%	44%	0.49	0.74
	Higher Tech	54%	56%	56%		
FPG	<100%	2%	2%	2%	0.90	0.72
	100%-200%	5%	5%	5%		
	>200%	66%	65%	67%		
Behavior Program	Y	53%	53%	49%	0.09	0.03
	N	47%	47%	51%		
DR Program	Y	20%	21%	19%	0.32	0.13
	N	80%	79%	81%		

Table 6-9 contains the list of customer characteristic variables with statistically significant differences between the treatment and control group by rate and segment. Overall, four different customer characteristic variables had at least one rate and segment combination with a significant difference. The Cool Non-CARE segment had the most customer characteristics with significant differences between treatment and control.

Table 6-9: Customer Characteristic Variables with Statistically Significant Differences between Treatment & Control Group by Rate and Segment

Characteristic	Rate	Segment
Behavior Program	2	Cool, Non-CARE
DR Program	1	Cool, CARE
Household Size	1	Cool, Non-CARE
MyAccount	2	Moderate, Non-CARE

While 4 statistically significant differences were observed, 88 different rate-segment-characteristic combinations were tested. This results in an overall rate of only 4.5% of those combinations exhibiting statistically significant differences. In a sample drawn to facilitate estimations of load impacts at a 90% confidence level, there is always a chance of observing some statistically significant differences just by random chance. Based on these observations, the number of statistically significant differences observed falls within the range that should be expected from a properly implemented randomization.

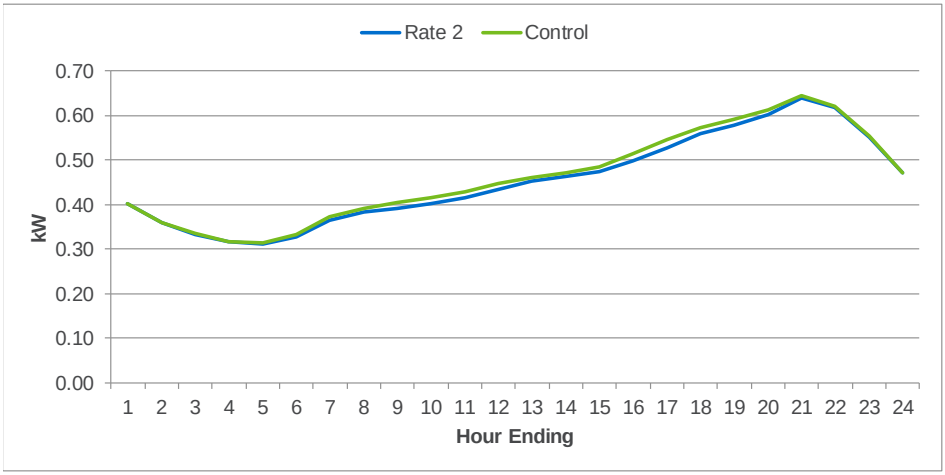
6.3.2 Comparison of Hourly Load Shapes by Season, Day Type, Rate Period, Segment, and Rate

Figure 6-4 was developed to identify any instances where the treatment and control group customers within a segment had preexisting differences in hourly load shapes. In the workbook, users are able to select a specific customer segment, season, day type, and rate and view the hourly load shapes for the treatment and control group along with counts showing the number of customers by treatment and control group. The example shows the hourly load shapes for CARE customers in the Cool Climate Region on a Summer Weekday on Rate 2 or the Control group. The lines are visually very close together and there is not a statistically significant difference in hourly load between the treatment and control groups for this segment on this particular day type.

Figure 6-4: Comparison of Hourly Load Shapes by Season, Day Type, Rate Period, Segment, and Rate

Segment	Cool, CARE
FPG	All
CARE	All
Senior	All
Season	Summer
Weekday	Weekday
Rate	Rate 2

Assignment	# of Customers
Rate 2	1,493
Control	867



Hour	Rate 2	Control
1	0.40	0.40
2	0.36	0.36
3	0.33	0.33
4	0.32	0.32
5	0.31	0.31
6	0.33	0.33
7	0.36	0.37
8	0.38	0.39
9	0.39	0.41
10	0.40	0.41
11	0.42	0.43
12	0.43	0.45
13	0.45	0.46
14	0.46	0.47
15	0.47	0.49
16	0.50	0.51
17	0.53	0.54
18	0.56	0.57
19	0.58	0.59
20	0.60	0.61
21	0.64	0.64
22	0.62	0.62
23	0.55	0.55
24	0.47	0.47

In order to efficiently evaluate all 80 combinations of Rate Type, Segment, Season, Day Type, and TOU Period, a program was written in Stata to systematically iterate through all of the different combinations and conduct T-tests to identify any combinations with a statistically significant difference in load. Ultimately, 6 instances out of the 80 combinations tested (7.5%) were found to have statistically significant differences in load—these are listed in Table 6-10. All of the statistically significant differences were between Rate 1 and Control customers in the Cool, CARE customer segment. During all day types and summer and winter months, the Control customers consistently had greater demand than Rate 1 customers in the pretreatment period from May 1, 2015 through May 31, 2016.

Table 6-10: Statistically Significant Differences in Hourly Load between Treatment & Control Group by Segment, Rate, Season, Day Type, and Rate Period

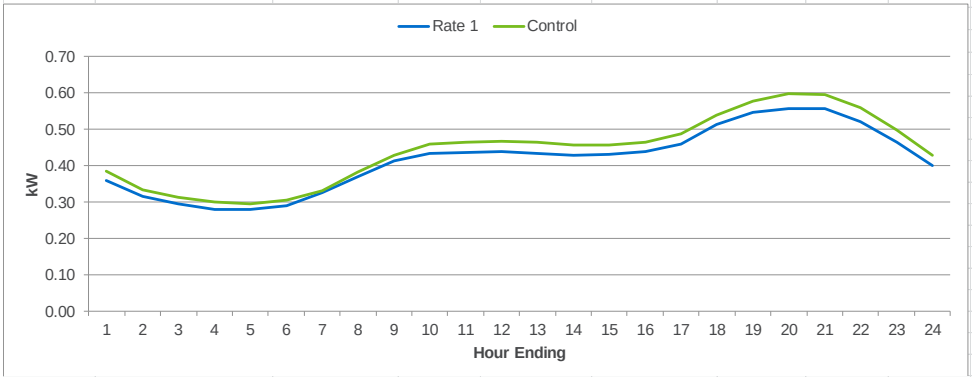
Issue	Segment	Rate	Season	Weekday/ Weekend	Rate Period	P-Value
1	Cool, CARE	Rate 1	Summer	Weekday	Peak	0.05
2	Cool, CARE	Rate 1	Summer	Weekend	Super Off-Peak	0.05
3	Cool, CARE	Rate 1	Winter	Weekday	Off-Peak	0.04
4	Cool, CARE	Rate 1	Winter	Weekday	Peak	0.03
5	Cool, CARE	Rate 1	Winter	Weekend	Off-Peak	0.03
6	Cool, CARE	Rate 1	Winter	Weekend	Peak	0.03

Figure 6-5 provides an example of a Segment-Rate-Season-Day Type- Rate Period combination with a statistically significant difference in hourly load. In this example, there is an approximately 6% difference in load during the peak period for CARE/FERA customers in the Cool Climate Region on Winter Weekend on Rate 1 compared to the Control group.

Figure 6-5: Example of Statistically Significant Difference in Hourly Load

Issue	6
Segment	Cool, CARE
Season	Winter
Weekday	Weekend
Rate	Rate 1
Treatment Customers	993
Control Customers	987

Period	Peak
Treatment Mean kW during Peak	0.52
Control Mean kW during Peak	0.56
% Difference	6%
P-value	0.027



Hour	Rate 1	Control
1	0.36	0.38
2	0.31	0.33
3	0.29	0.31
4	0.28	0.30
5	0.28	0.29
6	0.29	0.31
7	0.32	0.33
8	0.37	0.38
9	0.41	0.43
10	0.43	0.46
11	0.44	0.46
12	0.44	0.47
13	0.43	0.46
14	0.43	0.46
15	0.43	0.46
16	0.44	0.46
17	0.46	0.49
18	0.51	0.54
19	0.55	0.58
20	0.56	0.60
21	0.56	0.60
22	0.52	0.56
23	0.46	0.50
24	0.40	0.43

All of the statistically significant differences in load are related to the CARE/FERA customers in the Cool climate region on Rate 1. On average, it appears the difference in load between the treatment and control groups is approximately 6%. Historically, DiD estimations have offset much larger differences than this, so it is unlikely there will be a problem in generating the point estimate for the load impact. However, the power calculations used to determine the minimum sample sizes needed to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence indicate a minimum of 1,250 treatment and 1,250 control customers are needed in the Cool climate region. In this case, only approximately 990 customers are available for the treatment and control groups. This will likely result in less confidence in the estimates from the Cool climate region for CARE/FERA customers on Rate 1; expressed as having wider confidence intervals compared to if there was a larger sample size. Given the small sample size and the difference in load, when conducting the analysis we will check for any outliers that may be driving the difference in load and address them as appropriate.

7 Detailed Work Plan

The quantitative analysis to be conducted includes estimation of energy and load impacts for each treatment for a variety of customer segments and climate regions as well as the estimation of bill impacts for selected segments. Treatments include both TOU rates as well as usage alerts for SDG&E, smart thermostats for SCE, and an app for PG&E. For bill impacts, relevant customer segments include CARE/FERA and non-CARE/FERA customers in all climate regions, and senior households and CARE/FERA customers categorized by selected income strata within the hot climate regions of SCE and PG&E. For SDG&E, which only has about 16,000 households in its hot climate region, it is yet to be determined whether there will be enough participants to estimate either load impacts or bill impacts with reasonable statistical precision for any subpopulations of interest. The bill and impact evaluation work will be conducted through the four subtasks.

7.1 Task 2a: Data Cleaning and Preparation

This task will involve all necessary steps to request, transfer, receive, clean, format, and prepare data for analysis. Data to be provided over the course of the project will include, but not necessarily be limited to:

- Interval load data covering from May 1, 2015 to June 1, 2016 for pretreatment load validation; and for all hours from June 1, 2016 through December 2017 for the impact evaluation;
- Weather data for the same time period;
- Climate zone designation and weather station assignment for each account;
- Experimental assignment (which would encompass the rate and any other treatment to which each account is assigned, including whether or not they are assigned to the control condition);
- Assigned ME&O materials and the date of delivery for each set of materials;
- Customer demographic data from IOU databases (including psychographic profiles, customer characteristics from commercial databases held by the IOUs and also from the enrollment surveys that will be used to collect data on income, age and household size);
- Participation in other programs, including EE, behavioral conservation, and demand response programs;
- Customer enrollment date;
- Customer drop out date if any; and
- Account closure date.

Once the surveys have been completed, Nexant will request data on selected survey variables that may be incorporated into the billing and impact analysis.

Nexant provide the initial data request on June 8, 2016 identifying the data needed to conduct the initial data validation and randomization checks. Upon receipt of the data, Nexant has had regular conversations with the IOUs to discuss missing data and to resolve data issues.

Given that the evaluation will take place in stages, databases will be provided and updated several times. Customer enrollment, demographic, and historical load data will be provided once at the outset of the study. Load, and weather data will be provided four times: During the 2016 summer for initial validation checks; at the end of the 2016 summer period; after one full year of the pilot has gone by (June 2017); and at the conclusion of the pilot (Q4 2017).

Upon receiving the first batch of experimental assignment data and customer data, Nexant analyzed the data and compared the values of all relevant variables between all treatment and control samples to validate the random assignment of accounts to treatment and control conditions. These results are presented in Section 6 of this document. Nexant will also make similar comparisons between the enrolled population and those who were recruited but declined to determine the nature of selection bias associated with the enrolled population.

At the conclusion of the project, Nexant will deliver a project database that includes all of the data collected or developed over the course of the project. During the planning phase of the project, Nexant will seek input from the IOUs and Energy Division regarding whether just the final analysis database will be provided or whether interim databases will also need to be delivered. Recipients will include SCE, PG&E, and SDG&E under appropriate confidentiality protections. The database will be readable using a commercially available data management software package.

Task	Deliverables	Due Date
2a	Data requested, received, and cleaned	June 2016 (Complete) Oct/Nov 2016 June 2017 November 2017
2a	Brief memo summarizing experimental validation findings	Complete42 (See Section 6)
2a	Develop and maintain a data dictionary	On-going
2a	Deliver a project database at the conclusion of the project	March 2018

7.2 Task 2c: Bill Impact Analysis and Reporting

In this subtask, Nexant will estimate bill impacts from TOU rates for various customer segments to better inform the Commission's consideration of Section 745 issues. Bill impacts will be estimated by calculating the difference between bills based on the TOU rate and the otherwise applicable tariff (OAT), holding usage constant. Bill impacts will be estimated based on both pre and post-treatment usage for both treatment and control customers for a variety of customer segments, including seniors, CARE/FERA, non-CARE/FERA, households with incomes less than 100% of Federal Poverty Guidelines (FPG) and households with incomes between 100 and 200% of FPG in the hot climate regions. In moderate and cool climate regions, accurate bill impact distributions will be produced for CARE/FERA and non-CARE/FERA households and for the population as a whole. Nexant will seek input from the TOU Working Group regarding the most useful formats and metrics for reporting bill impacts, which may include:

1. Displaying the full distribution of bill impacts for each relevant customer segment based on pretreatment data (showing both percentage changes and absolute changes in separate graphs) so as to highlight the structural winners and non-winners in each segment;

[42] Complete for SCE and PG&E, SDG&E is currently pending due to outstanding questions regarding the data.

2. Displaying the same curves for the post-treatment period, with control and treatment customer distributions included in the same graph to illustrate if the distribution for participants shifts to the left or changes shape compared with the distribution for control customers; and
3. Tables showing the percent of customers with bill impacts greater than or less than various percentage or absolute values—e.g., percent that have bill impacts between 0 and $10, $10 and $20, greater than $20, etc.—in these tables, Nexant would use the difference-in-differences analysis as summarized in Section 5.2 to adjust these values for the participant population based on changes in bill impacts over time in the control group due to exogenous factors.

Bill impacts will be calculated after the first summer, and then again a full year after pilot launch (July 1, 2017 or after). Nexant will estimate bill impacts based on summer usage, winter usage, and annual usage. Nexant will also report whether bill impacts among drop-outs are different from those of the remaining population. The bill impacts among populations with enabling technology will also be investigated.

Task	Deliverables	Due Date
2c	Bill impact calculations (After first summer)	Oct/Nov/Dec 2016
2c	Complete a section of the First Interim Report describing the results from the bill impact analysis, for review by the IOU project team.	December 2016
2c	Bill impact calculations (After full year)	After July 1, 2017
2c	Complete a section of the Second Interim Report describing the results from the bill impact analysis, for review by the IOU project team.	August 2017
2c	Produce a revised draft bill impacts section of the Second Interim Report that reflects comments from the IOU project team and is suitable for presentation to the TOU Working Group, as part of the Second Interim Results Presentation.	September 2017
2c	Incorporate input as appropriate to finalize the bill impact section of the Second Interim Report.	By October 1, 2017

7.3 Task 2d: Load Impact Analysis and Reporting

In this subtask, Nexant will estimate load impacts for all pilot treatments. Estimates will be produced and reported at three times over the course of the study: after the first summer period ends (Q3 2016); one full year from the pilot launch (after July 1, 2017); and after completion of the pilot (Q4 2017). The impact evaluation will 1) assess changes in energy usage and load in response to TOU rates among different customer segments in the general pilot population; 2) assess load impacts among populations with enabling technology for SCE;[43] 3) estimate the incremental effect of an information treatment for PG&E[43] and SDG&E;[43] and 4) estimate the incremental effect of participation in a behavior program for those IOUs with a sufficient number of overlap among TOU rates and behavior programs.

[43] The sample size is very small for each of the IOU technology treatments and it may not be possible to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence.

The analysis will be done according to the methods presented in the Section 5 of this research plan. Most load impacts will be based on data on both treatment and control customers from the RCT and RED experiments that will be conducted using difference-in-differences estimation. Where enrollment is not large enough to support estimation based on RED analysis, Nexant will produce a suitable comparison group using statistical matching and estimate impacts using difference-in-differences analysis.

Nexant will produce load impact estimates that conform to the requirements for ex post evaluation of nonevent based demand response resources as indicated in California's Demand Response Load Impact protocols. These protocols require that load impacts in each hour be developed for the average weekday and monthly system peak day for each month of the year. Although not required by the protocols, Nexant plans to also produce impact estimates for weekends (unless directed not to do so), at least for the SDG&E rate treatments since SDG&E often experiences high demand days on weekends. Nexant will also produce and deliver the electronic load impact tables that are provided to the IOUs and the Commission in conjunction with the annual load impacts evaluations for demand response and rate programs each year. These Excel tables have pull down menus that allow users to select from among a large number of day types, seasons, customer segments, etc. Finally, Nexant will investigate whether load impacts persist across the two summers. This analysis will be done for the subset of customers that have stayed on the rates the entire time.

Task	Deliverables	Due Date
2d	Complete load impact calculation for summer 2016 period	Oct/Nov 2016
2d	Complete a section of the First Interim Report that documents the methodologies and load impact estimates, for review by the IOU project team	December 2016
2d	Revised draft interim report that reflects comments from the IOU project team and is suitable for presentation to the TOU Working Group, as part of the First Interim Results Presentation	January 2017
2d	Incorporate input as appropriate to finalize the load impact section of the First Interim Report	March 2017
2d	Complete load impact calculation for full first year of the pilot	July/August 2017
2d	Complete a section of the Second Interim Report that documents the methodologies and load impact estimates, for review by the IOU project team	September 2017
2d	Revised draft report that reflects comments from the IOU project team and is suitable for presentation to the TOU Working Group, as part of the Second Interim Results Presentation	September 2017
2d	Incorporate input as appropriate to finalize load impact section of the Second Interim Report	By October 1, 2017
2d	Complete load impact calculation for the entire duration of the pilot	Nov/Dec 2017
2d	Complete a section of the final report that documents the methodologies and load impact estimates, for review by the project team	January 2018
2d	Revised draft report that reflects comments from the IOU project team and is suitable for presentation to the TOU Working Group, as part of the Final Results Presentation	February 2018
2d	Incorporate input as appropriate to finalize load impact section of the Final Report	March 2018

8 Deliverables Schedule and Due Dates

Task	Deliverables	Due Date
2a	Data requested, received, and cleaned	• June 2016 (Complete) • Oct/Nov 2016 • June 2017 • November 2017
	Brief memo summarizing experimental validation findings	Complete[44] (See Section 6)
	Develop and maintain a data dictionary	On-going
	Deliver a project database at the conclusion of the project	Mar-18
2c	Bill impact calculations (After first summer)	Oct/Nov 2016
	Complete a section of the First Interim Report describing the results from the bill impact analysis, for review by the IOU project team.	Dec-16
	Bill impact calculations (After full year)	After July 1, 2017
	Complete a section of the Second Interim Report describing the results from the bill impact analysis, for review by the IOU project team.	Aug-17
	Produce a revised draft bill impacts section of the Second Interim Report that reflects comments from the IOU project team and is suitable for presentation to the TOU Working Group, as part of the Second Interim Results Presentation.	Sep-17
	Incorporate input as appropriate to finalize the bill impact section of the Second Interim Report	By October 1, 2017

Table continues below.

[44] Complete for SCE and PG&E, SDG&E is currently pending due to outstanding questions regarding the data.

Task	Deliverables	Due Date
2d	Complete load impact calculation for summer 2016 period	Oct/Nov 2016
	Complete a section of the First Interim Report that documents the methodologies and load impact estimates, for review by the IOU project team	Dec-16
	Revised draft interim report that reflects comments from the IOU project team and is suitable for presentation to the TOU Working Group, as part of the First Interim Results Presentation	Jan-17
	Incorporate input as appropriate to finalize the load impact section of the First Interim Report	Mar-17
	Complete load impact calculation for full first year of the pilot	July/August 2017
	Complete a section of the Second Interim Report that documents the methodologies and load impact estimates, for review by the IOU project team	Sep-17
	Revised draft report that reflects comments from the IOU project team and is suitable for presentation to the TOU Working Group, as part of the Second Interim Results Presentation	Sep-17
	Incorporate input as appropriate to finalize load impact section of the Second Interim Report	By October 1, 2017
	Complete load impact calculation for the entire duration of the pilot	Nov/Dec 2017
	Complete a section of the final report that documents the methodologies and load impact estimates, for review by the project team	Jan-18
	Revised draft report that reflects comments from the IOU project team and is suitable for presentation to the TOU Working Group, as part of the Final Results Presentation	Feb-18
	Incorporate input as appropriate to finalize load impact section of the Final Report	Mar-18

Appendix A Statewide TOU Pilot Evaluation Data Request 1

Date: June 8, 2016

To: PG&E, SCE, SDG&E

CC: CPUC Energy Division

From: Stephen George, Eric Bell; Nexant

Jane Peters, Alex Dunn; Research Into Action

Subject: Statewide TOU Pilot evaluation data request 1

This memo outlines the data we would like to receive in order to begin the evaluation of the California Statewide Time of Use (TOU) pilot. The evaluation will include customer surveys as well as load impacts associated with a variety of TOU rates. This is the initial data request for the evaluation and there will be additional data requests during the pilot. Before identifying the requested data, we define some key terms in order to ensure that there is no confusion about what is being requested.

- **Offer Recipients:** These are accounts that received an offer to participate in the pilot.
- **Customers Who Accept Offer:** This is different from enrollees since not everyone who accepts is successfully enrolled.
- **Enrollees:** This refers to customers who successfully enroll in the pilot and experience a rate change or are assigned to the control group.
- **Non-Respondents:** These are *Offer Recipients* who did not respond or did not accept the offer.
- **Opt-Out:** These are *Customers Who Accepted the Offer* initially and later opted out.
- **Over-Recruited Customers:** These are *Customers Who Accepted the Offer* and were not ultimately *enrolled* because they were surplus beyond the recruitment targets.
- **Ineligible:** These are *Customers Who Accepted the Offer* and later became ineligible.
- **Pilot ID Number:** Any ID number assigned for purposes of the pilot, including any ID that was given to them in their recruitment letter/email needed to enroll online or provide to the CSR if they called in to enroll.
- **Utility ID Numbers:** Any relevant ID numbers tied to these customers.
    a. **PG&E:** Account ID, Premise ID, Service Agreement ID, Service Point ID

b. **SCE:** Customer Account Number, Service Account Number, Premise ID

c. **SDG&E:** Customer Number, Account Number, Premise ID, Service Point ID

- **Climate region:** This refers to the region in which the customer is located as defined in the pilot: Hot, Moderate, or Cool.
- **Rate treatment:** The rate assigned to an enrollee at the onset of treatment. This includes assignment to a control group.
- **Technology treatment:** Various technology treatments such as a smart thermostat or using a smartphone app.
- **Education and Outreach treatment:** If different versions of education and outreach material are being tested, the version each customer receives should be identified for tracking purposes.
- **Customer segments:** This refers to the following demographic segments:[45]
  - Hot Region – Non-CARE
  - Hot Region – CARE
  - Hot Region – General
  - Hot Region – Seniors < 100% FPL
  - Hot Region – Seniors > 100% FPL
  - Hot Region – CARE Non-seniors < 100% FPL
  - Hot Region – CARE Non-seniors > 100% FPL
  - Moderate Region – Non-CARE
  - Moderate Region – CARE
  - Cool Region – Non-CARE
  - Cool Region – CARE
- **Random Sample of Non-Respondents**- for interval data
  - Utilities will randomly select a sample of *Non-Respondent* customers equal in size to the total number of *Customers Who Accepted an Offer*.
  - *Non-Respondent* customers should be randomly selected from within each *Customer Segment* (see prior bullet), as appropriate.

[45] To confirm, per the WG decision IOUs will first base classifications on self-reported data. If this data is missing they will go with third-party data. Please note what data was used for each customer. Note: Segmentation examples below were drawn from SCE's recruitment update report. Utilities should use segments as appropriate, i.e. SDG&E does not have segmentation targets within the Hot Region.

- The number of *Non-Respondent* customers randomly selected within each *Customer Segment* should be equal to the total number of *Customers Who Accepted the Offer* within that *Customer Segment*.
- The relevant *Utility ID Numbers* and corresponding *Customer Segment* in the sample will be provided in a dataset.

With these definitions in mind, the following data will be necessary to complete the analysis.

DATA REQUEST	DETAILED DESCRIPTION	NOTES/QUESTIONS
1. Offer Recipients	**Please include the following data for all *offer recipients*:** These are accounts that received an offer to participate in the pilot. 1. *Utility ID Numbers* tied to these customers. 2. *Pilot ID Number* 3. Customer Account start date 4. Service Account/Agreement Establishment Date 5. Service Account/Agreement Close Date 6. Rate schedule prior to pilot participation 7. CARE/FERA status (CARE, FERA, Neither) 8. Opower Treatment flag (if applicable to IOU) 9. Variables, criteria, and/or applicable thresholds used to screen the residential population to arrive at the final list of offer recipients[46] 10. Personas (include all personas, not just clusters for E&O) 11. Documentation/definitions needed to interpret any variables related to screening, segmentation, and personas 12. Service Zip Code 13. CEC Climate Zone 14. *Climate* Region: Hot, Moderate, or Cool as defined in the pilot 15. Rate Climate Zone / Baseline Territory 16. All Electric Flag 17. Weather Station 18. Local Capacity Area 19. Distribution data[47]: Circuit number/name , Substation number/name, Sublap, A-Bank, etc. 20. Annual Usage (last 12 months) 21. Annual Billing Days (last 12 months, consistent with annual usage) 22. Average Summer Monthly Usage[48] 23. Participation in other DSM programs in the past 12 months[49,50]	**Use:** This data will be used: • To facilitate analysis of acceptance and enrollment rates by treatment type and customer characteristics; and • For internal (randomization) and external validation checks. **Timeline:** As soon as possible

[46] While this data is not necessary for completing the validations, it will used for documenting the screening process in the report.

[47] Naming conventions may vary by utility, please include data typically provided in DR evaluations.

[48] Some IOUs have this as a readily available variable. If this isn't a standard variable, please contact Nexant to discuss.

[49] Data for the entire population rather than just offer recipients is acceptable if it is easier for the utility.

DATA REQUEST	DETAILED DESCRIPTION	NOTES/QUESTIONS
	a. Program name b. Start and end date (if applicable) c. If EE program: i. Installation date 24. Segmentation variables used for sampling in recruitment a. Climate region b. Senior/non-Senior c. Low income i. <100% FPG ii. 100%-200% FPG iii. >200% FPG	
2. Customers Who Accept Offer	**Please include the following data for all *customers accepting an offer*:** 1. Utility ID Numbers 2. *Pilot ID Number* 3. Customer acceptance 4. Date of customer acceptance 5. Distinguish between pretest and primary campaign, if applicable 6. A variable indicating if the customer was denied participation 7. Indicate if the customer was denied participation due to ineligibility or over-enrollment (separately) 8. Reason for declining customer, if available 9. Variables used for post acceptance segmentation assignment 10. Source(s) of data used for post acceptance segmentation assignment 11. Treatment assignment 12. Rate treatment (including control group) 13. Rate change effective date 14. Technology treatment 15. Education and outreach treatment i. Basic or Advanced ii. Persona cluster for purposes of E&O	**Use:** This data will be used: • To identify customers who accepted the offer; and • Begin tracking of customer participation and opt-out trends. **Timeline:** As soon as possible

[50] IOU may use best judgement on what programs to include. The objective for collecting this data is to ensure that DSM program participation is balanced between the treatment and control group, and to compare the DSM program participation rates between the customers who accept the offer and the non-responders. DSM programs that were excluded from the eligibility criteria need not be included. Nexant is available to discuss in further detail should there be interest or questions about particular DSM programs, or including other utility based programs that don't explicitly fall under the EE or DR program categories such as SCE's Budget Assistant Program.

DATA REQUEST	DETAILED DESCRIPTION	NOTES/QUESTIONS
	16. Date Welcome Kit mailed[51]	
3. Enrollment survey data	Please provide the final survey used for enrollment and all enrollment survey responses. 1. Utility ID Number 2. Pilot ID Number 3. Individual customer level survey response data	**Use:** This data will be used: • To validate customer segmentation initially completed with utility data; • To identify self-reported customer characteristics used for internal validation; and • For cross tabulation of various survey responses with self-reported customer characteristics. **Timeline:** As soon as possible
4. Customer contact information for survey deployment	**Please include the following data for all *enrollees*:** 1. Utility ID Numbers 2. *Pilot ID Number* 3. Customer Name 4. Customer Email Address 5. Customer Telephone Number 6. Service Address 7. Service City 8. Billing Address 9. Billing City 10. Billing Zip Code 11. Paperless billing flag 12. Flag indicating if a customer was originally on paperless billing, as this may change for some customers based on their rate assignment	**Use:** This data will be used: • To provide contact information for the survey deployment. **Timeline:** By 9/1/2016
5. Pilot implementation documentation	▪ Please provide any implementation process flow documentation and any documentation showing timelines for implementing key pilot aspects such as recruitment, delivery of Welcome Kits, dates for delivery of ME&O materials.	**Use:** This data will be used: • To develop survey questions; and • Documenting pilot timeline for report.

[51] If all welcome kits were mailed within a few days, the date range for the group is fine.

DATA REQUEST	DETAILED DESCRIPTION	NOTES/QUESTIONS
		Timeline: As soon as possible
6. All ME&O documents and implementation plans	▪ Please provide examples of all ME&O material and the plans/schedule for when the materials will be (or actually were) delivered to customers.	**Use:** This data will be used: • For developing survey question to test the recall and effectiveness of the ME&O efforts; and • For documenting the ME&O for the pilot in the report. **Timeline:** As soon as possible
7. Pilot opt-outs[52]	▪ Please provide monthly datasets indicating which customers have opted out of the pilot 1. Utility ID Numbers 2. Pilot ID Number 3. Opt-out date 4. Disposition a. Actively chose to leave while still eligible i. Opt-out reason (if available) b. Ineligible (e.g. NEM, CCA, Medical Baseline) c. Account closed	**Use:** This data will be used: • Tracking customer opt-outs during the pilot to determine rate preferences; and • Remove customers who have dropped out from the impact evaluation. **Timeline:** Monthly, starting at the end of June 2016
8. Interval Data	▪ Please provide hourly electricity consumption data for the following: • All days/hours from May 1, 2015 to present • All *Customers Who Accepted Offer* • *Random sample of Non-Respondents* ▪ Please note whether the interval data is provided in Pacific Daylight Time (PDT) or Pacific Standard Time (PST). If data is provided in sub-hourly intervals, please indicate whether the meter records kWh/hr (average hourly demand) or the kWh consumed over the time period. The	**Use:** This data will be used: • For internal (randomization) and external validation checks; and • Load impact estimation. **Timeline:** As soon as possible

[52] These are Customer Who Accepted the Offer initially and later opted out. This includes any customers who immediately opted out upon learning their rate assignment, even if they haven't officially been changed on to the rate.

DATA REQUEST	DETAILED DESCRIPTION	NOTES/QUESTIONS
	following variables should be provided: 1. Utility ID Numbers 2. Date 3. Hour ending 4. Average hourly kW or kWh 5. Units of measurement	

Appendix B SCE Deliverables and Outcomes from Resolution E-4761

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
1	The average change in peak and off-peak energy usage by seniors and customers in hot climate zones as a result of a given TOU rate.	SCE will employ a RCT design and pay-to-play (PTP) recruitment strategy to recruit approximately 2,888 customers onto each of Rate 2 and the control rate (the otherwise applicable tariff (OAT) or tiered rate) in SCE's hot climate region. Sample sizes will be large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence for a variety of customer segments on Rate 2 in SCE's hot climate region, including seniors, CARE/FERA customers, and households with incomes ≤ 100% of the federal poverty guidelines (FPG).	hot	2	+/-2-3% @ 90%	CARE/FERA	625	1851	1226
						HH $ < 100% FPG	625	1222	597
						Senior	625	1618	993
					Count	All of Rate 2 in Hot	2888	3359	471
			hot	Control	+/-2-3% @ 90%	CARE/FERA	625	1862	1237
						HH $ < 100% FPG	625	1216	591
						Senior	625	1678	1053
					Count	All Control in Hot	2888	3413	525
2	The impact of a given TOU rate on the bills of seniors and economically vulnerable customers in hot climate zones (i.e., the distribution of bill impacts).	Bills will be calculated for both treatment and control customers in two ways; as if their usage were billed on the TOU rate in question, and as if their usage were billed on the OAT. The difference between those two bills will result in a distribution of bill impacts for treatment customers and a distribution of bill impacts for control customers. Comparing the two distributions will illustrate how much of the bill impact results from structural wins and losses and how much results from changes in usage in response to the TOU rate. Sample sizes will be large enough to produce valid bill impact distributions for a variety of	Hot	2	Valid bill impact distributions	Senior	625	1618	993
						CARE/FERA	625	1851	1226
						HH $ < 100% FPG	625	1222	597
						100% FPG < HH $ < 200% FPG	625	996	371

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
		customer segments on Rate 2 in SCE's hot climate region, including seniors, CARE/FERA customers, households with incomes ≤ 100% of FPG, and households with incomes between 100 and 200% of FPG.							
3	The impact of a given TOU rate on how seniors and economically vulnerable customers in hot climate zones change their energy usage and on these customers' choices regarding other household expenses.	Surveys will be administered to both treatment and control customers, and will include questions regarding energy usage habits (e.g. the timing of end-use activities, thermostat settings by rate period) and barriers to load shifting or load reduction activities. Questions will also be designed to detect certain forms of hardship (e.g. not paying other bills to pay energy bill). Answers will be compared between treatment and control customers to determine whether certain behaviors or activities are higher among customers on TOU rates relative to customers on the OAT. Sample sizes will be large enough to produce valid survey data for a variety of customer segments in SCE's hot climate region, including CARE/FERA customers on Rate 1; seniors, CARE/FERA customers, households with incomes ≤ 100% of FPG, and households with incomes between 100 and 200% of FPG on Rate 2; and CARE/FERA customers on Rate 3.	Hot	1	large enough to produce valid survey data	CARE/FERA	313	733	420
				2		Seniors	313	1618	1305
						CARE/FERA	313	1851	1538
						HH $ < 100% FPG	313	1222	909
						100% FPG < HH $ < 200% FPG	313	996	683
				3		CARE/FERA	313	582	269

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
4	The average change in peak and off-peak energy usage as a result of a given TOU rate for all customers in SCE's service territory, all customers in SCE's hot climate region, and all customers in SCE's moderate climate region.	SCE will employ a RCT design to recruit customers onto the three TOU rates and the control rate. The total number of SCE customers on each of Rates 1 and 3 will be approximately 3,750, and 5,388 on Rate 2. The RCT sampling approach will also be used to create minimum samples of roughly 1,250 customers for each TOU rate in each of SCE's hot, moderate and cool climate regions. Sample sizes will be large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence for all customers for a given TOU rate across SCE's service territory as a whole and for a given TOU rate in each of SCE's hot and moderate climate regions.	All	1	Count	All	3750	4266	516
			All	2		All	5388	6219	831
			All	3		All	3750	3746	-4
			Hot	1		All	1250	1409	159
				2		All	1250	3359	2109
				3		All	1250	1246	-4
			Moderate	1		All	1250	1386	136
				2		All	1250	1383	133
				3		All	1250	1250	0
			Cool	1		All	1250	1471	221
				2		All	1250	1477	227
				3		All	1250	1250	0
			All	1	+/-2-3% @ 90%	All	1000	4266	3266
			All	2		All	1000	6219	5219
			All	3		All	1000	3548	2548
			Hot	1		All	625	1409	784
			Moderate	1		All	938	1386	448
			Hot	2		All	625	3359	2734
			Moderate	2		All	938	1383	445
			Hot	3		All	625	1170	545
			Moderate	3		All	938	1201	263

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
5	The average change in peak and off-peak energy usage as a result of a given TOU rate for CARE/FERA and non-CARE/FERA customers across SCE's territory as a whole and in the hot climate region for Rate 2.	The RCT design, PTP recruitment strategy and recruitment targets described above will create sample sizes large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence for CARE/FERA and non-CARE/FERA customers for a given TOU rate across SCE's service territory as a whole and for Rate 2 in SCE's hot climate region.	All	1	+/-2-3% @ 90%	CARE/FERA	1000	2194	1194
			All	2		CARE/FERA	1000	3314	2314
			All	3		CARE/FERA	1000	1770	770
			All	1		Non-CARE/FERA	1000	2072	1072
			All	2		Non-CARE/FERA	1000	2905	1905
			All	3		Non-CARE/FERA	1000	1778	778
			Hot	2		CARE/FERA	625	1851	1226
			Hot	2		Non-CARE/FERA	625	1508	883

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
6	The impact of a given TOU rate on the bills of CARE/FERA customers and non-CARE/FERA customers (i.e., the distribution of bill impacts) in SCE's entire territory and in the hot, moderate and cool climate regions separately.	Bills will be calculated for both treatment and control customers in two ways; as if their usage were billed on the TOU rate in question, and as if their usage were billed on the OAT. The difference between those two bills will result in a distribution of bill impacts for treatment customers and a distribution of bill impacts for control customers. Comparing the two distributions will illustrate how much of the bill impact results from structural wins and losses and how much results from changes in usage in response to the TOU rate. Sample sizes will be large enough to produce valid bill impact distributions for CARE/FERA and non-CARE/FERA customers for a given TOU rate across SCE's service territory as a whole and in each of SCE's hot, moderate and cool climate regions.	All	1	valid bill impact distributions	CARE/FERA	625	2194	1569
			All	2		CARE/FERA	625	3314	2689
			All	3		CARE/FERA	625	1770	1145
			All	1		Non-CARE/FERA	625	2072	1447
			All	2		Non-CARE/FERA	625	2905	2280
			All	3		Non-CARE/FERA	625	1778	1153
			Hot	1		CARE/FERA	625	733	108
			Hot	2		CARE/FERA	625	1851	1226
			Hot	3		CARE/FERA	625	621	-4
			Hot	1		Non-CARE/FERA	625	676	51
			Hot	2		Non-CARE/FERA	625	1508	883
			Hot	3		Non-CARE/FERA	625	625	0
			Moderate	1		CARE/FERA	625	727	102
			Moderate	2		CARE/FERA	625	728	103
			Moderate	3		CARE/FERA	625	625	0
			Moderate	1		Non-CARE/FERA	625	659	34
			Moderate	2		Non-CARE/FERA	625	655	30
			Moderate	3		Non-CARE/FERA	625	625	0
			Cool	1		CARE/FERA	625	734	109
			Cool	2		CARE/FERA	625	735	110
			Cool	3		CARE/FERA	625	625	0
			Cool	1		Non-CARE/FERA	625	737	112
			Cool	2		Non-CARE/FERA	625	742	117
			Cool	3		Non-CARE/FERA	625	625	0

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
7	The impact of a given TOU rate on how CARE/FERA customers and non-CARE/FERA customers – in SCE's entire territory and in the hot, moderate and cool climate regions separately – change their energy usage and on these customers' choices regarding other household expenses.	Surveys will be administered to both treatment and control customers, and will include questions regarding energy usage habits (e.g. the timing of end-use activities, thermostat settings by rate period) and barriers to load shifting or load reduction activities. Questions will also be designed to detect certain forms of hardship (e.g. not paying other bills to pay energy bill). Answers will be compared between treatment and control customers to determine whether certain behaviors or activities are higher among customers on TOU rates relative to customers on the OAT. Sample sizes will be large enough to produce valid survey data for CARE/FERA and non-CARE/FERA customers for a given TOU rate across SCE's service territory as a whole and in each of SCE's hot, moderate and cool climate regions.	All	1	large enough to produce valid survey data	CARE/FERA	313	2194	1881
			All	2		CARE/FERA	313	3314	3001
			All	3		CARE/FERA	313	1770	1457
			All	1		Non-CARE/FERA	313	2072	1759
			All	2		Non-CARE/FERA	313	2905	2592
			All	3		Non-CARE/FERA	313	1778	1465
			Hot	1		CARE/FERA	313	733	420
			Hot	2		CARE/FERA	313	1851	1538
			Hot	3		CARE/FERA	313	582	269
			Hot	1		Non-CARE/FERA	313	676	363
			Hot	2		Non-CARE/FERA	313	1508	1195
			Hot	3		Non-CARE/FERA	313	588	275
			Moderate	1		CARE/FERA	313	727	414
			Moderate	2		CARE/FERA	313	728	415
			Moderate	3		CARE/FERA	313	600	287
			Moderate	1		Non-CARE/FERA	313	659	346
			Moderate	2		Non-CARE/FERA	313	655	342
			Moderate	3		Non-CARE/FERA	313	601	288
			Cool	1		CARE/FERA	313	734	421
			Cool	2		CARE/FERA	313	735	422
			Cool	3		CARE/FERA	313	588	275
			Cool	1		Non-CARE/FERA	313	737	424
			Cool	2		Non-CARE/FERA	313	742	429
			Cool	3		Non-CARE/FERA	313	589	276

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
8	The level of understanding and acceptance of the TOU pilot rates among various customer segments and how they engage with the rate to potentially lower their energy bills.	The recruitment approach for SCE's TOU pilots does not allow for a direct measure of acceptance rates for each rate option because customers are being paid to participate in the study (and to stay on the rate) and will be randomly assigned to the three different TOU pilot rates. However, surveys will be used to assess customer awareness, understanding, acceptance and satisfaction and these metrics can be compared across rate options as an indirect measure of customer acceptance. Sample sizes will be large enough to produce valid survey data for a variety of customer segments. As part of the end-of-pilot survey in the summer of 2017, customers will be asked whether they would prefer to stay on the TOU rate or return to the OAT. They will also be asked if they would prefer one of the other TOU rates if they had an option. Following payment of the last portion of the incentive, which will be made after completion of the end-of-pilot survey, differential dropout rates will be tracked as an indicator of customer preferences.	N/A	N/A	N/A	N/A	N/A	N/A	0

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
9	The impact of PCTs on energy usage and/or customer understanding, acceptance, and engagement while taking service on a given TOU rate.	Using the same RCT design and PTP recruitment strategy described above, SCE will recruit an additional 3,750 customers who have already installed smart thermostats in their homes. These customers will be randomly assigned to either Rate 1, Rate 3 or the control group. Sample sizes will be large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence for Rates 1 and 3 across SCE's service territory as a whole. Answers to survey questions pertaining to customer awareness, understanding, acceptance, and satisfaction and other metrics will be compared between the treatment and control groups to determine whether there are significant differences in these metrics. Sample sizes are large enough to produce valid survey data. As part of the end-of-pilot survey in the summer of 2017, customers will be asked whether they would prefer to stay on the TOU rate or return to the OAT. They will also be asked if they would prefer one of the other TOU rates if they had an option. Following payment of the last portion of the incentive, which will be made after completion of the end-of-pilot survey, differential dropout rates will be tracked as an indicator of customer preferences.	All	1, 3, or Control	Count	Smart Thermostat	3750	675	-3075
			All	1	+/-2-3% @ 90%	Smart Thermostat	625	334	-291
			All	3	+/-2-3% @ 90%	Smart Thermostat	625	0	-625

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
10	The impact of education and outreach (E&O) materials that are tailored to various customer segments (including seniors, renters, and non-English speaking customers) and to certain cognitive profiles/customer personas on customer understanding, acceptance, and engagement while taking service on a TOU rate.	Surveys will be used to assess usefulness and preferences for each of the primary types of E&O materials. Responses will be compared across rate options, customer segments and customer personas to determine whether different treatment groups, customer segments or customer personas find some materials more or less useful than others. Answers to survey questions pertaining to customer awareness, understanding, acceptance, and satisfaction and other metrics will also be compared across rate options, customer segments and customer personas to determine whether there are significant differences in these metrics.	TBD	TBD	TBD	TBD	TBD	TBD	0

Appendix C PG&E Deliverables and Outcomes from Resolution E-4762

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
1	The average peak and off-peak change in energy usage (or lack thereof) by seniors and economically vulnerable customers in hot climate zones as a result of a given TOU rate.	PG&E will employ a RCT design and pay-to-play (PTP) recruitment strategy to recruit approximately 3,000 customers onto each of Rate 1 and the control rate (the otherwise applicable tariff (OAT) or tiered rate) in PG&E's hot climate region. Sample sizes will be large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence for a variety of customer segments on Rate 1 in PG&E's hot climate region, including seniors, CARE/FERA customers, and households with incomes ≤ 100% of the Federal Poverty Guideline (FPG).	hot	1	+/-2-3% @ 90%	CARE/FERA	625	2244	1619
						HH $ < 100% FPG	625	1034	409
						Senior	625	2489	1864
					Count	All of Rate 1 in Hot	3000	4011	1011
			hot	Control	+/-2-3% @ 90%	CARE/FERA	625	2283	1658
						HH $ < 100% FPG	625	1053	428
						Senior	625	2527	1902
					Count	All Control in Hot	3000	4090	1090
2	The impact of a given TOU rate on the bills of seniors and economically vulnerable customers in hot climate zones (i.e., the distribution of bill impacts).	Bills will be calculated for both treatment and control customers in two ways; as if their usage were billed on the TOU rate in question, and as if their usage were billed on the OAT. The difference between those two bills will result in a distribution of bill impacts for treatment customers and a distribution of bill impacts for control customers. Comparing the two distributions will illustrate how much of the bill impact results from structural wins and losses and how much results from changes in usage in response to the TOU rate. Sample sizes will be large enough to produce valid	Hot	1	Valid bill impact distributions	Senior	625	2489	1864
						CARE/FERA	625	2244	1619
						HH $ < 100% FPG	625	1034	409
						100% FPG < HH $ < 200% FPG	625	1259	634

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
		bill impact distributions for a variety of customer segments on Rate 1 in PG&E's hot climate region, including seniors, CARE/FERA customers, households with incomes ≤ 100% of FPG, and households with incomes between 100 and 200% of FPG.							

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
3	The impact of a given TOU rate on how seniors and economically vulnerable customers in hot climate zones change their energy usage and on these customers' choices regarding other household expenses.	Surveys will be administered to both treatment and control customers, and will include questions regarding energy usage habits (e.g. the timing of end-use activities, thermostat settings by rate period) and barriers to load shifting or load reduction activities. Questions will also be designed to detect certain forms of hardship (e.g. not paying other bills to pay energy bill). Answers will be compared between treatment and control customers to determine whether certain behaviors or activities are higher among customers on TOU rates relative to customers on the OAT. Sample sizes will be large enough to produce valid survey data for a variety of customer segments in PG&E's hot climate region, including seniors, CARE/FERA customers, households with incomes ≤ 100% of FPG, and households with incomes between 100 and 200% of FPG on Rate 1; and CARE/FERA customers on Rates 2 and 3.	Hot	1	large enough to produce valid survey data	Seniors	313	2489	2176
						CARE/FERA	313	2244	1931
						HH $ < 100% FPG	313	1034	721
						100% FPG < HH $ < 200% FPG	313	1259	946
				2		CARE/FERA	313	673	360
				3		CARE/FERA	313	677	364

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
4	The average peak and off-peak change in energy usage as a result of a given TOU rate for all customers in PG&E's service territory, all customers in PG&E's hot climate region, and all customers in PG&E's moderate climate region.	PG&E will employ a RCT design to recruit customers onto the three TOU rates and the control rate. The total number of PG&E customers on each of Rates 2 and 3 will be approximately 3,750, and 5,500 on Rate 1. The RCT sampling approach will also be used to create minimum samples of roughly 1,250 customers for each TOU rate in each of PG&E's hot, moderate and cool climate regions. Sample sizes will be large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence for all customers for a given TOU rate across PG&E's service territory as a whole and for a given TOU rate in each of PG&E's hot and moderate climate regions.	All	1	Count	All	5500	6516	1016
			All	2		All	3750	3809	59
			All	3		All	3750	3814	64
			Hot	1		All	1250	4011	2761
				2		All	1250	1303	53
				3		All	1250	1313	63
			Moderate	1		All	1250	1243	-7
				2		All	1250	1245	-5
				3		All	1250	1240	-10
			Cool	1		All	1250	1262	12
				2		All	1250	1261	11
				3		All	1250	1261	11
			All	1	+/-2-3% @ 90%	All	1000	6516	5516
			All	2		All	1000	3809	2809
			All	3		All	1000	3814	2814
			Hot	1		All	625	4011	3386
			Moderate	1		All	938	1243	305
			Hot	2		All	625	1303	678
			Moderate	2		All	938	1245	307
			Hot	3		All	625	1313	688
			Moderate	3		All	938	1240	302

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
5	The average peak and off-peak change in energy usage as a result of a given TOU rate for CARE/FERA and non-CARE/FERA customers across PG&E's territory as a whole and in the hot climate region for Rate 1.	The RCT design, PTP recruitment strategy and recruitment targets described above will create sample sizes large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence for CARE/FERA and non-CARE/FERA customers for a given TOU rate across PG&E's service territory as a whole and for Rate 1 in PG&E's hot climate region.	All	1	+/-2-3% @ 90%	CARE/FERA	1000	3523	2523
			All	2		CARE/FERA	1000	1958	958
			All	3		CARE/FERA	1000	1958	958
			All	1		Non-CARE/FERA	1000	2993	1993
			All	2		Non-CARE/FERA	1000	1851	851
			All	3		Non-CARE/FERA	1000	1856	856
			Hot	1		CARE/FERA	625	2244	1619
			Hot	1		Non-CARE/FERA	625	1767	1142

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
6	The impact of a given TOU rate on the bills of CARE/FERA customers and non-CARE/FERA customers (i.e., the distribution of bill impacts) in PG&E's entire territory and in the hot, moderate and cool climate regions separately.	Bills will be calculated for both treatment and control customers in two ways; as if their usage were billed on the TOU rate in question, and as if their usage were billed on the OAT. The difference between those two bills will result in a distribution of bill impacts for treatment customers and a distribution of bill impacts for control customers. Comparing the two distributions will illustrate how much of the bill impact results from structural wins and losses and how much results from changes in usage in response to the TOU rate. Sample sizes will be large enough to produce valid bill impact distributions for CARE/FERA and non-CARE/FERA customers for a given TOU rate across PG&E's service territory as a whole and in each of PG&E's hot, moderate and cool climate regions.	All	1	valid bill impact distributions	CARE/FERA	625	3523	2898
			All	2		CARE/FERA	625	1958	1333
			All	3		CARE/FERA	625	1958	1333
			All	1		Non-CARE/FERA	625	2993	2368
			All	2		Non-CARE/FERA	625	1851	1226
			All	3		Non-CARE/FERA	625	1856	1231
			Hot	1		CARE/FERA	125	2244	2119
			Hot	2		CARE/FERA	125	673	548
			Hot	3		CARE/FERA	125	677	552
			Hot	1		Non-CARE/FERA	313	1767	1454
			Hot	2		Non-CARE/FERA	313	630	317
			Hot	3		Non-CARE/FERA	313	636	323
			Moderate	1		CARE/FERA	125	654	529
			Moderate	2		CARE/FERA	125	657	532
			Moderate	3		CARE/FERA	125	653	528
			Moderate	1		Non-CARE/FERA	313	589	276
			Moderate	2		Non-CARE/FERA	313	588	275
			Moderate	3		Non-CARE/FERA	313	587	274
			Cool	1		CARE/FERA	125	625	500
			Cool	2		CARE/FERA	125	628	503
			Cool	3		CARE/FERA	125	628	503
			Cool	1		Non-CARE/FERA	125	637	512
			Cool	2		Non-CARE/FERA	125	633	508
			Cool	3		Non-CARE/FERA	125	633	508

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
7	The impact of a given TOU rate on how CARE/FERA customers and non-CARE/FERA customers – in PG&E's entire territory and in the hot, moderate and cool climate regions separately – change their energy usage and on these customers' choices regarding other household expenses.	Surveys will be administered to both treatment and control customers, and will include questions regarding energy usage habits (e.g. the timing of end-use activities, thermostat settings by rate period) and barriers to load shifting or load reduction activities. Questions will also be designed to detect certain forms of hardship (e.g. not paying other bills to pay energy bill). Answers will be compared between treatment and control customers to determine whether certain behaviors or activities are higher among customers on TOU rates relative to customers on the OAT. Sample sizes will be large enough to produce valid survey data for CARE/FERA and non-CARE/FERA customers for a given TOU rate across PG&E's service territory as a whole and in each of PG&E's hot, moderate and cool climate regions.	All	1	large enough to produce valid survey data	CARE/FERA	313	3523	3210
			All	2		CARE/FERA	313	1958	1645
			All	3		CARE/FERA	313	1958	1645
			All	1		Non-CARE/FERA	313	2993	2680
			All	2		Non-CARE/FERA	313	1851	1538
			All	3		Non-CARE/FERA	313	1856	1543
			Hot	1		CARE/FERA	313	2244	1931
			Hot	2		CARE/FERA	313	673	360
			Hot	3		CARE/FERA	313	677	364
			Hot	1		Non-CARE/FERA	313	1767	1454
			Hot	2		Non-CARE/FERA	313	630	317
			Hot	3		Non-CARE/FERA	313	636	323
			Moderate	1		CARE/FERA	313	654	341
			Moderate	2		CARE/FERA	313	657	344
			Moderate	3		CARE/FERA	313	653	340
			Moderate	1		Non-CARE/FERA	313	589	276
			Moderate	2		Non-CARE/FERA	313	588	275
			Moderate	3		Non-CARE/FERA	313	587	274
			Cool	1		CARE/FERA	313	625	312
			Cool	2		CARE/FERA	313	628	315
			Cool	3		CARE/FERA	313	628	315
			Cool	1		Non-CARE/FERA	313	637	324
			Cool	2		Non-CARE/FERA	313	633	320
			Cool	3		Non-CARE/FERA	313	633	320

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
8	The level of customer understanding, acceptance, and engagement while taking service on a given TOU rates among various customer segments.	The recruitment approach for PG&E's TOU pilots does not allow for a direct measure of acceptance rates for each rate option because customers are being paid to participate in the study (and to stay on the rate) and will be randomly assigned to the three different TOU pilot rates. However, surveys will be used to assess customer awareness, understanding, and satisfaction and these metrics can be compared across rate options as an indirect measure of customer acceptance. Sample sizes will be large enough to produce valid survey data for a variety of customer segments. As part of the end-of-pilot survey in the summer of 2017, customers will be asked whether they would prefer to stay on the TOU rate or return to the OAT. They will also be asked if they would prefer one of the other TOU rates if they had an option. Following payment of the last portion of the incentive, which will be made after completion of the end-of-pilot survey, differential dropout rates will be tracked as an indicator of customer preferences.	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
9	The impact of smartphone applications on energy usage and/or customer understanding, acceptance, and engagement while taking service on a given TOU rate.	PG&E will divide pilot participants in half and offer the smartphone application to one group and not to the other. If acceptance of the application is great enough, an impact assessment will be conducted to determine whether the information provided through the application increased load response for rate participants who receive it. If application acceptance is too low, statistical matching will be used to develop a control group for estimating load impacts. Answers to survey questions pertaining to customer awareness, understanding and satisfaction, and other metrics will be compared between those who download the application and those who don't to determine whether there are significant differences in these metrics. Application acceptance rates will also be reported and compared across rate options and customer segments.	N/A	N/A	N/A	Smartphone application offers made: Email	N/A	5,300	
						Smartphone application offers made: Mail	N/A	7,300	
						Smartphone application customers recruited	N/A	302	

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
10	The impact of education and outreach (E&O) materials that are tailored to various customer segments (including seniors, renters, and non-English speaking customers) and to certain cognitive profiles/customer personas on customer understanding of, acceptance of, and engagement with a TOU rate.	Surveys will be used to assess usefulness and preferences for each of the primary types of E&O materials. Responses will be compared across rate options, customer segments and customer personas to determine whether different treatment groups, customer segments or customer personas find some materials more or less useful than others. Answers to survey questions pertaining to customer awareness, understanding, and satisfaction, and other metrics will also be compared across rate options, customer segments and customer personas to determine whether there are significant differences in these metrics.	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Appendix D SDG&E Deliverables and Outcomes from Resolution E-476X

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
1	The average peak and off-peak change in energy usage by seniors and economically vulnerable customers in the hot climate region as a result of pilot rate 2.	SDG&E will employ a RCT design and pay-to-play (PTP) recruitment strategy to recruit approximately 1,250 customers onto pilot rate 2 in SDG&E's hot climate region. It is not expected that load impacts will be formally estimated but they may become available if a control group can be formed used statistical matching in the ex post analysis phase.	Hot	2	Count	All of Rate 2 in Hot	1250	423	-827

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
2	The impact of pilot rate 2 on the bills of seniors and economically vulnerable customers in the hot climate region (i.e., the distribution of bill impacts).	SDG&E will reach out to all CARE/FERA households in the hot climate region and all households with incomes below $40,000 and will then recruit from the remaining population to bring the total number of pilot rate 2 enrolled customers in the hot climate region to 1,250. There will not be a formal control group due to the small size of the customer base in SDG&E's hot climate region. Normally, bill impacts would be determined by calculating bills for both treatment and control customers in two ways; as if their usage were billed on the TOU rate in question, and as if their usage were billed on the otherwise applicable tariff (OAT). The difference between those two bills will result in a distribution of bill impacts for treatment customers and a distribution of bill impacts for control customers. Comparing the two distributions will illustrate how much of the bill impact results from structural wins and losses and how much results from changes in usage in response to the TOU rate. Due to the lack of a control group in SDG&E's hot climate region, it is not expected that bill impacts will be formally estimated. They may become available if a control group can be formed used statistical matching in the ex post analysis phase.	Hot	2	Count	CARE/FERA	All Households	All	
						HH $ < $40,000	All Households	All	

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
3	The impact of pilot rate 2 on how seniors and economically vulnerable customers in the hot climate region change their energy usage and on these customers' choices regarding other household expenses.	Normally, surveys would be administered to both treatment and control customers, and include questions regarding energy usage habits (e.g. the timing of end-use activities, thermostat settings by rate period) and barriers to load shifting or load reduction activities. Questions will also be designed to detect certain forms of hardship (e.g. not paying other bills to pay energy bill). Answers would be compared between treatment and control customers to determine whether certain behaviors or activities are higher among customers on TOU rates relative to customers on the OAT. Due to the lack of a control group in SDG&E's hot climate region, this process of formal comparison cannot be followed. Survey results of the 1,250 estimated hot climate region participants in rate 2 will still be collected and reviewed.	Hot	2	Count	All	1,250	423	-827

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
4	The average peak and off-peak change in energy usage as a result of pilot rates 1 and 2 for all customers in SDG&E's service territory, all customers in SDG&E's moderate climate region, and all customers in SDG&E's cool climate region.	SDG&E will employ a RCT design to recruit customers onto pilot rates 1 and 2, and the control rate. The total number of SDG&E customers on pilot rate 1 will be approximately 2,500 (1,250 in each of the moderate and cool regions) and on pilot rate 2 approximately 6,250 (2,500 in each of the moderate and cool regions). Sample sizes will be large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence for all customers for pilot rates 1 and 2 across SDG&E's service territory as a whole and in each of SDG&E's moderate and cool climate regions. It is noted that the territory-wide load impacts for pilot rate 1 are not affected by the lack of hot climate region sampling for that rate as hot climate region customers make up such a small proportion of SDG&E's total customer base.	All	1	Count	All	2,500	4036	1536
				2		All	6,250	6870	620
			Moderate	1		All	1250	1984	734
				2		All	2,500	3368	868
			Cool	1		All	1250	2052	802
				2		All	2500	3502	1002
			All	1	+/-2-3% @ 90%	All	1000	4036	3036
				2		All	1000	6870	5870
			Moderate	1		All	1250	1984	734
				2		All	1250	3368	2118
			Cool	1		All	1563	2052	489
				2		All	1563	3502	1939

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
5	The average peak and off-peak change in energy usage as a result of pilot rates 1 and 2 for CARE/FERA and non-CARE/FERA customers across SDG&E's territory as a whole.	The RCT design, PTP recruitment strategy and recruitment targets described above will create sample sizes large enough to produce load impacts with confidence intervals in the range of ±2-3% with 90% confidence for CARE/FERA and non-CARE/FERA customers for pilot rates 1 and 2 across SDG&E's service territory as a whole. As noted above, the territory-wide load impacts for pilot rate 1 are not affected by the lack of hot climate region sampling for that rate as hot climate region customers make up such a small proportion of SDG&E's total customer base.	All	1	+/-2-3% @ 90%	CARE/FERA	1250	1928	678
				2			1250	3299	2049
				1		Non-CARE/FERA	1250	2108	858
				2			1250	3571	2321

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
6	The impact of pilot rates 1 and 2 on the bills of CARE/FERA customers and non-CARE/FERA customers (i.e., the distribution of bill impacts) in SDG&E's entire territory and in the moderate and cool climate regions separately.	Bills will be calculated for both treatment and control customers in two ways; as if their usage were billed on the TOU rate in question, and as if their usage were billed on the OAT. The difference between those two bills will result in a distribution of bill impacts for treatment customers and a distribution of bill impacts for control customers. Comparing the two distributions will illustrate how much of the bill impact results from structural wins and losses and how much results from changes in usage in response to the TOU rate. Sample sizes	All	1	valid bill impact distributions	CARE/FERA	1250	1928	678
						Non-CARE/FERA	1250	2108	858
				2		CARE/FERA	1250	3299	2049
						Non-CARE/FERA	1250	3571	2321
			Moderate	1		CARE/FERA	625	935	310
						Non-CARE/FERA	625	1049	424
				2		CARE/FERA	625	1700	1075
						Non-CARE/FERA	625	1802	1177
			Cool	1		CARE/FERA	625	993	368

		will be large enough to produce valid bill impact distributions for CARE/FERA and non-CARE/FERA customers for pilot rates 1 and 2 across SDG&E's service territory as a whole and in each of SDG&E's moderate and cool climate regions.				Non-CARE/FERA	625	1059	434
				2		CARE/FERA	625	1700	1075
						Non-CARE/FERA	625	1802	1177
Item	**Deliverable**	**Proposal**	**Zone**	**Rate**	**Confidence**	**Group**	**Min. Threshold**	**Actual**	**Difference**
7	The impact of pilot rates 1 and 2 on how CARE/FERA customers and non-CARE/FERA customers – in SDG&E's entire territory and in the moderate and cool climate regions separately – change their energy usage and on these customers' choices regarding other household expenses.	Surveys will be administered to both treatment and control customers, and will include questions regarding energy usage habits (e.g. the timing of end-use activities, thermostat settings by rate period) and barriers to load shifting or load reduction activities. Questions will also be designed to detect certain forms of hardship (e.g. not paying other bills to pay energy bill). Answers will be compared between treatment and control customers to determine whether certain behaviors or activities are higher among customers on TOU rates relative to customers on the OAT. Sample sizes will be large enough to produce valid survey data for CARE/FERA and non-CARE/FERA customers for pilot rates 1 and 2 across SDG&E's service territory as a whole and in each of SDG&E's moderate and cool climate regions.	All	1	large enough to produce valid survey data	CARE/FERA	625	1928	1303
						Non-CARE/FERA	625	2108	1483
				2		CARE/FERA	625	3299	2674
						Non-CARE/FERA	625	3571	2946
			Moderate	1		CARE/FERA	313	935	622
						Non-CARE/FERA	313	1049	736
				2		CARE/FERA	313	1700	1387
						Non-CARE/FERA	313	1802	1489
			Cool	1		CARE/FERA	313	993	680
						Non-CARE/FERA	313	1059	746
				2		CARE/FERA	313	1700	1387
						Non-CARE/FERA	313	1802	1489

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
8	The level of customer understanding, acceptance, and engagement while taking service on a given TOU rate among various customer segments.	The recruitment approach for SDG&E's TOU pilots does not allow for a direct measure of acceptance rates for each rate option because customers are being paid to participate in the study (and to stay on the rate) and will be randomly assigned to pilot rates 1 or 2. Instead, surveys will be used to assess customer awareness, understanding, and satisfaction and these metrics can be compared across rate options as an indirect measure of customer acceptance. Sample sizes will be large enough to produce valid survey data for a variety of customer segments. As part of the end-of-pilot survey in the summer of 2017, customers will be asked whether they would prefer to stay on the TOU rate or return to the OAT. They will also be asked if they would prefer one of the other TOU rates if they had an option. Following payment of the last portion of the incentive, which will be made after completion of the end-of-pilot survey, differential dropout rates will be tracked as an indicator of customer preferences.	N/A	N/A	Sample sizes will be large enough to produce valid survey data for a variety of customer segments.	N/A	N/A	N/A	N/A

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
9	The impact of usage alerts and/or other technology on energy usage and/or customer understanding, acceptance, and engagement while taking service on a given rate.	SDG&E will double the number of cool and moderate climate region customers on pilot rate 2 and automatically enroll half of the participants in each climate region in the usage alert system that SDG&E is developing for the TOU pilots. Incremental load impacts will be estimated for participants who receive the alerts and SDG&E will also assess customer interest in, satisfaction with, and use of the usage alert through customer surveys. SDG&E plans to make the tips and tools information on their TOU pilot microwebsite available to pilot participants through a smartphone application. Users of the app would also be able to receive push notifications containing reminders of TOU period rate changes. As with other outreach materials, SDG&E will assess the impact of the app on customer understanding, acceptance and engagement using customer surveys.	Moderate	2	N/A	N/A	2500	N/A	N/A
			Cool	2	N/A	N/A	2500	N/A	N/A

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
10	For participants on pilot rates 1 and 2, evaluate the take rates for smart thermostats at two different rebate levels and qualitatively assess their usefulness to households that accept them. If possible, estimate load impacts of smart thermostat usage.	For the purposes of this pilot, SDG&E defines a smart thermostat as a device that is internet-connected and capable of receiving and responding to real-time information or equipped with the sensors and software necessary to automatically adjust to customer behavior. SDG&E's technology treatment will attempt to increase the purchase rate of smart thermostats by offering two different rebate amounts for the purchase of a smart thermostat. One of these offers will be made to all customers enrolled in SDG&E's pilot rates 1 and 2. If a sufficiently large number of customers purchase smart thermostats through the subsidies that will be offered, SDG&E will estimate load impacts for the purchasing households using a pseudo-control group developed using ex post statistical matching. The smart thermostat offer will be made after the first summer of the TOU pilot.	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Item	Deliverable	Proposal	Zone	Rate	Confidence	Group	Min. Threshold	Actual	Difference
11	For participants on pilot rate 3, assess customer interest, acceptance and understanding of the hourly rate; identify what strategies customers use to respond to hourly prices; identify what strategies customers use to respond to an over-generation credit; and assess the effectiveness of enabling technologies in conjunction with an hourly rate.	SDG&E's pilot rate 3 will test a proof of concept with regard to customer interaction with advanced technologies. Customers must have or purchase a smart programmable thermostat that is installed and operating at the onset of the pilot. Although there are many enabling technology options, SDG&E will be offering all pilot rate 3 customers rebates for the purchase of a new smart thermostat, installation or replacement of existing pool pump and motor or upgrade of electric vehicle charging equipment. Surveys of pilot rate 3 customers will presumably be used to conduct this assessment.	TBD	TBD	TBD	TBD	TBD	TBD	TBD

Appendix E SCE Power Analysis Memo

Date: December 15, 2015

To: Miriam Fischlein and Richard Song, SCE

From: Jon Cook and Steve George, Nexant

Re: Monte Carlo Simulations for Determining Default TOU Pilot Sample Sizes for SCE

Summary

This memorandum provides documentation of the process used to establish sample size requirements for the CA Default TOU Pilot in SCE's territory. Monte Carlo simulation was used in conjunction with a false experiment to determine the precision of estimated peak-period load impacts that would result from a stratified random sampling design with several potential sample sizes. The data used for the simulation consisted of a stratified random sample of 120,000 customers, with 20,000 customers in each of six segments characterized by climate region and CARE status. A separate analysis was conducted for a sample of customers that have smart thermostats to estimate precision and power for an add-on to the pilot involving enabling technology.

Data

The Default TOU pilot is being designed to provide valid estimates of TOU pricing impacts for each utility service territory and for three climate regions within each territory. SCE's climate zones are shown in Figure 1 and were condensed into three broader climate regions for purposes of this analysis – Cool (zones 6, 8 and 16), Moderate (zones 5, 9 and 10) and Hot (zones 13, 14 and 15). Most of SCE's residential customers reside in the Cool (45%) and Moderate (41%) climate regions, while the Hot region is more sparsely populated (14%).

The proposed pilot sampling plan involves oversampling CARE/FERA customers in all climate regions and oversampling seniors and CARE/FERA customers by two income stratum in the hot climate region. Sample sizes for these subpopulations are not being driven by the desired level of precision for estimating load impacts – rather, they are being driven by the desire to accurately characterize bill impacts and responses to surveys. However, because of the oversampling, the load impact estimates within each climate region will need to be based on a weighted regression analysis. As such, the analysis presented here is based on weighted regressions using a difference-in-differences analysis. We also compare estimates using weighting with estimates based on a random sample of the population to determine if the results from the stratified sample with weights are the same as would be produced from an un-weighted random sample of the general population.

Figure 1: SCE Climate Zones

For use in the simulations, SCE drew a random sample of 20,000 customers in each of the six subpopulations:

- CARE customers in Cool climate zones;
- Non-CARE customers in Cool climate zones;
- CARE customers in Moderate climate zones;
- Non-CARE customers in Moderate climate zones;
- CARE customers in Hot climate zones; and
- Non-CARE customers in Hot climate zones.

Interval data from the summer (June-September) of 2015 was also provided for each customer in the sample. The outcome variable of interest was the average load (kW) during a hypothetical peak period of 1-7 pm on weekdays. This peak period was based on prior analysis that we did in conjunction with the pilot design process. SCE's peak period for Rates 1 and 2 are from 2 to 8 PM and from 5 to 8 PM. We examined whether or not the definition of the peak period had a material impact on the simulation results and found that it did not.[53]

Data were collapsed so that the analysis dataset is a panel made up of individual customers and daily observations of average peak period load. Table 1 shows descriptive statistics for the average summer weekday peak period load in each sample segment.

Table 1: Summary Statistics for SCE Population Segments of Interest

Climate Zone	CARE Status	% of Customers in Climate Zone	Average Daily Peak Period kW	Std. Dev. Daily Peak Period kW	Coeff. Of Variation (SD/Mean)
Cool	CARE	25%	0.76	0.70	0.92
	Non-CARE	75%	1.04	1.23	1.18
Moderate	CARE	33%	1.40	1.23	0.88
	Non-CARE	67%	1.76	1.70	0.97
Hot	CARE	39%	1.79	1.31	0.73
	Non-CARE	61%	2.03	1.98	0.98

Both climate zone and CARE status have a significant effect on peak period usage such that load increases with temperature and is higher for Non-CARE customers than CARE customers within each climate region. Furthermore, differences in the variability in peak period usage also exist across the different segments. The coefficient of variation in the last column provides a measure of variability relative to the mean for each segment. Variability is lower for CARE customers in all climate regions and also tends to decrease as the climate regions get hotter. Note that the highest amount of variability (relative to the mean) exists for Non-CARE customers in the Cool climate region. Because underlying variation in the data is a key determinant of estimation precision, these patterns will also manifest themselves in the simulation results.

Stratified Sampling Design

Stratified sampling designs are often used in situations where impact estimates are desired for individual population segments as well as the general population. In the simplest form of a stratified design, the population is split into the different strata of interest and then random samples are drawn within each stratum. This approach yields large enough samples to estimate impacts within each stratum, while still allowing the individual samples to be pooled together to estimate the impact for the general population.[54] In a stratified design, the pooled sample of customers from the different segments of interest is not representative of the general population. Instead, certain segments that make up a

[53] See Table A.1 in the Appendix.

[54] Stratification is particularly beneficial if the segments of interest make up a very small portion of the general population since a very large random sample would be needed to yield enough customers in the segment of interest for analysis.

small portion of the population are "oversampled" to make up a larger portion of the pooled sample than they do in the population. When estimating population impacts, sample weights must be used to correct for this imbalance so that estimates generated from the sample are indeed representative of the population.

In the context of the TOU pilot for SCE, there are three populations of interest (the three climate regions) and two strata (CARE and Non-CARE). The simulations described below draw equivalent sized samples from each stratum in each population and use the appropriate sample weights to allow for inference in each climate region.[55]

Monte Carlo Simulation

Monte Carlo simulation (or experimentation) is a methodology that is commonly used for investigating the properties of econometric estimators and verifying that valid methods of statistical inference are being used.[56] The power of the methodology lies in its use of repeated sampling to understand the properties of a particular estimator or statistic under realistic data conditions.[57]

One of the key questions for the design of the Default TOU pilot is how large of a sample should be used. Sample size is important because it directly affects two related properties of statistical analysis – power and precision. Power is the ability of an analysis to detect an effect if it indeed exists, while precision deals with how close our estimates would be if we conducted the analysis many times using different samples. All else equal, larger sample sizes allow for more power and precision since there is more data available for estimation. Through discussions between TOU pilot stakeholders, the target level of precision for the analysis is to be able to measure peak period load impacts to within +/- 2% at a confidence level of 90%.

To evaluate the expected power and precision that would result from using different sample sizes, we conducted Monte Carlo simulations that incorporate a false experiment. The idea of a false experiment is to conduct an analysis in a situation where the magnitude of the treatment is known to be zero using data that is similar to what would be used in a real experiment. Knowing the answer beforehand allows us to assess whether or not our estimator may produce biased results and the repeated sampling allows for the precision of the estimator be evaluated.

The simulation process for SCE is shown in Figure 2. For each sample size, X, a sample of X/2 CARE customers and X/2 Non-CARE customers are randomly selected from the climate zone of interest. Next, the "experiment" is created by randomly assigning half of the customers in each strata to a "treatment" group on a TOU rate and the other half to a control group who remain on their current rate. We then assume that the imaginary TOU treatment went into effect on August 1 for all customers, which evenly divides the available data into pre-treatment and post-treatment. In this experimental framework, the

[55] The sample weights used are the inverse of the probabilities that a customer was included in the sample. E.g., if there are 100,000 Non-CARE customers in the Cool climate zone and 1,000 of them are included in the sample, then the weight would be 1/(1,000/100,000) = 100.

[56] For a more detailed discussion of Monte Carlo simulation, see Kennedy, Peter, "A Guide to Econometrics" (2008), Section 2.10 - http://www.masonlec.org/site/rte_uploads/files/Econometrics%20Book%20-%20Intro,%20Ch%201%20and%202.pdf

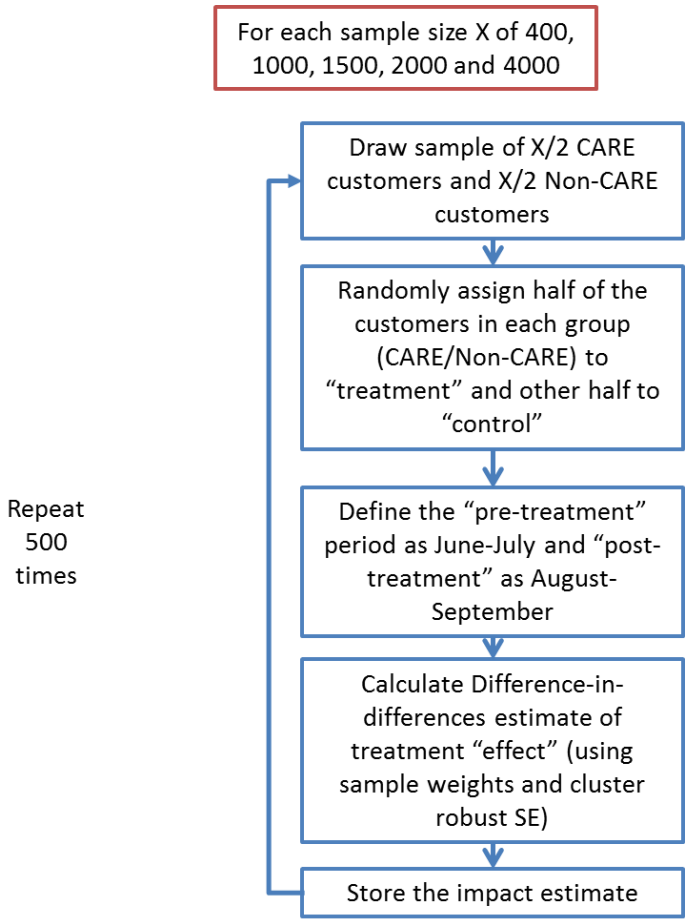
[57] Asymptotic properties of estimators are generally known, but rely on assuming sample sizes that approach infinity that are not appropriate in many applied research situations that rely on finite samples.

"impact" of the fictional TOU rate can be estimated using the following equation, where i subscripts denote individuals and t subscripts denote time periods (days):

$$kW_{i,t}^{\text{peak}} = \alpha + \delta \text{treat}_i + \gamma \text{post}_t + \beta(\text{treatpost})_{i,t} + \varepsilon_{i,t} \quad (1)$$

In Equation 1, the variable *treat* is equal to 1 for treatment customers and 0 for control customers, while the variable *post* is equal to 1 for days in August-September and a value of 0 for days in June-July. The *treatpost* term is the interaction of *treat* and *post* and its coefficient β is a difference-in-differences estimator of the treatment effect that makes use of the "pretreatment" data. In the simulation, Equation 1 is estimated using OLS regression with sample weights to account for the stratified sampling design and cluster robust standard errors to account for serial correlation that is likely to be present in the data.[58] This process is repeated 500 times and bootstrapped standard errors are reported.

Figure 2: Monte Carlo Simulation for False Experiment with Stratified Sampling Design



[58] Serial correlation certainly exists in the variable of interest (*treatpost*) and is very likely to be present in the dependent variable (daily peak period average load). If unaddressed, serial correlation will lead to standard errors that are systematically too small. This results in overstating the precision of the impact estimate and misleading inference. To adjust for serial correlation, we follow the best practices described by Bertrand, et al. (2002), Wooldridge (2003) and Cameron (2010).

Simulation Results

At the end of the simulation, we have 500 impact estimates for each climate zone. The next step of the process is to use this information to draw conclusions about the precision that can be achieved with each sample size. The precision will be based on the standard error of the impact estimate, which we calculate as the standard deviation of the 500 impact estimates for each sample size (bootstrap).

The final step is to translate the estimated standard errors into confidence intervals, which form the basis of statistical inference. This is a straightforward calculation that consists of multiplying the standard error by the t-value corresponding to the desired confidence level (approximately 1.96 for 95% confidence and 1.65 for 90% confidence[59]) to obtain the margin of error (MOE) that will be added and subtracted from the impact estimate to form the confidence interval. In our false experiment, we know that the true impact is zero, however the MOE captures the precision of that estimate if it was non-zero. For this reason, we focus discussion on the MOE.

Results of the stratified sampling simulation are shown in Table 2 along with results from simulations based on a simple random sampling design for comparison purposes. In the simple random sampling approach, sample weights are unnecessary since the sample is representative of the population. The results can be interpreted as follows – "With a sample of 2,000 customers in the Moderate climate region (1,000 CARE and 1,000 Non-CARE, with each segment split evenly between treatment and control conditions), we would expect to be able to estimate the impact of TOU rates on peak period usage to within plus or minus 2.1% with 90% confidence." Put another way, the 90% confidence interval around a true impact of 5% with a sample of 1,500 customers would be (2.9%, 7.1%).

Table 2: Precision for Peak Period Load Impacts in Segments of the SCE Population

Climate Zone	Sample Size (Treatment + Control)	Weighted Least Squares (Diff-in-Diff)		Diff-in-Diff with Representative Sample (no weights)	
		95% MOE	90% MOE	95% MOE	90% MOE
Cool	400	10.2%	8.6%	7.9%	6.7%
	1,000	5.9%	5.0%	5.1%	4.3%
	1,500	4.9%	4.1%	4.2%	3.5%
	2,000	4.3%	3.6%	3.6%	3.0%
	4,000	3.0%	2.6%	2.5%	2.1%
Moderate	400	6.0%	5.0%	5.2%	4.4%
	1,000	3.8%	3.2%	3.4%	2.9%
	1,500	3.0%	2.6%	2.9%	2.4%
	2,000	2.5%	2.1%	2.3%	1.9%
	4,000	1.7%	1.5%	1.7%	1.4%
Hot	400	5.1%	4.2%	5.0%	4.2%
	1,000	3.2%	2.7%	3.1%	2.6%
	1,500	2.7%	2.3%	2.5%	2.1%

[59] We assume a two-tailed hypothesis test.

	2,000	2.2%	1.8%	2.2%	1.8%
	4,000	1.6%	1.4%	1.6%	1.4%

The precision of the impact estimates improves as we move from Cool to Moderate to Hot and as the sample size increases within each climate region. Comparing the weighted estimates from the stratified design to the un-weighted estimates using a representative sample, the largest differences occur with the smallest samples and in the Cool climate region. For the Moderate and Hot regions, the two estimates converge as the sample size increases.

Achieving the two percent precision target can be done using samples of approximately 2,000 customers in the Hot and Moderate climate regions, but would require a larger sample of customers in the Cool climate region. This is primarily due to the larger amount of variability in peak period usage in the Cool climate region, particularly for Non-CARE customers (refer back to Table 1). The Cool climate region also has the largest disparity in the shares of CARE/Non-CARE customers, which likely contributes to the larger differences between the weighted and un-weighted results.

It is important to note that the results presented above were developed using a specific model in the context of a stratified sampling design with a pre-specified amount of data. Were any of these things to change (model, design or amount of data), so too would the levels of power and precision. For example, if pre-treatment data from a previous summer were available for analysis, precision would improve due to having more data points available for estimation. Similarly, adding additional regressors to Equation 1 could potentially lead to improved precision if peak period usage is determined by observable characteristics (e.g. temperature). Changes that could reduce precision include not having pre-treatment data available or adding additional strata to the sampling design.

Power

In addition to precision, a related concept that is generally of interest when determining sample sizes is statistical power. Power refers to the likelihood of finding a statistically significant impact when an impact actually exists and depends on the magnitude of the impact, sample size, inherent variability in the data and desired level of confidence. Based on the estimated standard errors from the stratified sampling simulations, we can map out the power level associated with different impact sizes for each sample size. These “power curves” are shown for each climate zone in Figures 3-5 for a 90% confidence level and two-sided hypothesis test. For reference, a 2% impact is marked by a black dotted line.

Figure 3: Power Curves for Cool Climate Zone (90% Confidence)

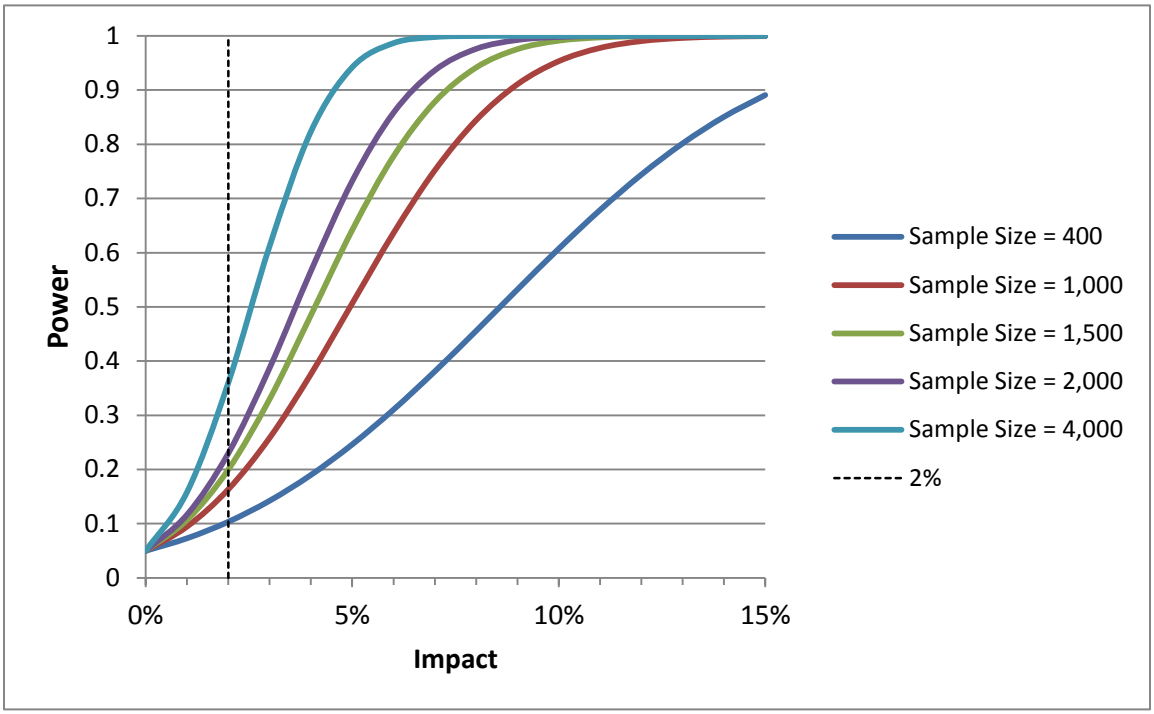


Figure 4: Power Curves for Moderate Climate Zone (90% Confidence)

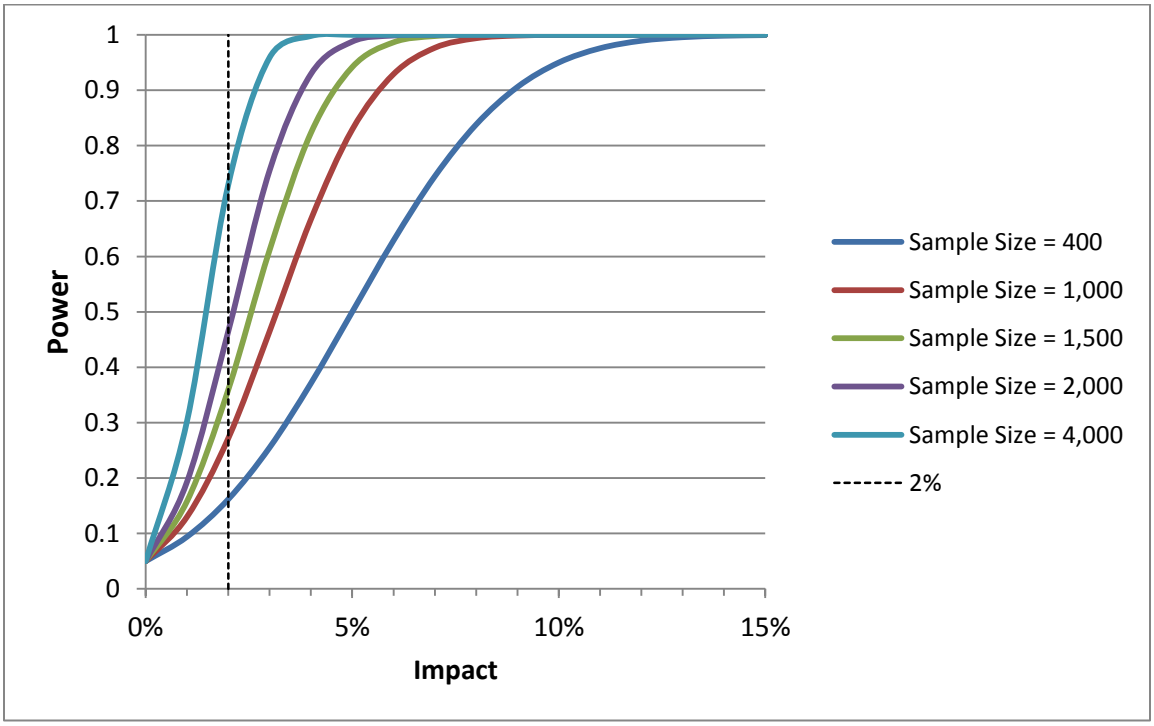
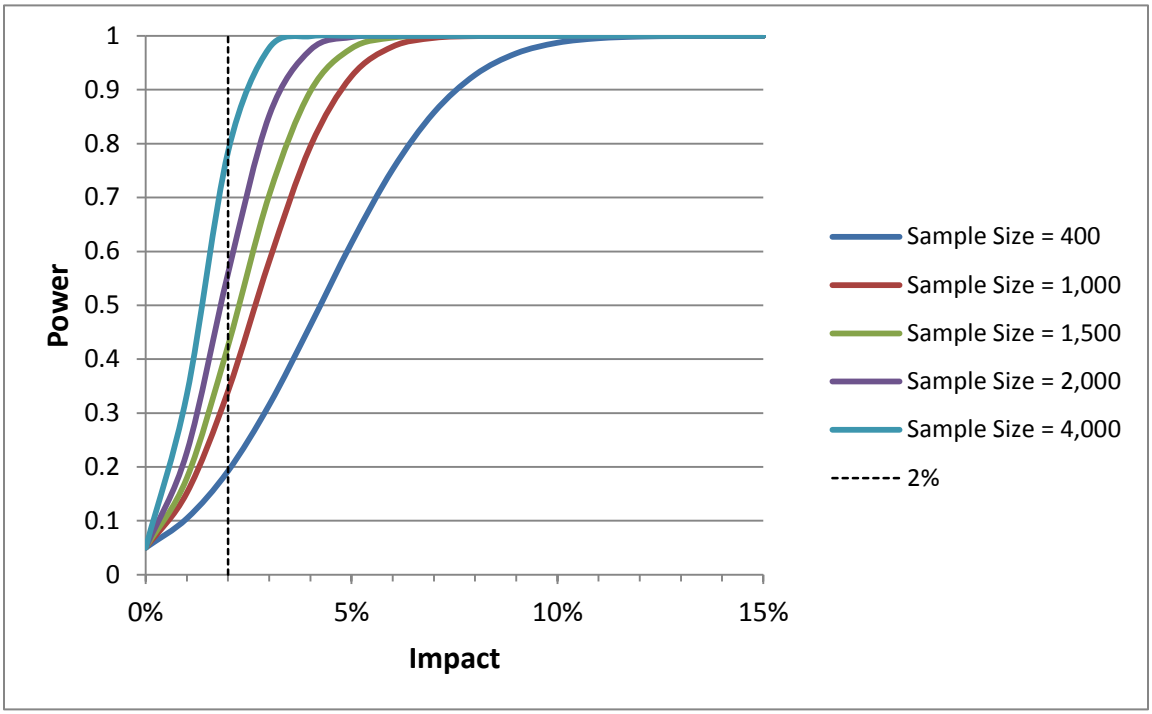


Figure 4: Power Curves for Hot Climate Zone (90% Confidence)



Because the power curves are based on the same estimated standard error as the precision calculations, similar patterns are apparent. As the sample size increases, so does the likelihood of finding statistically significant results for a given sized impact. For example, in Figure 4 the power associated with detecting a 2% impact in the Moderate climate zone with 90% confidence using a sample of 1,000 customers is about 0.3, but with a sample of 2,000 customers, power increases to about 0.5.

Smart Thermostat Owners

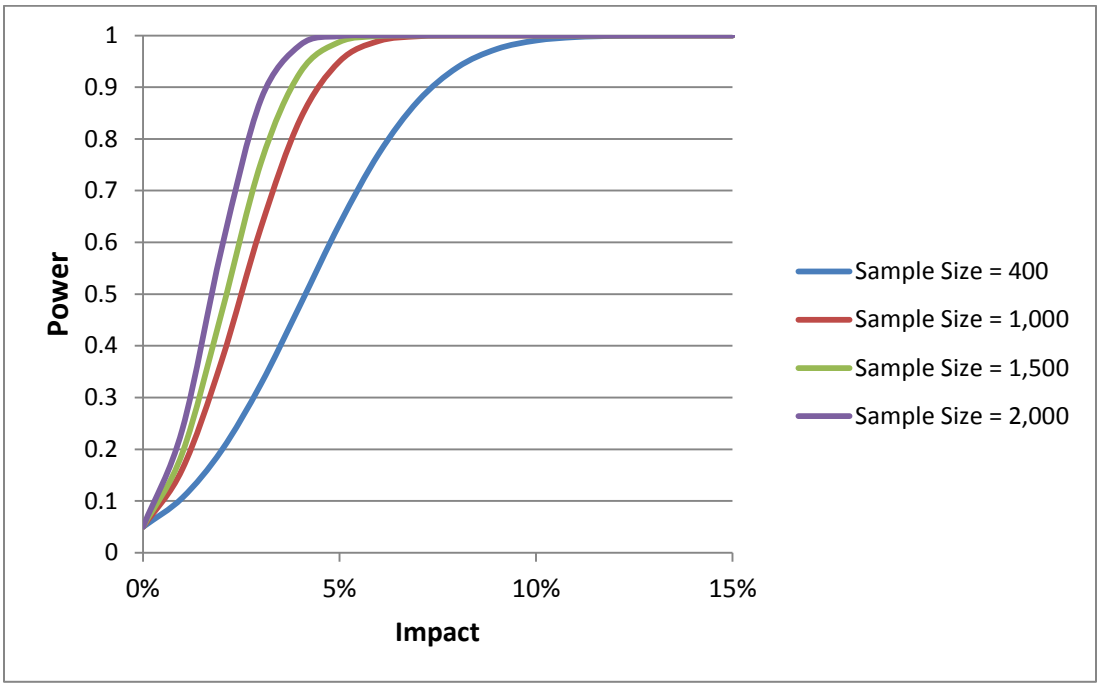
In addition to the general population of SCE customers, there is also interest in understanding power/precision for a subset of customers who would participate in an add-on to the Default TOU pilot involving enabling technology. To analyze this subset of customers, we utilized a separate dataset from SCE consisting of approximately 3,900 existing customers with smart thermostats and used similar simulation methods as those described above. Peak hours and pre-/post-treatment periods were defined in the same way as they were for the general population analysis. For the case of smart thermostat customers, there are no stratifications and so a simple random sampling approach with an un-weighted difference-in-differences estimator was used. Results of the simulations are shown in Table 3.

Table 3: Precision for Peak Period Load Impacts for Smart Thermostat Customers

Sample Size (Treatment + Control)	Diff-in-Diff Estimator	
	95% MOE	90% MOE
400	4.9%	4.1%
1000	3.0%	2.5%
1500	2.5%	2.1%
2000	2.1%	1.8%

Associated power curves are shown in Figure 6. The smart thermostat results are similar to those of the Moderate climate zone, such that a sample size of 2,000 customers (1,000 treatment and 1,000 control) is estimated to be capable of estimating peak period load impacts to within +/- 1.8% and detect a 2% impact with a probability of approximately 0.6.

Figure 6: Power Curves for Smart Thermostat Customers using Difference-in-Difference Estimator



Conclusions

The analysis summarized above indicates that it would be necessary to substantially increase the overall sample size in the cool climate region if the same level of precision for load impacts is needed in this region as in the other two regions. To achieve the same level of precision, it would be necessary to recruit 5,000 additional customers into the cool climate region (1,250 onto each rate and the control group), an increase of roughly 25% more than is currently planned. This would increase recruitment costs for SCE by $1 to $3 million depending on the acceptance rates which will be determined during the pretest in January. An alternative approach would be to lower the target level of precision in this climate zone, which is what Nexant recommends. There is no policy reason of which we are aware for

determining load impacts at the climate region level. The decision about what rate to offer should be based on average load impacts for the service territory as a whole. The level of precision at the service territory level exceeds ±2% because sample sizes are roughly 3,000 for each rate (for a total of 6,000 for the treatment and control groups combined).

References

Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan. *How much should we trust differences-in-differences estimates?*. No. w8841. National Bureau of Economic Research, 2002.

Wooldridge, Jeffrey M. "Cluster-sample methods in applied econometrics." *American Economic Review* (2003): 133-138.

Cameron, Adrian Colin, and Pravin K. Trivedi. "Microeconometrics using stata." (2010): 166.

Appendix E-1: Simulation Results Using Different Peak Periods

As a robustness check, we ran brief versions (100 iterations) of the stratified sampling simulations using three different definitions of the peak period – 1 to 7 pm, 2 to 8 pm and 5 to 8 pm. The margins of error (90%) associated with each of these peak period definitions are shown in Table A.1 for sample sizes of 2,000 and 4,000.

Table E-1-1: Simulation Results Using Different Peak Periods

Climate	Sample Size (Treatment + Control)	90% MOE 1to7	90% MOE 2to8	90% MOE 5to8
Cool	2000	3.0%	2.9%	2.8%
	4000	2.7%	2.5%	2.4%
Moderate	2000	2.3%	2.2%	2.2%
	4000	1.6%	1.6%	1.7%
Hot	2000	2.0%	2.0%	2.0%
	4000	1.5%	1.5%	1.5%

Appendix F PG&E Power Analysis Memo

Date: February 12, 2016

To: Andrew Lee, PG&E

From: Jon Cook and Steve George, Nexant

Re: Monte Carlo Simulations for Determining Default TOU Pilot Sample Sizes for PG&E

Summary

This memorandum provides documentation of the process used to establish sample size requirements for the CA Default TOU Pilot in PG&E's territory. Monte Carlo simulation was used in conjunction with a false experiment to determine the precision of estimated peak-period load impacts that would result from stratified random sampling designs of several potential sample sizes. The data used for the simulation consisted of a stratified random sample of 120,000 customers, with 20,000 customers in each of six segments characterized by climate region and CARE/FERA status.

Data

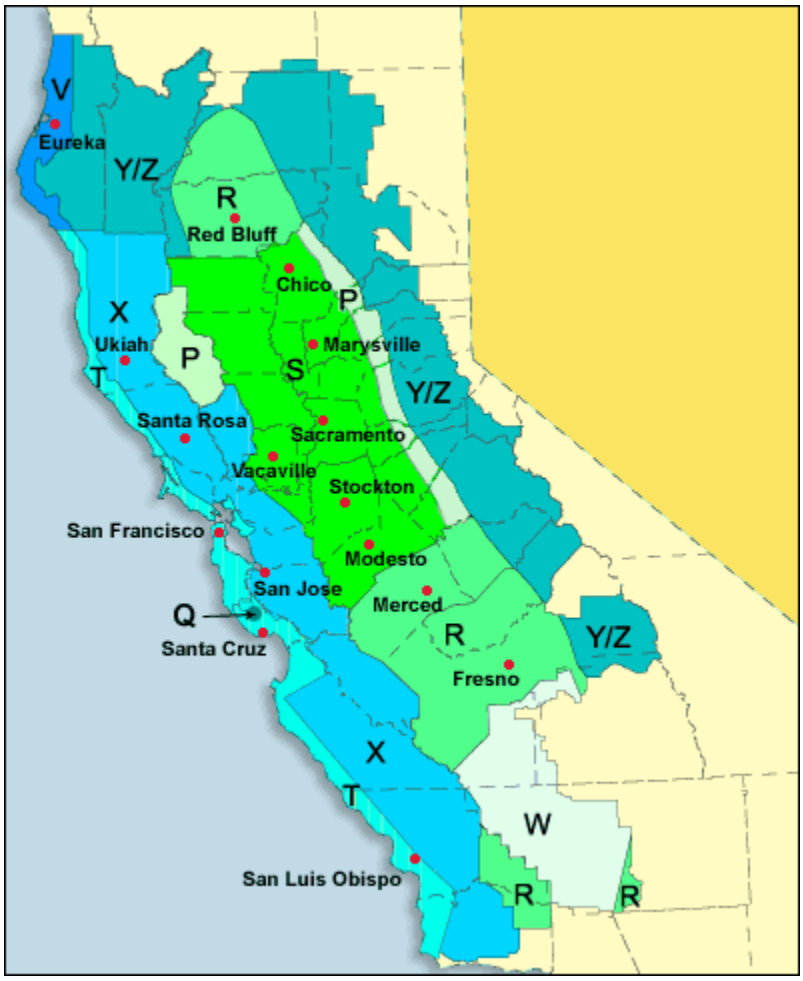
The Default TOU pilot is being designed to provide valid estimates of TOU pricing impacts for each utility service territory and for three climate regions within each territory. PG&E's climate zones are shown in Figure 1 and were condensed into three broader climate regions for purposes of this analysis – Cold (zones T, V and Z), Moderate (zones Q, X and Y) and Hot (zones P, R, S and W). The plurality of PG&E's residential customers reside in the Moderate climate zone (39%), followed by Hot (36%) and Cold (25%).

The TOU pilot sampling strategy also involves oversampling CARE/FERA[60] customers in all climate regions and oversampling seniors and CARE customers by two income stratum in the hot climate region. Sample sizes for these subpopulations are not being driven by the desired level of precision for estimating load impacts, but rather by the desire to accurately characterize bill impacts and responses to surveys. However, because of the oversampling, the load impact estimates within each climate region will need to be based on a weighted regression analysis. As such, the analysis presented here is based on weighted regressions using a difference-in-differences analysis. Previous analysis completed for SCE shows that the weighted analysis produces results comparable to what would be obtained from an un-weighted analysis using a simple random sample of the general population.[61]

[60] For brevity, we will refer to this group simply as CARE in the remainder of the memo.

[61] See Appendix D in SCE's Advice Letter, filed December 24, 2015 (Advice 3335-E)

Figure 1: PG&E Climate Zones



For use in the simulations, PG&E drew a random sample of 20,000 customers in each of the six subpopulations:

- CARE customers in Cold climate zones;
- Non-CARE customers in Cold climate zones;
- CARE customers in Moderate climate zones;
- Non-CARE customers in Moderate climate zones;
- CARE customers in Hot climate zones; and
- Non-CARE customers in Hot climate zones.

Interval data from the summer (May-October) of 2015 was provided for each customer in the sample. The outcome variable of interest was the average load (kW) during a hypothetical peak

period of 4-9 pm on weekdays, which is the peak period proposed in PG&E's TOU pilot rates 1 and 3.[62]

The data were organized so that the analysis dataset is a panel made up of individual customers and daily observations of average peak period load. Table 1 shows descriptive statistics for the average summer weekday peak period load in each sample segment.

Table 1: Summary Statistics for PG&E Population Segments of Interest

Climate Zone	CARE Status	% of Customers in Climate Zone	Average Daily Peak Period kW	Std. Dev. Daily Peak Period kW	Coeff. Of Variation (SD/Mean)
Cold	CARE	21%	0.52	0.31	0.59
	Non-CARE	79%	0.55	0.53	0.97
Moderate	CARE	18%	0.75	0.44	0.60
	Non-CARE	82%	0.93	0.74	0.79
Hot	CARE	39%	1.51	0.79	0.53
	Non-CARE	61%	1.61	1.07	0.66

Both climate zone and CARE status have a significant effect on peak period usage such that load increases with temperature and is higher for Non-CARE customers than CARE customers. Furthermore, differences in the variability in peak period usage also exist across the different segments. The coefficient of variation in the last column provides a measure of variability relative to the mean for each segment. Variability is lower for CARE customers in all climate zones and also tends to decrease as the climate zones move from cold to hot. Note that the highest amount of variability (relative to the mean) exists for Non-CARE customers in the cold climate zone. Because underlying variation in the data is a key determinant of estimation precision, these patterns will also manifest themselves in the simulation results.

Stratified Sampling Design

Stratified sampling designs are often used in situations where impact estimates are desired for individual population segments as well as the general population. In the simplest form of a stratified design, the population is split into the different strata of interest and then random samples are drawn within each strata. This approach yields large enough samples to estimate impacts within each strata, while still allowing the individual samples to be pooled together to estimate the impact for the general population.[63] In a stratified design, the pooled sample of customers from the different segments of interest is not representative of the general population. Instead, certain segments that make up a small portion of the population are "oversampled" to make up a larger portion of the pooled sample than they do in the population. When estimating population impacts, sample weights must be used to correct

[62] For SCE, we examined whether or not changes to the peak period (1-7 pm vs. 2-8 pm vs. 5-8 pm) had a material impact on the simulation results and found that it did not. See Table A.1 in the Appendix.

[63] Stratification is particularly beneficial if the segments of interest make up a very small portion of the general population since a very large random sample would be needed to yield enough customers in the segment of interest for analysis.

for this imbalance so that estimates generated from the sample are indeed representative of the population.

In the context of the TOU pilot for PG&E, there are three populations of interest (the three climate regions) and two strata (CARE and Non-CARE). The simulations described below draw equivalent sized samples from the strata in each population and use the appropriate sample weights to allow for inference in each climate region.[64]

Monte Carlo Simulation

Monte Carlo simulation (or experimentation) is a methodology that is commonly used for investigating the properties of econometric estimators and verifying the validity of statistical inference in a given population.[65] The power of the methodology lies in its use of repeated sampling to understand the properties of a particular estimator or statistic under realistic data conditions.[66]

One of the key questions for the design of the Default TOU pilot is how large of a sample should be used. Sample size is important because it directly affects two related properties of statistical analysis – power and precision. Power is the ability of an analysis to detect an effect if it indeed exists, while precision deals with how close the estimates would be if we conducted the analysis many times using different samples. All else equal, larger sample sizes allow for more power and greater precision since there is more data available for estimation. Target sample sizes for purposes of discussion during the working group process and the advice letter filings were based on measuring load impacts to within ±2% at a confidence level of 90%. The draft resolutions for SCE (E-47651) and PG&E (E-4762) dated February 25, 2016 indicated that the target level of confidence for load impact measures was between ±2 to 3%.

To evaluate the expected power and precision that would result from using different sample sizes, we conducted Monte Carlo simulations that incorporate a false experiment. The idea of a false experiment is to conduct an analysis in a situation where the magnitude of the treatment is known to be zero. The data used for the false experiment is similar to what would be used in a real experiment. By knowing the answer beforehand and drawing repeated samples, we can assess whether or not our estimator may produce biased results during the real experiment and determine the level of precision we expect to achieve.

The simulation process for PG&E is shown in Figure 2. For each sample size, X, a sample of X/2 CARE customers and X/2 Non-CARE customers are randomly selected from the climate zone of interest. Next, the "experiment" is created by randomly assigning half of the customers in each strata to a "treatment" group on a TOU rate and the other half to a control group who remain on their current rate. We then assume that the imaginary TOU treatment went into effect on August 1 for all customers, which evenly divides the available data into pre-treatment and post-treatment. In this experimental framework, the

[64] The sample weights used are the inverse of the probabilities that a customer was included in the sample. E.g., if there are 100,000 Non-CARE customers in the Cold climate zone and 1,000 of them are included in the sample, then the weight would be 1/(1,000/100,000) = 100.

[65] For a more detailed discussion of Monte Carlo simulation, see Kennedy, Peter, "A Guide to Econometrics" (2008), Section 2.10 - http://www.masonlec.org/site/rte_uploads/files/Econometrics%20Book%20-%20Intro,%20Ch%201%20and%202.pdf

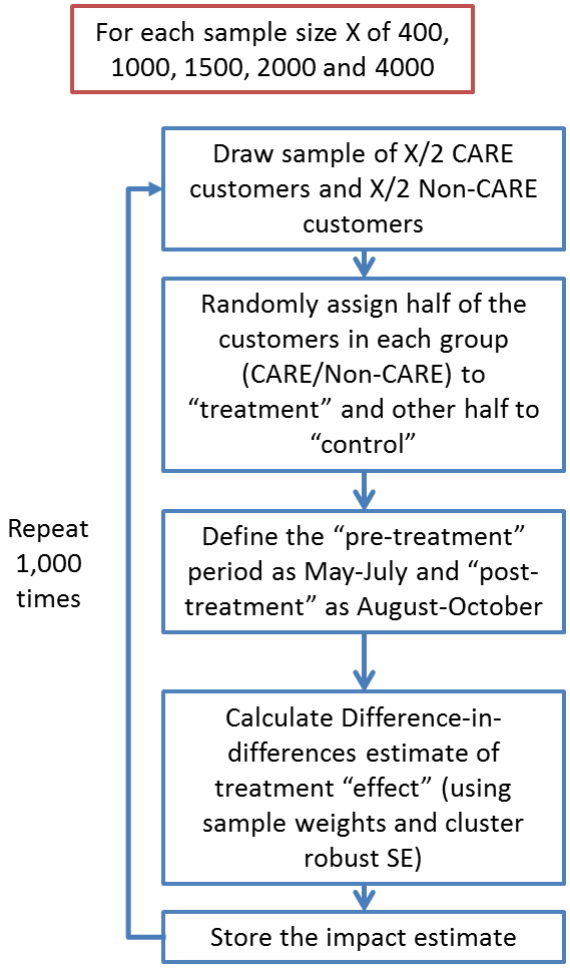
[66] Asymptotic properties of estimators are generally known, but rely on assuming sample sizes that approach infinity that are not appropriate in many applied research situations that rely on finite samples.

"impact" of the fictional TOU rate can be estimated using the following equation, where *i* subscripts denote individuals and *t* subscripts denote time periods (days):

$$kW_{i,t}^{\text{peak}} = \alpha + \delta \text{treat}_i + \gamma \text{post}_t + \beta(\text{treatpost})_{i,t} + \varepsilon_{i,t} \quad (1)$$

In Equation 1, the variable *treat* is equal to 1 for treatment customers and 0 for control customers, while the variable *post* is equal to 1 for days in August-October and a value of 0 for days in May-July. The *treatpost* term is the interaction of *treat* and *post* and its coefficient β is a differences-in-differences estimator of the treatment effect that makes use of the "pre-treatment" data. In the simulation, Equation 1 is estimated using weighted least squares regression with sample weights to account for the stratified sampling design and cluster robust standard errors to account for serial correlation that is likely to be present in the data.[67] This process is repeated 1,000 times and bootstrapped standard errors are reported.

Figure 2: Monte Carlo Simulation for False Experiment with Stratified Sampling Design



[67] Serial correlation certainly exists in the variable of interest (*treatpost*) and is very likely to be present in the dependent variable (daily peak period average load). If unaddressed, serial correlation will lead to standard errors that are systematically too small. This results in overstating the precision of the impact estimate and misleading inference. To adjust for serial correlation, we follow the best practices described by Bertrand, et al. (2002), Wooldridge (2003) and Cameron (2010).

Simulation Results

At the end of the simulation, we have 1,000 impact estimates for each climate zone. The next step of the process is to use this information to draw conclusions about the precision that can be achieved with each sample size. The precision will be based on the standard error of the impact estimate, which we calculate as the standard deviation of the 1,000 impact estimates for each sample size (bootstrap).

The final step is to translate the estimated standard errors into confidence intervals, which form the basis of statistical inference. This is a straightforward calculation that consists of multiplying the standard error by the t-value corresponding to the desired confidence level (approximately 1.96 for 95% confidence and 1.65 for 90% confidence[68]) to obtain the margin of error (MOE) around the impact estimate to form the confidence interval. In our false experiment, we know that the true impact is zero, however the MOE captures the precision of that estimate if it was non-zero. For this reason, we focus discussion on the MOE.

Results of the stratified sampling simulation are shown in Table 2. The results can be interpreted as follows – "With a sample of 2,000 customers in the Moderate climate zone (1,000 CARE and 1,000 Non-CARE with each group split evenly between treatment and control conditions), we would expect to be able to estimate the impact of TOU rates on peak period usage to within plus or minus 2.2% with 90% confidence." Put another way, the 90% confidence interval around a true impact of 5% with a sample of 2,000 customers (1,000 treatment and 1,000 control) would be (2.8%, 7.2%).

Table 2: Precision for Peak Period Load Impacts in Segments of the PG&E Population

Climate Zone	Sample Size (Treatment + Control)	Weighted Least Squares (Diff-in-Diff)	
		95% MOE	90% MOE
Cold	400	7.2%	6.0%
	1000	4.4%	3.7%
	1500	3.5%	2.9%
	2000	3.1%	2.6%
	4000	2.2%	1.8%
Moderate	400	5.7%	4.8%
	1000	3.6%	3.0%
	1500	2.9%	2.4%
	2000	2.7%	2.2%
	4000	1.7%	1.5%
Hot	400	4.4%	3.7%
	1000	2.9%	2.4%
	1500	2.3%	2.0%
	2000	2.0%	1.7%
	4000	1.4%	1.1%

[68] We assume a two-tailed hypothesis test.

The precision of the impact estimates improves as we move from Cold to Moderate to Hot and as the sample size increases within each climate region. With a sample of 1,000 treatment and 1,000 control customers in each climate zone (split evenly between CARE and non-CARE), for a total of 2,000 enrolled customers in each climate zone, the precision target of 2 to 3% with 90% confidence is obtained in all three climate regions. Indeed, a sample of 1,500 (750 treatment and 750 control) is sufficient to meet the target level of precision.

It is important to note that the results presented above were developed using a specific model in the context of a stratified sampling design with a pre-specified amount of data. Were any of these things to change (model, design or amount of data), so too would the levels of power and precision. For example, if pre-treatment data from a previous summer were available for analysis, precision would improve due to having more data available for estimation. Similarly, adding additional regressors to Equation 1 could potentially lead to improved precision if peak period usage is determined by observable characteristics (e.g. temperature). Changes that could reduce precision include not having pre-treatment data available or adding additional strata to the sampling design.

Power

In addition to precision, a related concept that is generally of interest when determining sample sizes is statistical power. Power refers to the likelihood of finding a statistically significant impact when an impact actually exists and depends on the magnitude of the impact, sample size, inherent variability in the data and desired level of confidence. Based on the estimated standard errors from the stratified sampling simulations, we can calculate the power levels associated with different impact sizes for each sample size. These can be conveniently displayed as “power curves”, which are shown for each climate zone in Figures 3 through 5 for a 90% confidence level and two-sided hypothesis test. For reference, a 2% impact is marked by a black dotted line.

Figure 3: Power Curves for Cold Climate Zone (90% Confidence)

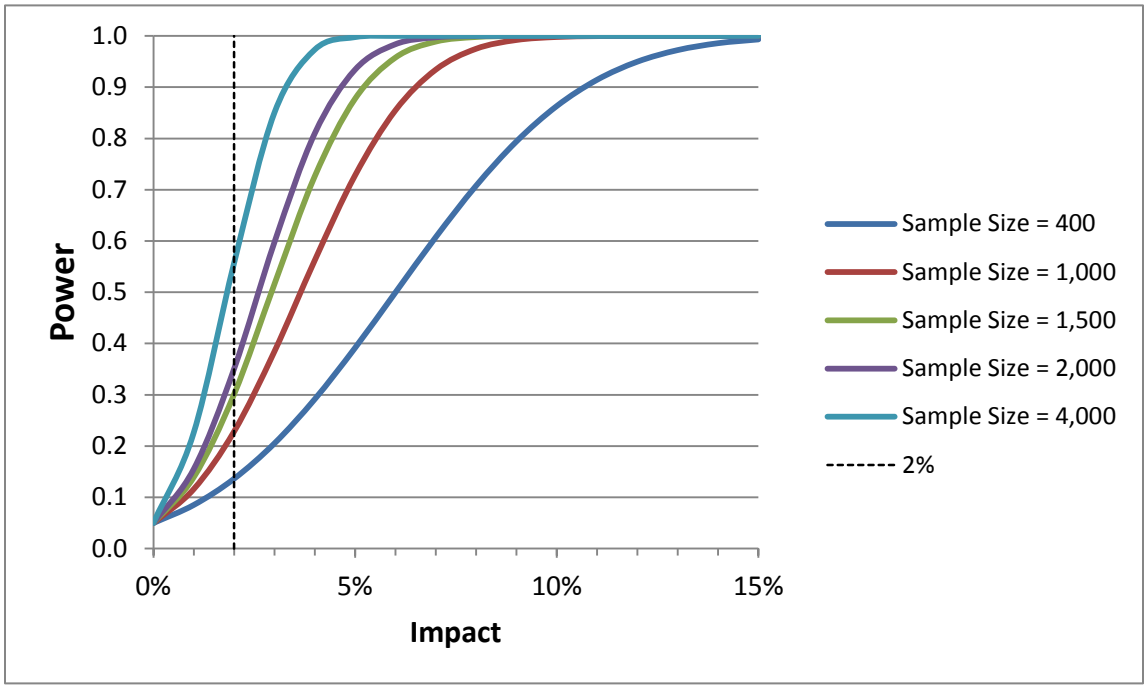


Figure 4: Power Curves for Moderate Climate Zone (90% Confidence)

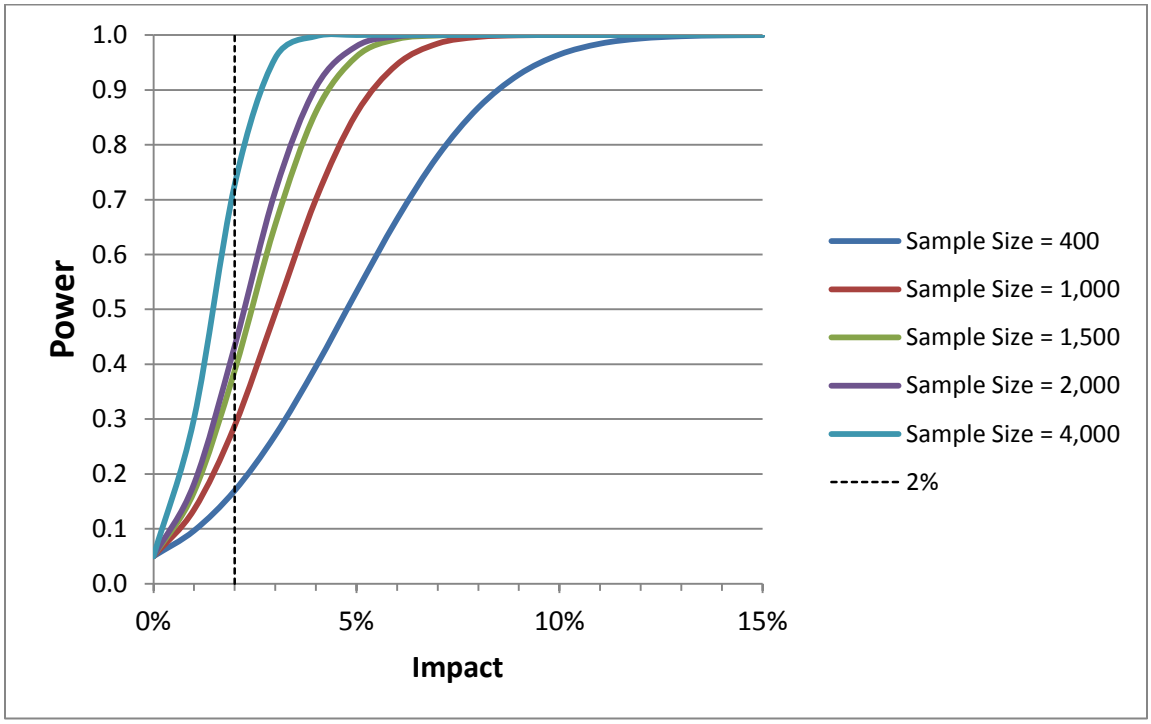
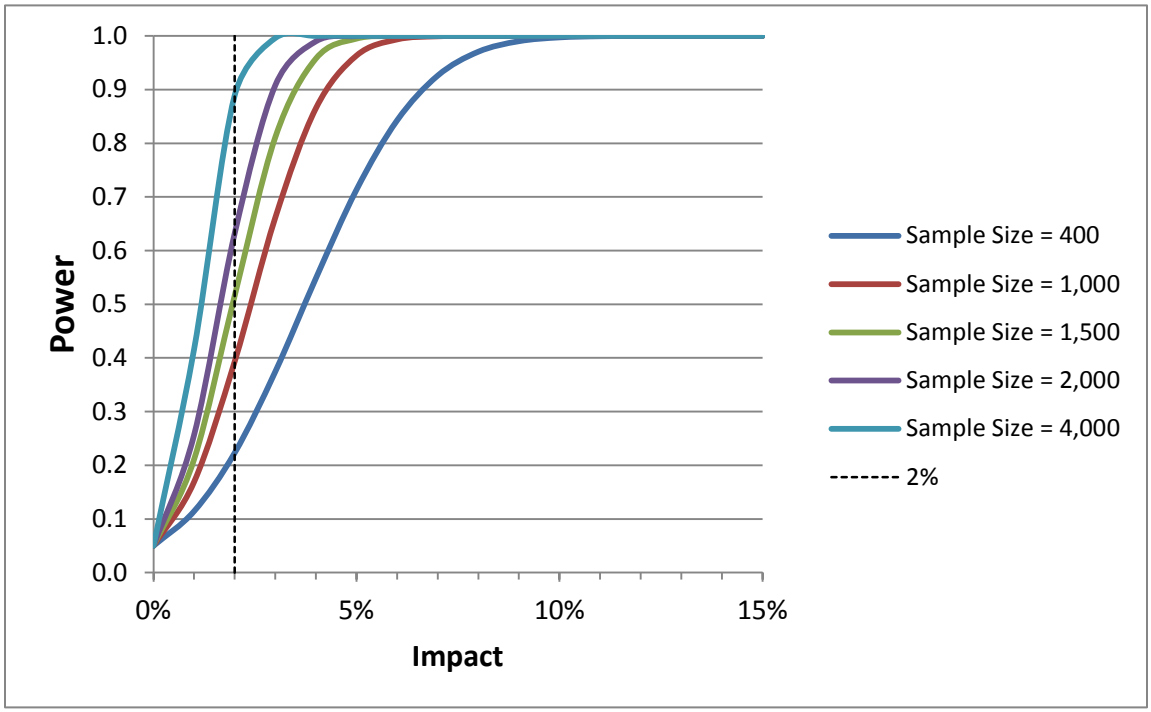


Figure 4: Power Curves for Hot Climate Zone (90% Confidence)



Because the power curves are based on the same estimated standard error as the precision calculations, similar patterns are apparent. As the sample size increases, so does the likelihood of finding statistically significant results for a given sized impact. For example, in Figure 4 the power associated with detecting a 2% impact in the Moderate climate zone with 90% confidence using a sample of 1,000 customers is about 0.3, but with a sample of 2,000 customers, power increases to about 0.45.

Conclusions

The analysis above shows that a sampling plan involving 1,000 treatment and 1,000 control customers, split evenly between CARE and non-CARE customers within each climate region, is sufficient to meet the requirement in the draft resolution to draw samples large enough to achieve a precision target of 2 to 3% with 90% confidence. Indeed, the samples could be reduced to 750 treatment and 750 control customers in cold and moderate climate regions. A similar reduction in the hot region would not meet the requirement to estimate load impacts for CARE and non-CARE customers separately in the hot climate region and could also violate other sampling criteria.

References

Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan. *How much should we trust differences-in-differences estimates?*. No. w8841. National Bureau of Economic Research, 2002.

Wooldridge, Jeffrey M. "Cluster-sample methods in applied econometrics." *American Economic Review* (2003): 133-138.

Cameron, Adrian Colin, and Pravin K. Trivedi. "Microeconometrics using stata." (2010): 166.

Appendix F-1: Comparison of Simulation Results Using Different Peak Periods (SCE)

As a robustness check for the SCE simulation analysis referenced previously (contained in Appendix D of SCE's advice letter), we ran brief versions (100 iterations) of the stratified sampling simulations using three different definitions of the peak period – 1 to 7 pm, 2 to 8 pm and 5 to 8 pm. The margins of error (90%) associated with each of these peak period definitions are shown in Table A.1 for sample sizes of 2,000 and 4,000.

Table F-1-1: Simulation Results Using Different Peak Periods for SCE

Climate	Sample Size (Treatment + Control)	90% MOE 1to7	90% MOE 2to8	90% MOE 5to8
Cool	2000	3.0%	2.9%	2.8%
	4000	2.7%	2.5%	2.4%
Moderate	2000	2.3%	2.2%	2.2%
	4000	1.6%	1.6%	1.7%
Hot	2000	2.0%	2.0%	2.0%
	4000	1.5%	1.5%	1.5%

Appendix G SDG&E Power Analysis Memo

Date: April 6, 2016

To: Leslie Willoughby, Kathryn Smith and Sabrina Butler – SDG&E

From: Jon Cook and Steve George – Nexant

Re: Monte Carlo Simulations for Determining Default TOU Pilot Sample Sizes for SDG&E

Summary

This memorandum provides documentation of the process used to establish sample size requirements for the CA Default TOU Pilot in SDG&E's territory. Monte Carlo simulation was used in conjunction with a false experiment to determine the precision of estimated peak-period load impacts that would result from stratified random sampling designs of several potential sample sizes. The data used for the simulation consisted of a stratified random sample of 80,000 customers, with 20,000 customers in each of four segments characterized by climate region and CARE/FERA status. This analysis indicates that a sample size of 1,000 treatment and 1,000 control customers is sufficient to meet the target level of precision of ±2 to 3% with 90% confidence in the moderate climate region. A sample of 1,250 treatment and control customers each will be needed in the cold climate region to achieve the required level of precision.

Data

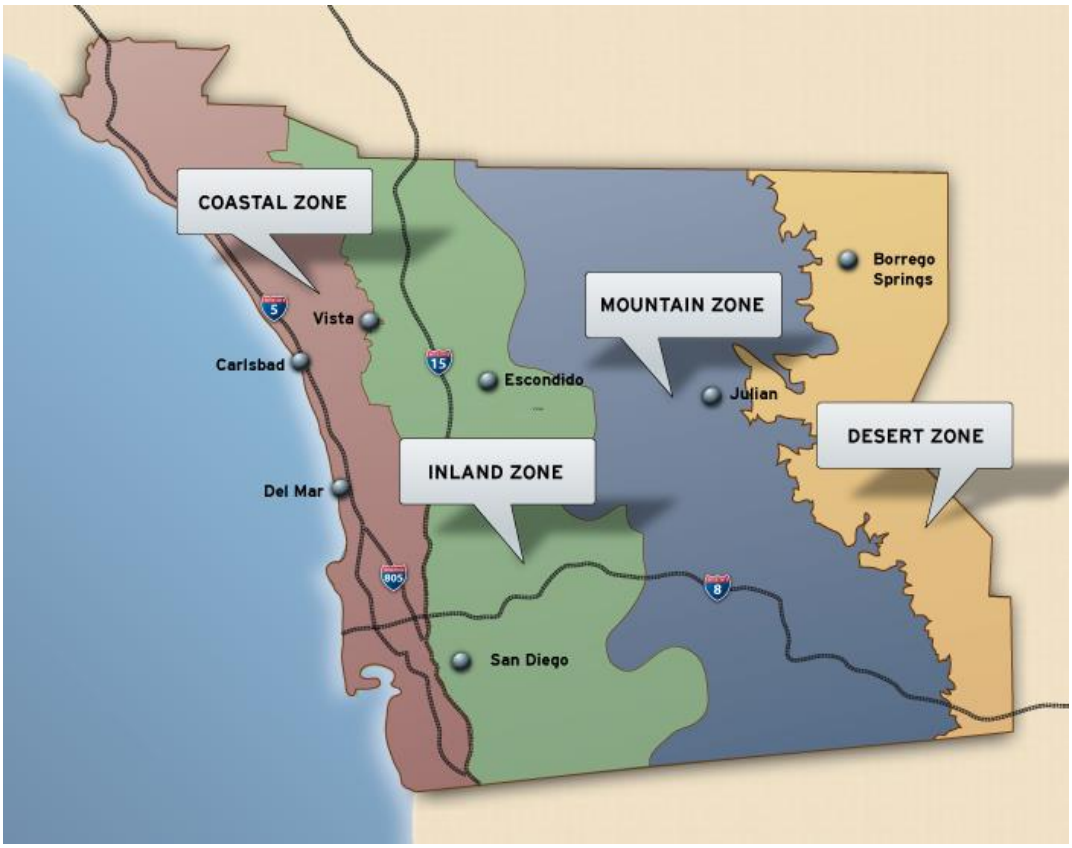
The Default TOU pilot is being designed to provide valid estimates of TOU pricing impacts for each utility service territory and for three climate regions within each territory. SDG&E's climate zones are shown in Figure 1 and were condensed into three broader climate regions for purposes of this analysis – Cold (Coastal), Moderate (Inland) and Hot (Mountain and Desert). Roughly 99% of SDG&E's residential customers reside in the Cold and Moderate climate zones so the analysis focuses on those two zones.

The TOU pilot sampling strategy also involves oversampling CARE/FERA[69] customers in all climate regions. Sample sizes for these subpopulations are not being driven by the desired level of precision for estimating load impacts, but rather by the desire to accurately characterize bill impacts and responses to surveys. However, because of the oversampling, the average load impact estimates within each climate region will need to be based on a weighted regression analysis. As such, the analysis presented here is based on weighted regressions using a difference-in-differences analysis. Previous analysis completed for SCE shows that the weighted analysis produces results comparable to what would be obtained from an un-weighted analysis using a simple random sample of the general population.[70]

[69] For brevity, we will refer to this group simply as CARE in the remainder of the memo.

[70] See Appendix D in SCE's Advice Letter, filed December 24, 2015 (Advice 3335-E)

Figure 1: SDG&E Climate Zones



For use in the simulations, SDG&E drew a random sample of 20,000 customers in each of the four subpopulations:

- CARE customers in Cold climate zones;
- Non-CARE customers in Cold climate zones;
- CARE customers in Moderate climate zones;
- Non-CARE customers in Moderate climate zones;

Interval data from the summer (May-October) of 2014 and 2015 was provided for each customer in the sample. The outcome variable of interest was the average load (kW) during a hypothetical peak period of 4-9 pm on weekdays, which is the peak period proposed for both of SDG&E's TOU pilot rates.[71]

The data were organized so that the analysis dataset is a panel made up of individual customers and daily observations of average peak period load. Table 11 shows descriptive statistics for the average summer weekday peak period load in each sample segment.

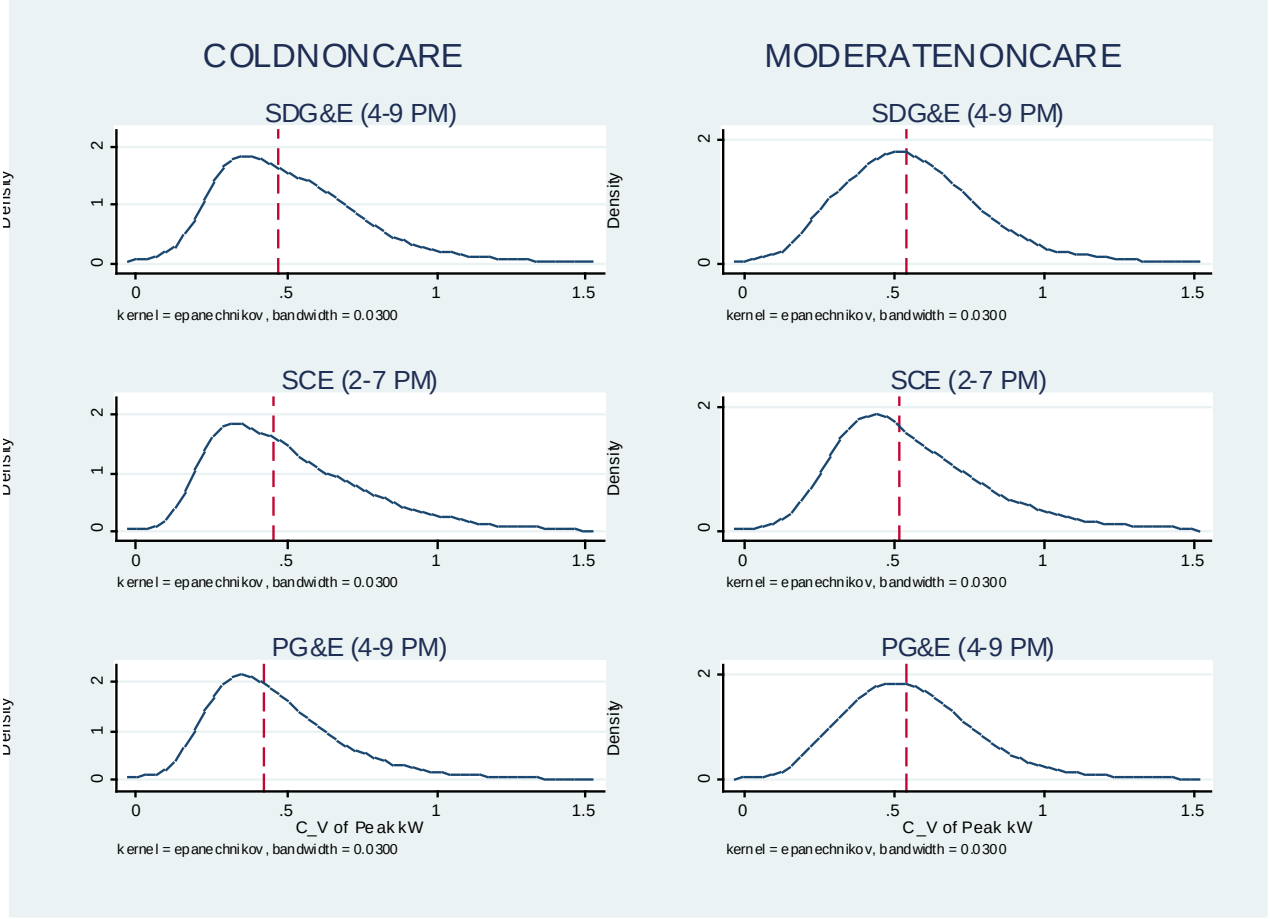
[71] For SCE, we examined whether or not changes to the peak period (1-7 pm vs. 2-8 pm vs. 5-8 pm) had a material impact on the simulation results and found that it did not. See Table A.1 in the Appendix.

Table 11: Summary Statistics for Summer Usage in SDG&E Population Segments

Climate Zone	CARE Status	% of Customers in Climate Zone	Average Daily Peak Period kW	Std. Dev. Daily Peak Period kW	Coeff. Of Variation (SD/Mean)
Cold	CARE	19%	0.61	0.35	0.57
	Non-CARE	81%	0.85	0.80	0.93
Moderate	CARE	27%	0.82	0.46	0.56
	Non-CARE	73%	1.10	0.76	0.69

Both climate zone and CARE status have a significant effect on peak period usage such that load increases with temperature and is higher for Non-CARE customers than CARE customers. Furthermore, differences in the variability in peak period usage also exist across the different segments. The coefficient of variation in the last column provides a measure of cross-sectional variability relative to the mean for each segment. Variability is lower for CARE customers in all climate zones. Note that the highest amount of cross-sectional variability (relative to the mean) exists for Non-CARE customers in the cold climate zone. The other source of variability is temporal, i.e. differences in peak period usage from day to day for a given individual. Figure 6 shows the distributions of individual Non-CARE customers' coefficients of variation in the two SDG&E climate zones and compares them to the distributions in the other IOUs. Temporal variation in the Moderate zone is very similar for the three utilities, but in the Cold zone, the median coefficient of variation in SDG&E is approximately 12% higher than PG&E and 5% higher than SCE. Because underlying variation in the data is a key determinant of estimation precision, these patterns will also manifest themselves in the simulation results.

Figure 6: Temporal Variability in SDG&E Peak Period Usage



Stratified Sampling Design

Stratified sampling designs are often used in situations where impact estimates are desired for individual population segments as well as the general population. In the simplest form of a stratified design, the population is split into the different strata of interest and then random samples are drawn within each stratum. This approach yields large enough samples to estimate impacts within each stratum, while still allowing the individual samples to be pooled together to estimate the impact for the general population.[72] In a stratified design, the pooled sample of customers from the different segments of interest is not representative of the general population. Instead, certain segments that make up a small portion of the population are "oversampled" to make up a larger portion of the pooled sample than they do in the population. When estimating population impacts, sample weights must be used to correct for this imbalance so that estimates generated from the sample are indeed representative of the population.

In the context of the TOU pilot for SDG&E, there are two populations of interest (the two climate regions) and two strata (CARE and Non-CARE). The simulations described below draw equivalent sized

[72] Stratification is particularly beneficial if the segments of interest make up a very small portion of the general population since a very large random sample would be needed to yield enough customers in the segment of interest for analysis.

samples from the strata in each population and use the appropriate sample weights to allow for inference in each climate region.[73]

Monte Carlo Simulation

Monte Carlo simulation (or experimentation) is a methodology that is commonly used for investigating the properties of econometric estimators and verifying the validity of statistical inference in a given population.[74] The power of the methodology lies in its use of repeated sampling to understand the properties of a particular estimator or statistic under realistic data conditions.[75]

One of the key questions for the design of the Default TOU pilot is how large of a sample should be used. Sample size is important because it directly affects two related properties of statistical analysis – power and precision. Power is the ability of an analysis to detect an effect if it indeed exists, while precision deals with how close the estimates would be if we conducted the analysis many times using different samples. All else equal, larger sample sizes allow for more power and greater precision since there is more data available for estimation. The draft resolutions for SCE (E-47651) and SDG&E (E-4762) dated February 25, 2016 indicated that the target level of confidence for load impact measures was between ± 2 to 3% at a confidence level of 90%.

To evaluate the expected power and precision that would result from using different sample sizes, Nexant conducted Monte Carlo simulations that incorporate a false experiment. The idea of a false experiment is to conduct an analysis in a situation where the magnitude of the treatment is known to be zero. The data used for the false experiment is similar to what would be used in a real experiment. By knowing the answer beforehand and drawing repeated samples, it is possible to assess whether or not our estimator may produce biased results during the real experiment and determine the level of precision that is expected to be achieved.

The simulation process for SDG&E is shown in Figure 7. For each sample size, X, a sample of X/2 CARE customers and X/2 Non-CARE customers was randomly selected from the climate zone of interest. Next, the "experiment" was created by randomly assigning half of the customers in each stratum to a "treatment" group on a TOU rate and the other half to a control group who remain on their current rate. It was assumed that the imaginary TOU treatment went into effect prior to the summer of 2015 for all customers, which evenly divides the available data into pre-treatment and post-treatment. In this experimental framework, the "impact" of the fictional TOU rate can be estimated using the following equation, where *i* subscripts denote individuals and *t* subscripts denote time periods (days):

$$kW_{i,t}^{\text{peak}} = \alpha + \delta \text{treat}_i + \gamma \text{post}_t + \beta(\text{treatpost})_{i,t} + \varepsilon_{i,t} \quad (1)$$

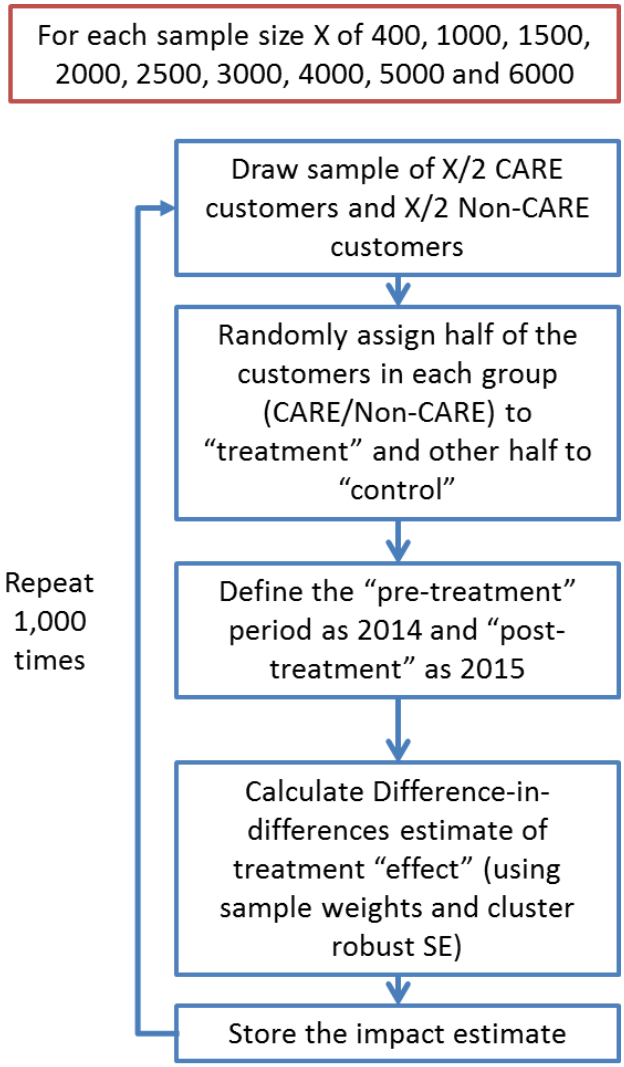
[73] The sample weights used are the inverse of the probabilities that a customer was included in the sample. E.g., if there are 100,000 Non-CARE customers in the Cold climate zone and 1,000 of them are included in the sample, then the weight would be 1/(1,000/100,000) = 100.

[74] For a more detailed discussion of Monte Carlo simulation, see Kennedy, Peter, "A Guide to Econometrics" (2008), Section 2.10 - http://www.masonlec.org/site/rte_uploads/files/Econometrics%20Book%20-%20Intro,%20Ch%201%20and%202.pdf

[75] Asymptotic properties of estimators are generally known, but rely on assuming sample sizes that approach infinity that are not appropriate in many applied research situations that rely on finite samples.

In Equation 1, the variable *treat* is equal to 1 for treatment customers and 0 for control customers, while the variable *post* is equal to 1 for days in 2015 and a value of 0 for days in 2014. The *treatpost* term is the interaction of *treat* and *post* and its coefficient β is a differences-in-differences estimator of the treatment effect that makes use of the "pre-treatment" data. In the simulation, Equation 1 is estimated using weighted least squares regression with sample weights to account for the stratified sampling design and cluster robust standard errors to account for serial correlation that is likely to be present in the data.[76] This process is repeated 1,000 times and bootstrapped standard errors are reported.

Figure 7: Monte Carlo Simulation for False Experiment with Stratified Sampling Design



[76] Serial correlation certainly exists in the variable of interest (*treatpost*) and is very likely to be present in the dependent variable (daily peak period average load). If unaddressed, serial correlation will lead to standard errors that are systematically too small. This results in overstating the precision of the impact estimate and misleading inference. To adjust for serial correlation, we follow the best practices described by Bertrand, et al. (2002), Wooldridge (2003) and Cameron (2010).

Simulation Results

For each sample size and climate zone, the simulation produced 1,000 impact estimates. The next step of the process was to use this information to draw conclusions about the precision that can be achieved. Precision calculations were based on the standard error of the impact estimate, which was calculated as the standard deviation of the 1,000 impact estimates for each sample size (bootstrap).

The final step was to translate the estimated standard errors into confidence intervals, which formed the basis of statistical inference. This was a straightforward calculation that consisted of multiplying the standard error by the t-value corresponding to the desired confidence level (approximately 1.96 for 95% confidence and 1.65 for 90% confidence[77]) to obtain the margin of error (MOE) around the impact estimate to form the confidence interval. In our false experiment, the true impact is zero; however the MOE captures the precision of that estimate if it was non-zero. For this reason, discussion is focused on the MOE. The results of the simulation are shown in Table 12.

Table 12: Precision for Peak Period Load Impacts in Segments of the SDG&E Population

Climate Zone	Sample Size (Treatment + Control)	Weighted Least Squares (Diff-in-Diff)	
		95% MOE	90% MOE
Cold	400	9.0%	7.6%
	1,000	5.5%	4.6%
	1,500	4.4%	3.7%
	2,000	3.8%	3.2%
	2,500	3.4%	2.9%
	3,000	3.1%	2.6%
	4,000	2.7%	2.2%
	5,000	2.4%	2.0%
	6,000	2.2%	1.8%
Moderate	400	7.2%	6.0%
	1,000	4.5%	3.8%
	1,500	4.0%	3.4%
	2,000	3.3%	2.8%
	2,500	3.1%	2.6%
	3,000	2.6%	2.2%
	4,000	2.3%	1.9%
	5,000	2.1%	1.7%
	6,000	1.8%	1.5%

The results can be interpreted as follows – "With a sample of 2,000 customers in the Moderate climate zone (1,000 CARE and 1,000 Non-CARE with each group split evenly between treatment and control conditions), we would expect to be able to estimate the impact of TOU

[77] Two-tailed hypothesis tests were used.

rates on peak period usage to within plus or minus 2.8% with 90% confidence." Put another way, the 90% confidence interval around a true impact of 5% with a sample of 2,000 customers (1,000 treatment and 1,000 control) would be (2.2%, 7.8%).

The precision of the impact estimates improves as we move from Cold to Moderate and as the sample size increases within each climate region. With a sample of 1,000 treatment and 1,000 control customers in the Moderate climate zone (split evenly between CARE and non-CARE), for a total of 2,000 enrolled customers, the precision target of 2 to 3% with 90% confidence is obtained. Due to a larger amount of underlying variability, a sample of 2,500 (1,250 treatment, 1,250 control) is required to meet the target level of precision for the Cold climate zone.

It is important to note that while the model used to produce the results presented above was designed to mimic the analysis of the pilot as closely as possible, any changes to the model or sample design would affect the resulting levels of power and precision. For example, adding additional regressors to Equation 1 could potentially lead to improved precision if peak period usage is determined by observable characteristics (e.g. temperature). Changes that could reduce precision include not having pre-treatment data available or adding additional strata to the sampling design.

Power

In addition to precision, a related concept that is generally of interest when determining sample sizes is statistical power. Power refers to the likelihood of finding a statistically significant impact when an impact actually exists and depends on the magnitude of the impact, sample size, inherent variability in the data and desired level of confidence. Based on the estimated standard errors from the stratified sampling simulations, the power levels associated with different impact sizes for each sample size can be calculated. These can be conveniently displayed as "power curves", which are shown for each climate zone in Figure 8 and Figure 9 for a 90% confidence level and two-sided hypothesis test. For reference, a 3% impact is marked by a black dotted line.

Figure 8: Power Curves for Cold Climate Zone (90% Confidence)

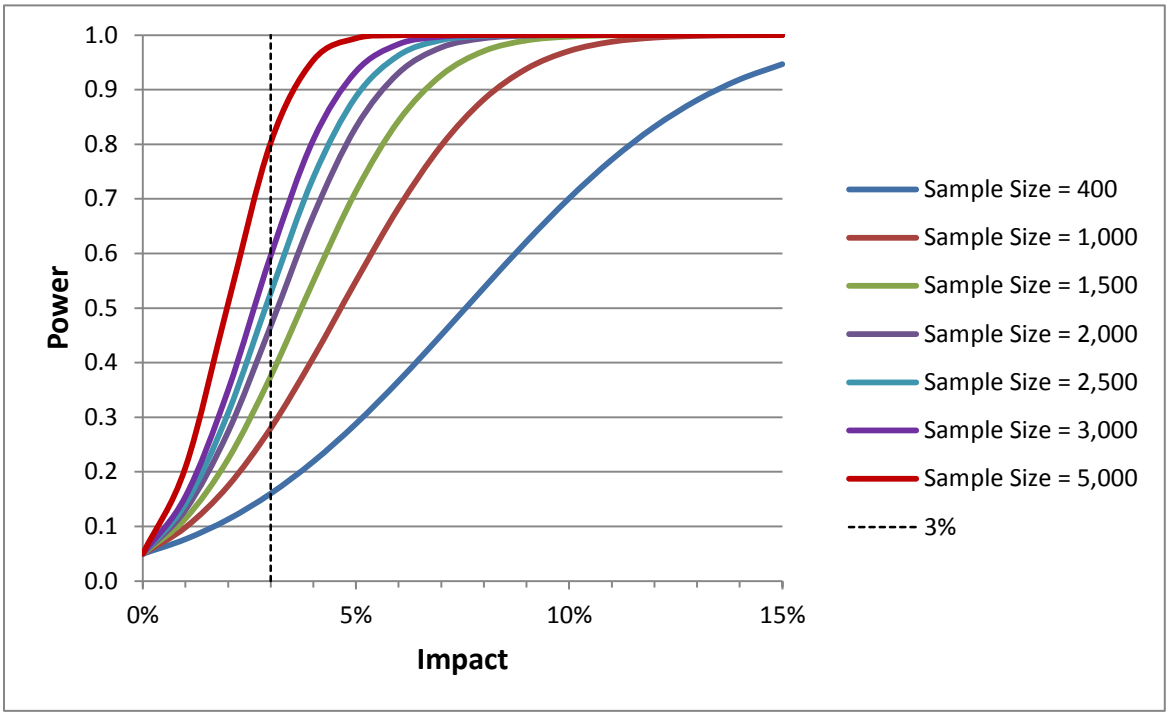
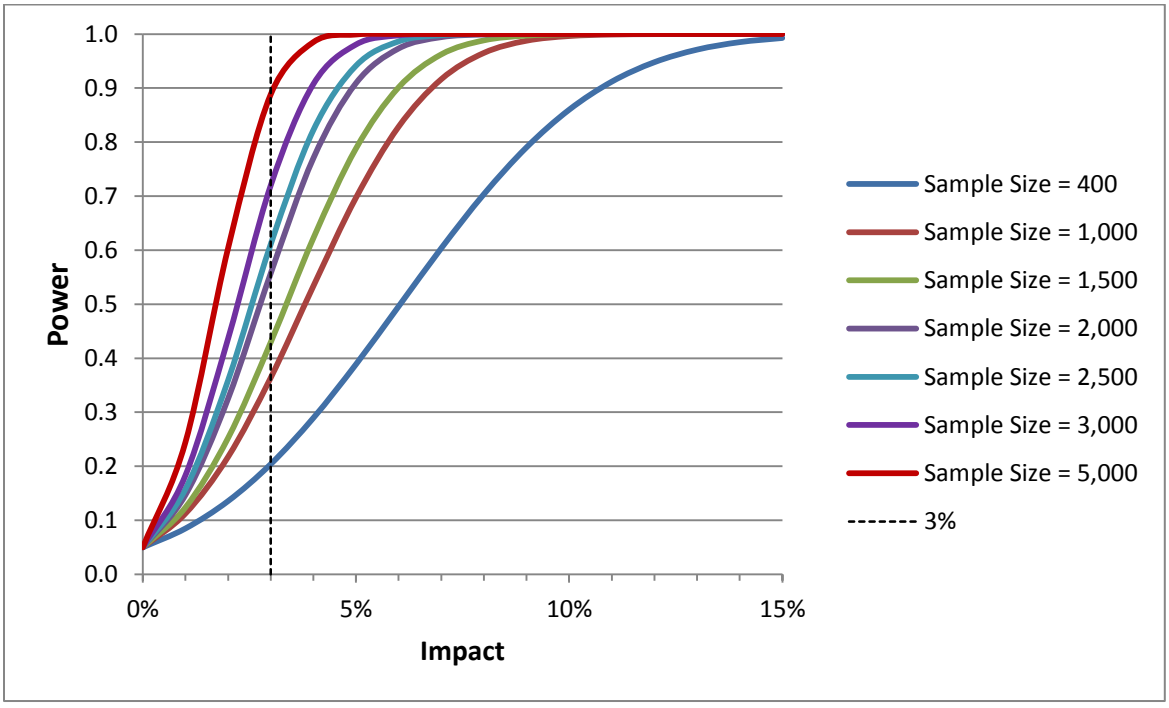


Figure 9: Power Curves for Moderate Climate Zone (90% Confidence)



Because the power curves are based on the same estimated standard error as the precision calculations, similar patterns are apparent. As the sample size increases, so does the likelihood

of finding statistically significant results for a given sized impact. For example, in Figure 4 the power associated with detecting a 3% impact in the Moderate climate zone with 90% confidence using a sample of 1,000 customers is about 0.35, but with a sample of 2,000 customers, power increases to about 0.55. Power in the Cold climate with a sample of 2,500 customers is approximately 0.55.

Conclusions

The analysis above shows that a sampling plan involving 1,000 treatment and 1,000 control customers split evenly between CARE and non-CARE customers within the Moderate climate region is sufficient to meet the 2 to 3% precision target (90% confidence) in the draft resolution. For the Cold climate region, a sample of 2,500 customers would be needed to meet the precision threshold.

References

Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan. *How much should we trust differences-in-differences estimates?*. No. w8841. National Bureau of Economic Research, 2002.

Wooldridge, Jeffrey M. "Cluster-sample methods in applied econometrics." *American Economic Review* (2003): 133-138.

Cameron, Adrian Colin, and Pravin K. Trivedi. "Microeconometrics using stata." (2010): 166.

Appendix G-1: Comparison of Simulation Results Using Different Peak Periods (SCE)

As a robustness check for the SCE simulation analysis referenced previously (contained in Appendix D of SCE's advice letter), we ran brief versions (100 iterations) of the stratified sampling simulations using three different definitions of the peak period – 1 to 7 pm, 2 to 8 pm and 5 to 8 pm. The margins of error (90%) associated with each of these peak period definitions are shown in Table A.1 for sample sizes of 2,000 and 4,000.

Table G-1-1: Simulation Results Using Different Peak Periods for SCE

Climate	Sample Size (Treatment + Control)	90% MOE 1to7	90% MOE 2to8	90% MOE 5to8
Cool	2000	3.0%	2.9%	2.8%
	4000	2.7%	2.5%	2.4%
Moderate	2000	2.3%	2.2%	2.2%
	4000	1.6%	1.6%	1.7%
Hot	2000	2.0%	2.0%	2.0%
	4000	1.5%	1.5%	1.5%