Interim Evaluation

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

Draft Interim Evaluation

February 10, 2017

Prepared for
Southern California Edison Company

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1 Executive Summary

To be added.

2 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 tariff 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; and
- Assess the effectiveness of alternative information, education, and outreach options.

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[1] George, S., Sullivan, M., Potter, J., & Savage, A. (2015). Time-of-Use Pricing Opt-in Pilot Plan. *Nexant, Inc.* (hereafter referred to as the TOU Pilot Design Report).

[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. For eight of the nine options, more than 50,000 households were enrolled and assigned to one of the TOU rates or retained in the study on the standard tiered rate to act as a control group for those who were placed on the new tariffs. The ninth rate option is a complex, dynamic rate that SDG&E is testing on a very small group of customers. Recruitment for this rate began in late August and led to enrollment of roughly 65 customers.

All eight TOU pilot tariffs have peak periods that primarily cover late afternoon and evening hours year round. This later peak period is driven by the increasing penetration of solar in California and is a significant departure from the vast majority of pilots and tariffs that have been implemented previously in California and elsewhere. With most of the rates having peak periods ending at 9 PM and some with peak periods that don't start until 6 PM, these pilots will be among the first in the industry to study the magnitude of load reductions during evening hours.

<u>Focus on Evening Peak Periods</u>

While numerous TOU tariffs have been examined in pilot settings and through evaluation of full scale programs, few historical studies have included tariffs with peak periods that extend well into the evening period when most household members are home and when cooling loads diminish in many of the populous climate zones in California. Most of the tariffs included in the pilots evaluated in this report have peak periods that primarily cover the evening hours. Determining the magnitude of demand reductions during evening hours will provide useful insights for setting pricing policies that help manage load increases in evening hours when output from distributed resources drops.

Another key focus of the pilot tariffs is the willingness and ability of consumers to respond to time-varying price signals that vary across more than two daily rate periods and across more than two seasons. Low prices in midday in the spring—when excess supply conditions sometimes exist—is also something that has not been previously tested. Some of the tariffs have the same pricing structure on weekends as on weekdays, which is yet another atypical tariff feature. For most other existing TOU tariffs, off-peak prices apply on the weekend. In short, these pilots will break new ground both in California and in the industry with regard to the timing of peak periods, the use of TOU pricing on weekends in addition to weekdays, the frequency of price changes, and the response of customers to low daytime prices during excess supply conditions.

In addition to assessing the impacts of each tariff, these pilots are also studying the impact of various technologies and information services. These include estimating TOU load impacts for households with smart thermostats in SCE's service territory and households that receive usage alerts via email in SDG&E's service territory. In PG&E's service territory, TOU customers were offered the option of downloading a smart phone app that 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. SCE is also testing whether "enhanced" education and outreach to customers on TOU rates influences demand response and customer satisfaction.

2.1 Experimental Design[4]

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 Unique, Internally Valid Experimental Design

The opt-in pilots are randomized control trials (RCTs), which ensures that the estimated load impacts are internally valid. A unique aspect of the pilot designs is that customers were asked to enroll into the pilot with the knowledge that they would be randomly assigned to one of several rate options. They were given limited information about the specific structure of the various options. Enrollment was encouraged through payment of financial incentives. It is believed that this "pay-to-play" approach will include a larger number of "complacent" customers who are prevalent when default enrollment is used.

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 significantly higher enrollment.[5]

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[6] rate options or to the

[4] More details on pilot design and the reasons underlying the design decisions can be found the TOU Pilot Design Report.

[5] Cite SMUD evaluation.

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

control condition after agreeing to participate. Since a key motivation for enrolling on the study is likely to be the PTP incentive rather than the attractiveness of any particular rate feature, this approach may enroll a reasonable number of participants who would likely be complacents, and even some who might be unaware, under a default enrollment strategy.

Another important aspect of the pilot design concerns assessment of whether TOU rates may cause unreasonable hardship for selected customer segments. Public Utility Code Section 745 requires that the CPUC ensure that any default TOU rate schedule does not cause unreasonable hardship for senior citizens or economically vulnerable customers in hot climate regions. In order to provide insights on this important issue, a stratified sampling and recruitment plan was developed. Each IOU service territory was divided into three climate regions designated as hot, moderate and cool.[7] Within the hot regions for PG&E and SCE, senior households[8] and CARE/FERA[9] customers with incomes greater and less than 100% of Federal Poverty Guidelines (FPG) were oversampled for one rate in each service territory. Oversampling was not possible in SDG&E's hot climate region because the region only contains about 16,000 customers. For the remaining rates in PG&E and SCE's hot climate regions and for all rates in the mild and cool climate regions for all three utilities, an equal number of CARE/FERA and non-CARE/FERA customers were recruited, which means that CARE/FERA customers were oversampled in those zones as well since they make up less than half of the regional population.

2.2 Pilot Evaluation

Evaluation of the opt-in pilots focused 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;
- Determining satisfaction with and perceptions about, understanding of and reported changes in behavior associated with different treatment options.

Load impacts for each rate and technology treatment were estimated by comparing loads for customers randomly assigned to each TOU tariff (e.g., treatment customers) with loads for customers randomly assigned to the OAT (e.g., control customers). The difference in loads between treatment and control customers in each rate period before customers are placed on the TOU rate (e.g., the pretreatment period) is subtracted from the difference after customers are placed on the rate (e.g., the treatment period) to ensure that there is no bias in the estimated impact due to random chance. This is referred to as a "difference-in-differences" (DiD) analysis. When applied to data collected through an RCT design, DiD analysis produces the most accurate load impact estimates possible through experimental research.

[7] See Appendix A for a summary of the geographic regions included in the hot, moderate and cool climate regions for each IOU.

[8] Senior households are defined as households with one or more members aged 65 or older.

[9] Provide definition of CARE and FERA households.

Bill impacts were estimated in a similar manner to load impacts in that a DiD analysis was conducted in order to control for exogenous factors that might impact bills between the pre- and post-treatment periods. Bill impacts were estimated as the difference between bills using pre- or post-treatment loads based on the TOU tariff compared with the OAT. Average bill impacts are reported as well as changes in the percent of customers who experience bill impacts above a certain threshold. It is important to note that bill impacts for this interim evaluation are being reported for the summer rate period when the majority of customer's bills will be higher under TOU rates compared with the OAT. Average bill impacts over the course of a year will be significantly lower than those reported here.

Assessing the extent to which TOU rates cause unreasonable hardship among selected customer segments such as seniors and economically vulnerable customers in hot climate areas is done primarily through survey questions designed to measure hardship. Responses between treatment and control customers are compared to determine if TOU rates significantly increase the percent of customers that report hardship conditions. Satisfaction with, perceptions about, understanding of and reported changes in behavior associated with different rate and other treatment options are also determined through surveys. The entire treatment and control group population was surveyed using an email, mail, and phone (EMP) mixed-mode survey approach. Response rates varied across customer segments and treatment cells but were excellent in all cases. The lowest response rate was around 65% and the highest exceeded 90%. The survey was designed, managed and analyzed by Research Into Action (RIA).

2.3 Report Organization

The remainder of this report is organized as follows. Section 3 contains a summary of the evaluation methodologies that were used to produce the results reported in subsequent sections. A more detailed methodological discussion for the load and bill impacts is contained in Appendix Volume I, which is comprised of the detailed Load Impact Evaluation Plan that was produced by Nexant in October 2016. Appendix Volume II contains a detailed discussion of the survey approach and implementation process written by RIA.

Sections 4, 5 and 6 summarize the load impact, bill impact and survey results for PG&E, SCE and SDG&E, respectively. Each section starts with a brief summary of the treatments included in each utility's pilots, the sampling plan, the recruitment process and other elements of pilot implementation. More detailed discussion of these implementation efforts is contained in Appendix Volume I. Following this summary, load impacts by rate period are presented for each rate option and relevant customer segment. The next subsection discusses bill impacts and this is followed by a summary of key survey findings. The survey discussion focuses on key research issues such as hardship and does not contain a full accounting of all survey research findings. A detailed summary of the responses to each survey question is contained in Appendix Volume II. The final subsections of Sections 4 through 6 provide a high level summary and synthesis of the impact and survey results for each IOU.

Section 7 provides a comparison of results across the utilities as well as overall conclusions that can (or cannot) be drawn from the entire body of research. While the pilots were designed jointly and are meant to be complementary, they were not designed specifically to allow cross-utility comparisons in most instances. For example, it is not appropriate to compare Rate 1 from SCE's pilot to Rate 2 from PG&E's pilot and conclude that one rate produced greater load impacts than the other due to differences in rate structure because differences in other factors, such as climate, customer demographics, customer satisfaction, perceptions about the utility, economic conditions and perhaps others may partially or fully explain any observed differences in the load impacts between the two rate options. Nevertheless, cross-utility comparisons are likely to be made by reviewers and some comparisons are more valid than others. As such, we provide a brief comparison of some key findings across utilities in this final section.

A large volume of supplemental and useful information is contained in appendices. As mentioned above, Appendix Volume I contains the load and bill impact evaluation plan report that was produced in October 2016. This 200 page report contains more detailed descriptions of the implementation process for each pilot, including copies of most of the marketing, education and outreach materials used by each utility. This appendix also contains a detailed validation analysis that was conducted by Nexant to determine if the internal validity of the experimental design was retained through implementation (it was for nearly all treatments). Finally, this volume assesses the extent to which each utility met the very specific requirements of the resolutions issued by the CPUC approving the pilot designs and budgets.

Appendix Volume II, written by RIA, provides a detailed discussion of the design and implementation of the surveys that were conducted. It also contains summaries of responses to each survey question.

There are also several short appendices to this report that may also be contained in the separate appendix volumes but are being provided here for convenience. Interested readers may also wish to review the TOU Pilot Design Report,[10] which contains a detailed discussion of research issues and explanations for the design decisions that were made by the TOU Working Group. The IOU advice letters[11] and the CPUC resolutions may also contain information of interest.[12]

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

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

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

3 Methodology

As discussed in Section 2, this interim report provides load impacts and bill impacts for each of eight rate treatments tested across the three IOUs for various customer segments and climate regions. The incremental load impacts for SDG&E's Weekly Alert Emails and for SCE's enhanced education treatment are also estimated. Analysis of survey data assessing hardship, customer satisfaction and other variables of interest is also provided. This section summarizes the methodological approaches used to estimate the metrics of interest for each pilot treatment. The discussion is organized into three broad sections summarizing the approach for estimating load impacts, bill impacts and survey analysis.

3.1 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. Estimating load impacts for other pilot treatments, such as smart thermostats and usage alerts, is also important. 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.

The approach used to estimate load impacts for the eight rate treatments spread across the three IOUs and for each customer segment that was oversampled rigorously adheres to the RCT design, which ensures that the impacts are internally valid. Internal validity 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 used is referred to as 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 rate 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 analysis 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.[13] 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 below:

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

$$kW_{i,t} = \alpha_i + \delta \text{treat}_i + \gamma \text{post}_t + \beta(\text{treatpost})_{i,t} + \ v_i + \ \varepsilon_{i,t} \qquad \text{Equation 3-1}$$

In Equation 3-1, 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 differences-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 was 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.[14]

Customer attrition is an important factor to address in the load impact analysis. Customer attrition stems from three factors; customers who move (referred to as churn); customers who become ineligible after enrolling in the pilot; and customers who drop off the pilot because they are unhappy being on the TOU rate. Customer churn and changes in eligibility should the same for both treatment and control customers. As such, dropping customers from both treatment and control groups due to churn and changes in eligibility do not introduce selection effects. That is, dropping these customers maintains the integrity of the RCT design. On the other hand, dropout rates will differ between treatment and control customers since, aside from completing a few surveys, there is no real reason for a control customer to drop off the pilot. As such, dropping these customers from the estimating sample will introduce a selection bias into the estimated impacts if they are analyzed as an RCT.

In order to address the differential opt-out rates between the treatment and control group, the load impact analysis was conducted as if the experiment was based on a Randomized Encouragement Design (RED). 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 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 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 that a portion of customers originally assigned to the treatment group do not actually receive the treatment in some periods. However, in order to maintain the initial randomization and internal validity of the experimental design, all customers assigned to the treatment group must be retained as treatment

[14] 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 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 below.

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 some 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 a RED there are two treatments of interest, each vital to producing the final treatment impact estimate. First, there is the encouragement treatment, which gives a 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 3-1 for an RCT design can be used to estimate the first stage impact, which estimates the impact of the encouragement.[15] The estimating database includes all customers who were offered the treatment, whether or not they accepted it—meaning it includes those who actually opt-out at some point.[16] 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 those who opt-out revert to their pretreatment behavior once they return to the OAT, the intention-to-treat estimate can be transformed into the effect of the treatment on those who stay 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.

The model shown in Equation 3-1 is a simple and transparent specification that produces unbiased impact estimates with precise standard errors. It does not incorporate variables such as weather, time, day of week, customer segment or other factors that can influence hourly loads. Adding additional

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[15] Through the research plan review process Nexant received a suggestion that rather than using the RED analysis approach as described above, "opt-outs could be included in the analysis dataset if the variable *treatpost* was given a value of 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 allows the β from Equation 1 to model what we've intuitively come to expect in terms of the impact of the TOU rates". Nexant conducted some simulation analysis comparing the two approaches and found the differences in estimates to be small. This analysis as well as the reasons for staying with the approach outlined here are summarized in Appendix Volume 1 (Section 5.3)

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

variables like these can reduce variation in loads over time, thus increasing the precision of the estimated impacts. Doing so can also allow for determining whether impacts vary across customer characteristics by using interaction terms and observing whether the estimated coefficients are statistically significant. Finally, such models can be used to predict what impacts would be for other populations or other conditions than those experienced during the pilot. In spite of these potential advantages, this approach was not taken for the following reasons.

- **Lack of transparency:** The simple DiD model summarized in Equation 3- 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 non-linear 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., a/c 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).

The load impact estimates reported here conform to the requirements for ex post evaluation of non-event based demand response resources as indicated in California's Demand Response Load Impact Protocols.[17] 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 are also 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 are based on the observed customer load pooled across the weekdays in each month, and similarly for weekend days. Monthly system peak day impacts are estimated based on loads that occur 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 are presented in both nominal (kWh) and proportional (%) terms.

Figure 3-1 displays an image from an Excel spreadsheet containing the output that is produced for each IOU, rate treatment, customer segment, climate region, day type and month covered by this interim analysis. These Excel spreadsheets are available upon request through the CPUC. Pull down menus in the upper left hand corner of the spreadsheet allow users to select different customer segments, climate regions, day types (e.g., weekdays, weekends, monthly peak day) and time period (individual

[17] Provide citation.

months or the average of July, August and September). In this written report, tables and graphs are presented that report estimated load impacts by treatment, rate period, customer segment and day type for the summer period.

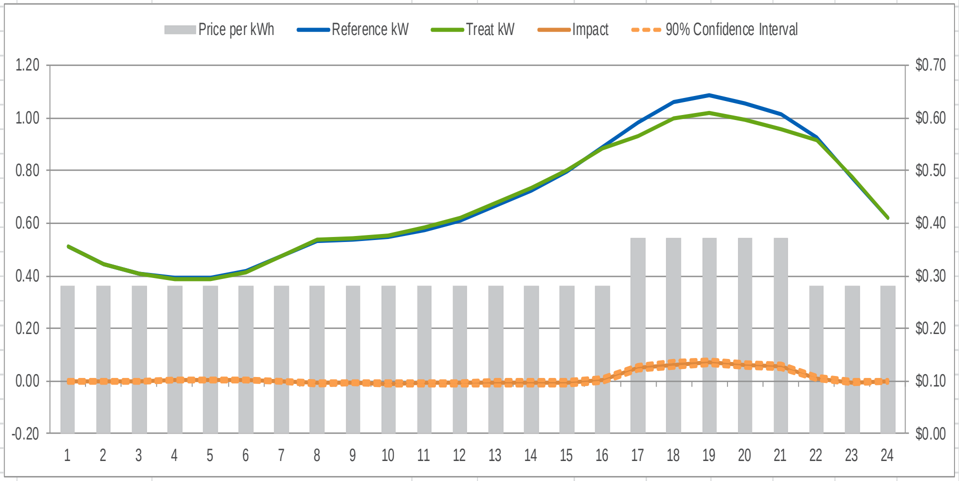
As discussed in Section 2.1, the experimental design and sampling were constructed so that load impacts and other metrics can be reported for selected customer segments and climate regions. For the segments around which the pilots were designed, load impacts are estimated using the model represented in Equation 3- 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.

There is also interest in knowing whether load impacts might vary across numerous other customer segments. Characteristics of potential interest might include psychological 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. A discussion of the conditions under which such analysis is valid is contained in Appendix Volume 1, Section 5.3.3. Analysis for segments other than those for which the pilot was designed is not provided in this interim report.

Figure 3-1: Average Hourly Load Impact Estimates for PG&E's TOU Pilot Rate 1

Segment	All
Rate	Rate 1
Month	July, August, September 2016
Day Type	Average Weekday
Treated Customers	6,428

Period	Reference kW	Treat kW	Impact	Percent Impact	90% Confidence Interval	
Peak	1.04	0.98	0.06	6%	0.055	0.065
Partial Peak	N/A	N/A	N/A	N/A	N/A	N/A
Off Peak	0.59	0.59	0.00	0%	0.00	0.00
Super Off Peak	N/A	N/A	N/A	N/A	N/A	N/A
Daily kWh	16.43	16.17	0.26	2%	0.22	0.30



Hour Ending	Reference kW	Treat kW	Impact	Percent Impact	90% Confidence Interval		Price	Period
1	0.51	0.51	0.00	0%	-0.01	0.01	$0.28	Off Peak
2	0.45	0.45	0.00	0%	-0.01	0.00	$0.28	Off Peak
3	0.41	0.41	0.00	0%	-0.01	0.01	$0.28	Off Peak
4	0.39	0.39	0.00	1%	0.00	0.01	$0.28	Off Peak
5	0.39	0.39	0.00	1%	0.00	0.01	$0.28	Off Peak
6	0.42	0.41	0.00	1%	0.00	0.01	$0.28	Off Peak
7	0.48	0.48	0.00	0%	-0.01	0.01	$0.28	Off Peak
8	0.53	0.54	-0.01	-2%	-0.02	0.00	$0.28	Off Peak
9	0.54	0.54	-0.01	-1%	-0.01	0.00	$0.28	Off Peak
10	0.55	0.56	-0.01	-2%	-0.02	0.00	$0.28	Off Peak
11	0.57	0.58	-0.01	-2%	-0.02	0.00	$0.28	Off Peak
12	0.61	0.62	-0.01	-1%	-0.02	0.00	$0.28	Off Peak
13	0.67	0.67	-0.01	-1%	-0.02	0.00	$0.28	Off Peak
14	0.73	0.73	-0.01	-1%	-0.02	0.00	$0.28	Off Peak
15	0.80	0.80	-0.01	-1%	-0.02	0.00	$0.28	Off Peak
16	0.89	0.89	0.00	0%	-0.01	0.01	$0.28	Off Peak
17	0.98	0.93	0.05	5%	0.04	0.06	$0.37	Peak
18	1.06	1.00	0.06	6%	0.05	0.07	$0.37	Peak
19	1.09	1.02	0.07	6%	0.06	0.08	$0.37	Peak
20	1.05	0.99	0.06	6%	0.05	0.07	$0.37	Peak
21	1.01	0.96	0.06	5%	0.05	0.07	$0.37	Peak
22	0.92	0.91	0.01	1%	0.00	0.02	$0.28	Off Peak
23	0.77	0.77	0.00	-1%	-0.01	0.00	$0.28	Off Peak
24	0.62	0.62	0.00	0%	-0.01	0.01	$0.28	Off Peak
Daily kWh	16.43	16.17	0.26	2%	0.22	0.30	N/A	N/A

3.2 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 regions, 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 myriad 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 or 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, a key challenge 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 used 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, the percent of customers in each segment that would see bill increases of, say, 10% or more or $20 dollars or more, if they didn'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 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 is driven by price-induced behavior change and how much is 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 were estimated for a set of metrics including an estimation of the average bill impact due to changes in usage, estimation of the total bill impact due to differences in the tariffs (holding usage constant) and behavior change, and the change in the distribution of bill impacts due to behavior change.

The calculation of bill impacts is quite straightforward. The primary challenge in this instance is to determine the best way to present the analysis so that it clearly answers the policy questions of interest. Based on iterative discussions with stakeholders, the following four analyses were conducted:

- **Structural benefiter/non-benefiter analysis based on pretreatment usage-** Displaying the proportions of structural benefiters and non-benefiters for each rate and relevant customer segment based on pretreatment data on an annual and summer season basis;
- **Estimation of the average bill impact due to changes in usage-** Displaying the average bill impact resulting from changes in behavior in response to the new price signals for each rate and relevant customer segment (after controlling for exogenous factors);
- **Estimation of the total bill impact due to differences in the tariffs (holding usage constant) and behavior change-** Displaying the bill impact for each rate and relevant customer segment due to structural differences in the rate mitigated by changes in behavior;
- **Change in the distribution of bill impacts due to behavior change-** Displaying the distribution curves of bill impacts (percentage of customers with bill impacts within $10 incremental bins) with and without behavior change in the same graph to illustrate if the distribution for participants shifted to the left or changed shape compared with the distribution for control customers without behavior change.

The following subsections provide detailed descriptions of the analysis methods implemented in each of the four billing impact analyses. Given the number of terms and variation in the equations used for each analysis, a common set of abbreviations used below are defined in Table 3-1.

Table 3-1: Terms Used in Billing Analysis Equations

Abbreviation	Term / Definition
PRE	Pre-Treatment Period –The period of time prior to enrollment on the TOU rate
POST	Post-Treatment Period – The period of time after enrollment on the — the treatment period
OAT	Otherwise Applicable Tariff – The rate a customer would be on if they weren't enrolled on the TOU rate
TOU	Time-of-use Rate – The TOU rate for the Pilot
TREAT	Treatment Group – Customers on the TOU rate

Abbreviation	Term / Definition
CTRL	Control Group – Customers on the OAT rate
CUST	Customers

3.2.1 Structural Benefiter/Non-Benefiter Analysis Based on Pretreatment Usage

The structural benefiter analysis was conducted for the summer and annual time periods using pretreatment data for the treatment group for each rate and relevant customer segment. Annual impacts are based on hourly load data from May 2015 through April 2016 for all three utilities. This time period was selected to ensure that customer energy use was as close to the present time as possible, but wasn't significantly influenced by the utilities' communications with customers about the pilot. Summer impacts are based on June 2015 through September 2015 for PG&E and SCE, and May 2015 through October 2015 for SDG&E due to their longer summer period.

Average monthly bills are estimated for each treatment group customer on the OAT and TOU rate using the hourly load data. Prior to estimating any bill impacts, the monthly bills generated from the hourly load data were compared to the actual bills generated by the utilities for validation. After working with the utilities to understand any discrepancies, all rates for all utilities ultimately passed the validation test. The difference between the TOU rate and the OAT rate determined if a customer was a structural benefiter or non-benefiter, as shown in Equation 3-2.

Equation 3-2: Structural Benefiter / Non-Benefiter

(PRE, TREAT, TOU)[18] – (PRE, TREAT, OAT)

On some rates a significant portion of the customers exhibited differences that were close to zero. As such, it could appear that a large share of customers were structural benefiters or non-benefiters even when bill impacts for a large number of customers are quite small. To address this, a neutral category of +/- $3 per month was defined. The neutral category helps ensure that the assignment to the structural benefiter or non-benefiter category is more meaningful and not overly influenced by customers who would experience a difference in bills of only a few dollars.

Similar to the load impact analysis, in some instances, customers are allowed to be represented in multiple segments. For example, a senior customer on CARE in the hot climate region is allowed to represent CARE customers and senior customers. This is accomplished using a weighting scheme where each segment's proportion within the general population is known. If a segment happens to be over-sampled, its weight is scaled accordingly so that in the final calculations, it was properly represented. The weights used for each segment and treatment cell are shown in Sections 4.2, 5.2 and 6.2 for PG&E, SCE and SDG&E, respectively.

The final results from the structural benefiter / non-benefiter analysis are presented in column graphs and shown as percentages for the summer season and on an annual basis. For each rate and relevant

[18] Each parenthetical term in the equation contains three acronyms which were defined in Table 3-2. The first acronym refers to the time period (re- or post-enrollment), the second to the customer group (control or treatment) and the third the rate (OAT or TOU). For example, (PRE, TREAT, TOU) refers to the bill amount based on pretreatment usage for treatment customers using the TOU tariff.

segment, the percentage of customers who are non-benefiters, neutral (+/- $3), or benefiters based on their average monthly bills for the time period of interest are shown as individual columns. The three columns within each rate and segment combination total 100%, thus showing the distribution of structural benefiters and non-benefiters for each rate and segment of interest.

3.2.2 Estimation of the Average Bill Impact Due to Behavior Change

The average bill impact due to customers changing their behavior in response to the TOU rates is estimated by first calculating bills for both the treatment and control group under the TOU rate during the pre-and post-treatment periods. A difference-in-differences (DiD) fixed effects model, similar to that used for estimating load impacts, is then used to estimate the average bill impact for the rate and segment of interest. The DiD analysis can be expressed by Equation 3-3.[19]

Equation 3-3: Average Bill Impact Due to Changes in Usage

[(POST, CTRL, TOU) - (POST, TREAT, TOU)] - [(PRE, CTRL, TOU) - (PRE, TREAT, TOU)]

In simplified terms, the estimated value equals the difference between the control group and the treatment group bills calculated on the TOU rate using post-treatment usage minus any pre-existing differences between the control and treatment group bills based on pretreatment usage. The control group bill calculated on the TOU rate represents the bill that would be expected if a customer was billed on the TOU rate, but didn't change their energy use behavior. The bill for the treatment group customers on the TOU rate reflects any behavioral changes in response to being on the TOU rate. By subtracting the treatment group's average bill from the control group's average bill—and removing any pre-existing differences—we are able estimate the average bill impact attributable to the treatment group's change in behavior resulting from exposure to the pilot rate, after controlling for exogenous factors. A positive impact indicates that customers successfully reduced their bills relative to the control group who did not respond to a TOU rate.

Bill impacts are presented on a column graph and shown as dollar impacts for the average summer monthly bill across July, August, and September for PG&E and SCE[20]; October is included for SDG&E due to their longer summer season. Impacts are organized by rate, climate region, and segment. The bill impact in percentage terms that corresponds to the dollar amount is also reported. It should also be noted that small bill impacts do not necessarily indicate that customers did not change their behavior. Bill impacts depend on the combination of changes in usage in each rate period. Customer may reduce use during the peak period but increase it in the off-peak period not just due to load shifting but also due to increased end-use activity. Depending on the relative magnitude of these changes and the rate differentials, significant behavior changes could lead to minimal changes in the total bill.

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[19] In practice this is estimated via an econometric model, and some of the terms drop out. However, this equation is provided in order to present the concept of the calculations that are involved with the analysis. The outcome of this equation and the econometric model are identical, but the econometric model also produces standard errors which are used to determine if the results are statistically significant.

[20] July is omitted for SCE Rate 3 customers due to the timing of customers being transitioned onto the rate during that month.

3.2.3 Estimation of the Total Bill Impact Due to Differences in the Tariffs (Holding Usage Constant) and Behavior Change

Total bill impacts experienced by customers on a TOU rate can be decomposed into two components: the structural impact, and the behavioral impact. The structural impact represents the change in customer bills based solely on the change in the underlying structure and prices for the rate. In this case, it is the change from the OAT to the time-differentiated TOU pilot rates. The behavioral impact represents how the customer changed their energy usage in response to the new pricing structure of the rate—which includes higher prices in the afternoon and evening and lower prices at other times of the day. During the summer period, most customers experienced a structural increase in their bills due to transitioning to the TOU rate. However, customers also had an opportunity to offset that increase by changing their energy use behavior in response to the new price signals. As noted above, it is the combination of the structural and behavioral impacts that produces the total bill impact experienced by the average study participant.

The estimation of the total bill impact requires the calculation of three components:

- **No Change in Behavior or Tariff [1]:** Estimate bills for control group customers based on post-treatment usage and the OAT and adjust for any small pretreatment difference in bills between control and treatment customers.

  Equation 3-4: No Change in Behavior or Tariff

  (POST, CTRL, OAT) - [(PRE, CTRL, OAT) – (PRE, TREAT, OAT)]

  - This represents what the treatment group bills would have been in the post-treatment period if they were on the OAT and had not changed their behavior.
  - It adjusts for exogenous factors that might affect bills such as differences in weather, economic conditions or the like.

- **No Change in Behavior, Change in Tariff [2]:** Estimate bills for control customers based on the TOU tariff using post-treatment usage and adjust for any small pretreatment differences in bills between control and treatment customers.

  Equation 3-5: No Change in Behavior, Change in Tariff

  (POST, CTRL, TOU) - [(PRE, CTRL, TOU) – (PRE, TREAT, TOU)]

  - This represents what the treatment group bills would have been in the post-treatment period if they were on the TOU rate and had not changed their behavior.

- **Change in Behavior and in Tariff [3]:** Estimate bills for treatment customers based on the TOU tariff using post-treatment usage.

  Equation 3-6: Change in Behavior and in Tariff

  (POST, TREAT, TOU)

  - This represents what the treatment group bills were in the post-treatment period on the TOU rate with a change in behavior

Based on the components defined above, the following metrics are calculated:

- The difference between **[1]** and **[2]** is the structural bill impact;
- The difference between **[1]** and **[3]** is the bill impact due to structural differences in the rates, but mitigated by changes in behavior;
- The difference between **[2]** and **[3]** is the amount customers were able reduce their bills by changing their behavior.

The results from this analysis are presented as the average summer monthly bills for July, August, and September for PG&E and SCE[21] —October is included for SDG&E due to their longer summer season—for [1], [2], and [3] as defined above. Presenting the total expected bill amount helps to provide context for the magnitude of the differences. In this exercise, one of the major factors is the relationship between the structural bill impacts, and how customers were able to respond. This relationship is represented by the "percentage of structural loss mitigated by the change in behavior". Put differently, this percentage represents how much of the bill increase from the TOU rate the customer are able to offset. Results are reported by rate, climate region, and segment; similarly to the other bill impact analysis sections.

3.2.4 Change in the Distribution of Bill Impacts Due to Behavior Change

The fourth analysis presents the distribution of bill impacts for customers with and without behavioral change, and is designed to show how the distribution shifts in when customers respond to the rate by changing behavior. Similar to the other analyses, impact distributions are based on the average summer monthly bills for July, August, and September for PG&E and SCE,[21] and October is included for SDG&E due to their longer summer season. The distributions are developed by estimating the percentage of customers who fall into bill impact ranges or bins, organized in $10 increments. The underlying calculations used to develop the distributions are based on a DiD approach that compares the bills for treatment and control customers using both pre- and post-treatment usage. This analysis involves the following steps.

Equation 3-7: Steps for Calculating Change in Distribution of Bill Impacts

- **Develop bill distributions:** For each range from $X to $Y in $10 increments, the percentage of customers experiencing bill impacts is calculated with and without a behavior change.
    - With change in behavior:
        - (POST, TREAT, $X, $Y)
    - No change in behavior:
        - (POST, CTRL, $X, $Y)- **[**(PRE, CTRL, $X, $Y) - (PRE, TREAT, $X, $Y)**]**
- **Underlying calculations:** (by bins or range from $X to $Y)
    - (PRE, CTRL, $X, $Y) = % of segment where:
      $X < [(PRE, CTRL, TOU) - (PRE, CTRL, OAT)] < $Y

[21] July is omitted for SCE Rate 3 customers due to the timing of customers being transitioned onto the rate during that month.

- o (PRE, TREAT, $X, $Y) = % of segment where:
  $X < [(PRE, TREAT, TOU) - (PRE, TREAT, OAT)] < $Y
- o (POST, CTRL, $X, $Y) = % of segment where:
  $X < [(POST, CTRL, TOU) - (POST, CTRL, OAT)] < $Y
- o (POST, TREAT, $X, $Y) = % of segment where:
  $X < [(POST, TREAT, TOU) - (POST, TREAT, OAT)] < $Y.

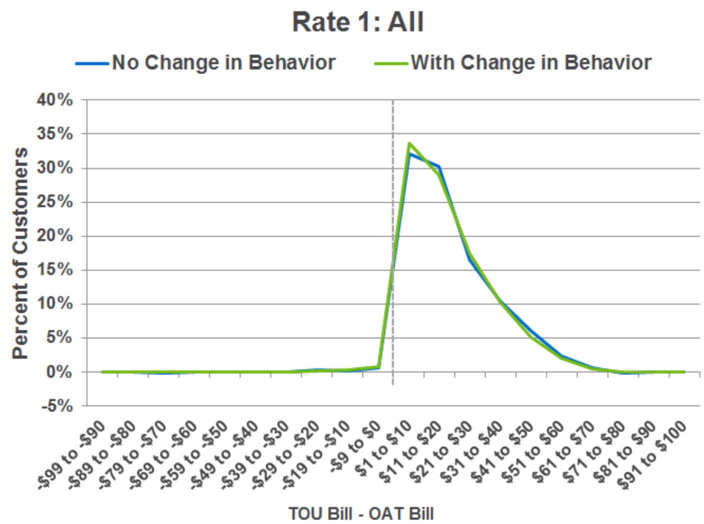
Structural bill impacts are estimated for two cases, with and without behavior change, using the four terms defined above. Customers are segmented into bill impact bins. The percentage of customers in each $10 increment (with and without behavior change) is used to produce the two distributions of bill impacts.

The two distributions are presented on a line graph, with the height of the line at any given $10 increment representing the percentage of customers experiencing a bill impact of the corresponding dollar amount. An example is provided in Figure 3-2. In this case, the bill impact is measured as the difference between the TOU bill and the OAT bill. For example, if the point on the line graph in the $21 to $30 range is at 25% for the group without behavior change, it indicates that 25% of customers in the group could expect to see an increase of between $21 and $30 per month on their bill if they switched from the OAT to a TOU rate and didn't change their behavior. If the line for the group with behavior change is to the left of the line representing the group with no change in behavior, it shows that at least some customers were able to lower their bills by modifying their energy use. It is important to note that customers could move up or down through the incremental impact bins, and could potentially move more than one bin—meaning that a customer could potentially experience a bill increase due to their behavioral response, or they could jump down several bins and go from a $21 to $30 per month bill impact down to $1 to $10 impact, for example.

Given customers can shift anywhere along the curve on the graph, the key take away from this analysis is to observe the changes in the shape of the distribution of the line representing the group who changed their behavior, relative to the line representing no change in behavior. The interpretation of the changing shape of the distributions will be discussed in more detail in the results sections where actual results are presented.

Figure 3-2: PG&E Rate 1 Change in the Distribution of Bill Impacts Due to Behavior Change

Pilot Bill - Tiered Bill	No Change in Behavior	With Change in Behavior
-$99 to -$90	0%	0%
-$89 to -$80	0%	0%
-$79 to -$70	0%	0%
-$69 to -$60	0%	0%
-$59 to -$50	0%	0%
-$49 to -$40	0%	0%
-$39 to -$30	0%	0%
-$29 to -$20	0%	0%
-$19 to -$10	0%	0%
-$9 to $0	1%	1%
$1 to $10	32%	34%
$11 to $20	30%	29%
$21 to $30	17%	17%
$31 to $40	10%	10%
$41 to $50	6%	5%
$51 to $60	2%	2%
$61 to $70	1%	1%
$71 to $80	0%	0%
$81 to $90	0%	0%
$91 to $100	0%	0%



3.3 Survey Design and Analysis

To be written by RIA and included in the next report draft.

4 PG&E Evaluation

This report section summarizes the design, implementation and evaluation of the PG&E pilot. It begins with a summary of the rate and other treatments that were tested in the pilot. This is followed by a brief overview of the pilot implementation process, which includes a discussion of enrollment rates and customer attrition. Section 4.3 presents the load impact estimates for each rate and complementary treatment and Section 4.4 summarizes the bill impacts. Section 4.5 presents the survey results, including key findings regarding hardship for selected customer segments. The final section contains a high level summary and synthesis of the survey and impact findings.

4.1 Pilot Treatments

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 4-1 and Figures 4-1 through 4-3.

Table 4-1: 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 4-1: TOU Pilot Rate 1 (Hour Ending)

<table>
<tr><th>Tariff</th><th>Season</th><th>1:00</th><th>2:00</th><th>3:00</th><th>4:00</th><th>5:00</th><th>6:00</th><th>7:00</th><th>8:00</th><th>9:00</th><th>10:00</th><th>11:00</th><th>12:00</th><th>13:00</th><th>14:00</th><th>15:00</th><th>16:00</th><th>17:00</th><th>18:00</th><th>19:00</th><th>20:00</th><th>21:00</th><th>22:00</th><th>23:00</th><th>24:00</th></tr>
<tr><td rowspan="3">Weekday</td><td>Summer</td><td colspan="16">Off-Peak (31.67¢)</td><td colspan="5">Peak (41.97¢)</td><td colspan="3"></td></tr>
<tr><td>Winter</td><td colspan="16">Off-Peak (27.1¢)</td><td colspan="5">Peak (28.98¢)</td><td colspan="3"></td></tr>
<tr><td>Spring</td><td colspan="16">Off-Peak (27.1¢)</td><td colspan="5">Peak (28.98¢)</td><td colspan="3"></td></tr>
<tr><td rowspan="3">Weekend</td><td>Summer</td><td colspan="24">Off-Peak (31.67¢)</td></tr>
<tr><td>Winter</td><td colspan="24">Off-Peak (27.1¢)</td></tr>
<tr><td>Spring</td><td colspan="24">Off-Peak (27.1¢)</td></tr>
</table>

Figure 4-2: 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
	Summer	Off Peak (29.59¢)																Partial Peak (39.27¢)		Peak (44.48¢)					
Weekday	Winter	Off Peak (26.99¢)																		Peak (29.6¢)					
	Spring	Off Peak (26.99¢)																		Peak (29.6¢)					
	Summer	Off Peak (29.59¢)																Partial Peak (39.27¢)		Peak (44.48¢)					
Weekend	Winter	Off Peak (26.99¢)																		Peak (29.6¢)					
	Spring	Off Peak (26.99¢)																		Peak (29.6¢)					

Figure 4-3: 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
	Summer	Off-Peak (28.59¢)																Peak (57.19¢)							
Weekday	Winter	Off-Peak (27.08¢)																Peak (28.97¢)							
	Spring	Off Peak (26.74¢)										Super Off-Peak (18.02¢)						Peak (36.05¢)							
	Summer	Off-Peak (28.59¢)																							
Weekend	Winter	Off-Peak (27.08¢)																							
	Spring	Off Peak (26.74¢)										Super Off-Peak (18.02¢)													

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 region. The baseline credit significantly reduces average prices, especially for lower usage customers.

Rate 1 is a simple, two-period rate with weekday peak period from 4 to 9 PM all year long and off-peak prices in effect on all other weekday hours and for all hours on weekends. The tier-2, 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 6:00 to 9:00 PM on weekdays and weekends. In order to offset the additional complexity incurred with a third TOU period, PG&E kept the same prices in effect on both weekdays and weekends.

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 10:00 am until 4:00 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 excess supply in the future. Rate 3 has the same design as Rate 1 for the summer and winter seasons, with peak times from 4:00 to 9:00 PM and all other hours being off-peak. In the spring, the peak hours are also the same as Rate 1, but the remaining hours are divided into off-peak and super-off-peak periods.

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 rate plans (control group not included). The HomeBeat app by Bidgely provides a means to visualize electricity usage data. In order to encourage energy reductions, the app 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 assess 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 it. PG&E implemented the study by randomly assigning customers into two groups, and offering the app to only one of the two groups. Roughly 300 customers out of 7,016 who were invited to download the app success did so, completed registration and connected the app to their accounts.

4.2 Implementation Summary

The sampling plan for PG&E's hot climate zone oversampled selected customer segments such as low income and senior households and oversampled CARE/FERA customers in climate regions designated as hot, moderate and cool. Table 4-2 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 designated for oversampling in the hot climate zone for purposes of assessing hardship for seniors and low income households. 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 4-2 would result in a distribution of enrolled customers by microsegment in the hot climate region is shown in column labeled "Count" in Table 4-3. The right hand column in the table shows the required sample sizes for each segment from the Resolution. 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 4-2: PG&E Sampling Plan

Climate Zone	Segment	Random Sample				Targeted		
		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 4-3: 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

Prior to pulling the recruitment sample, selected customers were screened out from participating in the pilot. A detailed accounting of all exclusion criteria is contained in Section 3.1 of Appendix Volume 1. After applying all exclusions, PG&E had an eligible population of roughly 3.6 million customers.

4.2.1 Customer Recruitment

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. As such, 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 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.

Based on input from the pretests, PG&E decided to mail out roughly 350,000 invitation letters over a four-day period starting on April 1, 2016. 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, a link to the PG&E TOU website, as well as a postage paid enrollment card/form that customers could 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 an email solicitation in 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.

Table 4-4 shows the number of customers that received solicitations in each segment, the number who accepted the offer, and the acceptance rate. 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 region, to a high of 11% for CARE individuals in cool climate region. Importantly, the 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. Given this, one cannot draw conclusions about how acceptance rates differ across segments by simply comparing the rates in Table 4-4.

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

Category	Hot Climate Region				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 Region		Cool Climate Region		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%

In July 2016, roughly 50% of all customers who were enrolled on pilot rates 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. As previously mentioned, acceptance rates for the smart phone app were quite low.

4.2.2 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. There were several reasons why customers were not placed on one of the rate treatments or assigned to the control group. 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 1st. 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 4-2, 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 the moderate climate region (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. Both those declined due to over enrollment or due to a change in eligibility were sent a decline notice and offered a 4-pack of LED light bulbs as recompense.

Table 4-5 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 sample, 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, data on these variables was collected from the vast majority of participants at the time of enrollment. As such, the enrollment survey data was 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 aged 65 or older. This change increased the number of senior households in the sample by about 10 percent

Table 4-5: Distribution of PG&E 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
Assignments	3,023	3,773	2,921	1,145	2,653	2,375	2,537	2,573	21,000
Customers Assigned to a Pilot Rate	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	2,952	3,692	2,897	1,130	2,626	2,356	2,514	2,546	20,713

Once the cell assignments were made, customers were notified of their acceptance into the pilot through the Welcome Package that was sent to customers. 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 and schedules and bill protection and providing a telephone number and treatment specific website for any inquiries. The welcome kits 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 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 link for further information.

4.2.3 Customer Attrition

Table 4-6 shows customer attrition from the pilot between when customers were assigned to a rate in May and December 31, 2016. Attrition over that period was the result of changes in eligibility, customers closing their account due to moving (e.g., customer churn), and customers dropping out of the pilot. Attrition is divided into three periods: the time between rate assignment/notification and when customers were submitted for a rate change; the time during the rate transition process; and the time between transfer onto the rate and December 31.

Over this period, 2,417 customers left the pilot due either to ineligibility, moving or proactively dropping out. Of this total, roughly 44% left because they moved location. Given that this period of time covered roughly seven months (mid-May through December), this equates to approximately 152 customers moving each month, or an annual churn rate of 1,824, or less than 10%. This is significantly less than the assumed churn rate underlying the sampling plan, which was in the 15% to 20% range.

Out of the total attrition of 2,417, 2,178 (or 90%) occurred after customers were enrolled onto the rate. Drop outs occurring over the roughly six month period following transition onto a rate (or control) equaled 398, or 2.1% of the 18,583 customers who were enrolled onto a rate or placed into the control group. Almost twice that number (788) became ineligible during that same period. The vast majority of these were customers who switched their service to one of several Community Choice Aggregators (CCAs) that are active in PG&E's service territory. Losses to CCAs are concentrated in PG&E's moderate and cool regions and are expected to continue over the course of the pilot. These losses may lead to sample sizes during the second summer of the study that dip below the minimum planning target in the moderate and cool regions but are not expected to significantly impact the hot climate region test cells.

Table 4-6: PG&E Customer Attrition

Attrition Reason	Hot Climate Zones, CARE Customers	Hot Climate Zones, Non-CARE Customers	Hot Climate Zones, Non-Senior CARE Customers below FPL	Hot Climate Zones, Non-Senior CARE Customers above FPL	Hot Climate Zones, Seniors below FPL	Hot Climate Zones, Seniors above FPL	Moderate Climate Zones, CARE Customers	Moderate Climate Zones, Non-CARE Customers	Cool Climate Zones, CARE Customers	Cool Climate Zones, Non-CARE Customers	None	Total
Customers assigned to rate treatment or control	3,023	3,773	398	306	745	2,580	2,653	2,375	2,537	2,573	37	21,000
Customers transitioned to pilot rate (or control custome	2,951	3,692	390	302	735	2,547	2,616	2,352	2,503	2,538	35	20,661
Customers enrolled as of 12-31-2016	2,621	3,394	332	264	678	2,423	2,278	2,038	2,337	2,190	28	18,583
Ineligible Post-Rate Assignment	**68**	**44**	**7**	**3**	**18**	**30**	**212**	**175**	**69**	**223**	**3**	**852**
Ineligibles, Prior to Rate Change Process	3	1	0	0	0	1	0	1	0	0	1	7
Ineligibles, During Rate Change Process	11	10	1	0	4	4	6	7	6	10	0	59
Ineligibles, Post-Rate Change	54	33	7	3	14	25	206	167	63	214	2	788
Moved Post-Rate assignment	**251**	**177**	**51**	**33**	**36**	**70**	**130**	**101**	**110**	**107**	**4**	**1,070**
Moves, Prior to Rate Change Process	4	5	2	0	0	0	3	0	5	1	0	20
Moves, During Rate Change Process	12	9	0	2	0	3	12	5	7	8	0	58
Moves, Post-Rate Change	235	163	49	31	36	67	115	96	98	98	4	992
Opt-Out Post-Rate Assignment	**83**	**158**	**8**	**6**	**13**	**57**	**33**	**61**	**21**	**53**	**2**	**495**
Opt-Outs, Prior to Rate Change Process	9	21	1	0	2	11	5	4	4	6	1	64
Opt-Outs, During Rate Change Process	4	17	1	0	0	5	1	2	1	2	0	33
Opt-Outs, Post-Rate Change	70	120	6	6	11	41	27	55	16	45	1	398
Total	**402**	**379**	**66**	**42**	**67**	**157**	**375**	**337**	**200**	**383**	**9**	**2,417**
Attrition rate	13%	10%	17%	14%	9%	6%	14%	14%	8%	15%	24%	12%

Figures 4-4 through 4-6 show the cumulative opt-out rates over time for each test cell and climate region. The cumulative number of opt-outs is highest in the hot region, second highest in the moderate region and lowest in the cool region. The number of control customers dropping out is very low in all climate regions. The cumulative opt-out rate in the moderate and cool regions is below 2% for all customer segments and rates. In the hot region, the opt-out rate exceeds 2% for four customer-segment/rate combinations, all of them involving non-CARE/FERA customers. Almost 4.5% of non-CARE/FERA customers on Rate 3 in the hot climate region have dropped out of the study. While there is evidence of an upturn in the opt-out rates starting in late July, after the first bills were sent out, there is also evidence of a significant leveling off near the beginning of October, when customers were transitioned to the winter rate period.

Figure 4-4: PG&E Opt Outs by Month – Hot Climate Region

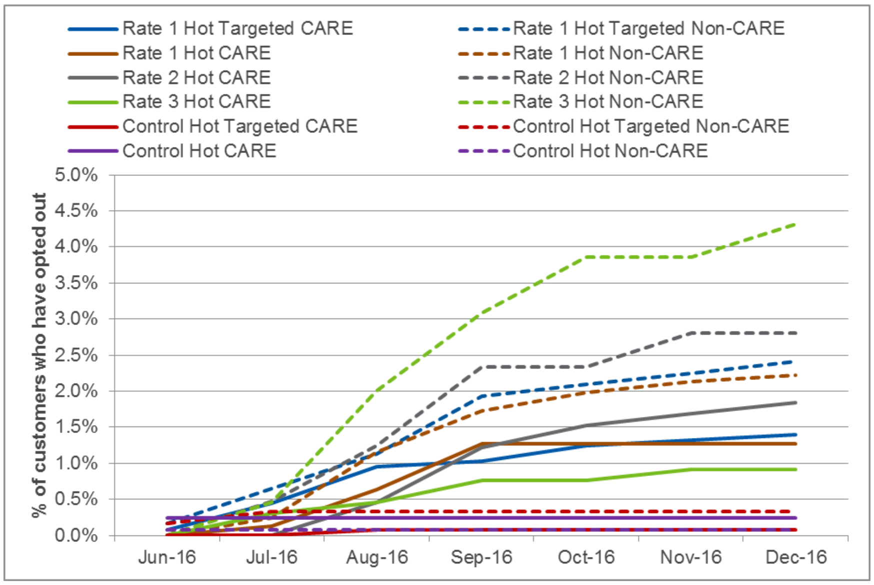


Figure 4-5: PG&E Opt Outs by Month – Moderate Climate Region

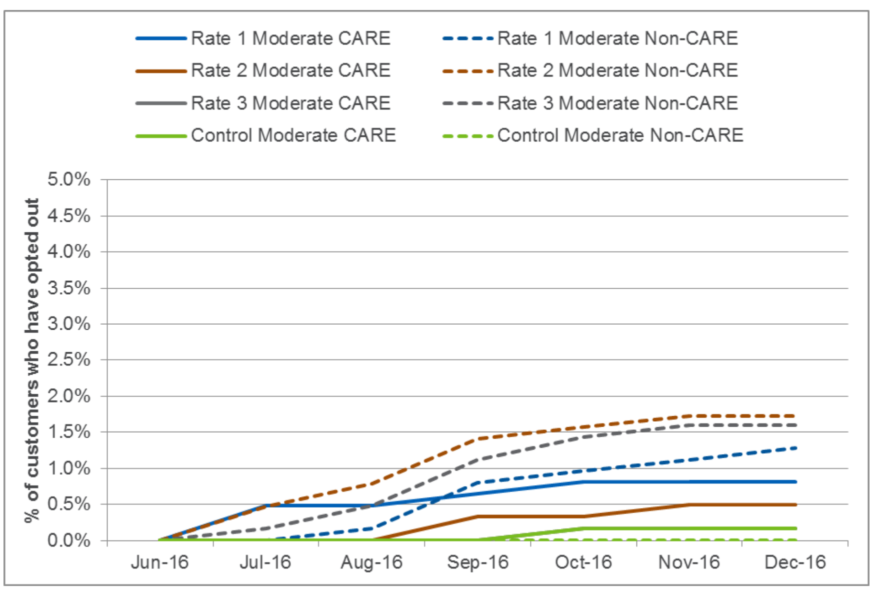
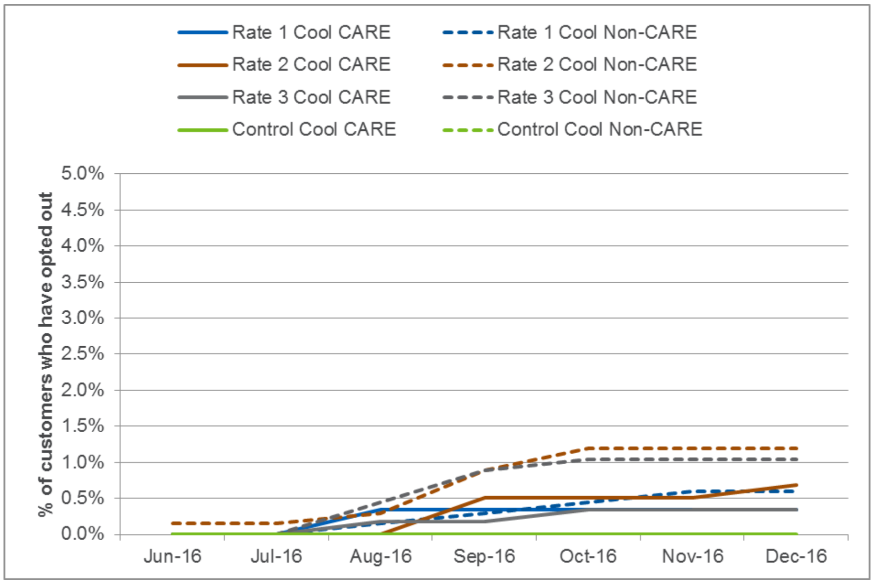


Figure 4-6: PG&E Opt Outs by Month – Cool Climate Region



Figures 4-7 through 4-9 show the overall attrition rate over time for each climate region, customer segment and TOU rate. As seen in Figure 4-7, the cumulative attrition is quite constant over time in the hot region, with the final attrition rate ranging from a low of roughly 4% for the non-CARE/FERA control group and a high of nearly 12% for CARE/FERA customers on Rate 3. The attrition in the moderate and cool climate regions have a very different shape over time, with a significant increase in attrition starting in August in the moderate region and in September in the cool region. These higher rates coincide with more active transitions of customers to CCAs during those periods.

Figure 4-7: PG&E Attrition by Month – Hot Climate Region

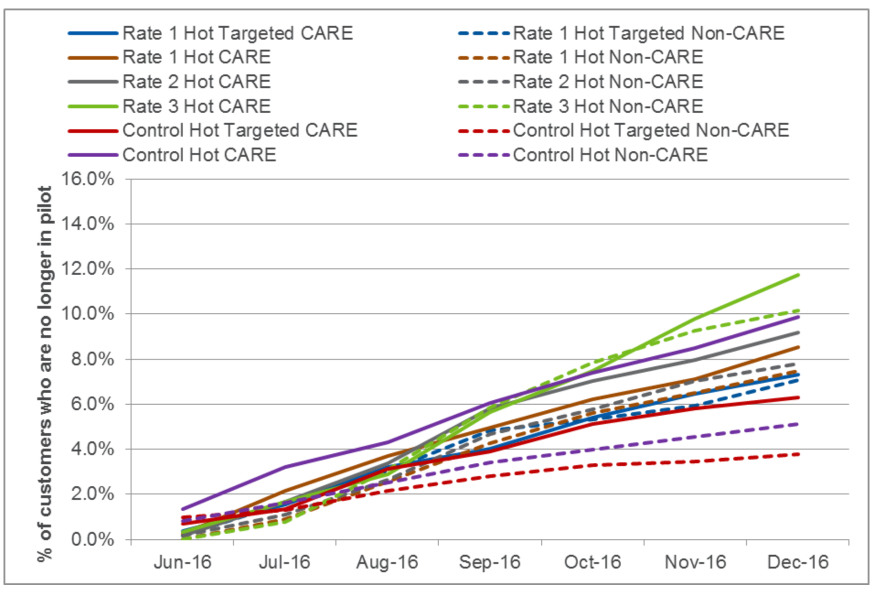


Figure 4-8: PG&E Attrition by Month – Moderate Climate Region

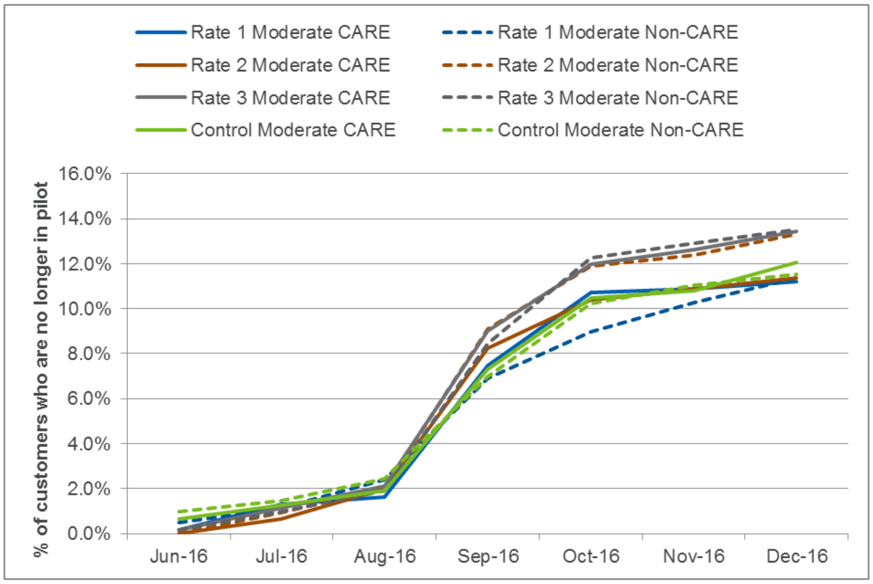
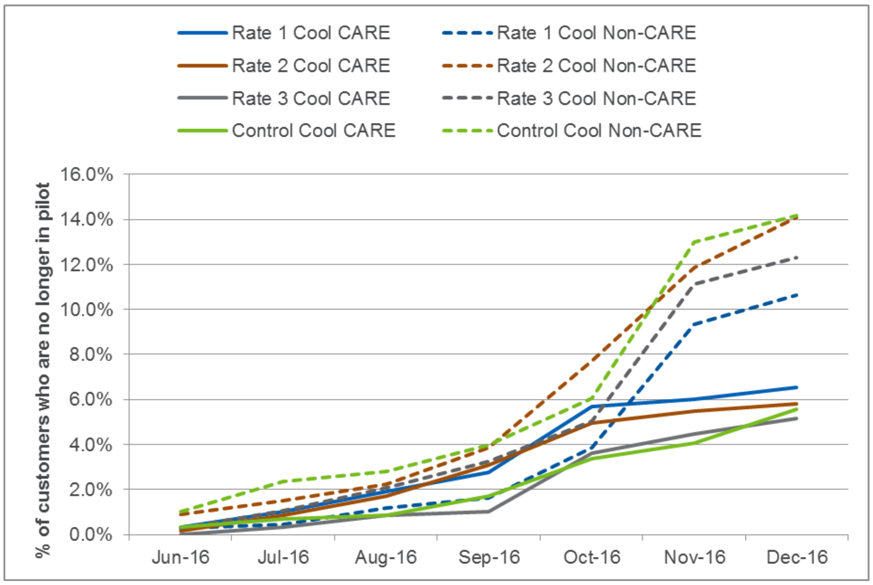


Figure 4-9: PG&E Attrition by Month – Cool Climate Region



4.2.4 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 & 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. 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.

4.2.5 Operational Challenges and Lessons Learned

To be written by PG&E and included in the next draft.

4.3 Load Impacts

This section summarizes the load impact estimates for the three rate treatments tested by PG&E. The CPUC resolution approving PG&E’s pilot requires that load impacts be estimated for the peak and off-peak periods and for daily energy use for the following rates, customer segments and climate regions:

- Seniors, CARE/FERA customers, non-CARE/FERA customers and households with incomes below 100% of FPG in PG&E’s hot climate region for Rate 1;
- For all three rates for all customers in PG&E’s service territory as a whole and for all customers in PG&E’s hot and moderate climate regions; and
- For CARE/FERA and non-CARE/FERA customers on each rate across PG&E’s service territory as a whole.

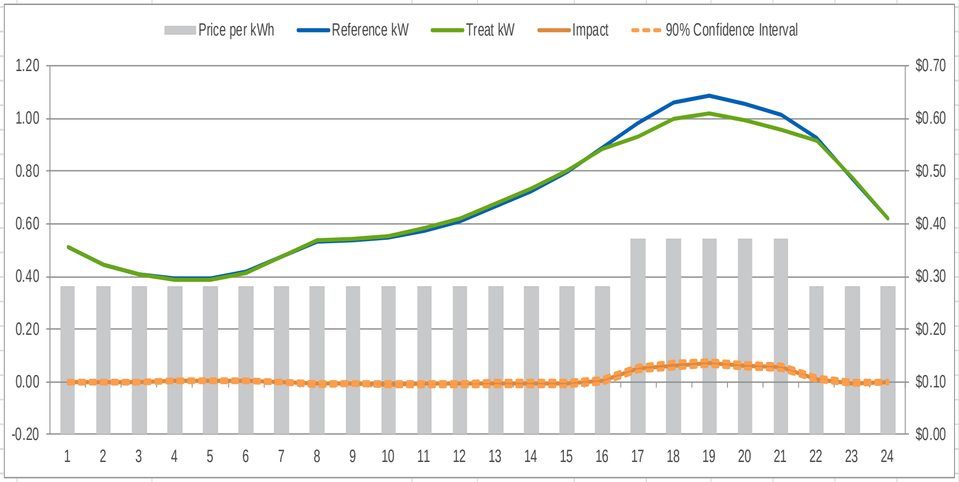
In addition to these required segments, Nexant estimated load impacts for CARE/FERA and non-CARE/FERA customers for each rate for each climate region. Load impacts are reported here for each rate period for the average weekday, average weekend and for the average monthly peak day for the summer months of July, August and September[22] for each rate, climate zone and customer segment summarized above. Underlying the values presented in the report are electronic tables that contain estimates for each hour of the day for each day type, segment and climate zone and for each month separately. These values are contained in Excel spreadsheets that are available upon request through the CPUC. Figure 4-10 shows an example of the content of these tables for PG&E Rate 1 for all eligible customers in the service territory. Pull down menus in the upper left hand corner allow users to select different customer segments, climate regions, day types (e.g., weekdays, weekends, monthly peak day) and time period (individual months or the average of July, August and September).

[22] Estimates were not produced for the month of June because enrollment changed dramatically from the beginning to the end of the month and the estimates would not be comparable to those for other months.

Figure 4-10: Example of Content of Electronic Tables Underlying Load Impacts Summarized in this Report (PG&E Rate 1, Average Summer Weekday, All Customers)

Segment	All
Rate	Rate 1
Month	July, August, September 2016
Day Type	Average Weekday
Treated Customers	6,428

Period	Reference kW	Treat kW	Impact	Percent Impact	90% Confidence Interval	
Peak	1.04	0.98	0.06	6%	0.055	0.065
Partial Peak	N/A	N/A	N/A	N/A	N/A	N/A
Off Peak	0.59	0.59	0.00	0%	0.00	0.00
Super Off Peak	N/A	N/A	N/A	N/A	N/A	N/A
Daily kWh	16.43	16.17	0.26	2%	0.22	0.30



Hour Ending	Reference kW	Treat kW	Impact	Percent Impact	90% Confidence Interval		Price	Period
1	0.51	0.51	0.00	0%	-0.01	0.01	$0.28	Off Peak
2	0.45	0.45	0.00	0%	-0.01	0.00	$0.28	Off Peak
3	0.41	0.41	0.00	0%	-0.01	0.01	$0.28	Off Peak
4	0.39	0.39	0.00	1%	0.00	0.01	$0.28	Off Peak
5	0.39	0.39	0.00	1%	0.00	0.01	$0.28	Off Peak
6	0.42	0.41	0.00	1%	0.00	0.01	$0.28	Off Peak
7	0.48	0.48	0.00	0%	-0.01	0.01	$0.28	Off Peak
8	0.53	0.54	-0.01	-2%	-0.02	0.00	$0.28	Off Peak
9	0.54	0.54	-0.01	-1%	-0.01	0.00	$0.28	Off Peak
10	0.55	0.56	-0.01	-2%	-0.02	0.00	$0.28	Off Peak
11	0.57	0.58	-0.01	-2%	-0.02	0.00	$0.28	Off Peak
12	0.61	0.62	-0.01	-1%	-0.02	0.00	$0.28	Off Peak
13	0.67	0.67	-0.01	-1%	-0.02	0.00	$0.28	Off Peak
14	0.73	0.73	-0.01	-1%	-0.02	0.00	$0.28	Off Peak
15	0.80	0.80	-0.01	-1%	-0.02	0.00	$0.28	Off Peak
16	0.89	0.89	0.00	0%	-0.01	0.01	$0.28	Off Peak
17	0.98	0.93	0.05	5%	0.04	0.06	$0.37	Peak
18	1.06	1.00	0.06	6%	0.05	0.07	$0.37	Peak
19	1.09	1.02	0.07	6%	0.06	0.08	$0.37	Peak
20	1.05	0.99	0.06	6%	0.05	0.07	$0.37	Peak
21	1.01	0.96	0.06	5%	0.05	0.07	$0.37	Peak
22	0.92	0.91	0.01	1%	0.00	0.02	$0.28	Off Peak
23	0.77	0.77	0.00	-1%	-0.01	0.00	$0.28	Off Peak
24	0.62	0.62	0.00	0%	-0.01	0.01	$0.28	Off Peak
Daily kWh	16.43	16.17	0.26	2%	0.22	0.30	N/A	N/A

Because of the targeting and oversampling that was done for selected subpopulations in the hot climate region for Rate 1 and for CARE/FERA customers in all climate regions for all rates, as described in Tables 4-2 and 4-3 above, when aggregating to higher segment levels, it is necessary to weight the data. For example, when presenting load impact estimates for each climate zone, it is necessary to apply weights to the enrolled population of CARE/FERA and non-CARE/FERA customers because CARE/FERA customers were oversampled in each climate region. Similarly, when reporting estimates at the service territory level, it is necessary to apply weights to the climate region level estimates because roughly equal sized samples were drawn in each climate region. And in the hot climate region for Rate 1 in PG&E's service territory, customers with incomes below 100% of FPG, with incomes between 100 and 200% of FPG and senior households were all oversampled. As such, when reporting load impacts for CARE/FERA and non-CARE/FERA households in the hot region for Rate 1, it is necessary to apply weights to the subpopulations so that, for example, households with incomes below 100% of FPG are not over represented in the CARE/FERA segment.

Table 4-7 shows the weights used when aggregating CARE/FERA and non-CARE/FERA customers within each climate region and when aggregating across climate regions to produce estimates at the service territory as a whole. The weights are based on the eligible population contained in each customer segment and climate region.

Table 4-7: Weights Used for Aggregating up to Climate Region and Service Territory

Segment		Eligible for Pilot Participation	Population Weight	Climate Region Weight
Hot	CARE	548,819	15.4%	39.2%
	Non-CARE	850,419	23.8%	79.4%
Moderate	CARE	220,803	6.2%	17.2%
	Non-CARE	1,059,794	29.7%	84.7%
Cool	CARE	192,156	5.4%	21.5%
	Non-CARE	700,745	19.6%	16.4%
Total		3,572,736	100.0%	n/a

Table 4-8 shows the weights that were used to aggregate up from the customer subpopulations to the CARE/FERA populations in the hot climate region for each group of customers assigned to rate and control conditions. These weights are based on the number of customers that were enrolled into the study from the general population recruitment category in the hot climate region. Since customers in the sub-segments (e.g., below 100% of FPG, 100 to 200% of FPG, seniors) contained in this general population group were not over or under sampled, the shares of each sub-segment in this group are conceptually analogous to the shares in the CARE/FERA and non-CARE/FERA segments contained in other climate regions.

The remainder of this section is organized by rate treatment – that is, load impacts are presented for each relevant customer segment and climate region for each of the three rates. Following the summary for each rate, load impacts are compared across rates. This comparison is made only for the hours within each peak period that are common across all three rates (6 to 9 PM). Because the rates differ with respect to the length and timing of peak and off-peak periods, differences in load impacts across rates for any particular rate period may be due not only to differences in prices within the rate period but also due to differences in the length or timing of the rate periods.

As discussed at the outset of Section 4, in addition to the three rate treatments, PG&E offered a smart phone app to a subset of roughly 7,000 customers. However, only a few hundred customers successfully downloaded the app. This small sample size does not support estimation of load impacts for this self-selected group of customers. Survey information on customer perceptions about the smart phone app is summarized in Section 4.9.

Table 4-8: Weights Used to Aggregate Sub-segments Into CARE/FERA and Non-CARE/FERA Segments in the Hot Climate Region

Assignment	FPG	Senior	CARE	Sample Proportion (SP)	Proportion in "General Population" (GP)	Weight (GP/SP)
Control	<100%	N	N	1.6%	2.3%	1.41
			Y	11.3%	14.6%	1.30
		Y	N	1.1%	1.1%	1.04
			Y	11.7%	6.3%	0.54
	100-200%	N	N	2.0%	3.3%	1.68
			Y	6.9%	10.2%	1.47
		Y	N	3.3%	3.3%	0.99
			Y	18.4%	7.7%	0.42
	>200%	N	N	13.9%	24.2%	1.74
			Y	2.3%	3.1%	1.33
		Y	N	23.4%	22.0%	0.94
			Y	4.1%	1.8%	0.45
Rate 1	<100%	N	N	1.4%	2.3%	1.69
			Y	11.5%	14.6%	1.27
		Y	N	1.3%	1.1%	0.90
			Y	11.6%	6.3%	0.54
	100-200%	N	N	1.9%	3.3%	1.80
			Y	7.6%	10.2%	1.35
		Y	N	4.2%	3.3%	0.78
			Y	17.8%	7.7%	0.43
	>200%	N	N	13.8%	24.2%	1.76
			Y	1.8%	3.1%	1.70
		Y	N	23.6%	22.0%	0.93
			Y	3.6%	1.8%	0.51

Assignment	FPG	Senior	CARE	Sample Proportion (SP)	Proportion in "General Population" (GP)	Weight (GP/SP)
Rate 2	<100%	N	N	1.8%	2.3%	1.29
			Y	16.8%	14.6%	0.87
		Y	N	0.5%	1.1%	2.09
			Y	6.9%	6.3%	0.91
	100-200%	N	N	3.2%	3.3%	1.03
			Y	11.9%	10.2%	0.86
		Y	N	2.9%	3.3%	1.11
			Y	9.1%	7.7%	0.84
	>200%	N	N	20.2%	24.2%	1.20
			Y	3.6%	3.1%	0.88
		Y	N	20.8%	22.0%	1.05
			Y	2.2%	1.8%	0.85
Rate 3	<100%	N	N	1.6%	2.3%	1.42
			Y	16.9%	14.6%	0.87
		Y	N	1.1%	1.1%	1.05
			Y	6.6%	6.3%	0.95
	100-200%	N	N	3.5%	3.3%	0.95
			Y	12.7%	10.2%	0.81
		Y	N	3.0%	3.3%	1.09
			Y	9.1%	7.7%	0.84
	>200%	N	N	20.8%	24.2%	1.16
			Y	3.1%	3.1%	1.02
		Y	N	19.6%	22.0%	1.12
			Y	2.0%	1.8%	0.92

4.3.1 Rate 1

PG&E's Rate 1 is a two-period rate with a peak-period from 4 to 9 PM on weekdays. In summer, for electricity usage above the baseline quantity, prices equal roughly 42.0 ¢/kWh in the peak period and 31.7¢/kWh in the off-peak period. All usage on weekends is priced at the off-peak price. For usage below the baseline quantity, a credit of 11.7 ¢/kWh is applied.

Figure 4-11 shows the average peak-period load reduction in percentage terms for Rate 1 for PG&E's service territory as a whole and for each climate region. Figure 4-12 shows the absolute load impacts for each region. The lines bisecting the top of each bar in the figures show the 90% confidence band for each estimate. If the confidence band includes 0, it means that the estimated load impacts are not statistically different from 0 at the 90% level of confidence. If the confidence bands for two bars overlap, as they do for the moderate and cool regions, it means that the observed difference in the load impacts across the two bars is not statistically significant.

Figure 4-11: Average Percent Load Impacts for Peak Period for PG&E Rate 1 (Positive values represent load reductions)

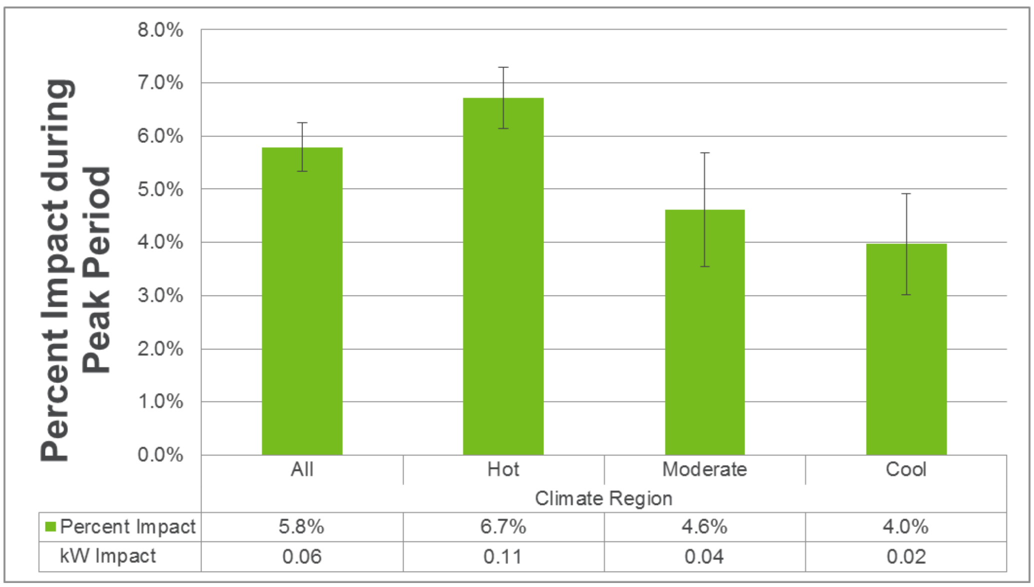
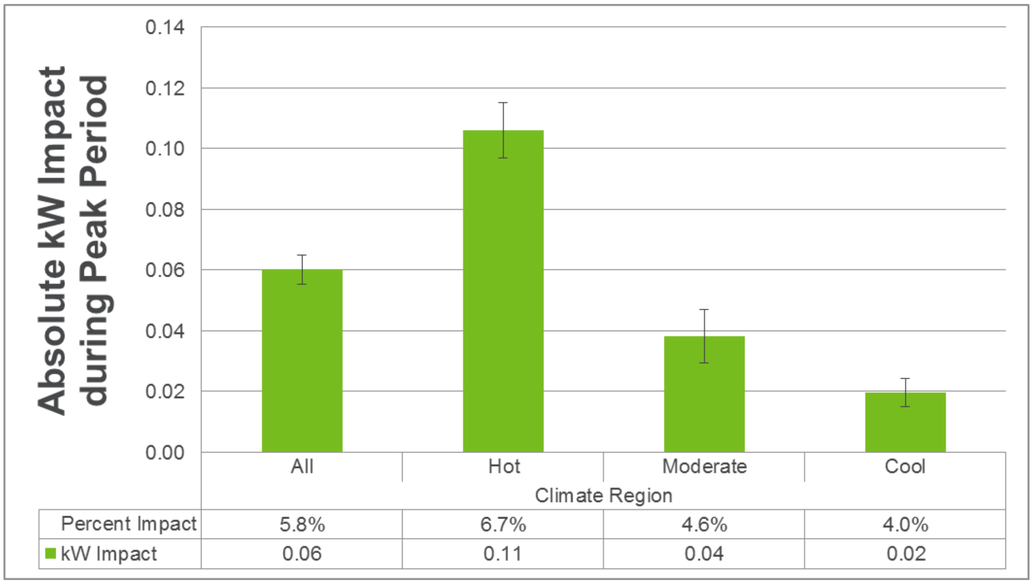


Figure 4-12: Average Absolute Load Impacts for Peak Period for PG&E Rate 1 (Positive values represent load reductions)



As seen in the figures, all of the average peak-period load impacts for the service territory as a whole and for each climate region are statistically significant at the 90% level of confidence. On average, pilot participants across PG&E's service territory reduced peak-period electricity use by 5.8%, or 0.06 kW,[23] across the five-hour peak period from 4 to 9 PM. The average peak-period load reductions range from a high of 6.7% and 0.11 kW in the hot climate region to a low of 4.0% and 0.02 kW in the cool climate region. In the moderate climate region, load reductions equal 4.6%, or 0.04 kW. The variation in absolute impacts across climate regions is much greater than the variation in percent impacts due in large part to variation in electricity usage (e.g., the reference load) across regions.

Table 4-9 shows the average percent and absolute load impacts for each rate period for weekdays and weekends and for the average monthly system peak day for the PG&E service territory as a whole and for the participant population in each climate region. The percent reduction equals the load impact in absolute terms (kW) divided by the reference load. Shaded cells in the table contain load impact estimates that are not statistically significant at the 90% confidence level. The percentage and absolute values in the first row of Table 4-9, which represent the load impacts in the peak period on the average weekday, equal the values shown in Figures 4-5 and 4-5, which were discussed above.

The reference loads shown in Table 4-9 represents estimates of what customers on the TOU rate would have used if they had not responded to the price signals contained in the TOU tariff. As seen in the table, average hourly usage during the peak period is roughly 1 kW for the service territory as a whole, and around 0.68 kW over the 24 hour average weekday. In the hot climate region, average usage in the peak period is more than 50% larger, at 1.58 kW. Average usage in the moderate region is 0.83 kW and in the cool region, at 0.49 kW, it is roughly one third what it is in the hot region.

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[23] The kW value represents the average kWh/hour across the five hour peak period. It is not an instantaneous measure of peak demand during the period. The value can be multiplied by the number of hours in the peak period to determine the total reduction in electricity use (kWh) that occurred over the period.

When examining the change in usage across rate periods, it is important to keep in mind a reduction in peak-period usage could result from conservation (e.g., using air conditioning energy use during the period without doing any pre-cooling or without experiencing a snapback effect after the end of the period) or from load shifting (doing laundry in the off-peak period rather than the peak period). An increase in off-peak usage could be the result of load shifting from the peak to the off-peak period, from increased energy use during the off-peak period unrelated to load shifting (e.g., less careful attention to lighting usage because rates are lower in the off-peak period), or both.

As seen in the Table 4-9, on the average weekday, there were small but statistically significant load increases in the off-peak period in the service territory as a whole and in the moderate and cool climate regions. In the hot region, there was no statistically significant change in average electricity use in the off-peak period.

A reduction in daily electricity use (depicted by positive values in the row labeled Day in the table) means that the combination of changes in use across all rate periods resulted in less electricity use for the day as a whole. As seen in Table 4-9, for the service territory as a whole, there was a 1.6% reduction in daily electricity use on the average weekday. In the hot climate region, the estimated conservation effect equals 2.3% while in the moderate region, it is 0.9%. In the cool climate region, the estimated reduction in electricity use is not statistically significant.

While the daily reduction in electricity use for Rate 1 is small in percentage and absolute terms, this average is spread over 24 hours each day, so the average reduction in electricity use on weekday equals roughly 0.26 kWh.[24] Over three months, this adds up to about 16 kWh per customer. If this average conservation effect was provided under default conditions and, say, 90% of the eligible population of roughly 3.5 million customers in PG&E's service territory remained on the rate, the total reduction in electricity use over the three-month period would equal more than 57 Gwh. This is quite significant. It is roughly half of the total reduction of 107 Gwh obtained for the entire year from roughly 1.5 million customers who received PG&E's Home Energy Reports program in 2014.[25]

On PG&E's Rate 1, off-peak prices are in effect all day on the weekend. In spite of these lower prices, for the service territory as a whole, the load impact estimate indicates that participants reduced electricity usage on the weekend relative to what they would have used on the OAT. Statistically significant conservation savings are also seen on the weekend in the hot and moderate climate regions.

The monthly system peak day estimates represent the average across the three weekdays, one each in July, August and September, when PG&E's system peaked in 2016. This day type is a standard one for which impacts are estimated for all demand response programs and is included here so that results can be compared with other rate and demand response programs at PG&E. Reference loads are higher on these days than on the average weekday. For the service territory as a whole, the percent reduction in peak period loads, 7.5%, is greater than on the average weekday (5.8%) and the absolute load reduction, 0.10 kW, is significantly greater than on the average weekday (0.06 kW).

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[24] The value in the table, 0.01 kW, is actually 0.011 kW. When multiplied by 24 hours, the estimate kWh reduction equals 0.26 kWh per day.

[25] Sullivan, M., & Savage, A. (2016) 2014 Energy Efficiency Savings Estimates, Pacific Gas and Electric Company, Home Energy Reports Program. *Nexant, Inc.*

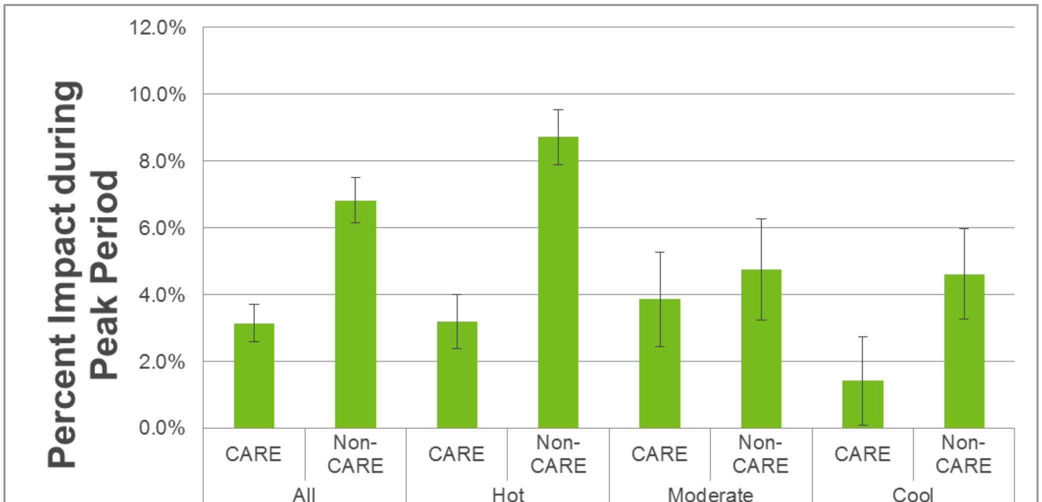
Table 4-9: Rate 1 Load Impacts by Rate Period and Day Type[26]
(Positive values represent load reductions, negative values represent load increases)

Rate 1														
Day Type	Period	Hours	All			Hot			Moderate			Cool		
			Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact
Average Weekday	Peak	4 PM to 9 PM	1.04	0.06	5.8%	1.58	0.11	6.7%	0.83	0.04	4.6%	0.49	0.02	4.0%
	Off Peak	12 AM to 4 PM, 9 PM to 12 AM	0.59	0.00	-0.4%	0.81	0.00	0.0%	0.51	0.00	-0.7%	0.36	0.00	-1.0%
	Day	**All Hours**	**0.68**	**0.01**	**1.6%**	**0.97**	**0.02**	**2.3%**	**0.58**	**0.01**	**0.9%**	**0.39**	**0.00**	**0.3%**
Average Weekend	Off Peak	All Hours	0.71	0.01	1.2%	1.02	0.02	1.9%	0.60	0.00	0.6%	0.40	0.00	-0.5%
	Day	**All Hours**	**0.71**	**0.01**	**1.2%**	**1.02**	**0.02**	**1.9%**	**0.60**	**0.00**	**0.6%**	**0.40**	**0.00**	**-0.5%**
Monthly System Peak Day	Peak	4 PM to 9 PM	1.36	0.10	7.5%	2.11	0.16	7.5%	1.14	0.11	9.5%	0.51	0.00	0.9%
	Off Peak	12 AM to 4 PM, 9 PM to 12 AM	0.70	-0.01	-1.2%	1.01	-0.01	-1.0%	0.60	-0.01	-0.9%	0.36	-0.01	-3.3%
	Day	**All Hours**	**0.84**	**0.01**	**1.7%**	**1.24**	**0.03**	**2.1%**	**0.71**	**0.02**	**2.6%**	**0.39**	**-0.01**	**-2.2%**

26 Shaded values are NOT statistically significant at the 90% level of confidence.

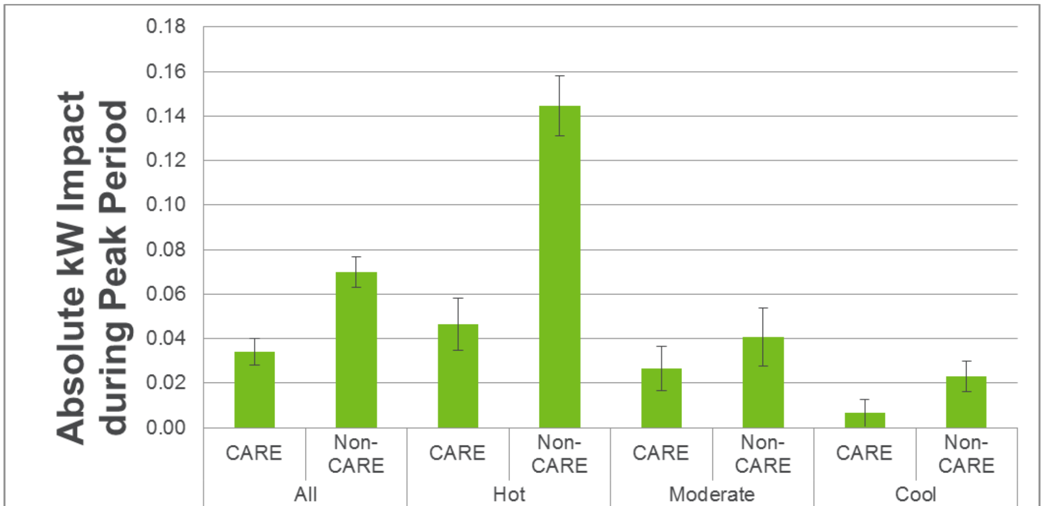
Figures 4-13 and 4-14, respectively, show the percentage and absolute peak period load impacts for Rate 1 for CARE/FERA and non-CARE/FERA customers for the service territory as a whole and for each climate region. In all regions, both the percent and absolute load impacts in the peak period are greater for non-CARE/FERA customers than for CARE/FERA customers, often significantly greater. For example, in the hot climate region, the average weekday peak period reduction is 8.7% and 0.14 kW for non-CARE/FERA customers whereas for CARE/FERA customers, the average reduction is 3.2% or 0.05 kW, which is only one third as much as for non-CARE/FERA customers. Load reductions in the cool climate region are significantly less than in the hot region for both segments and the difference between the two segments is also significant. Interestingly, in the moderate climate region, the difference between the two segments is not nearly as great. In the moderate region, the percent reduction on weekdays equals 4.7% for non-CARE/FERA and 3.9% for CARE/FERA customers. The absolute load reductions are 0.04 kW and 0.03 kW, respectively.

Figure 4-13: Average Percent Load Impacts for Peak Period for PG&E Rate 1 for CARE/FERA and non-CARE/FERA Customers (Positive values represent load reductions)



	All CARE	All Non-CARE	Hot CARE	Hot Non-CARE	Moderate CARE	Moderate Non-CARE	Cool CARE	Cool Non-CARE
Percent Impact	3.1%	6.8%	3.2%	8.7%	3.9%	4.7%	1.4%	4.6%
kW Impact	0.03	0.07	0.05	0.14	0.03	0.04	0.01	0.02

Figure 4-14: Average Absolute Load Impacts for Peak Period for PG&E Rate 1 for CARE/FERA and non-CARE/FERA Customers (Positive values represent load reductions)



	CARE (All)	Non-CARE (All)	CARE (Hot)	Non-CARE (Hot)	CARE (Moderate)	Non-CARE (Moderate)	CARE (Cool)	Non-CARE (Cool)
Percent Impact	3.1%	6.8%	3.2%	8.7%	3.9%	4.7%	1.4%	4.6%
kW Impact	0.03	0.07	0.05	0.14	0.03	0.04	0.01	0.02

Table 4-10 shows the estimated load impacts for each rate period and day type by climate zone and for the service territory as a whole for non-CARE/FERA customers and Table 4-11 shows the estimated values for CARE/FERA customers. It should be noted that, for the service territory as a whole, CARE/FERA customers have average peak-period loads that are slightly larger than non-CARE/FERA customers (1.08 for CARE/FERA and 1.02 for non-CARE/FERA) but within each climate region, CARE/FERA customers use less electricity during the peak-period than non-CARE/FERA customers. In the hot, moderate and cool climate regions, non-CARE/FERA households use 14%, 25% and 10% more electricity during the peak period, respectively, than do CARE/FERA households. Similar ratios exist for average weekday daily electricity use. This pattern across and within climate regions reflects the fact that in PG&E's service territory, a greater percent of CARE/FERA customers live in the hot climate region than in the moderate and cool region but within each region, a greater share of CARE/FERA customers may live in smaller houses and perhaps have a higher concentration of multi-family housing than non-CARE/FERA customers.

For the service territory as a whole, both customer segments reduced average daily usage on weekdays by more than 1%. On weekends, non-CARE/FERA customers reduced electricity use by 1.4% while CARE/FERA customers had a smaller reduction in electricity use (0.6%). In the hot climate region, non-CARE/FERA customers reduced electricity use on weekdays by 3%, nearly three times more than for CARE/FERA customers (0.9%). In the cool climate region, CARE/FERA customers had a small but statistically significant increase in daily electricity use on weekdays while non-CARE/FERA customers had a small, but statistically insignificant reduction in electricity use.

Table 4-10: Rate 1 Load Impacts by Rate Period and Day Type – Non-CARE/FERA Customers (Positive values represent load reductions, negative values represent load increases)

Rate 1															
Day Type	Period	Hours	All, Non-CARE			Hot, Non-CARE			Moderate, Non-CARE			Cool, Non-CARE			
			Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact
Average Weekday	Peak	4 PM to 9 PM	1.02	0.07	6.8%	1.66	0.14	8.7%	0.86	0.04	4.7%	0.50	0.02	4.6%
	Off Peak	12 AM to 4 PM, 9 PM to 12 AM	0.59	0.00	-0.6%	0.84	0.00	0.1%	0.53	-0.01	-1.4%	0.37	0.00	-0.8%
	Day	**All Hours**	**0.68**	**0.01**	**1.7%**	**1.01**	**0.03**	**3.0%**	**0.60**	**0.00**	**0.5%**	**0.40**	**0.00**	**0.6%**
Average Weekend	Off Peak	All Hours	0.71	0.01	1.4%	1.07	0.03	2.7%	0.62	0.00	0.3%	0.42	0.00	-0.2%
	Day	**All Hours**	**0.71**	**0.01**	**1.4%**	**1.07**	**0.03**	**2.7%**	**0.62**	**0.00**	**0.3%**	**0.42**	**0.00**	**-0.2%**
Monthly System Peak Day	Peak	4 PM to 9 PM	1.36	0.12	9.1%	2.27	0.22	9.6%	1.20	0.13	10.7%	0.51	0.00	0.4%
	Off Peak	12 AM to 4 PM, 9 PM to 12 AM	0.70	-0.01	-1.6%	1.06	-0.01	-1.1%	0.62	-0.01	-1.3%	0.37	-0.01	-3.8%
	Day	**All Hours**	**0.84**	**0.02**	**2.0%**	**1.31**	**0.04**	**2.7%**	**0.74**	**0.02**	**2.7%**	**0.40**	**-0.01**	**-2.7%**

Table 4-11: Rate 1 Load Impacts by Rate Period and Day Type – CARE/FERA Customers (Positive values represent load reductions, negative values represent load increases)

Rate 1															
Day Type	Period	Hours	All, CARE			Hot, CARE			Moderate, CARE			Cool, CARE			
			Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact
Average Weekday	Peak	4 PM to 9 PM	1.08	0.03	3.1%	1.46	0.05	3.2%	0.69	0.03	3.9%	0.46	0.01	1.4%
	Off Peak	12 AM to 4 PM, 9 PM to 12 AM	0.60	0.00	0.3%	0.76	0.00	-0.2%	0.45	0.01	3.3%	0.33	-0.01	-1.6%
	Day	**All Hours**	**0.70**	**0.01**	**1.2%**	**0.90**	**0.01**	**0.9%**	**0.50**	**0.02**	**3.5%**	**0.36**	**0.00**	**-0.8%**
Average Weekend	Off Peak	All Hours	0.72	0.00	0.6%	0.94	0.00	0.5%	0.51	0.01	2.4%	0.36	-0.01	-1.8%
	Day	**All Hours**	**0.72**	**0.00**	**0.6%**	**0.94**	**0.00**	**0.5%**	**0.51**	**0.01**	**2.4%**	**0.36**	**-0.01**	**-1.8%**
Monthly System Peak Day	Peak	4 PM to 9 PM	1.36	0.04	3.3%	1.87	0.07	3.6%	0.85	0.02	1.9%	0.48	0.01	2.5%
	Off Peak	12 AM to 4 PM, 9 PM to 12 AM	0.71	0.00	-0.4%	0.93	-0.01	-0.7%	0.50	0.01	1.7%	0.34	0.00	-1.4%
	Day	**All Hours**	**0.85**	**0.01**	**0.8%**	**1.13**	**0.01**	**0.8%**	**0.58**	**0.01**	**1.8%**	**0.36**	**0.00**	**-0.4%**

As discussed earlier in this section, certain groups were oversampled and assigned to Rate 1 in PG&E's service territory. The Commission's Resolution approving PG&E's pilots required that load impacts be estimated for Rate 1 in the hot climate region for senior households and for households with average incomes below 100% of FPG. Figure 4-15 shows the percent load reduction during the peak period on average weekdays for each of these customer segments and Figure 4-16 shows the load impacts in absolute terms. Table 4-12 shows the estimated values for other rate periods and day types for each segment and for the hot climate region as a whole.

A comparison of the values in Figures 4-15 and 4-16 with those for the hot region in Figures 4-11 and 4-12 shows that load impacts for senior households were very similar to the hot climate region, participant population as a whole in both percentage (7%) and absolute (0.10 kW) terms. The reference load for senior households (1.46 kW) is also similar to that of the general participant population in the hot climate region (1.58 kW). That is, senior households do not, on average, consume materially less electricity than the average customer in PG&E's hot climate region. Estimated load impacts in the off-peak period, which were not statistically different from 0, and a 2.3% reduction in daily energy use on weekdays indicates that senior households did more conservation than load shifting. This conservation effect carried over into the weekend, which showed a 1.7% load reduction on average over the summer. Peak-period load reductions on the average monthly system peak day were the same in percentage terms (7%) as on weekdays but were higher in absolute terms because average reference loads were higher on the monthly system peak days.

Figure 4-15: Average Percent Load Impacts in the Peak Period on Weekdays for PG&E Rate 1 for Senior Households and Households with Incomes Below 100% of FPG (Positive values represent load reductions)

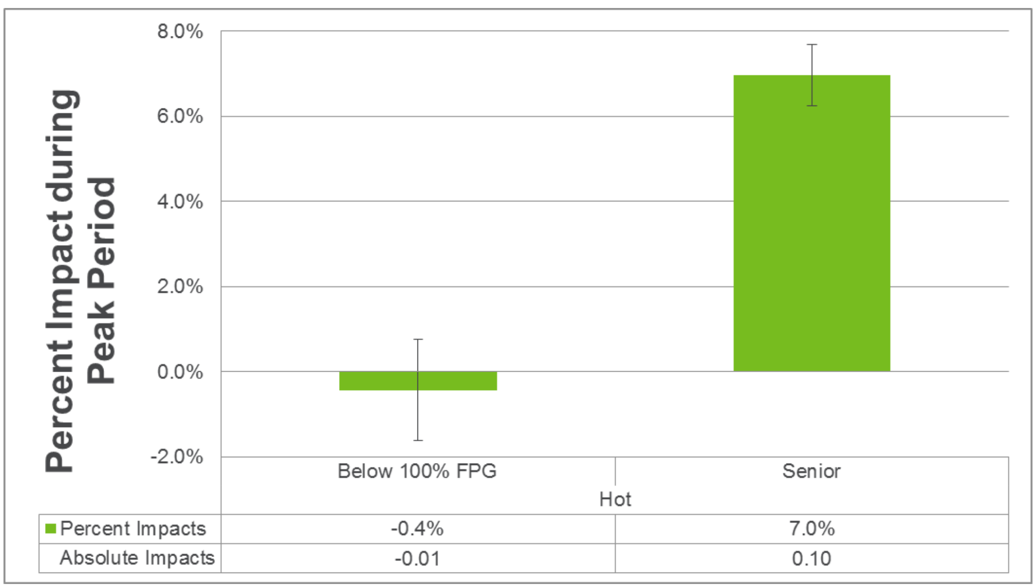
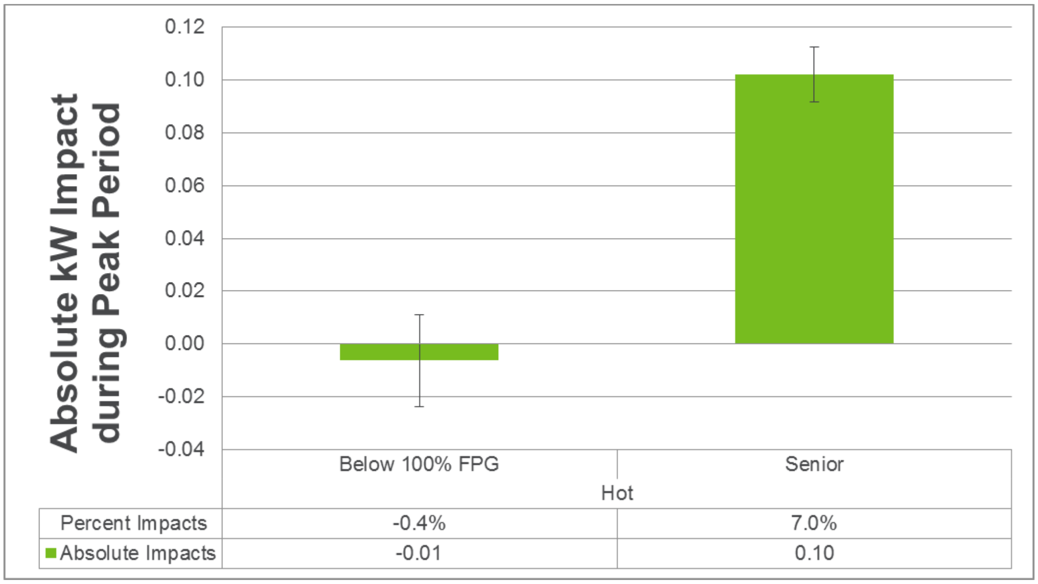


Figure 4-16: Average Absolute Load Impacts in the Peak Period on Weekdays for PG&E Rate 1 for Senior Households and Households with Incomes Below 100% of FPG (Positive values represent load reductions)



The load impacts for households with incomes less than or equal to 100% of FPG were quite different from those of senior households or the general population. These households did not reduce load at all during the peak period (the estimated values were not statistically different from 0). In fact, low income households increased usage significantly in the off-peak period on average weekdays, monthly system peak days and on the weekend. Daily electricity use increased by roughly 1.9% on weekdays and 1.6% weekends. It is also worth noting that reference loads for these households were nearly identical to loads for CARE/FERA customers in the hot climate region (as shown previously in Table 4-11) and were only about 7% lower than the overall population in the hot climate region. Put another way, low income households are not, on average, low users of electricity in PG&E's hot climate region but they are low responders to TOU price signals in this instance.[27]

[27] As seen in Section 5, results in SCE's service territory are quite different.

Table 4-12: Rate 1 Load Impacts by Rate Period and Day Type for PG&E Rate 1 for Senior Households and Households with Incomes Below 100% of FPG (Positive values represent load reductions)

Rate 1								
Day Type	Period	Hours	Hot, Below 100% FPG			Hot, Senior		
			Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact
Average Weekday	Peak	4 PM to 9 PM	1.47	-0.01	-0.4%	1.46	0.10	7.0%
	Off Peak	12 AM to 4 PM, 9 PM to 12 AM	0.80	-0.02	-2.6%	0.74	0.00	-0.1%
	Day	**All Hours**	**0.94**	**-0.02**	**-1.9%**	**0.89**	**0.02**	**2.3%**
Average Weekend	Off Peak	All Hours	0.96	-0.02	-1.6%	0.92	0.02	1.7%
	Day	**All Hours**	**0.96**	**-0.02**	**-1.6%**	**0.92**	**0.02**	**1.7%**
Monthly System Peak Day	Peak	4 PM to 9 PM	1.88	-0.01	-0.6%	1.99	0.15	7.4%
	Off Peak	12 AM to 4 PM, 9 PM to 12 AM	0.97	-0.04	-3.9%	0.94	0.00	-0.4%
	Day	**All Hours**	**1.16**	**-0.03**	**-2.8%**	**1.16**	**0.03**	**2.4%**

4.3.2 Rate 2

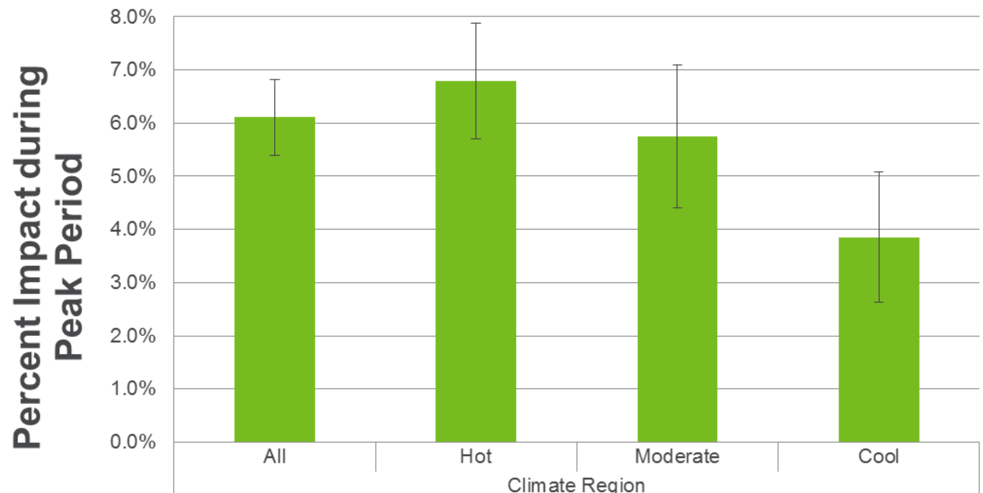
PG&E's Rate 2 differs from Rate 1 in several important ways. First, Rate 2 has three rate periods on weekdays in the summer, rather than two rate periods. Second, the Rate 2 peak period is a shorter, with a three-hour peak period covering only the evening hours from 6 to 9 PM compared with the five-hour peak period from 4 to 9 PM in Rate 1. Rate 2 has a partial peak period from 4 to 6 PM and from 9 to 10 PM. Finally, on weekends, the same three rate periods as on weekdays are in effect with Rate 2, whereas for Rate 1, all weekend hours are charged at the off-peak, weekday price. Rate 2 peak-period prices above the baseline usage amount are about 2.5 ¢/kWh higher than Rate 1 peak period prices and the off-peak price for Rate 2 is roughly 2.0 ¢/kWh lower. The shoulder period price for Rate 2 is 39.3 ¢/kWh.

Figures 4-17 and 4-18 show the percent and absolute load impacts for the weekday peak period for Rate 2 for PG&E's service territory as a whole and for each climate region. From a policy perspective, it is important to note that there are statistically significant and materially significant load reductions in the Rate 2 peak period, which coincides completely with evening hours from 6 to 9 PM. The magnitude and pattern of load reductions across climate regions are very similar for Rate 2 as they were for Rate 1. The average weekday peak-period load reduction for Rate 2 equals 6.1% and 0.06 kW. The estimated impacts in the hot region (6.8% and 0.11 kW) are nearly identical to the Rate 1 reductions as are the estimates for the cool region. In the moderate climate region, the percent reduction in the peak period on weekdays for Rate 2, 5.8%, is higher than the 4.6% reduction for Rate 1 but this difference is not statistically significant.

Table 4-13 contains load impact estimates for each rate period and day type for Rate 2. Importantly, peak-period load reductions are similar on weekends and weekdays. Peak-period reductions on the monthly system peak days are 50% larger in percentage terms and twice as large in absolute terms for the service territory as a whole. The biggest difference between average weekday and monthly peak day values occurs in the moderate climate region, where absolute load reductions nearly tripled on the monthly peak days compared with the average weekday.

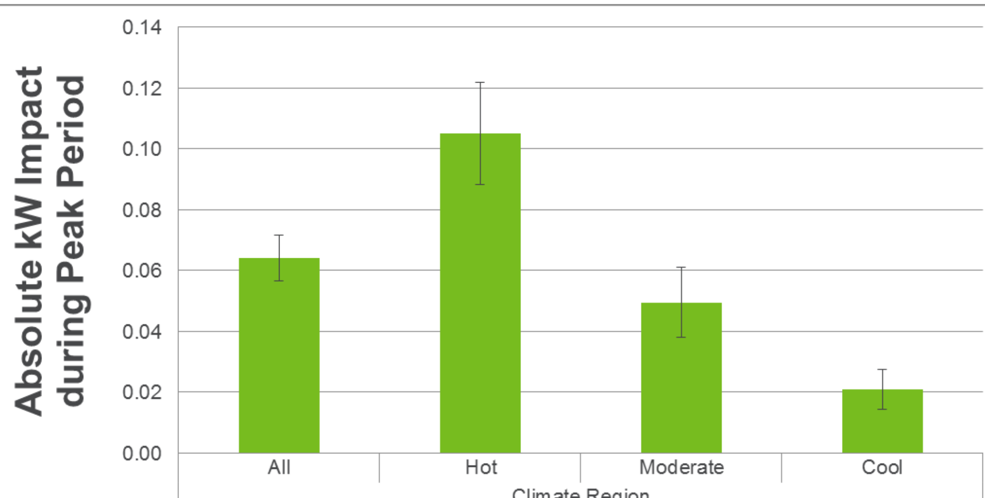
For the service territory as a whole, load reductions during the partial peak period were roughly half as large as peak period load reductions on weekdays and weekends, and about 33% lower on the average monthly peak day. All day types show statistically significant increases in off-peak usage for Rate 2. These increases were much larger than for Rate 1, and the difference between the two rates is statistically significant, even though the hours covered by the off-peak period are quite similar for both rates. The change in daily electricity use is also quite different between Rates 1 and 2, with the conservation effect being much less for Rate 2 (0.4%) compared with Rate 1 (1.6%) on the average weekday.

Figure 4-17: Average Percent Load Impacts for Peak Period for PG&E Rate 2 (Positive values represent load reductions)



	All	Hot	Moderate	Cool
Percent Impact	6.1%	6.8%	5.8%	3.9%
kW Impact	0.06	0.11	0.05	0.02

Figure 4-18: Average Absolute Load Impacts for Peak Period for PG&E Rate 2 (Positive values represent load reductions)



	All	Hot	Moderate	Cool
Percent Impact	6.1%	6.8%	5.8%	3.9%
kW Impact	0.06	0.11	0.05	0.02

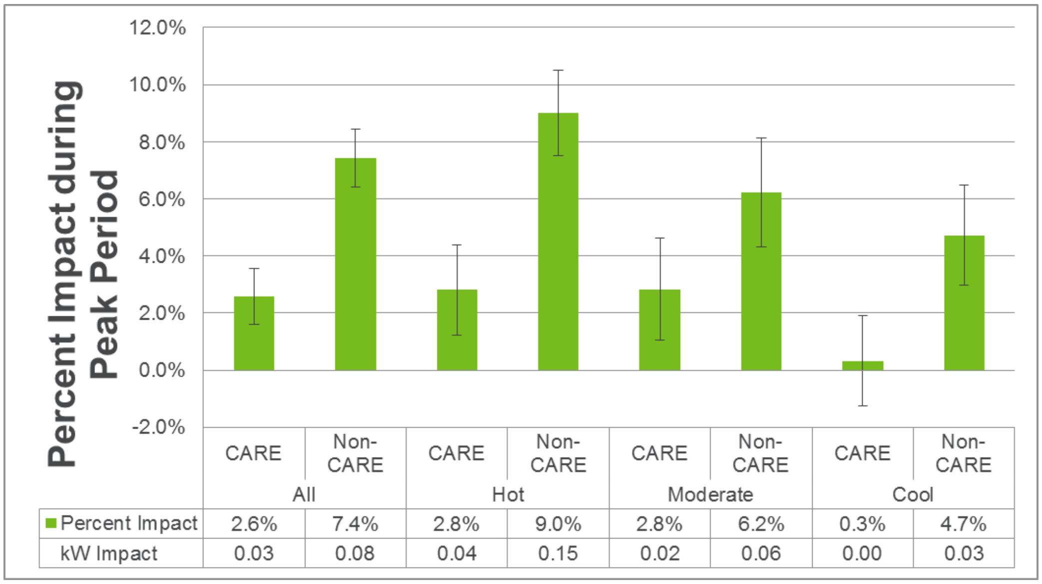
Table 4-13: Rate 2 Load Impacts by Rate Period and Day Type[28]
(Positive values represent load reductions, negative values represent load increases)

Rate 2															
Day Type	Period	Hours	All			Hot			Moderate			Cool			
			Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact
Average Weekday	Peak	6 PM to 9 PM	1.05	0.06	6.1%	1.55	0.11	6.8%	0.86	0.05	5.8%	0.54	0.02	3.9%
	Partial Peak	4 PM to 6 PM, 9 PM to 10 PM	0.99	0.03	3.1%	1.51	0.07	4.3%	0.79	0.01	1.8%	0.47	0.00	0.1%
	Off Peak	12 AM to 4 PM, 10 PM to 12 AM	0.57	-0.01	-2.1%	0.78	-0.01	-1.8%	0.50	-0.02	-3.1%	0.35	0.00	-1.4%
	Day	**All Hours**	**0.68**	**0.00**	**0.4%**	**0.97**	**0.01**	**1.1%**	**0.58**	**0.00**	**-0.6%**	**0.39**	**0.00**	**-0.3%**
Average Weekend	Peak	6 PM to 9 PM	1.05	0.06	5.4%	1.55	0.10	6.2%	0.86	0.04	4.7%	0.54	0.02	3.0%
	Partial Peak	4 PM to 6 PM, 9 PM to 10 PM	1.02	0.03	3.3%	1.55	0.07	4.8%	0.82	0.01	1.5%	0.49	0.00	0.5%
	Off Peak	12 AM to 4 PM, 10 PM to 12 AM	0.61	-0.01	-1.6%	0.84	-0.01	-0.6%	0.52	-0.02	-3.2%	0.37	-0.01	-1.8%
	Day	**All Hours**	**0.71**	**0.00**	**0.6%**	**1.02**	**0.02**	**1.7%**	**0.60**	**-0.01**	**-1.0%**	**0.40**	**0.00**	**-0.7%**
Monthly System Peak Day	Peak	6 PM to 9 PM	1.36	0.12	8.9%	2.06	0.16	7.6%	1.15	0.14	12.4%	0.55	0.03	5.9%
	Partial Peak	4 PM to 6 PM, 9 PM to 10 PM	1.29	0.08	6.2%	2.01	0.11	5.7%	1.08	0.10	9.0%	0.48	0.00	0.2%
	Off Peak	12 AM to 4 PM, 10 PM to 12 AM	0.68	-0.01	-2.0%	0.98	-0.02	-2.2%	0.58	-0.01	-2.0%	0.35	-0.01	-1.4%
	Day	**All Hours**	**0.84**	**0.01**	**1.8%**	**1.24**	**0.02**	**1.4%**	**0.71**	**0.02**	**3.0%**	**0.39**	**0.00**	**0.1%**

28 Shaded values are NOT statistically significant at the 90% level of confidence.

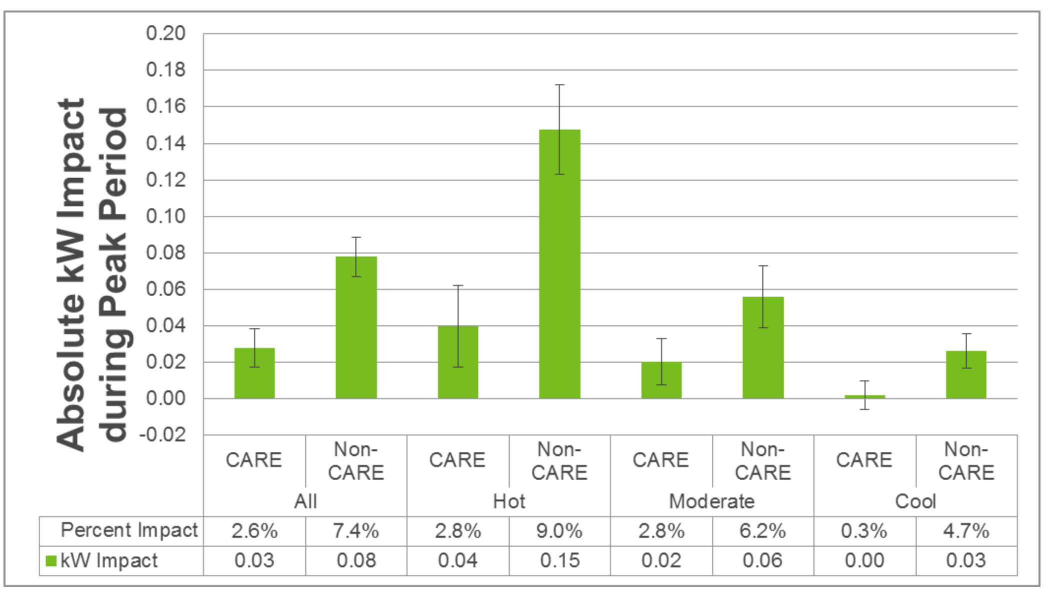
Figures 4-19 and 4-20 show the estimated peak period load impacts for Rate 2 for CARE/FERA and non-CARE/FERA households for the service territory as a whole and for each climate region. There are significant differences in load reductions between the two segments, with load reductions for non-CARE/FERA households being much larger in both percentage and absolute terms than for CARE/FERA households.

Figure 4-19: Average Percent Load Impacts for Peak Period for PG&E Rate 2 for CARE/FERA and non-CARE/FERA Customers (Positive values represent load reductions)



	All		Hot		Moderate		Cool	
	CARE	Non-CARE	CARE	Non-CARE	CARE	Non-CARE	CARE	Non-CARE
Percent Impact	2.6%	7.4%	2.8%	9.0%	2.8%	6.2%	0.3%	4.7%
kW Impact	0.03	0.08	0.04	0.15	0.02	0.06	0.00	0.03

Figure 4-20: Average Absolute Load Impacts for Peak Period for PG&E Rate 2 for CARE/FERA and non-CARE/FERA Customers (Positive values represent load reductions)



	All		Hot		Moderate		Cool	
	CARE	Non-CARE	CARE	Non-CARE	CARE	Non-CARE	CARE	Non-CARE
Percent Impact	2.6%	7.4%	2.8%	9.0%	2.8%	6.2%	0.3%	4.7%
kW Impact	0.03	0.08	0.04	0.15	0.02	0.06	0.00	0.03

Tables 4-14 and 4-15 show the load impacts for non-CARE/FERA and CARE/FERA customers, respectively, for each rate period and day-type. As a reminder, the values in the first row of each table are the same as those found in Figures 4-19 and 4-20. As with the peak period load impacts, there are significant differences in load impacts between the two segments in other rate periods. For example, while there are statistically significant load reductions in the partial-peak period for non-CARE/FERA customers, most of the load impacts in this rate period for CARE/FERA customers are not statistically significant. In the cool climate region, CARE/FERA customers actually increased use in the partial peak period. Furthermore, whereas non-CARE/FERA customers produced statistically significantly daily reductions in energy use overall and in most climate regions, non-CARE/FERA customers either showed no statistically significant change in daily electricity use or showed statistically significant increases in electricity use for some regions and day types. This result is different than for Rate 1, where there were quite small, but often statistically significant, reductions in daily electricity use for CARE/FERA customers.

Table 4-14: Rate 2 Load Impacts by Rate Period and Day Type – Non-CARE/FERA Customers (Positive values represent load reductions, negative values represent load increases)

Rate 2															
Day Type	Period	Hours	All, Non-CARE			Hot, Non-CARE			Moderate, Non-CARE			Cool, Non-CARE			
			Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	
Average Weekday	Peak	6 PM to 9 PM	1.04	0.08	7.4%	1.64	0.15	9.0%	0.89	0.06	6.2%	0.55	0.03	4.7%	
	Partial Peak	4 PM to 6 PM, 9 PM to 10 PM	0.97	0.04	4.0%	1.57	0.10	6.2%	0.81	0.02	2.0%	0.48	0.00	0.6%	
	Off Peak	12 AM to 4 PM, 10 PM to 12 AM	0.57	-0.01	-2.2%	0.81	-0.01	-1.4%	0.51	-0.02	-3.6%	0.36	-0.01	-1.4%	
	Day	**All Hours**	**0.68**	**0.01**	**0.8%**	**1.01**	**0.02**	**2.2%**	**0.60**	**0.00**	**-0.8%**	**0.40**	**0.00**	**-0.1%**	
Average Weekend	Peak	6 PM to 9 PM	1.05	0.07	6.5%	1.65	0.14	8.5%	0.89	0.04	4.7%	0.55	0.02	3.6%	
	Partial Peak	4 PM to 6 PM, 9 PM to 10 PM	1.01	0.04	4.4%	1.64	0.12	7.2%	0.85	0.01	1.4%	0.50	0.00	0.9%	
	Off Peak	12 AM to 4 PM, 10 PM to 12 AM	0.60	-0.01	-1.8%	0.87	0.00	-0.4%	0.53	-0.02	-3.4%	0.38	-0.01	-1.9%	
	Day	**All Hours**	**0.71**	**0.01**	**0.9%**	**1.07**	**0.03**	**2.8%**	**0.62**	**-0.01**	**-1.1%**	**0.42**	**0.00**	**-0.6%**	
Monthly System Peak Day	Peak	6 PM to 9 PM	1.37	0.14	10.4%	2.23	0.19	8.7%	1.21	0.17	14.2%	0.57	0.04	6.8%	
	Partial Peak	4 PM to 6 PM, 9 PM to 10 PM	1.29	0.10	7.6%	2.14	0.15	7.2%	1.13	0.12	10.4%	0.49	0.00	0.0%	
	Off Peak	12 AM to 4 PM, 10 PM to 12 AM	0.67	-0.01	-2.2%	1.02	-0.02	-2.3%	0.60	-0.01	-2.0%	0.36	-0.01	-2.1%	
	Day	**All Hours**	**0.84**	**0.02**	**2.3%**	**1.31**	**0.03**	**2.0%**	**0.74**	**0.03**	**3.7%**	**0.40**	**0.00**	**-0.2%**	

Table 4-15: Rate 2 Load Impacts by Rate Period and Day Type – CARE/FERA Customers (Positive values represent load reductions, negative values represent load increases)

Rate 2														
Day Type	Period	Hours	All, CARE			Hot, CARE			Moderate, CARE			Cool, CARE		
			Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact
Average Weekday	Peak	6 PM to 9 PM	1.07	0.03	2.6%	1.41	0.04	2.8%	0.71	0.02	2.8%	0.49	0.00	0.3%
	Partial Peak	4 PM to 6 PM, 9 PM to 10 PM	1.05	0.01	0.7%	1.41	0.01	1.1%	0.67	0.00	0.6%	0.44	-0.01	-1.9%
	Off Peak	12 AM to 4 PM, 10 PM to 12 AM	0.58	-0.01	-1.8%	0.74	-0.02	-2.3%	0.44	0.00	-0.1%	0.32	0.00	-1.3%
	Day	**All Hours**	**0.70**	**0.00**	**-0.5%**	**0.90**	**-0.01**	**-0.7%**	**0.50**	**0.00**	**0.5%**	**0.36**	**0.00**	**-1.1%**
Average Weekend	Peak	6 PM to 9 PM	1.04	0.02	2.2%	1.38	0.03	2.0%	0.69	0.03	4.4%	0.48	0.00	0.4%
	Partial Peak	4 PM to 6 PM, 9 PM to 10 PM	1.05	0.00	0.5%	1.41	0.01	0.4%	0.67	0.01	1.7%	0.44	0.00	-1.0%
	Off Peak	12 AM to 4 PM, 10 PM to 12 AM	0.62	-0.01	-1.2%	0.78	-0.01	-0.9%	0.45	-0.01	-2.0%	0.33	0.00	-1.3%
	Day	**All Hours**	**0.72**	**0.00**	**-0.3%**	**0.94**	**0.00**	**-0.2%**	**0.51**	**0.00**	**-0.3%**	**0.36**	**0.00**	**-1.0%**
Monthly System Peak Day	Peak	6 PM to 9 PM	1.33	0.06	4.5%	1.80	0.10	5.5%	0.85	0.00	0.1%	0.51	0.01	2.3%
	Partial Peak	4 PM to 6 PM, 9 PM to 10 PM	1.31	0.03	2.4%	1.81	0.05	3.0%	0.83	0.00	-0.3%	0.45	0.01	1.1%
	Off Peak	12 AM to 4 PM, 10 PM to 12 AM	0.69	-0.01	-1.7%	0.90	-0.02	-2.0%	0.49	-0.01	-2.3%	0.33	0.00	1.3%
	Day	**All Hours**	**0.85**	**0.00**	**0.3%**	**1.13**	**0.01**	**0.5%**	**0.58**	**-0.01**	**-1.5%**	**0.36**	**0.01**	**1.5%**

4.3.3 Rate 3

PG&E's Rate 3 is structurally identical to Rate 1 in the summer (and winter) periods, with a peak period from 4 to 9 PM on weekdays and off-peak prices in effect for all hours on the weekends. In spring, Rate 3 has a super off-peak price in effect from 10 AM to 4 PM on weekdays to encourage increased electricity use during a time when high levels of hydroelectric generation combined with below average electricity use create minimum load issues for the CAISO. In summer, the Tier 2 peak period price is significantly higher for Rate 3 than for Rate 1 (57.2 ¢/kWh for Rate 3 compared with 42.0 ¢/kWh for Rate 1) and the off-peak price is lower (28.6 ¢/kWh versus 31.7 ¢/kWh).

Figures 4-21 and 4-22 show the peak period load reductions on average weekdays for Rate 3. Once again, the overall load reduction and the pattern in the load reductions across climate regions are very similar to Rates 1 and 2. There are no statistically significant differences in the load reductions between Rate3 and Rate 1 in spite of the significantly higher, Tier 2 peak-to-off-peak price ratios (2.0 for Rate 3 versus 1.3 for Rate 1). It may be that an even larger price ratio, say 3 or 4 to 1, is required in order to significantly increase peak-period load reductions.

Figure 4-21: Average Percent Load Impacts for Peak Period for PG&E Rate 3 (Positive values represent load reductions)

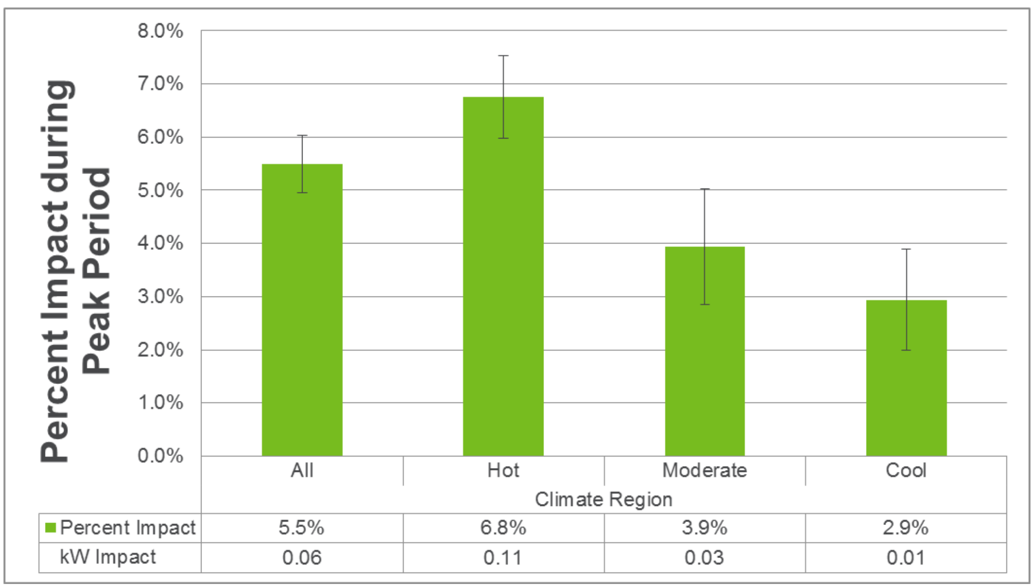
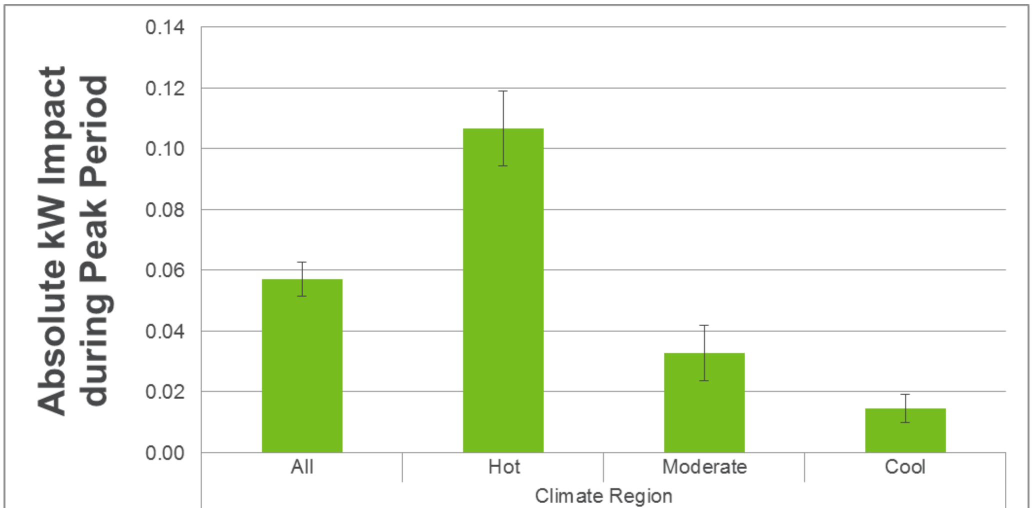


Figure 4-22: Average Absolute Load Impacts for Peak Period for PG&E Rate 3 (Positive values represent load reductions)



	All	Hot	Moderate	Cool
Percent Impact	5.5%	6.8%	3.9%	2.9%
kW Impact	0.06	0.11	0.03	0.01

Table 4-16 contains estimates of load impacts for all relevant rate periods and day types. On weekdays, the change in usage in the off-peak period differs across regions, with no statistically significant change in the hot region, a statistically significant increase in usage in the moderate region, and a reduction in usage in the cool region. For the service territory as a whole, there was no significant change in off-peak usage on the average weekday. There is an overall conservation effect of 1.6% for the service territory as a whole with a larger, 2.6%, reduction in the hot region. In the moderate climate region, there was no change in daily electricity use on weekdays. The reduction in daily electricity use on weekends is similar to the reduction on weekdays for the service territory as a whole and for the hot climate region.

Table 4-16: Rate 3 Load Impacts by Rate Period and Day Type

Rate 3															
Day Type	Period	Hours	All			Hot			Moderate			Cool			
			Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact
Average Weekday	Peak	4 PM to 9 PM	1.04	0.06	5.5%	1.58	0.11	6.8%	0.83	0.03	3.9%	0.49	0.01	2.9%
	Off Peak	12 AM to 4 PM, 9 PM to 12 AM	0.59	0.00	-0.2%	0.81	0.00	0.4%	0.51	-0.01	-1.7%	0.36	0.00	0.9%
	Day	**All Hours**	**0.68**	**0.01**	**1.6%**	**0.97**	**0.02**	**2.6%**	**0.58**	**0.00**	**0.0%**	**0.39**	**0.01**	**1.4%**
Average Weekend	Off Peak	All Hours	0.71	0.01	1.4%	1.02	0.03	2.7%	0.60	0.00	-0.3%	0.40	0.00	0.2%
	Day	**All Hours**	**0.71**	**0.01**	**1.4%**	**1.02**	**0.03**	**2.7%**	**0.60**	**0.00**	**-0.3%**	**0.40**	**0.00**	**0.2%**
Monthly System Peak Day	Peak	4 PM to 9 PM	1.36	0.08	6.0%	2.11	0.12	5.5%	1.14	0.09	8.0%	0.51	0.01	2.7%
	Off Peak	12 AM to 4 PM, 9 PM to 12 AM	0.70	-0.01	-1.0%	1.01	-0.01	-1.1%	0.60	-0.01	-1.6%	0.36	0.00	1.1%
	Day	**All Hours**	**0.84**	**0.01**	**1.4%**	**1.24**	**0.02**	**1.2%**	**0.71**	**0.01**	**1.6%**	**0.39**	**0.01**	**1.5%**

Figures 4-23 and 4-24 show the peak period load reductions on weekdays for non-CARE/FERA and CARE/FERA customers and Tables 4-17 and 4-18 show the load impacts for each rate period and day type for the two segments. As seen in the figures, there are large and statistically significant differences in peak period reductions between CARE/FERA and non-CARE/FERA customers in the service territory as a whole and in the hot region. However, the differences in the moderate and cool regions are much smaller and are not statistically significant.

Figure 4-23: Average Percent Load Impacts for Peak Period for PG&E Rate 3 for CARE/FERA and non-CARE/FERA Customers (Positive values represent load reductions)

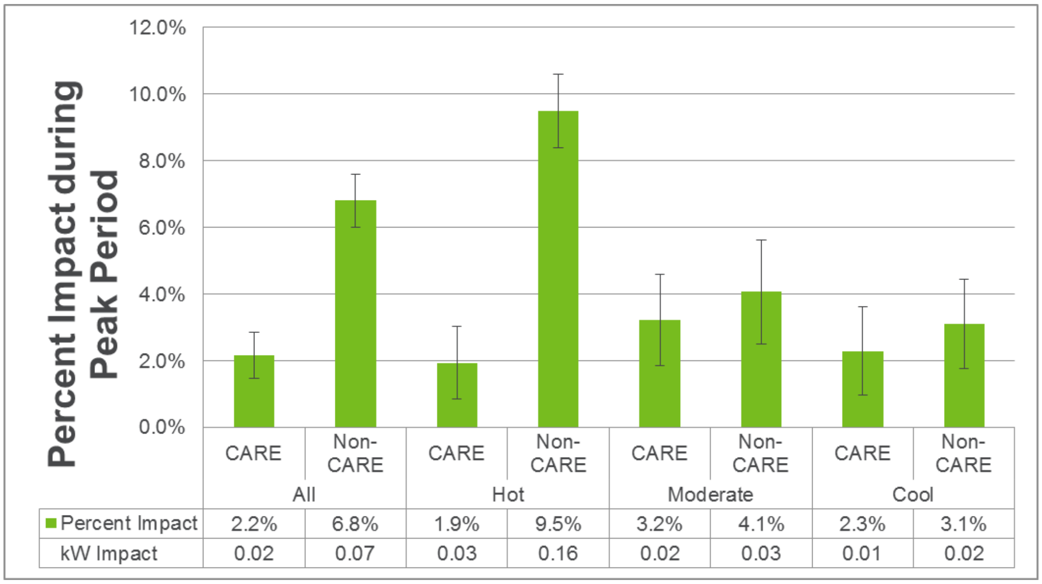
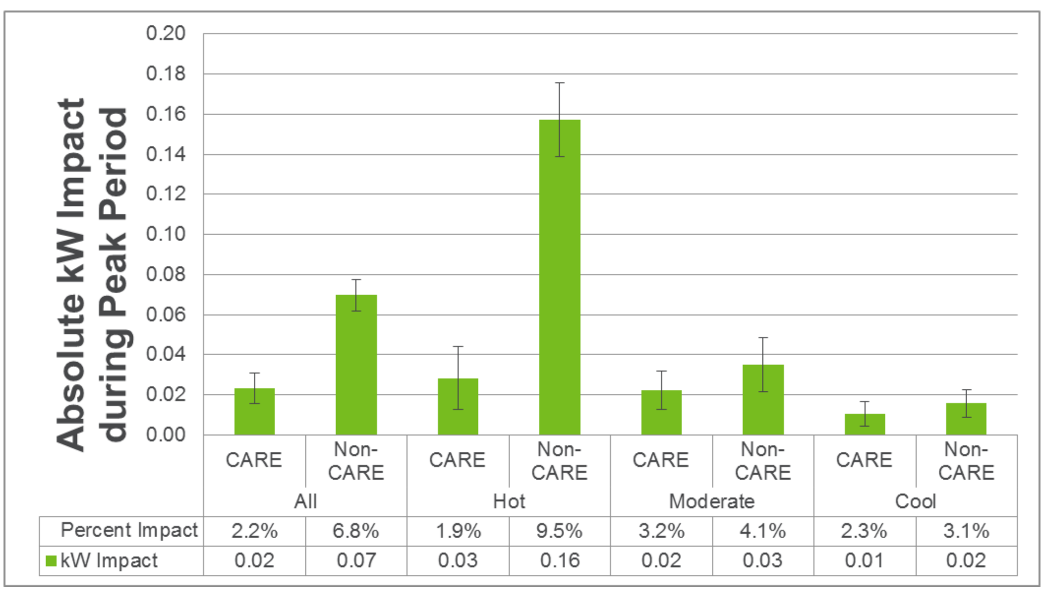


Figure 4-24: Average Absolute Load Impacts for Peak Period for PG&E Rate 3 for CARE/FERA and non-CARE/FERA Customers (Positive values represent load reductions)



As seen in Tables 4-17 and 4-18, there are also significant differences in the load impacts between CARE/FERA and non-CARE/FERA customers for other rate periods and day types. For the service territory as a whole, non-CARE/FERA customers reduced daily electricity use by 2.3% and in the hot region, the reduction in daily usage was a very substantial 4.5%. CARE/FERA customers, on the other hand, showed no statistically significant reduction in usage for the service territory as a whole and showed small but statistically significant increases in usage in the hot and moderate climate regions.

Table 4-17: Rate 3 Load Impacts by Rate Period and Day Type – Non-CARE/FERA Customers (Positive values represent load reductions, negative values represent load increases)

Rate 3														
			All, Non-CARE			Hot, Non-CARE			Moderate, Non-CARE			Cool, Non-CARE		
Day Type	Period	Hours	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact
Average Weekday	Peak	4 PM to 9 PM	1.02	0.07	6.8%	1.66	0.16	9.5%	0.86	0.03	4.1%	0.50	0.02	3.1%
	Off Peak	12 AM to 4 PM, 9 PM to 12 AM	0.59	0.00	0.3%	0.84	0.02	2.0%	0.53	-0.01	-2.2%	0.37	0.00	1.2%
	Day	**All Hours**	**0.68**	**0.02**	**2.3%**	**1.01**	**0.05**	**4.5%**	**0.60**	**0.00**	**-0.3%**	**0.40**	**0.01**	**1.7%**
Average Weekend	Off Peak	All Hours	0.71	0.01	2.0%	1.07	0.05	4.2%	0.62	0.00	-0.4%	0.42	0.00	0.2%
	Day	**All Hours**	**0.71**	**0.01**	**2.0%**	**1.07**	**0.05**	**4.2%**	**0.62**	**0.00**	**-0.4%**	**0.42**	**0.00**	**0.2%**
Monthly System Peak Day	Peak	4 PM to 9 PM	1.36	0.10	7.1%	2.27	0.16	6.9%	1.20	0.11	8.8%	0.51	0.01	2.6%
	Off Peak	12 AM to 4 PM, 9 PM to 12 AM	0.70	0.00	-0.6%	1.06	0.00	-0.2%	0.62	-0.01	-1.9%	0.37	0.01	1.3%
	Day	**All Hours**	**0.84**	**0.02**	**2.0%**	**1.31**	**0.03**	**2.3%**	**0.74**	**0.01**	**1.7%**	**0.40**	**0.01**	**1.7%**

Table 4-18: Rate 3 Load Impacts by Rate Period and Day Type – CARE/FERA Customers (Positive values represent load reductions, negative values represent load increases)

Rate 3														
			All, CARE			Hot, CARE			Moderate, CARE			Cool, CARE		
Day Type	Period	Hours	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact
Average Weekday	Peak	4 PM to 9 PM	1.08	0.02	2.2%	1.46	0.03	1.9%	0.69	0.02	3.2%	0.46	0.01	2.3%
	Off Peak	12 AM to 4 PM, 9 PM to 12 AM	0.60	-0.01	-1.5%	0.76	-0.02	-2.3%	0.45	0.01	1.2%	0.33	0.00	-0.4%
	Day	**All Hours**	**0.70**	**0.00**	**-0.3%**	**0.90**	**-0.01**	**-0.8%**	**0.50**	**0.01**	**1.8%**	**0.36**	**0.00**	**0.3%**
Average Weekend	Off Peak	All Hours	0.72	0.00	0.1%	0.94	0.00	0.0%	0.51	0.00	0.7%	0.36	0.00	-0.1%
	Day	**All Hours**	**0.72**	**0.00**	**0.1%**	**0.94**	**0.00**	**0.0%**	**0.51**	**0.00**	**0.7%**	**0.36**	**0.00**	**-0.1%**
Monthly System Peak Day	Peak	4 PM to 9 PM	1.36	0.04	2.9%	1.87	0.06	3.0%	0.85	0.02	2.4%	0.48	0.01	3.0%
	Off Peak	12 AM to 4 PM, 9 PM to 12 AM	0.71	-0.01	-2.0%	0.93	-0.03	-2.7%	0.50	0.00	0.3%	0.34	0.00	0.2%
	Day	**All Hours**	**0.85**	**0.00**	**-0.3%**	**1.13**	**-0.01**	**-0.8%**	**0.58**	**0.01**	**1.0%**	**0.36**	**0.00**	**0.9%**

4.3.4 Comparison Across Rates

Figures 4-25 and 4-26 compare the load impacts for the three rates tested by PG&E for the common set of peak-period hours, 6 to 9 PM, shared by all three tariffs. Using a common set of hours reduces differences in impacts across rates that might be due to differences in the number of hours included in the peak period or the timing of those hours. The hours from 6 to 9 PM define the peak period for Rate 2, which is a three period rate with a shoulder period from 4 to 6 PM and 9 to 10 PM. Rates 1 and 3 are two period rates with the same peak period, from 4 to 9 PM. Rate three has a higher Tier 2, peak to off-peak price ratio than Rate 1. As such, one would expect the peak-period load reductions to be higher for Rate 3 than for Rate 1. The peak to off-peak price ratio for Rate 2 is in between the other two but the partial peak period and the shorter peak period makes it difficult to predict whether the load reductions might be greater or less than the other rates.

As seen in the figures, there are no statistically significant differences in load impacts for the common hours from 6 to 9 PM across the three rates in either percentage or absolute terms overall or in any climate region. This is true in spite of the fact that the confidence bands are quite narrow.

Figure 4-25: Average Percent Impacts from 6 to 9 PM Across Rates|
(Positive values represent load reductions, negative values represent load increases)

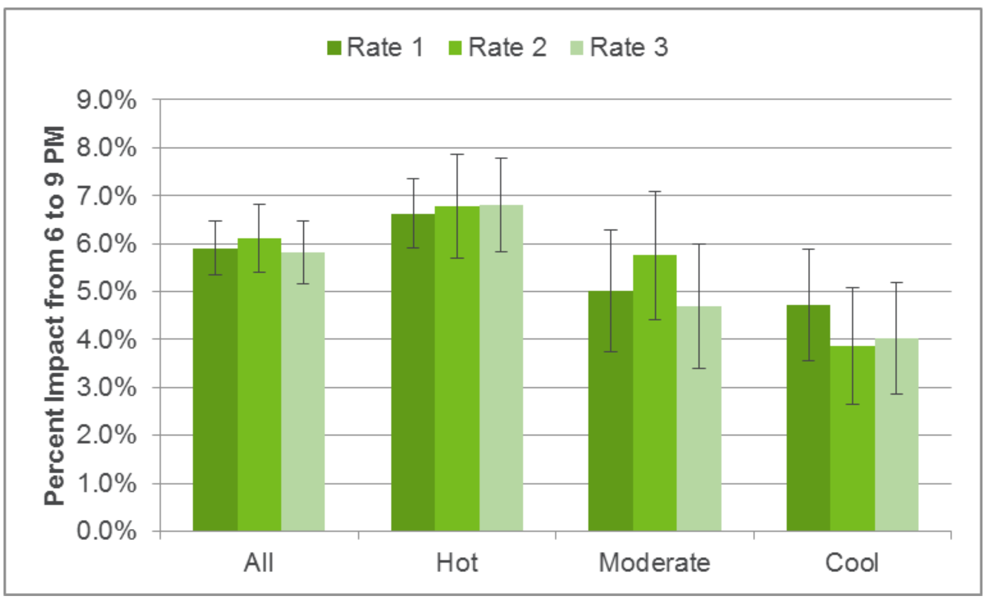
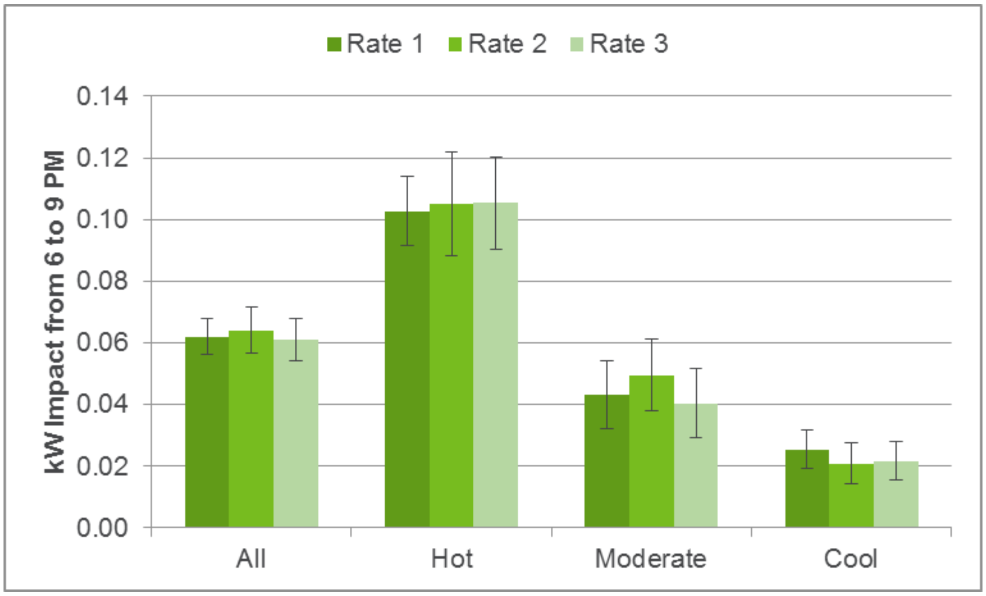


Figure 4-26: Average Absolute Impacts from 6 to 9 PM Across Rates
(Positive values represent load reductions, negative values represent load increases)



Figures 4-27 and 4-28 show the average change in daily electricity use for each rate and climate region. Whether daily electricity use increases or decreases depends on whether the peak period reductions consist primarily of load shifting or conservation and whether consumers take advantage of the lower price in the off-peak period to actually increase consumption of end-uses independent of load shifting (e.g., are less careful about turning off lights during the lower priced periods or heat a spa to a higher temperature in light of the lower off-peak prices). As Seen in the figures, there are significant differences in the reduction in daily electricity consumption between Rate 2 and the other two rates, with the reductions for Rate 2 being significantly less than for the other two rates. Customers on Rates 1 and 3 reduced consumption by about 1.5% for the service territory as a whole and reduced usage between 2% and 2.5% in the hot climate region. Reductions for Rates 1 and 3 were much smaller in both percentage and absolute terms in the moderate and cool regions and in some cases were not statistically significant. Rate 2 also showed a small reduction in daily use in the hot climate region and overall but in the moderate climate region, the average customer on Rate 2 actually used more electricity than they would have on the OAT. In the cool region, the average Rate 2 customer may have increased electricity use slightly but the change is not statistically significant.

Figure 4-27: Average Percent Daily kWh Impacts Across Rates
(Positive values represent load reductions, negative values represent load increases)

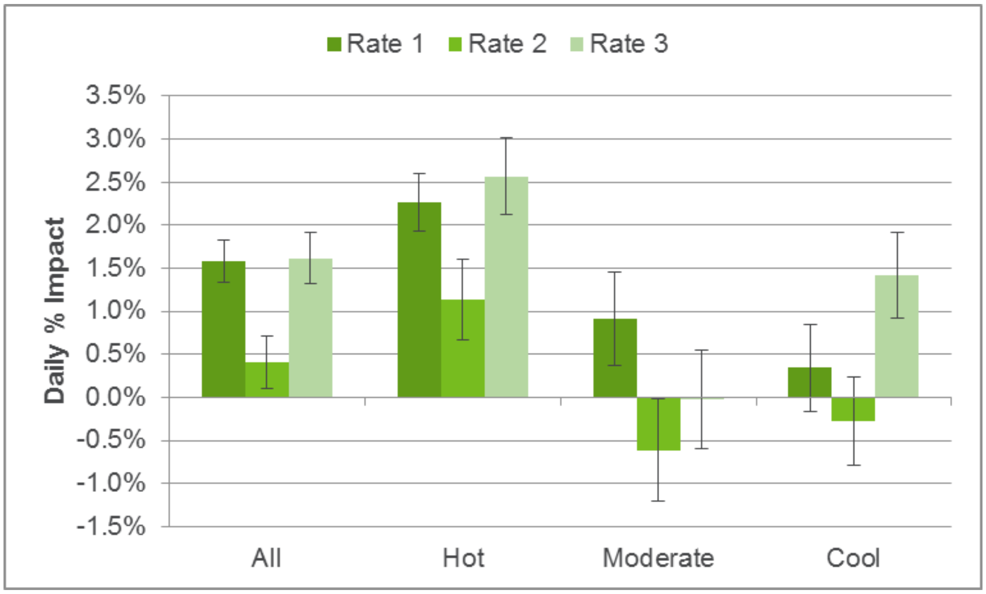
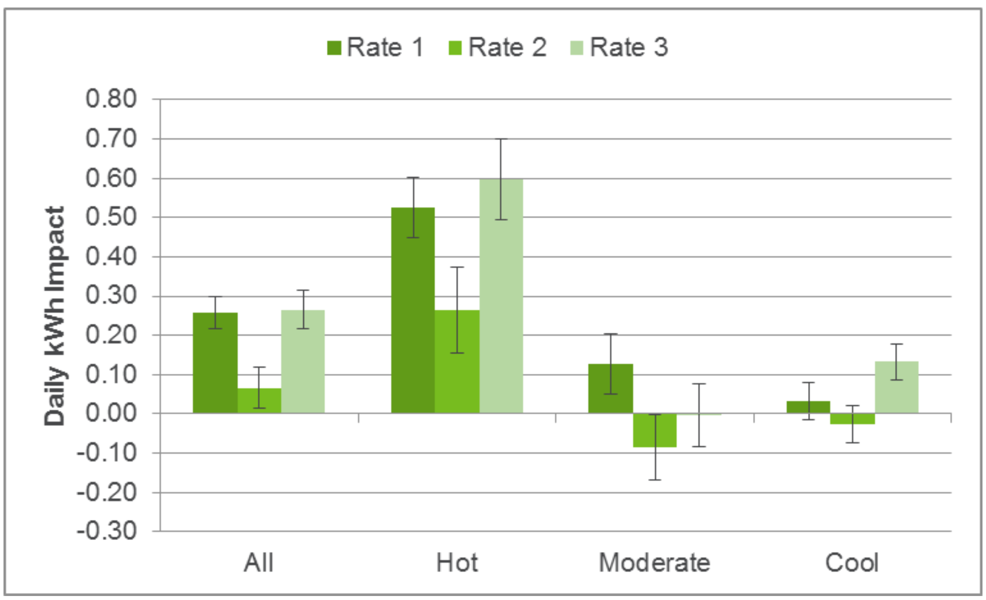


Figure 4-28: Average Absolute Daily kWh Impacts Across Rates
(Positive values represent load reductions, negative values represent load increases)



4.4 Bill Impacts

This section summarizes the bill impact estimates for the three rate treatments tested by PG&E. The CPUC resolution approving PG&E's pilot requires that bill impacts be estimated for the following rates, customer segments and climate regions:

- Seniors, CARE/FERA customers, non-CARE/FERA customers, households with incomes below 100% of FPG, and households with incomes between 100% and 200% of FPG in PG&E's hot climate region for Rate 1; and
- For CARE/FERA and non-CARE/FERA customers on each rate across PG&E's service territory as a whole and for each climate region.

In addition to these required segments, Nexant estimated bill impacts for seniors, households with incomes below 100% of FPG, and households with incomes between 100% and 200% of FPG in PG&E's hot climate region for Rate 2 and Rate 3. Bill impacts are reported as the average monthly impact for the summer months of July, August and September[29] for each rate, climate zone, and customer segment summarized above. Following an iterative process with stakeholders to determine the best way to present the analysis so that it clearly answered the policy questions of interest, the following four analyses were conducted:

- **Structural benefiter/non-benefiter analysis based on pretreatment usage-** Displaying the proportions of structural benefiters and non-benefiters for each rate and relevant customer segment based on pretreatment data on an annual and summer season basis;
- **Estimation of the average bill impact due to changes in usage-** Displaying the average bill impact resulting from changes in behavior in response to the new price signals for each rate and relevant customer segment (after controlling for exogenous factors);
- **Estimation of the total bill impact due to both the difference in the tariffs (holding usage constant) and behavior change-** Displaying the bill impact for each rate and relevant customer segment due to structural differences in the rate mitigated by changes in behavior; and
- **Change in the distribution of bill impacts due to behavior change-** Displaying the distribution curves of bill impacts (percentage of customers with bill impacts within $10 incremental bins) with and without behavior change in the same graph to illustrate if the distribution for participants shifted to the left or changed shape compared with the distribution for control customers without behavior change.

A more detailed explanation of each type of analysis and how the analysis was conducted is contained in Section 3.7. The remainder of this section is organized according to the four analysis types summarized above – that is, bill impacts are presented for each rate, relevant customer segment, and climate region for each of the four analyses.

4.4.1 Structural Benefiter/Non-Benefiter Analysis Based on Pretreatment Usage

The structural benefiter analysis was conducted for the summer and annual time periods using pretreatment data from the treatment group for each rate and relevant customer segment. Annual impacts were based on hourly load data from May 2015 through April 2016. Summer impacts were based on June 2015 through September 2015. Monthly bills were estimated for each treatment group customer on the OAT and TOU rate using the hourly load data. The difference in bills based on the TOU

[29] Estimates were not produced for the month of June because enrollment changed dramatically from the beginning to the end of the month and the estimates would not be comparable to those for other months.

rate and the OAT determines if a customer is a structural benefiter, a structural non-benefiter, or falls in a neutral range defined as have a structural bill impact between ±$3.[30]

Final results from the structural benefiter / non-benefiter analysis are presented in column graphs and shown as percentages for the summer season and on an annual basis. For each rate and relevant segment, the percentage of customers who are non-benefiter, neutral (+/- $3), or benefiters based on their average monthly bills for the time period of interest are shown as individual columns. The three columns within each rate and segment combination total to 100%, thus showing the distribution of structural benefiters and non-benefiters for each rate and segment of interest.

Figure 4-29 presents the outcome of the structural benefiter analysis for Rate 1 at the aggregate level across climate regions for all customers as well as for CARE/FERA and non-CARE/FERA. The graph on the left presents the analysis on an annual basis, and the graph on the right presents the findings for the summer period. Nearly all customers are structural non-benefiters in the summer season, which was expected. The large proportion of non-benefiters on an annual basis is due in part to the fact that PG&E's glide path OAT transition has been delayed – the TOU rate was designed to be revenue neutral relative to the 2017 glide path rate, but the OAT used here is the 2016 glide path tariff. A higher proportion of non-CARE/FERA customers are structural non-benefiters than CARE/FERA customers.

Figure 4-29: Rate 1 Structural Benefiter / Non-Benefiter Analysis
All | CARE/FERA | Non-CARE/FERA

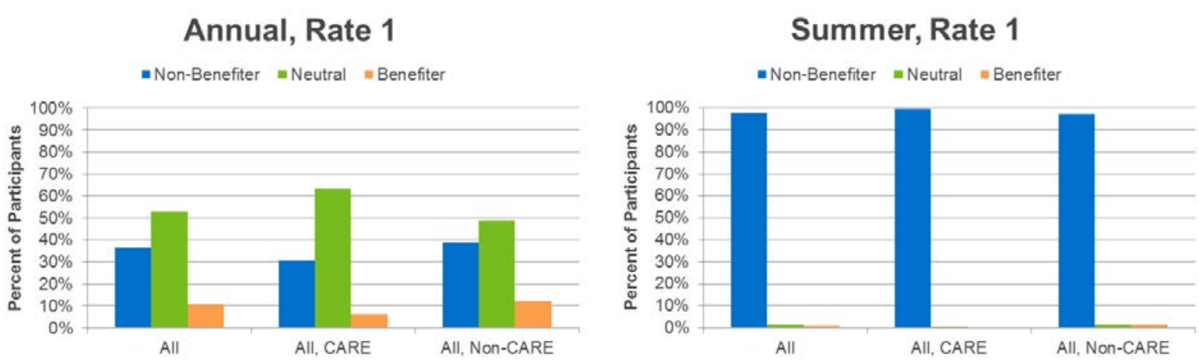
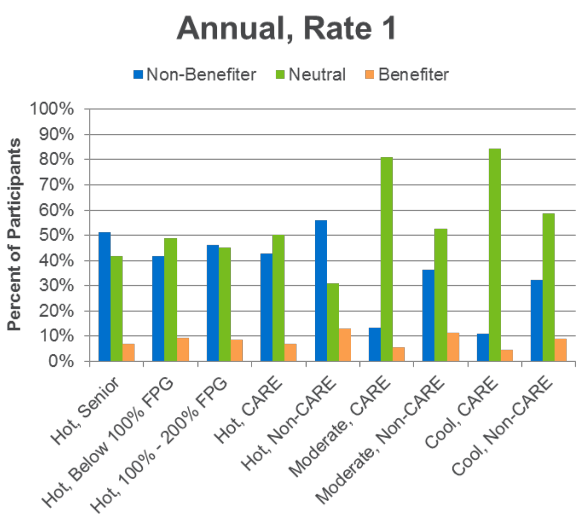


Figure 4-30 presents the outcome of the structural benefiter analysis for Rate 1 at the detailed segment level by climate region. The findings at the aggregate level still hold, with nearly all customers as structural non-benefiters in the summer season. On an annual basis, the hot climate region had a greater proportion of structural non-benefiters than the moderate or cool regions. Finally, a higher proportion of non-CARE/FERA customers than CARE/FERA customers are non-benefiters within each climate region, which is also consistent with the aggregate findings.

[30] See section 3.2.1 for additional details on the methodology.

Figure 4-30: Rate 1 Structural Benefiter / Non-Benefiter Analysis
Detailed Segments by Climate Region



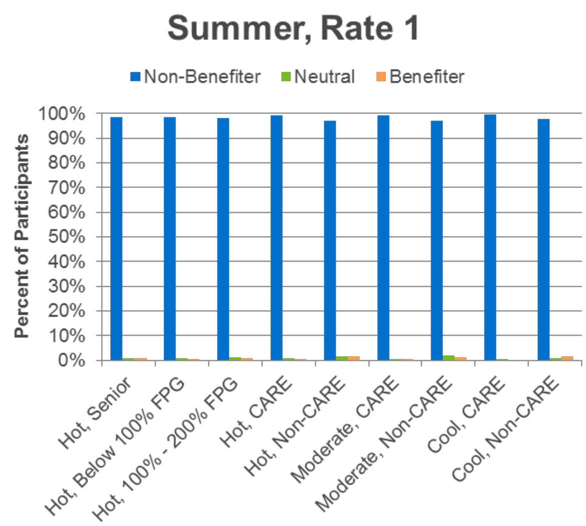
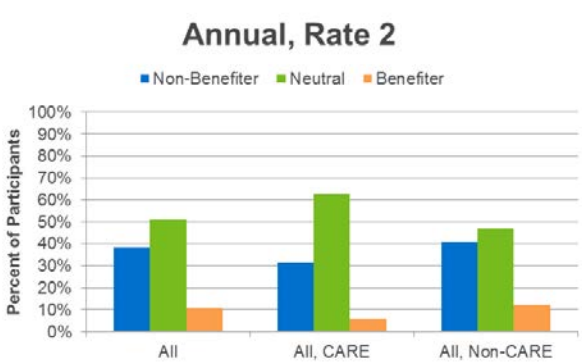


Figure 4-31 presents the outcome of the structural benefiter analysis for Rate 2 at the aggregate level across climate regions. Rate 2 differs from Rate 1 in several ways: the peak period is from 6 to 9 PM rather than 4 to 9 PM, it is a three period rate with a shoulder period from 4 to 6 PM and 9 to 10 PM, and prices are the same on weekends and weekdays. Overall, the general pattern of structural benefiters, non-benefiters, and neutrals is similar between Rate 1 and Rate 2. Nearly all customers are structural non-benefiters in the summer season, and there are a higher proportion of structural non-benefiters among non-CARE/FERA customers compared to CARE/FERA customers.

Figure 4-31: Rate 2 Structural Benefiter / Non-Benefiter Analysis
All | CARE/FERA | Non-CARE/FERA



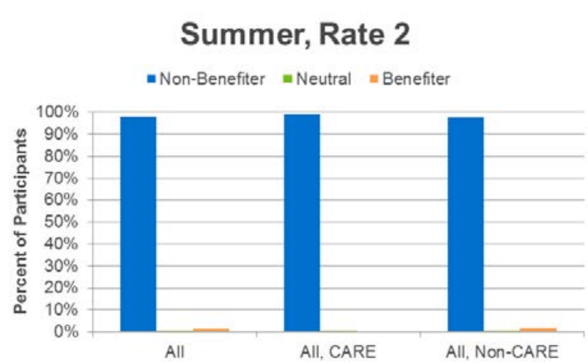


Figure 4-32 presents the outcome of the structural benefiter analysis for Rate 2 at the detailed segment level by climate region. The findings at the aggregate level still hold, with nearly all customers as structural non-benefiters in the summer season. On an annual basis, the hot climate region had a greater proportion of structural non-benefiters than the moderate or cool regions. Finally, a higher proportion of non-CARE/FERA customers are non-benefiters than CARE/FERA customers in each climate region, which is also consistent with the aggregate findings. Overall the findings for Rate 2 at the detailed segment level are also very similar to the distribution of structural benefiters and non-benefiters from Rate 1.

Figure 4-32: Rate 2 Structural Benefiter / Non-Benefiter Analysis
Detailed Segments by Climate Region

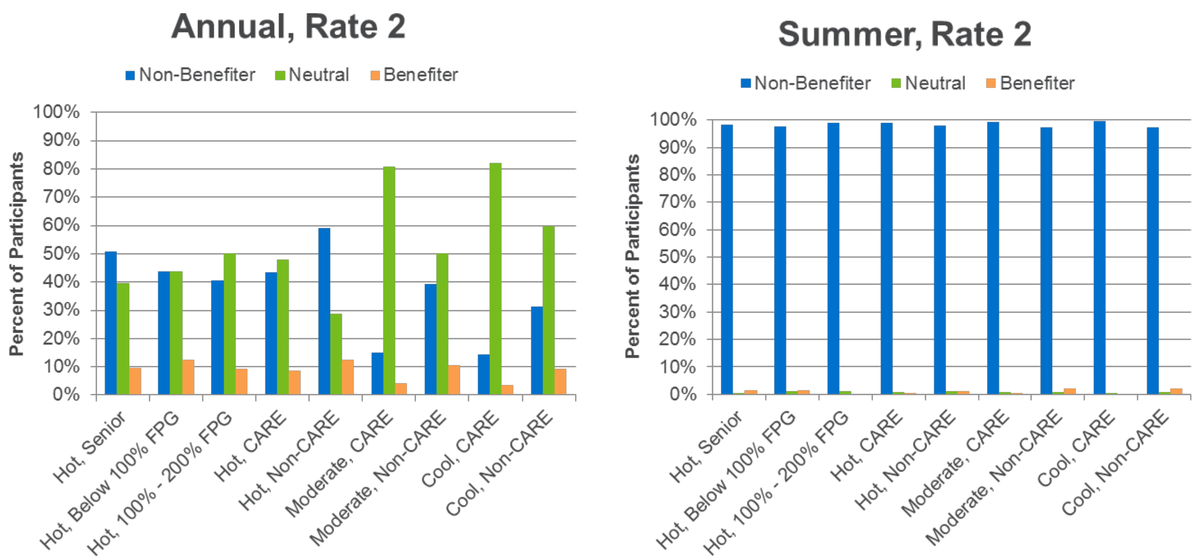


Figure 4-33 presents the outcome of the structural benefiter analysis for Rate 3 at the aggregate level across climate regions. PG&E's Rate 3 has the same peak period on weekdays as Rate 2 but has a higher peak-to-off-peak price ratio than Rate 1. Like Rate 1, and unlike Rate 2, all weekend hours are priced at the off-peak rate. Additionally, in the spring, Rate 3 has a super off-peak price from 11 AM to 4 PM. As with the other two rates, nearly all customers are structural non-benefiters in the summer season, and non-CARE/FERA customers have a higher proportion of non-benefiters than CARE/FERA customers

Figure 4-33: Rate 3 Structural Benefiter / Non-Benefiter Analysis
All | CARE/FERA | Non-CARE/FERA

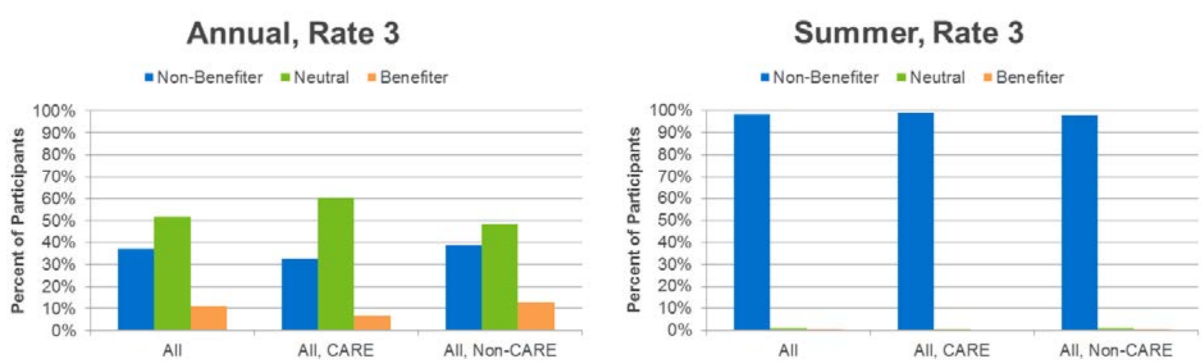
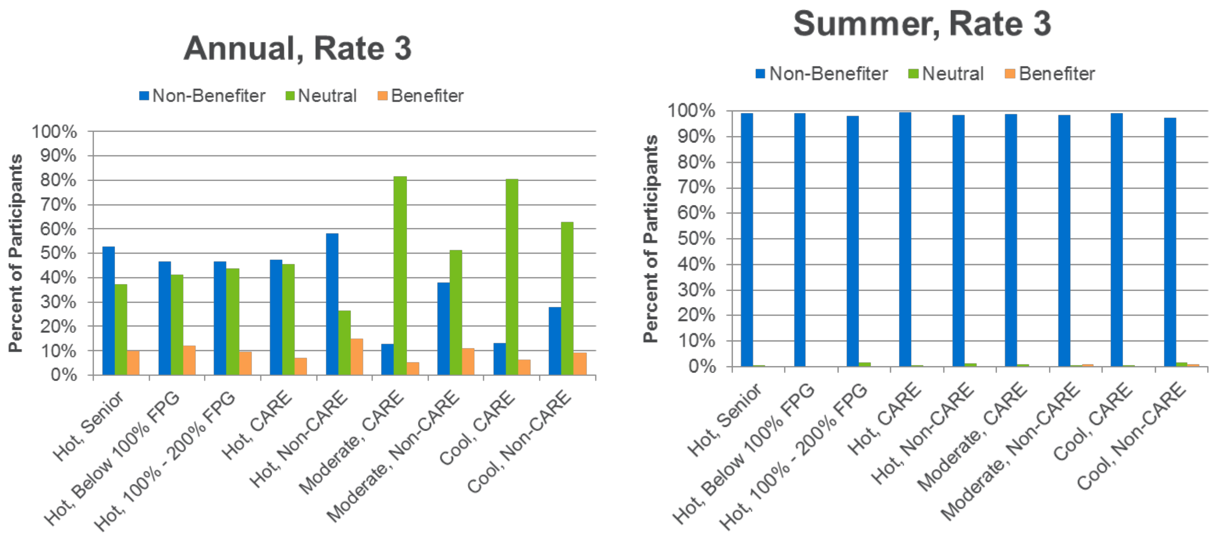


Figure 4-34 presents the outcome of the structural benefiter analysis for Rate 3 at the detailed segment level by climate region. As with the other two rates, the findings at the aggregate level still hold. On an annual basis, the hot climate region had a greater proportion of structural non-benefiters than the moderate or cool regions.

Figure 4-34: Rate 3 Structural Benefiter / Non-Benefiter Analysis Detailed Segments by Climate Region



Overall, a general pattern of structural benefiters and non-benefiters emerged that was consistent across all three rates. Nearly all customers were non-benefiters in the summer season, regardless of climate region or customer segment. On an annual basis, the hot climate region had a greater proportion of structural non-benefiters than the moderate or cool regions, and non-CARE/FERA customers were more likely to be structural non-benefiters than CARE/FERA customers. As noted previously, the large proportion of non-benefiters on an annual basis is due in part to the fact that PG&E's glide path OAT transition has been delayed – the TOU rate was designed to be revenue neutral relative to the 2017 glide path rate but the OAT used here is the 2016 glide path tariff.

The next section presents the analysis showing how much customers were able to reduce their bills as a result of behavior change. Section 4.4.3 combines the findings from the structural benefiter analysis with average bill impact findings to provide the full picture of how much of the structural loss customers were able to offset based on changing their energy use behavior.

4.4.2 Estimation of the Average Bill Impact Due to Changes in Usage

The average bill impact due to customers changing their energy usage in response to the TOU rate was estimated by calculating the difference in bills calculated using the TOU rate and post-enrollment usage for both the control and treatment group minus the difference in bills on the TOU rate using pretreatment usage for both the control and treatment groups. The control group bill calculated on the TOU rate represents the bill that would be expected if a customer was billed on the TOU rate, but didn't change their energy use behavior. The bill for the treatment group customers on TOU rate reflects any behavioral changes in response to being on the TOU rate. By subtracting the treatment group's average bill from the control group's average bill—and removing any pre-existing differences—we are able estimate the average bill impact attributable to the treatment group's change in behavior resulting from exposure to the pilot rate, after controlling for exogenous factors. [31] A positive impact indicates that

[31] See section 3.2.2 for additional details on the methodology.

customers successfully reduced their bills relative to the control group who did not respond to a TOU rate.

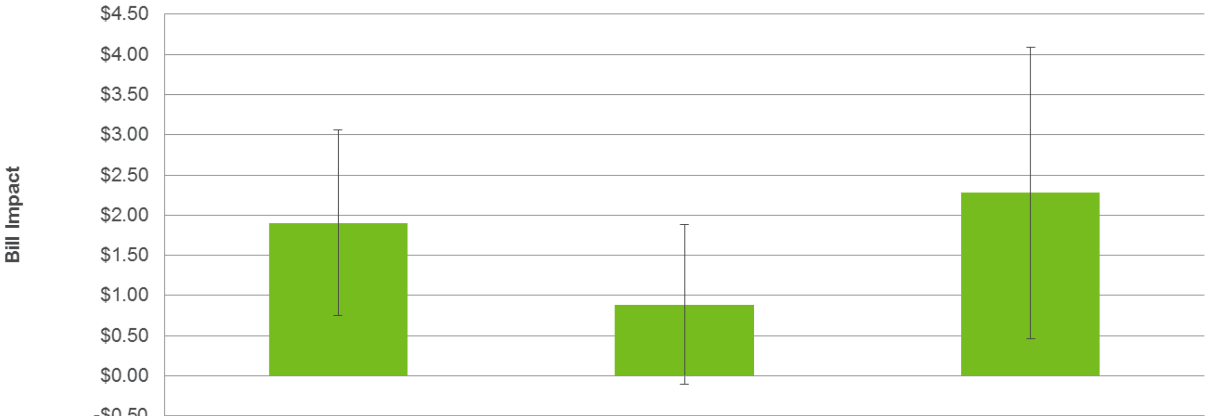
Bill impacts are presented on a column graph and shown as dollar impacts for the average summer monthly bill for July, August, and September 2016. The error bars on the graph represent the 90% confidence interval. Therefore, any impacts with error bars that cross below zero are not statistically significant at the 90% confidence level. Impacts are organized by rate, climate region, and segment. The bill impact in percentage terms that corresponds to the dollar amount is also included in the figure to provide context.

It should be noted the aggregate level results were weighted following the same approach as used in the load impacts.[32] The weights are representative of the mix of customers eligible to participate in the pilot, not just those who enrolled. Consequently, some of the individual segments shown in the detailed findings section may have more or less weight than other segments when they are combined together to develop the aggregate results. It is important to note that small bill impacts do not necessarily indicate customers did not change their behavior. As seen in the load impact section, load reductions in peak or shoulder periods, which would lead to lower bills all other things equal, are sometimes offset by load increases in the off-peak period. Depending on the relative magnitude of each change, bill impacts could go up, down, or remain largely unchanged even though customers made significant changes in behavior. It is also important to note that the values shown here represent changes in bills due to change in behavior – they do not represent the total change in the bill (nearly all bills increased in the summer). The total changes in the bill will be presented in the next section.

Figure 4-35 provides the overall results for customers on Rate 1. Through changing their energy use the average Rate 1 customer was able to reduce what their average monthly bill would have otherwise been by $1.90, or 1.6%. Though small, this result is statistically significant at the 90% confidence level. Average hourly peak period load impacts for Rate 1 customers were 5.8% or 0.06 kW. The relatively small bill impact is due, in part, to the relatively short peak period over which load reductions occur and the fact that there were small increases in usage on average in the longer off-peak period. For the five hour peak period, the average daily energy savings is approximately 0.3 kWh (5 hours times 0.06 kWh). If we assume four weeks in a month, and five days a week, the result is twenty days where we would expect to observe the peak period reductions. Multiplying 20 days by the 0.3 kWh we expect to find about 6 kWh savings from the peak period per month. When factoring in both the CARE/FERA and non-CARE/FERA rates, the average summer weekday peak period price per kWh on Rate 1 is $0.37. An impact of 6 kWh per month at $0.37 per kWh equals a total estimated peak period bill reduction of $2.22. When factoring in slight increases in energy use during off-peak hours, the $1.90 monthly bill impact appears quite reasonable. Bill impacts for CARE/FERA customers were less than half of the average customer impact at $0.88 (1%) and were not statistically significant. Non-CARE/FERA customer bill impacts were statistically significant at $2.28 (1.7%) per month.

[32] See section XXXX for a detailed discussion of the weighting approach.

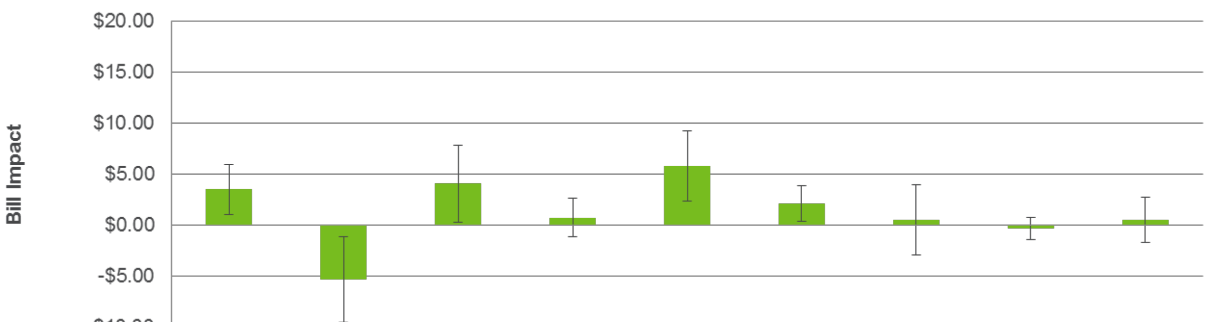
Figure 4-35: Rate 1 Average Bill Impacts from Behavior Change
All | CARE/FERA | Non-CARE/FERA
(Positive values represent bill reductions)



	All Customers	CARE	Non-CARE
	All		
Bill Impact	$1.90	$0.88	$2.28
Percent Impact	1.6%	1.0%	1.7%

Figure 4-36 provides the detailed results by climate region and segment for customers on Rate 1. Non-CARE/FERA customers in the hot climate region exhibited the largest bill reduction due to changes in behavior at $5.87 per month (2.7%). Seniors and customers between 100% and 200% of FPG also exhibited statistically significant bill reductions due to behavior change of $3.56 (2.3%) and $4.10 (2.9%), respectively. Low income customers in the hot climate region saw statistically significant bill increases from behavior change – they increased usage on the TOU rate.

Figure 4-36: Rate 1 Average Bill Impacts from Behavior Change
Detailed Segments by Climate Region
(Positive values represent bill reductions)

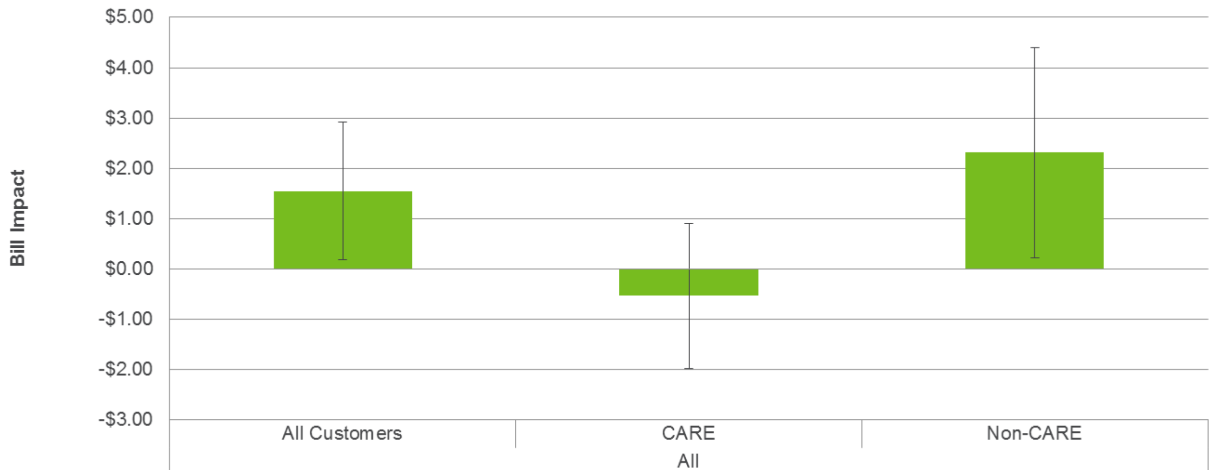


	Senior	Below 100% FPG	100% - 200% FPG	CARE	Non-CARE	CARE	Non-CARE	CARE	Non-CARE
			Hot			Moderate		Cool	
Bill Impact	$3.56	-$5.32	$4.10	$0.79	$5.87	$2.16	$0.55	-$0.30	$0.54
Percent Impact	2.3%	-4.4%	2.9%	0.7%	2.7%	3.5%	0.5%	-0.7%	0.7%

Figure 4-37 provides the overall results for customers on Rate 2, which are generally very similar to Rate 1. Through changes in behavior, the average Rate 2 customer was able to reduce what their average monthly bill would have otherwise been by $1.54, or 1.2%. This result is statistically significant at the 90% confidence level. Average hourly peak period load impacts for Rate 2 customers were 6.1% or 0.06

kW. Bill impacts for CARE/FERA customers were negative—meaning CARE/FERA customers' bills increased slightly as a result of their energy use behavior—however, the impacts are not statistically significant. Similar to Rate 1, non-CARE/FERA customer bill impacts were statistically significant at $2.31 (1.6%) per month.

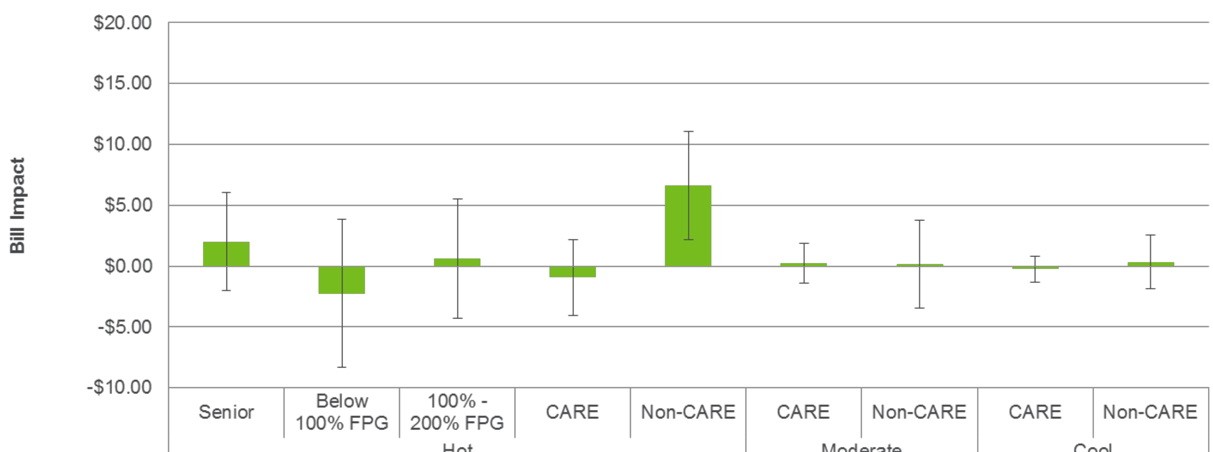
Figure 4-37: Rate 2 Average Bill Impacts from Behavior Change
All | CARE/FERA | Non-CARE/FERA
(Positive values represent bill reductions)



	All Customers	CARE	Non-CARE
		All	
Bill Impact	$1.54	-$0.53	$2.31
Percent Impact	1.2%	-0.6%	1.6%

Figure 4-38provides the detailed level results by climate region and segment for customers on Rate 2. Similar to Rate 1, non-CARE/FERA customers in the hot climate region exhibited the largest bill reductions due to changes in behavior at $6.64 per month (3.1%). No other segments exhibited statistically significant bill reductions due to changes in behavior.

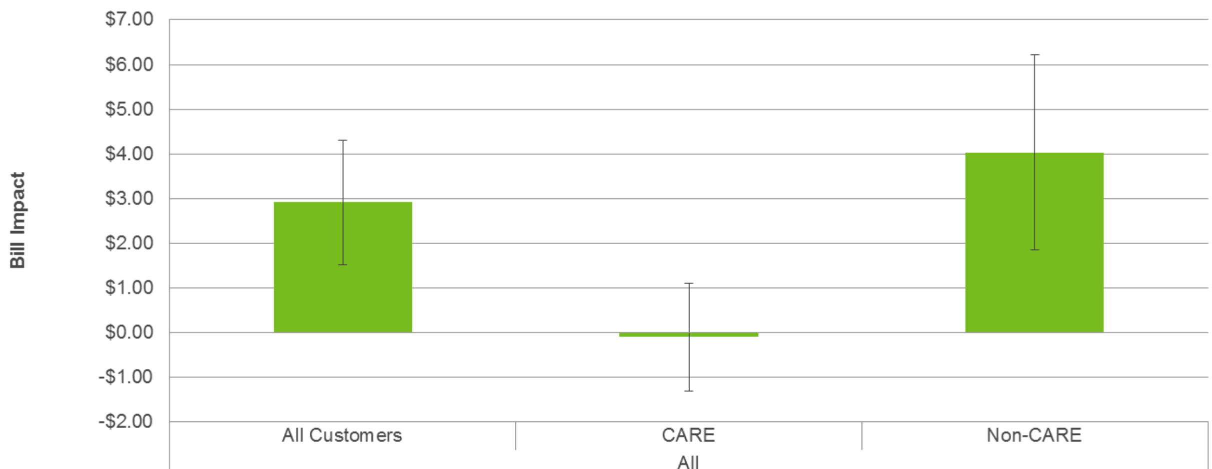
Figure 4-38: Rate 2 Average Bill Impacts from Behavior Change
Detailed Segments by Climate Region
(Positive values represent bill reductions)



	Senior	Below 100% FPG	100% - 200% FPG	CARE	Non-CARE	CARE	Non-CARE	CARE	Non-CARE
	Hot					Moderate		Cool	
Bill Impact	$2.00	-$2.26	$0.60	-$0.94	$6.64	$0.22	$0.16	-$0.25	$0.31
Percent Impact	1.3%	-1.7%	0.4%	-0.8%	3.1%	0.4%	0.1%	-0.6%	0.4%

Figure 4-39 provides the overall results for customers on Rate 3. PG&E's Rate 3 has the same peak period on weekdays as Rate 2 but has a higher peak-to-off-peak price ratio than Rate 1. In fact, Rate 3 has the highest peak period price of all PG&E rates, and is significantly higher than Rates 1 and 2. Like Rate 1, and unlike Rate 2, all weekend hours are priced at the off-peak rate. Through changing their energy use, the average Rate 3 customer was able to reduce what their average monthly bill would have otherwise been by $2.92, or 2.4%. This result is statistically significant at the 90% confidence level and nearly twice the size of the bill impacts from Rates 1 and 2. Average hourly peak period load impacts for Rate 2 customers were 5.5% or 0.06 kW. Bill impacts for CARE/FERA customers were close to zero and weren't statistically significant. Non-CARE/FERA customer bill impacts were statistically significant at $4.03 (2.9%) per month.

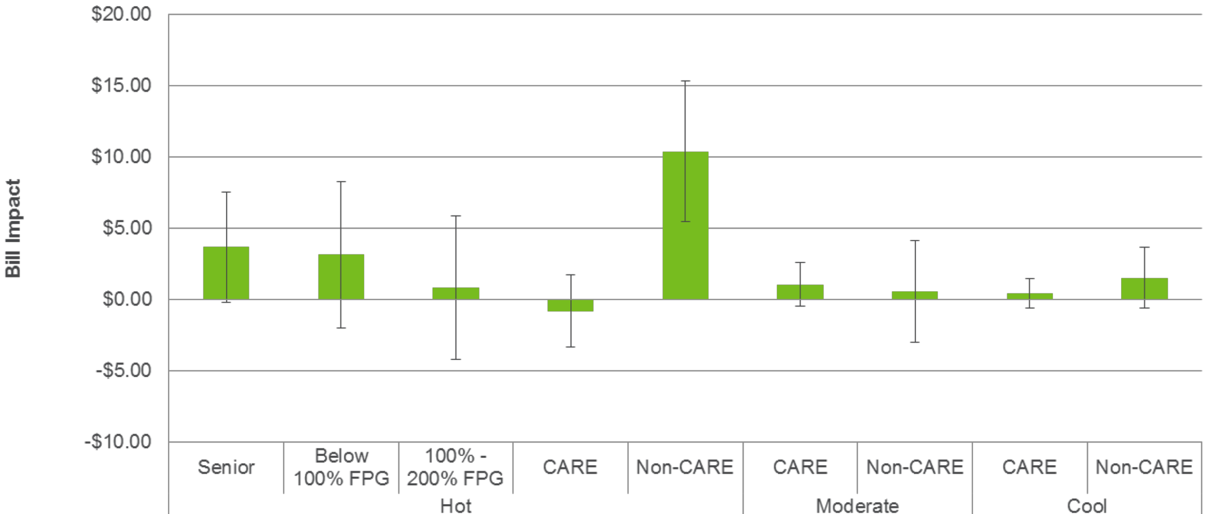
Figure 4-39: Rate 3 Average Bill Impacts from Behavior Change
All | CARE/FERA | Non-CARE/FERA
(Positive values represent bill reductions)



	All Customers	CARE	Non-CARE
		All	
Bill Impact	$2.92	-$0.10	$4.03
Percent Impact	2.4%	-0.1%	2.9%

Figure 4-40 provides the detailed level results by climate region and segment for customers on Rate 3. Similar to Rates 1 and 2, non-CARE/FERA customers in the hot climate region exhibited the largest bill reductions due to changes in behavior at $10.41 per month (4.7%). No other segments exhibited statistically significant bill reductions due to changes in behavior.

Figure 4-40: Rate 3 Average Bill Impacts from Behavior Change Detailed Segments by Climate Region
(Positive values represent bill reductions)



	Hot					Moderate		Cool	
	Senior	Below 100% FPG	100% - 200% FPG	CARE	Non-CARE	CARE	Non-CARE	CARE	Non-CARE
Bill Impact	$3.70	$3.16	$0.87	-$0.78	$10.41	$1.08	$0.56	$0.48	$1.55
Percent Impact	2.3%	2.3%	0.6%	-0.7%	4.7%	1.9%	0.5%	1.1%	2.0%

Overall, bill impacts across all of the rates appear to have been largely driven by the non-CARE/FERA customers in the hot climate region. Other segments, such as seniors in the hot climate region on Rate 1, also experienced statistically significant bill impacts, but for the most part, bill impacts for other segments, rates and climate regions were very small and not statistically significant.

4.4.3 Estimation of the Total Bill Impact Due to Differences in the Tariffs (Holding Usage Constant) and Behavior Change

Total bill impacts experienced by customers on a TOU rate can be decomposed into two components: the structural impact, and the behavioral impact. The structural impact represents the change in customer bills based solely on the change in the underlying structure of the rate. In this case, it is the change from the OAT to the time-differentiated TOU pilot rates. The behavioral impact represents how the customer changed their energy usage in response to the new pricing structure of the rate—which includes higher prices in the afternoon and evening and lower prices at other times of the day. During the summer period, nearly all customers on the TOU rates experienced a structural increase in their bills. However, customers also had an opportunity to offset that increase by changing their energy use behavior in response to the new price signals. As noted above, it is the combination of structural and behavioral bill impacts that produces the total bill impact experienced by the average study participant on each rate.

The results from this analysis represent the average monthly bill across the summer months of July, August, and September 2016. Three different bills were calculated for each customer segment:[33]

- **No Change in Behavior or Tariff [1]:** This represents what the treatment group bills would have been in the post-treatment period if they were on the OAT and had not changed their behavior

[33] See section 3.2.3 for additional details on the methodology.

- **No Change in Behavior, Change in Tariff [2]:** This represents what the treatment group bills would have been in the post-treatment period if they were on the TOU rate and had not changed their behavior
- **Change in Behavior and in Tariff [3]:** This represents what the treatment group bills were in the post-treatment period on the TOU rate with a change in behavior

Based off of components defined above, the following metrics were calculated:

- The difference between **[1]** and **[2]** is the structural bill impact (based on post-treatment usage after adjusting for any pretreatment difference between control and treatment customers);
- The difference between **[1]** and **[3]** is the bill impact due to structural differences in the rates, but mitigated by changes in behavior; and
- The difference between **[2]** and **[3]** is the amount customers were able reduce their bills by changing their behavior.

In the bill impact analysis, a major policy question was to better understand the relationship between the structural bill impacts, and how customers were able to respond. This relationship is represented by the "percentage of structural loss mitigated by change in behavior" shown in the data table at the bottom of the figures below. Put differently, this percentage represents how much of the bill increase from the TOU rate the average customer was able to offset. Results are organized by rate, climate region, and segment; similarly to the other bill impact analysis sections.

Figure 4-41 presents a set of three average monthly bills as defined above for all customers, CARE/FERA customers, and non-CARE/FERA customers on Rate 1. The blue bar represents a typical summer monthly bill for a customer still on the OAT and not responding to a TOU rate— noted as "No Change in Behavior or Tariff." For the average customer on Rate 1, this dollar amount was $104.14. The green bar represents what a typical summer monthly bill would be for a customer who was billed on a TOU rate, but didn't change their energy use behavior— noted as "No Change in Behavior, Change in Tariff." This dollar amount is $122.70 for the average Rate 1 customer. The difference between the two values, $18.56, is the average increase a customer would see in their bills by changing from the OAT to Rate 1, and not changing their energy use behavior; this is also referred to as the customer's structural loss. The orange bar represents the average Rate 1 customer's bill after factoring in the change in rate from the OAT to the Pilot Rate 1, and then also taking into account any changes in energy use behavior— noted as "With Change in Behavior and Tariff." This bill amount averaged $120.80 for the typical Rate 1 customer. Based off these values, it is possible to estimate the total change in bills including both the change in tariff and in behavior, which was a bill increase of $16.60 per month (16%). The total change in bill is calculated by subtracting the blue ($104.14) from the orange ($120.80).

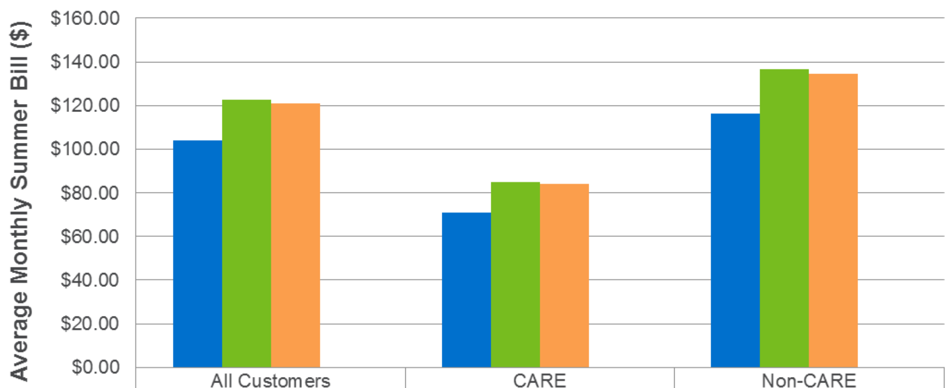
An additional important metric is the percent of the structural loss—increase in the bills due strictly to the change in tariff—that can be offset or mitigated by customers changing their energy use behavior. As noted above, the average structural loss for Rate 1 customers was $18.56. The amount customers were able to reduce their bills by changing their behavior—compared to what it would have been without any behavior change—is obtained by subtracting the orange bar ("With Change in Behavior and Tariff": $120.80) from the green bar ("No Change in Behavior, Change in Tariff": $122.70), which equals

$1.90. Based on these values, customers were able to offset $1.90 out of the $18.56 structural loss, or 10.3%. This value is provided at the bottom of the data table in each figure for convenience.

CARE/FERA customers experienced an average structural loss of $14.01 (20%). Through changes in energy use behavior they were able to offset $0.88 (6.3%), resulting in a total monthly bill increase of $13.30 (19%) after factoring in both changes in the tariff and behavior. It should be noted that the behavior change for CARE/FERA customers on Rate 1 was not statistically significant. Given the small dollar amount to begin with, and the lack of statistical significance, the key take away from this analysis is that the average CARE/FERA customer on Rate 1 did not change their energy use behavior sufficiently to mitigate any of the structural loss.

Conversely, non-CARE/FERA customers were able to mitigate some of their structural loss, though only a relatively small portion at 11.3% ($2.28). The average structural loss for non-CARE/FERA customers was $20.23 (17%), resulting in a total monthly bill increase of $17.95 (15%) after factoring in changes in the tariff and behavior.

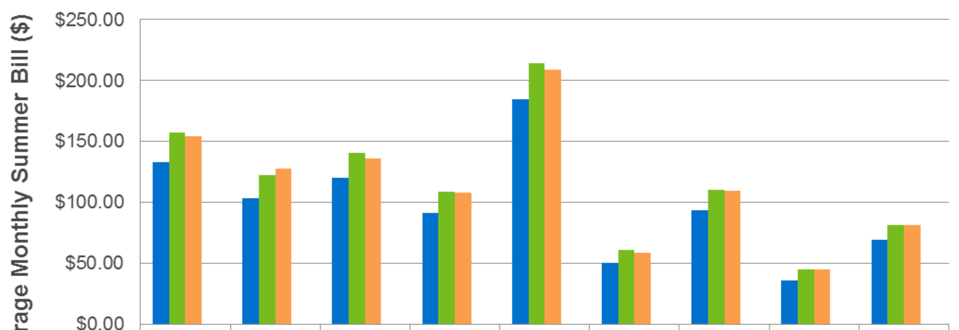
Figure 4-41: Rate 1 Total Bill Impact Due to Differences in the Tariff and Behavior Change All | CARE/FERA | Non-CARE/FERA



	All Customers	CARE	Non-CARE
		All	
No Change in Behavior or Tariff	$104.14	$70.77	$116.44
No Change in Behavior, Change in Tariff	$122.70	$84.77	$136.67
With Change in Behavior and Tariff	$120.80	$83.89	$134.39
% of structural loss mitigated by change in behavior	10.3%	6.3%	11.3%

Figure 4-42 presents the three sets of average monthly bills as defined above for the detailed segments by climate region on Rate 1. CARE/FERA customers in the moderate region, non-CARE/FERA customers in the hot region, seniors in the hot region, and customers with incomes between 100 and 200% of FPG in the hot region offset their structural bill increase by ~20% through behavior change. Behavioral offsets for the other customer segments were less than 5% and not statistically significant.

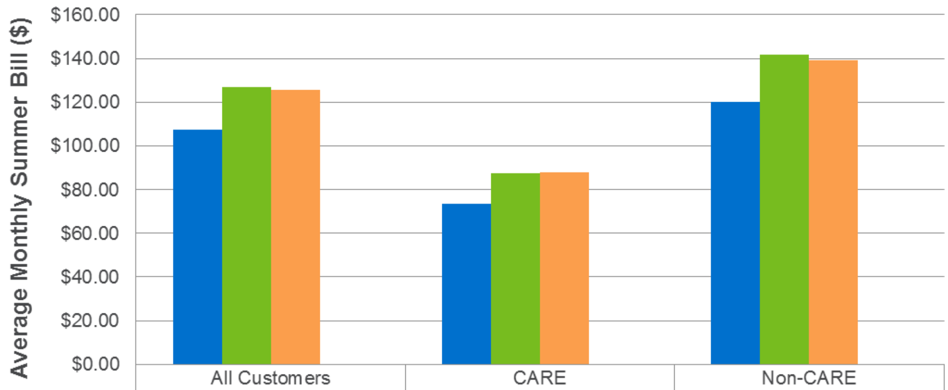
Figure 4-42: Rate 1 Total Bill Impact Due to Differences in the Tariff and Behavior Change Detailed Segments by Climate Region



	Hot					Moderate		Cool	
	Senior	Below 100% FPG	100% - 200% FPG	CARE	Non-CARE	CARE	Non-CARE	CARE	Non-CARE
No Change in Behavior or Tariff	$133.23	$103.69	$119.80	$91.16	$184.43	$50.39	$93.25	$35.92	$68.99
No Change in Behavior, Change in Tariff	$157.49	$122.15	$140.42	$108.46	$214.55	$60.82	$110.46	$44.66	$81.80
With Change in Behavior and Tariff	$153.94	$127.48	$136.32	$107.67	$208.68	$58.67	$109.91	$44.96	$81.26
% of structural loss mitigated by change in behavior	14.7%	-28.8%	19.9%	4.6%	19.5%	20.7%	3.2%	-3.5%	4.2%

Figure 4-43 presents the three sets of average monthly bills for all customers, CARE/FERA customers, and non-CARE/FERA customers on Rate 2, which were similar in nature to Rate 1. The average Rate 2 customer experienced a structural loss of $19.63 (18%). Through changes in energy use behavior they were able to offset $1.54 (7.9%), resulting in a total monthly bill increase of $18.09 (17%) after factoring in both changes in the tariff and behavior. CARE/FERA customers experienced an average structural loss of $14.23 (19%). They did not reduce energy usage compared to the control group, resulting in a total monthly bill increase of $14.76 (20%) after factoring in changes in the tariff and behavior. Non-CARE/FERA customers were able to mitigate some of their structural loss, though only a relatively small portion at 10.7% ($2.31). The average structural loss for non-CARE/FERA customers was $21.62 (18%), resulting in a total monthly bill increase of $19.31 (16%) after factoring in the changes in the tariff and behavior.

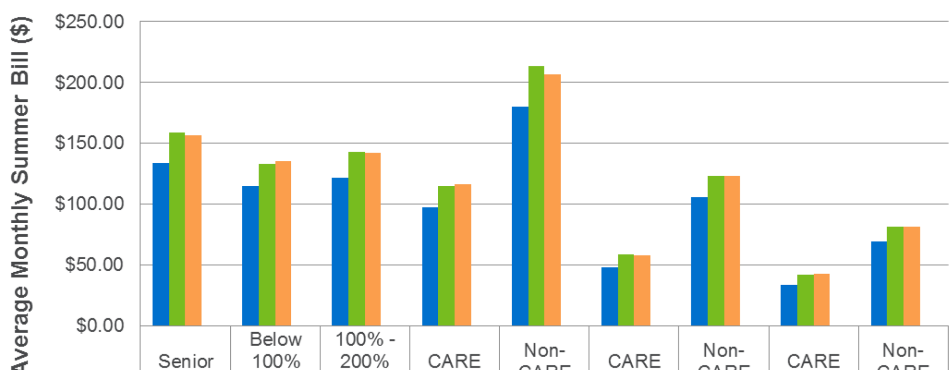
Figure 4-43: Rate 2 Total Bill Impact Due to Differences in the Tariff and Behavior Change All | CARE/FERA | Non-CARE/FERA



	All Customers	CARE	Non-CARE
		All	
No Change in Behavior or Tariff	$107.37	$73.25	$119.93
No Change in Behavior, Change in Tariff	$127.00	$87.48	$141.56
With Change in Behavior and Tariff	$125.45	$88.02	$139.25
% of structural loss mitigated by change in behavior	7.9%	-3.8%	10.7%

Figure 4-44 presents the three sets of average monthly bills for the detailed segments by climate region on Rate 2. Non-CARE/FERA customers in the hot region were the only segment to offset any portion of their structural bill increase through behavior change at 19.8%. Behavioral offsets for the other customer segments were less than 8% and not statistically significant; or even negative in some cases.

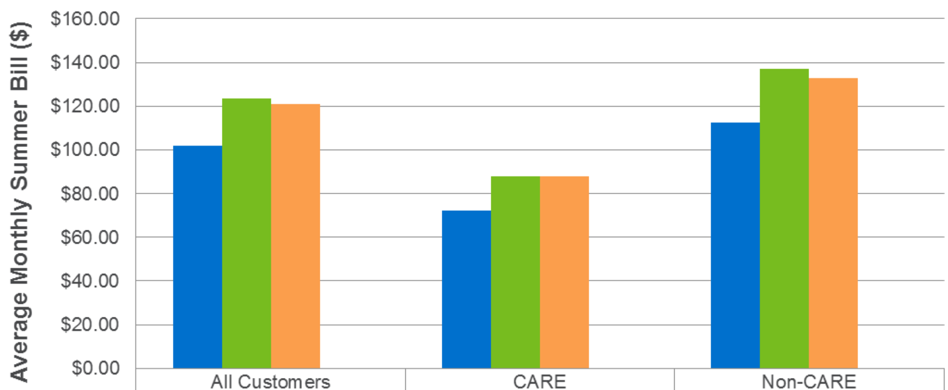
Figure 4-44: Rate 2 Total Bill Impact Due to Differences in the Tariff and Behavior Change Detailed Segments by Climate Region



	Senior	Below 100% FPG	100% - 200% FPG	CARE	Non-CARE	CARE	Non-CARE	CARE	Non-CARE
	Hot					Moderate		Cool	
No Change in Behavior or Tariff	$133.48	$114.81	$121.41	$97.39	$179.75	$47.90	$105.58	$33.44	$69.05
No Change in Behavior, Change in Tariff	$158.65	$132.83	$142.73	$115.08	$213.31	$58.32	$123.51	$42.17	$81.76
With Change in Behavior and Tariff	$156.65	$135.09	$142.12	$116.02	$206.68	$58.10	$123.35	$42.41	$81.45
% of structural loss mitigated by change in behavior	7.9%	-12.5%	2.8%	-5.3%	19.8%	2.1%	0.9%	-2.8%	2.5%

Figure 4-45 presents the three sets of average monthly bills for all customers, CARE/FERA customers, and non-CARE/FERA customers on Rate 3, which were similar to Rates 1 and 2. The average Rate 3 customer experienced a structural loss of $21.97 (22%). Through changes in energy use behavior they were able to offset $2.92 (13.3%), resulting in a total monthly bill increase of $19.05 (19%) after factoring in the changes in the tariff and behavior. CARE/FERA customers experienced an average structural loss of $15.52 (21%). Similar to Rate 2, they did not reduce energy usage compared to the control group, resulting in a total monthly bill increase of $15.62 (22%) after factoring in the changes in the tariff and behavior. Non-CARE/FERA customers were able to mitigate some of their structural loss, though only a relatively small portion at 16.6% ($4.03). The average structural loss for non-CARE/FERA customers was $24.35 (22%), resulting in a total monthly bill increase of $21.31 (18%) after factoring in the changes in the tariff and behavior.

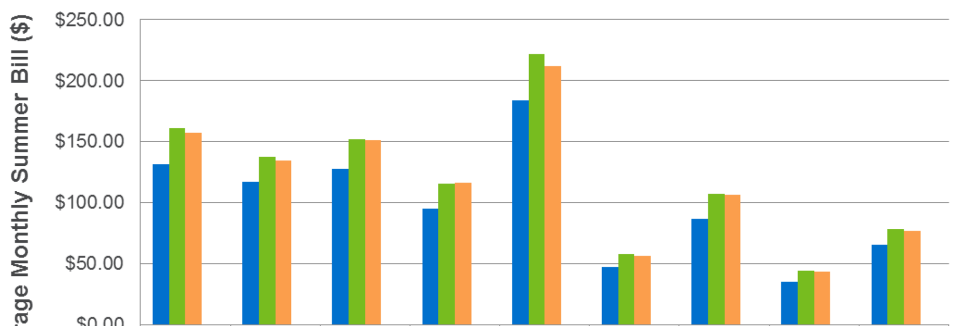
Figure 4-45: Rate 3 Total Bill Impact Due to Differences in the Tariff and Behavior Change
All | CARE/FERA | Non-CARE/FERA



	All Customers	CARE	Non-CARE
	All		
No Change in Behavior or Tariff	$101.71	$72.31	$112.54
No Change in Behavior, Change in Tariff	$123.68	$87.83	$136.89
With Change in Behavior and Tariff	$120.76	$87.93	$132.86
% of structural loss mitigated by change in behavior	13.3%	-0.7%	16.6%

Figure 4-46 presents the three sets of average monthly bills for the detailed segments by climate region on Rate 3. Similar to Rate 2, non-CARE/FERA customers in the hot region were the only segment to offset any portion of their structural bill increase through behavior change at 27.0%. This was the largest offset among any customer segments. Behavioral offsets for the other customer segments varied, but were not statistically significant; and were even negative in the case of CARE/FERA customers in the hot climate region.

Figure 4-46: Rate 3 Total Bill Impact Due to Differences in the Tariff and Behavior Change Detailed Segments by Climate Region



	Hot					Moderate		Cool	
	Senior	Below 100% FPG	100% - 200% FPG	CARE	Non-CARE	CARE	Non-CARE	CARE	Non-CARE
No Change in Behavior or Tariff	$131.52	$117.02	$127.70	$95.38	$183.59	$47.09	$86.72	$35.41	$65.37
No Change in Behavior, Change in Tariff	$161.15	$137.47	$152.19	$115.31	$222.16	$57.65	$106.99	$43.99	$78.63
With Change in Behavior and Tariff	$157.45	$134.31	$151.33	$116.10	$211.75	$56.56	$106.43	$43.51	$77.08
% of structural loss mitigated by change in behavior	12.5%	15.4%	3.5%	-3.9%	27.0%	10.3%	2.8%	5.6%	11.7%

Overall, the average customer across each of the rates was able to offset a small portion of the structural bill impact by between 8% and 13%. However, the offsets were largely driven by the non-CARE/FERA customers in the hot climate region who were able to offset between 20% and 27% of their structural loss. For the most part, the other segments were not able to offset much of their structural loss and many of the observed behavioral impacts were not statistically significant.

4.4.4 Change in the Distribution of Bill Impacts Due to Behavior Change

The fourth analysis presents the distribution of bill impacts for customers with and without behavioral change, and is designed to show how the distribution shifts when customers respond to the rates by changing behavior. Similar to the other analyses, impact distributions are based on the average summer monthly bills for July, August, and September. Bill impacts were estimated for two cases—with and without behavior change. Customers were segmented into ranges of bill impacts. The percentage of customers in each $10 increment from negative $100 to positive $100 per month (with and without behavior change) was determined with and without behavior change. The underlying calculations used to develop the distributions are based off of a difference-in-differences approach that compares the treatment and control customers based on both pre- and post-treatment bill impacts.[34]

The two distributions are presented on a line graph, with the height of the line at any given $10 increment representing the percentage of customers experiencing a bill impact of the corresponding dollar amount. In this case, the bill impact is measured as the difference between the TOU bill and the OAT bill. If the line for the group with changes in behavior is to the left of the line representing the group with no change in behavior, it shows that at least some customers were able to modify their energy usage such that they had lower bill impacts compared to if they had not changed their behavior.

[34] See section 3.2.4 for additional details on the methodology.

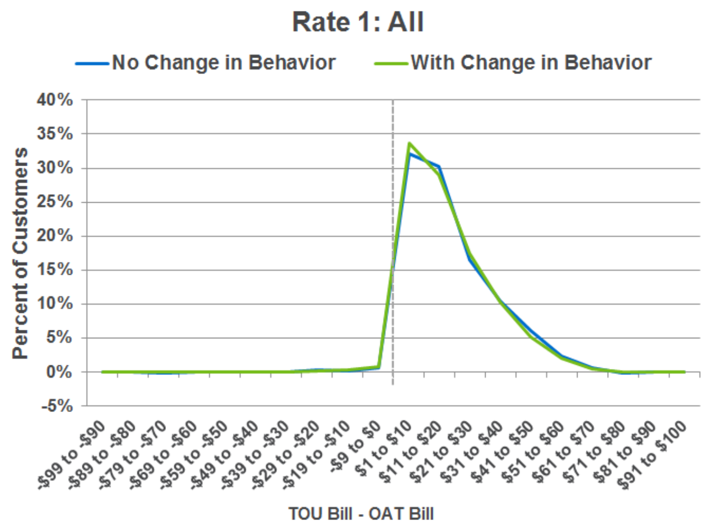
Figure 4-47 presents the distribution of bill impacts with and without energy use behavior change. The blue line represents the structural bill impacts that result when customers are billed on the TOU rate and do not change their energy use behavior. The green line shows the bill impacts when customers have responded to the TOU rate and, in some cases, changed their energy use behavior. Bill impacts are calculated as the difference between the TOU bill and the OAT bill. Each point along the line graph represents the percentage of customers within a specific bill impacts bin or range. For example, on Rate 1, approximately 30% of the customers have structural bill impact of $11 to $20 per month—the blue line. In other words, approximately 30% of the Rate 1 customers would experience an increase of $11 to $20 per month on Rate 1 compared to the OAT without changing their behavior. The green line represents the bill impacts when customers have had the opportunity to respond to the TOU rate. In this case, the percent of customers experiencing an increase of $11 to $20 per month on Rate 1 compared to the OAT is 29%, showing a slight reduction.

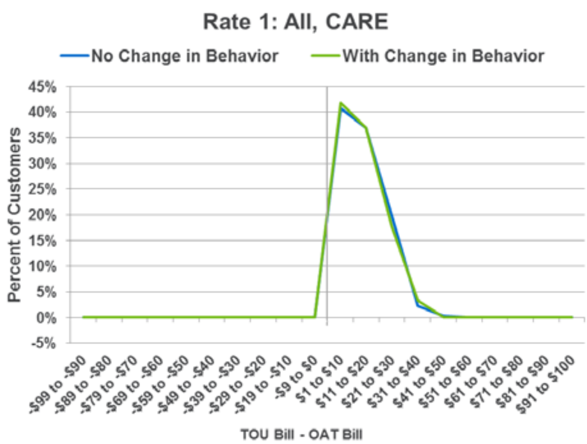
It is important to note that customers could move up or down through the incremental impact bins, and could potentially move more than one bin—meaning that a customer could potentially experience a bill increase due to their behavioral response, or they could jump down several bins and go from a $21 to $30 per month bill impact down to $1 to $10 impact, for example. In the case of the average Rate 1 customers, there is an increase in the percent of customers with a bill impact of between $1 and $10 per month. With no change in behavior, 32% of customers were in this bin and with behavior change 34% of customers are now in this bin. Looking at the shape of the distributions and the table reporting the percentages, it is clear that with behavior change there were fewer customers in the $41 to $50 range, and in the$11 to $20 range. While it isn’t clear exactly where those customers moved, it is clear that ultimately some customers were able to make changes in their energy use behavior that resulted in offsetting some of the structural loss, as covered in the previous sections. While the percentage of customers in the $1 to $10 bin increased, it was because they were originally in higher bill impact ranges and have since transitioned down to a lower bin.

As noted in the previous section, CARE/FERA customers on average did not offset any of the structural loss through behavior change. This is also apparent in the graph below, where there is very little separation between the green and blue lines. On the other hand, the non-CARE/FERA customers were able to slightly offset the structural bill impacts, and this can be observed in the graph where sections of the green line are to the left of or below the blue line. It’s also important to note that instances where the green line is to the right of or above the blue line in the lower bill impact ranges indicate more customers have moved into that bin, likely from higher impact bins. This is the case where there is a higher percentage of non-CARE/FERA customers in the $1 to $10 range after behavior change compared to before behavior change.

Figure 4-47: Rate 1 Change in the Distribution of Bill Impacts Due to Behavior Change All | CARE/FERA | Non-CARE/FERA

Pilot Bill - Tiered Bill	No Change in Behavior	With Change in Behavior
-$99 to -$90	0%	0%
-$89 to -$80	0%	0%
-$79 to -$70	0%	0%
-$69 to -$60	0%	0%
-$59 to -$50	0%	0%
-$49 to -$40	0%	0%
-$39 to -$30	0%	0%
-$29 to -$20	0%	0%
-$19 to -$10	0%	0%
-$9 to $0	1%	1%
$1 to $10	32%	34%
$11 to $20	30%	29%
$21 to $30	17%	17%
$31 to $40	10%	10%
$41 to $50	6%	5%
$51 to $60	2%	2%
$61 to $70	1%	1%
$71 to $80	0%	0%
$81 to $90	0%	0%
$91 to $100	0%	0%





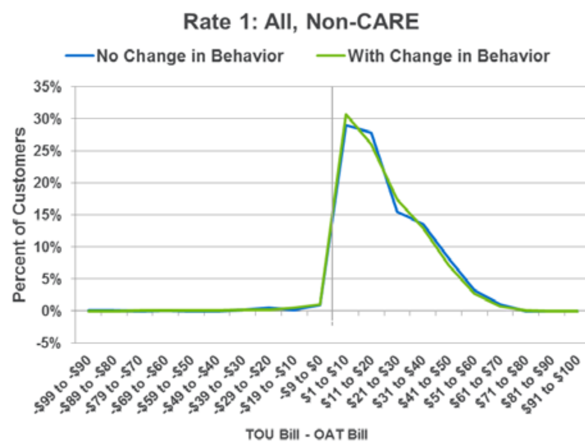
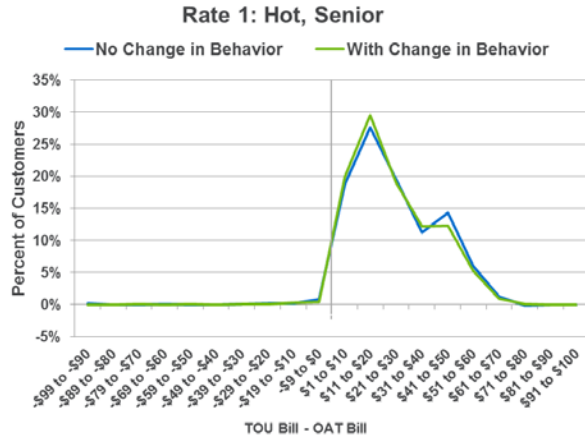
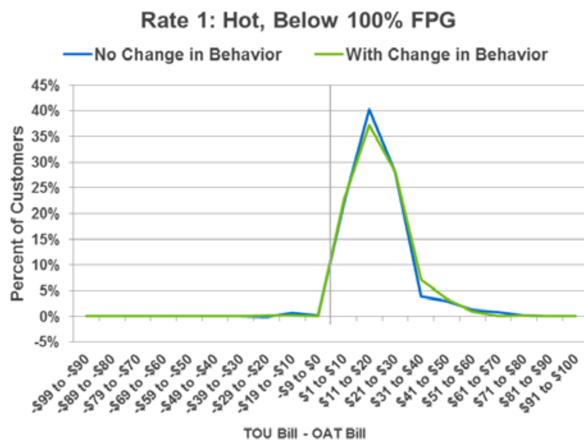
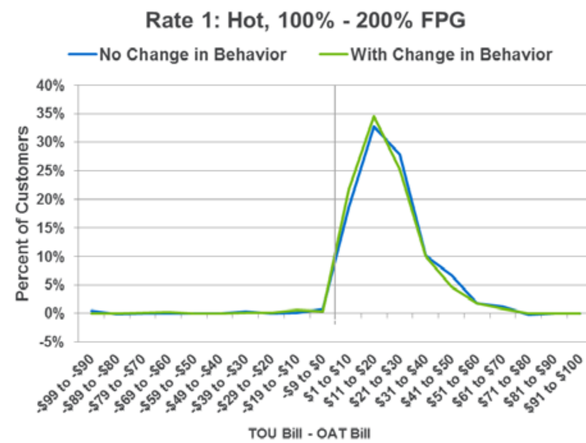


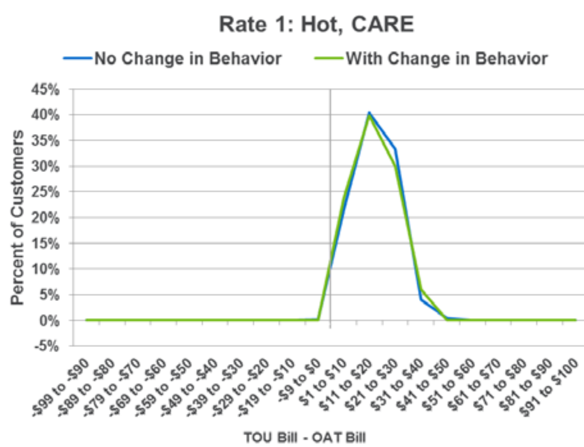
Figure 4-48 provides the distribution of bill impacts for the detailed segments by climate zone. As noted above in section 4.4.2 , the only Rate 1 segments with statistically significant bill impacts were Seniors, 100% to 200% FPG, non-CARE/FERA customers in the hot region, and CARE/FERA customers in the moderate region. In each of those segments, it is possible to see how the distribution has shifted slightly. It's also worth noting that there are instances such as non-CARE/FERA customers in the moderate region where there weren't statistically significant bill impacts. However, it's clear some shifting took place. Nevertheless, based on the outcomes it is apparent that not all of the shifting was into lower bill impact ranges given that the overall outcome for that segment was near zero and not statistically significant.

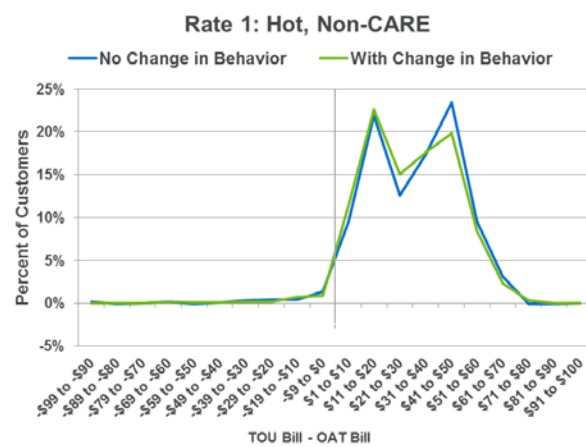
Figure 4-48: Rate 1 Change in the Distribution of Bill Impacts Due to Behavior Change Detailed Segments by Climate Region











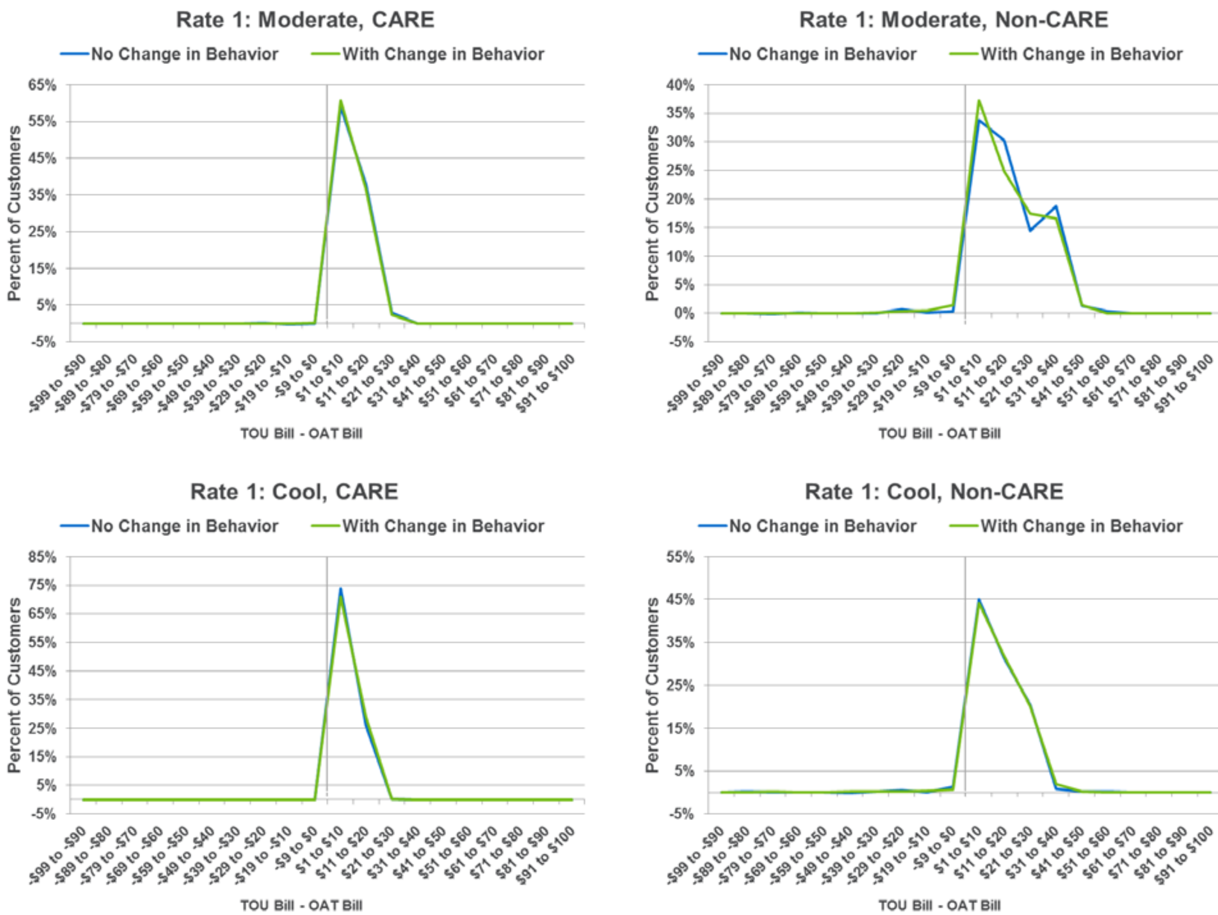
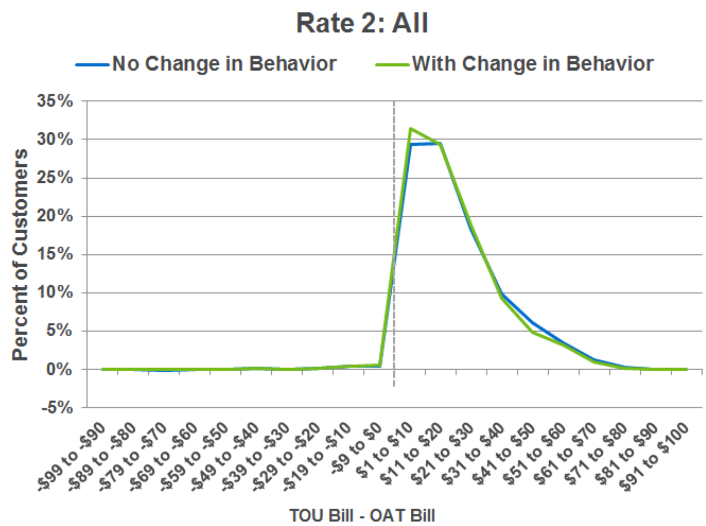
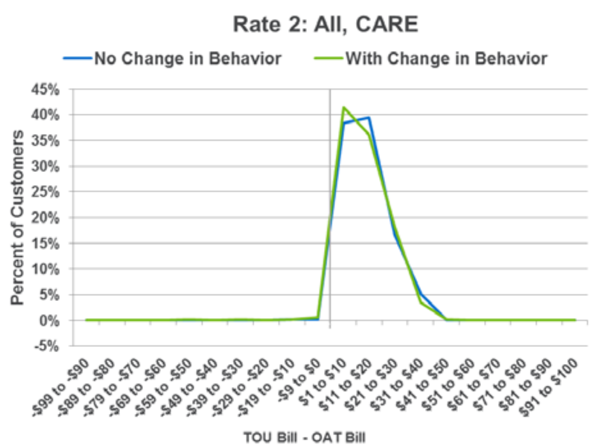


Figure 4-49 provides the distributions of bill impacts for all customers and CARE/FERA and non-CARE/FERA customers on Rate 2. The average Rate 2 customer was able to offset approximately $1.54 (7.9%) of the structural loss through behavior change. Based on the graph, some customers with larger impacts in the $50 range were able to transition down to lower bins. On average, Rate 2 CARE/FERA customers were not able to offset any of the structural loss. However, it appears that at least some customers were able to move into lower bill impact bins. As with Rate 1, non-CARE/FERA customers show the largest behavioral bill impacts. This is shown where there is a notable reduction in the $50 per month bill impact range, and growth in the lower impact ranges.

Figure 4-49: Rate 2 Change in the Distribution of Bill Impacts Due to Behavior Change
All | CARE/FERA | Non-CARE/FERA

Pilot Bill - Tiered Bill	No Change in Behavior	With Change in Behavior
-$99 to -$90	0%	0%
-$89 to -$80	0%	0%
-$79 to -$70	0%	0%
-$69 to -$60	0%	0%
-$59 to -$50	0%	0%
-$49 to -$40	0%	0%
-$39 to -$30	0%	0%
-$29 to -$20	0%	0%
-$19 to -$10	0%	1%
-$9 to $0	0%	1%
$1 to $10	29%	31%
$11 to $20	30%	29%
$21 to $30	18%	19%
$31 to $40	10%	9%
$41 to $50	6%	5%
$51 to $60	4%	3%
$61 to $70	1%	1%
$71 to $80	0%	0%
$81 to $90	0%	0%
$91 to $100	0%	0%





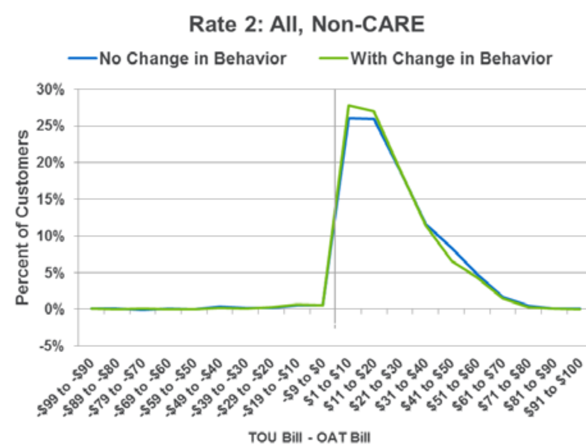
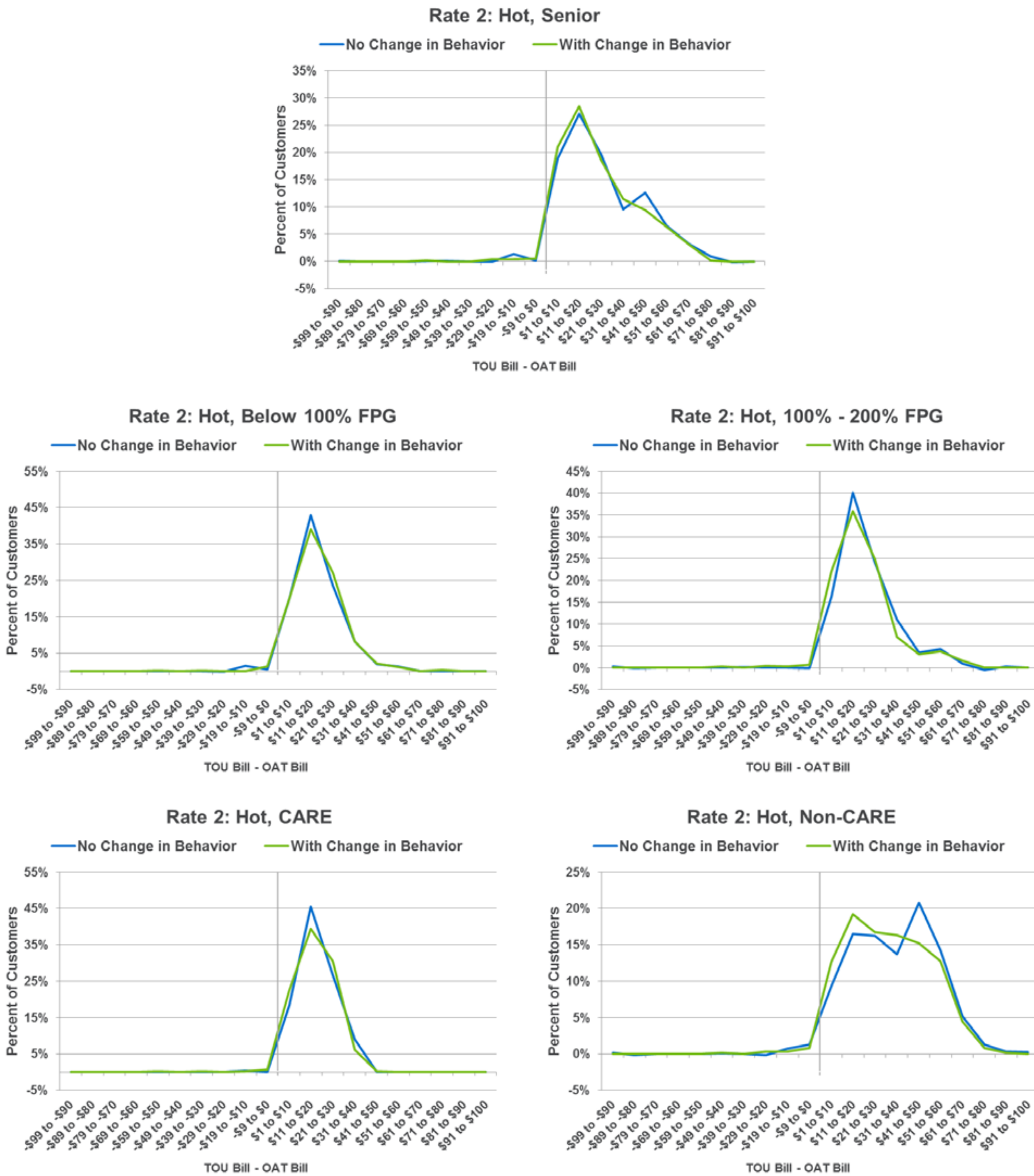


Figure 4-50 shows the distribution of bill impacts for the detailed segments by climate zone for Rate 2. As noted above in section 4.4.2 , the only Rate 2 segment with statistically significant bill impacts was non-CARE/FERA customers in the hot region. This segment shows a dramatic shift in the distribution of bill impacts with and without behavior change. Some of the other segments, such as hot 100% to 200% FPG customers and moderate CARE/FERA customers show changes in the distribution. However, the bill impacts for the remaining segments were not statistically significant. This indicates that while on average there were no bill impacts, there are customers within the segments that are experiencing meaningful bill impacts.

Figure 4-50: Rate 2 Change in the Distribution of Bill Impacts Due to Behavior Change Detailed Segments by Climate Region



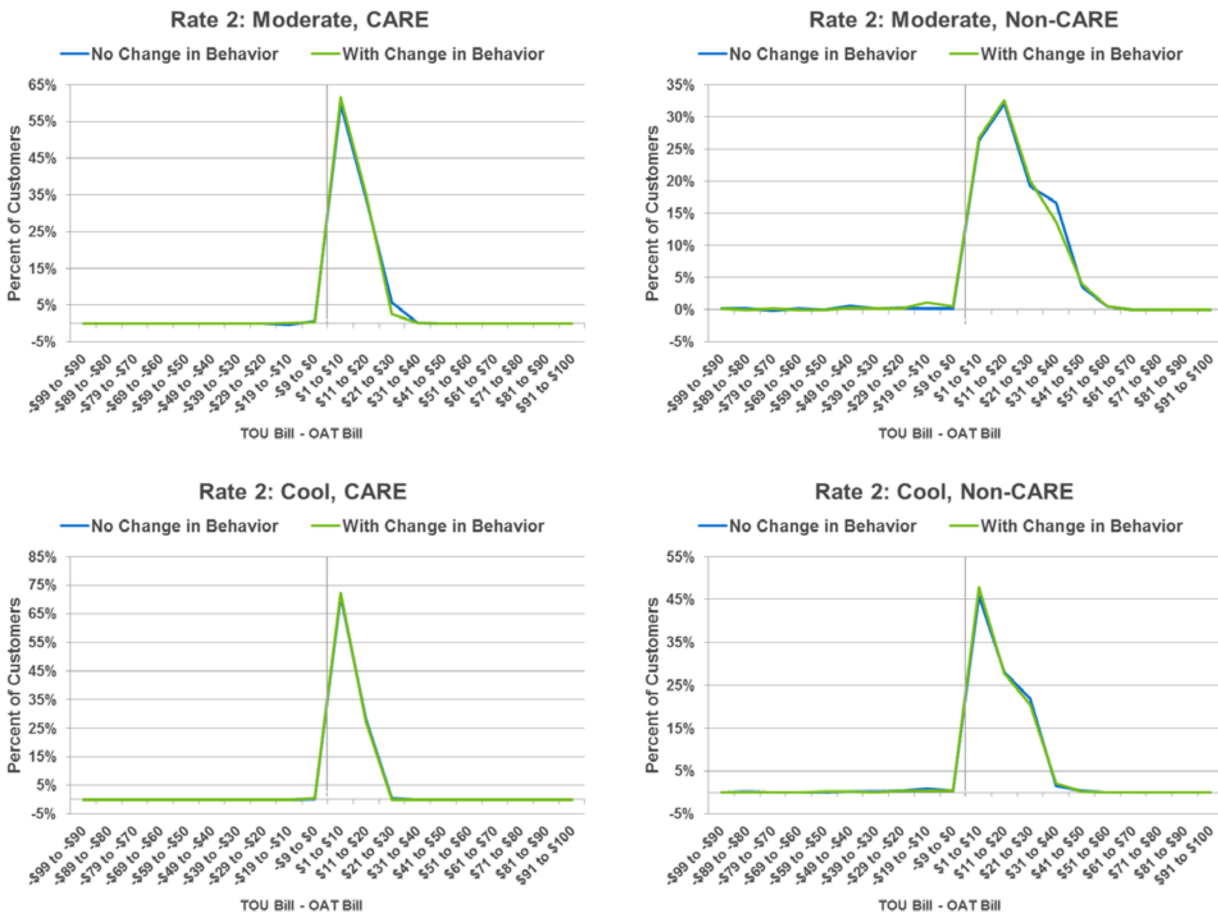
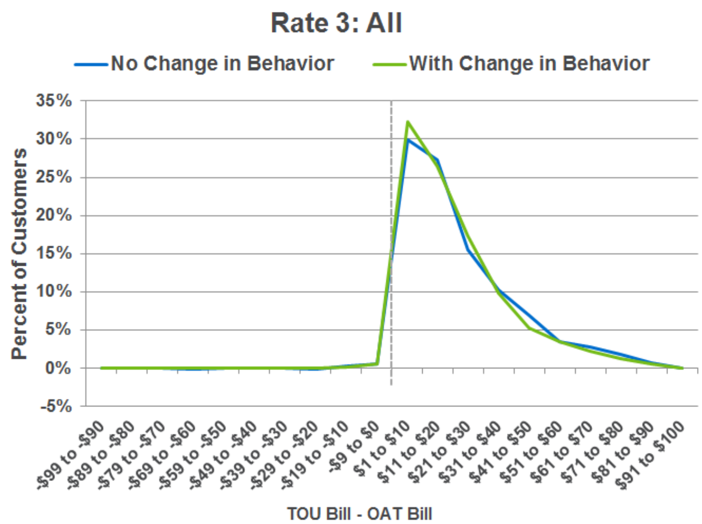
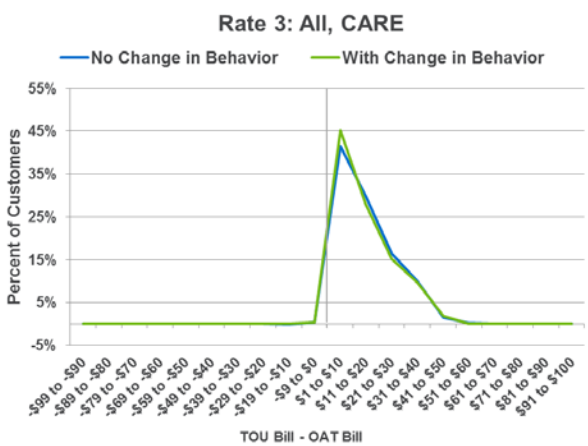


Figure 4-51 shows the distribution of bill impacts for all customers and for CARE/FERA and non-CARE/FERA customers on Rate 3. The average Rate 3 customer was able to offset approximately $2.92 (13.3%) of the structural loss. Based on the graph, some customers with larger impacts in the $50 range were able to transition down to lower bins. On average, Rate 3 CARE/FERA customers were not able to offset any of the structural loss. As with Rates 1 and 2, non-CARE/FERA customers were the segment showing the largest behavioral bill impacts. This is shown where there is a notable reduction in the $50 per month bill impact range, and growth in the lower impact ranges.

Figure 4-51: Rate 3 Change in the Distribution of Bill Impacts Due to Behavior Change
All | CARE/FERA | Non-CARE/FERA

Pilot Bill - Tiered Bill	No Change in Behavior	With Change in Behavior
-$99 to -$90	0%	0%
-$89 to -$80	0%	0%
-$79 to -$70	0%	0%
-$69 to -$60	0%	0%
-$59 to -$50	0%	0%
-$49 to -$40	0%	0%
-$39 to -$30	0%	0%
-$29 to -$20	0%	0%
-$19 to -$10	0%	0%
-$9 to $0	1%	1%
$1 to $10	30%	32%
$11 to $20	27%	26%
$21 to $30	15%	17%
$31 to $40	10%	10%
$41 to $50	7%	5%
$51 to $60	4%	3%
$61 to $70	3%	2%
$71 to $80	2%	1%
$81 to $90	1%	1%
$91 to $100	0%	0%





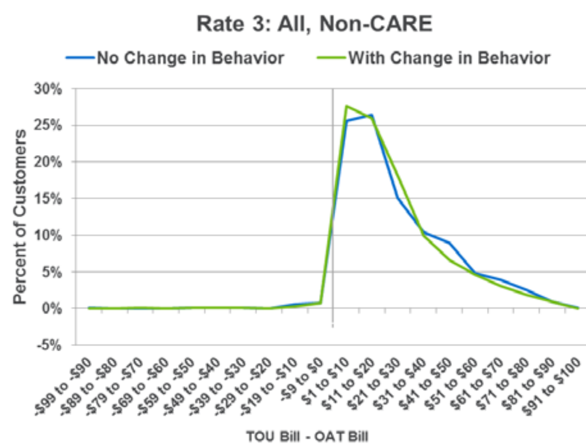
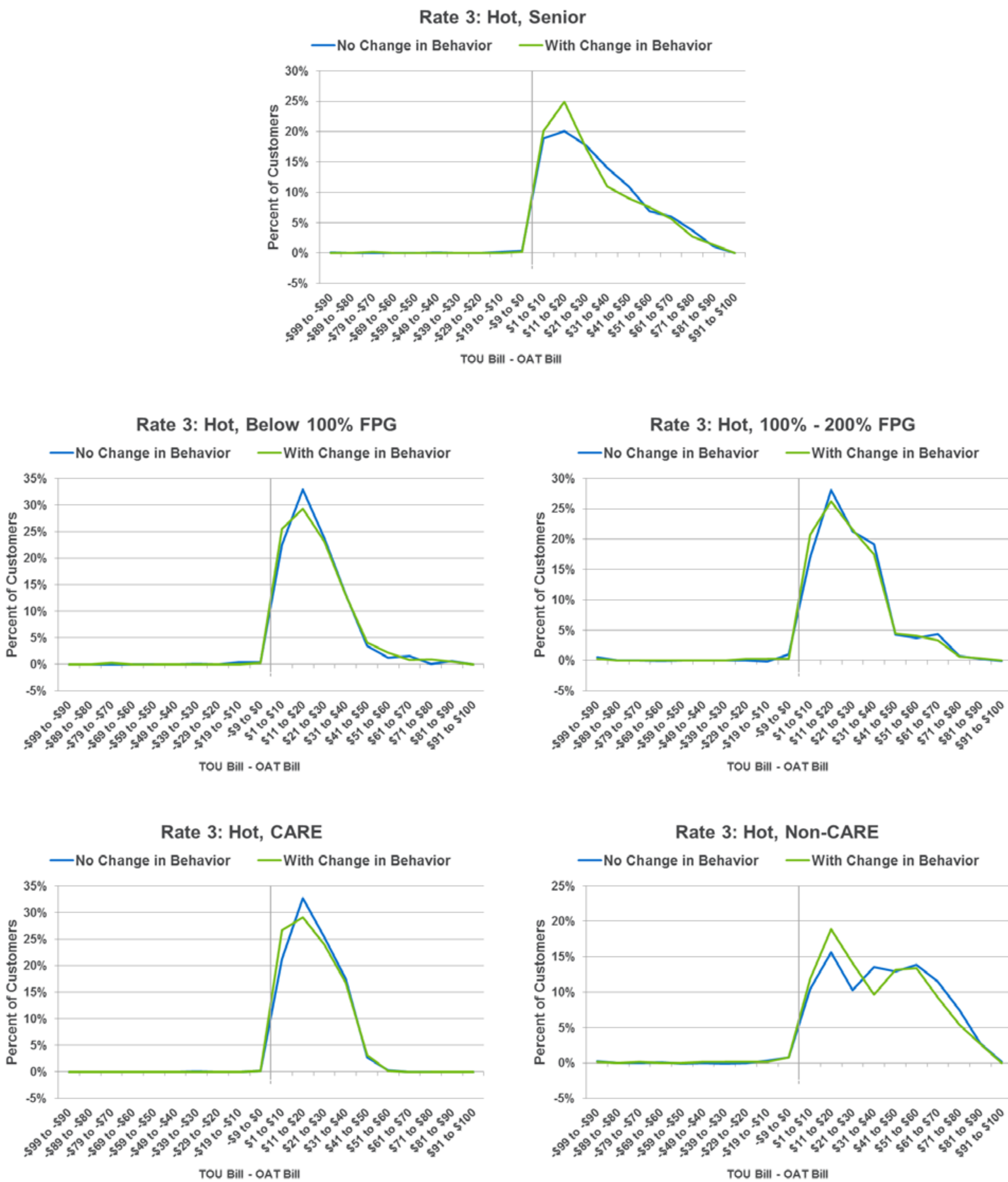
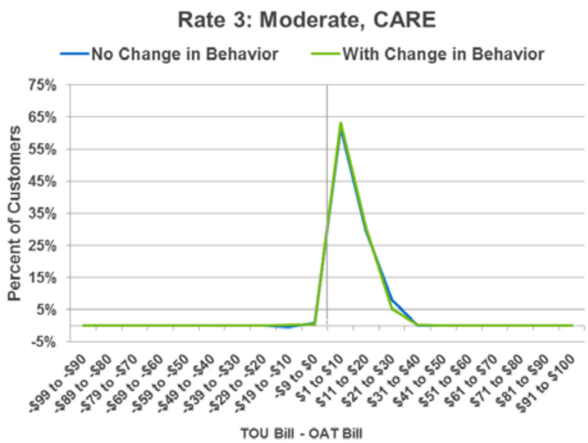
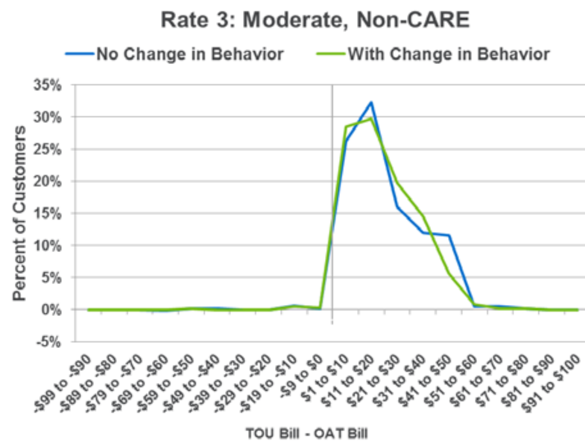


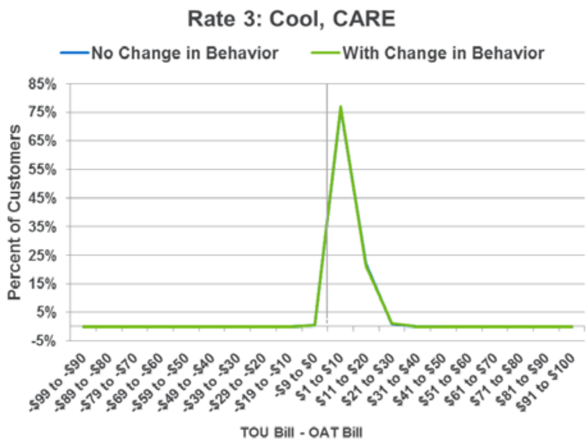
Figure 4-52 shows the distribution of bill impacts for the detailed segments by climate zone for Rate 3. As noted above in Section 4.4.2 , the only Rate 3 segment with statistically significant bill impacts was non-CARE/FERA customers in the hot region. This segment shows a dramatic shift, where the distribution with behavior change is clearly shifted. Some of the other segments such as the seniors in the hot climate region and the moderate CARE/FERA customers show changes in the distribution. However, the bill impacts for those and the remainder of the segments were not statistically significant. This indicates that while on average there were no bill impacts, there are customers within the segments that are experiencing meaningful bill impacts.

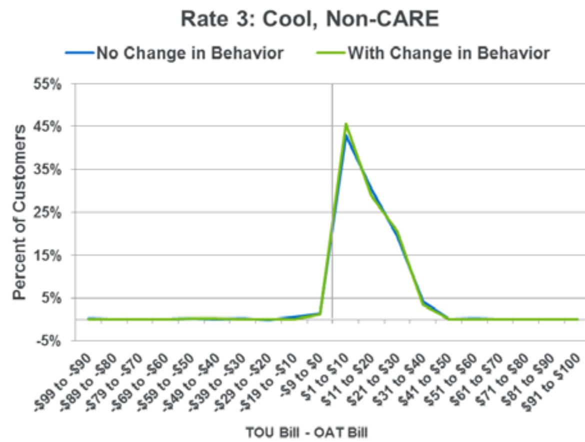
Figure 4-52: Rate 3 Change in the Distribution of Bill Impacts Due to Behavior Change Detailed Segments by Climate Region











4.5 Survey Findings

To be added

4.6 Synthesis and Conclusions

To be added

5 SCE Evaluation

This report section summarizes the design and evaluation of the SCE pilot. It begins with a summary of the rate and other treatments that were tested in the pilot. This is followed by a brief overview of the pilot implementation process, which includes a discussion of enrollment rates and customer attrition. Section 5.3 presents the load impact estimates for each rate and complementary treatment and Section 5.4 summarizes the bill impacts. Section 5.5 presents the survey results, including key findings regarding hardship for selected customer segments. The final section contains a high level summary and synthesis of the survey and impact findings.

5.1 Pilot Treatments

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.[35] 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 5-1 and Figures 5-1 through 5-3.

Table 5-1: 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 (¢/kWh)	Summer	11.5	35.9	20.6
	Winter	4.58	10.5	10.6
	Spring	N/A	N/A	14.9
Peak Period[36]		2-8 PM	5-8 PM	4-9 PM
Duration of Peak		6 Hours	3 Hours	5 Hours

[35] 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).
[36] The figures use a nomenclature that SCE used in its education and outreach material. However, in this table, "peak period" refers to the highest priced period on a particular day type regardless of whether it is called on-peak, super-on-peak or mid-peak.

Figure 5-1: SCE Pilot Rate 1

Rate 1	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 (23.0₵)								Off-Peak (27.61₵)						On-Peak (34.51₵)									
	Winter	Super Off-Peak (22.91₵)								Off-Peak (22.91₵)						On-Peak (27.49₵)									
Weekend	Summer	Super Off-Peak (23.0₵)								Off-Peak (27.61₵)															
	Winter	Super Off-Peak (22.91₵)								Off-Peak (22.91₵)															

Figure 5-2: 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 5-3: 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 for Rates 1 and 2 do not reflect the 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 3 does not include a baseline credit. Given this difference in baseline credits between Rates 1 and 2 and Rate 3, it is not possible to directly compare prices in each rate period from the above figures.

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. 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. Compared with Rate 1, it has a much shorter peak period on weekdays and has significantly, higher, tier 2 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 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 5-3 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 on weekdays. Finally, as mentioned above, a very important difference is the lack of a baseline credit in Rate 3.

In addition to assessing the rate treatments summarized above based on customers recruited from the general, eligible 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 Nest thermostat 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) rather than through the direct mail solicitation that was employed for the rate treatment groups. Target enrollment for the technology treatment was 3,750 customers and participants were to be randomly assigned to Rates 1 and 3 or to the control condition. In reality, enrollment fell well short of this target and those who enrolled were randomly assigned only to Rate 1 and to the control group.

SCE also varied the education and outreach provided to participants who were on the three TOU rates. The majority of customers (75%) on each of the three TOU rates received what SCE describes as enhanced education and outreach while the remainder received fewer contacts during the post enrollment phase.

5.2 Implementation Summary

As discussed in the TOU Pilot Design Report 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 and 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 for assignment to Rate 2 and oversampling CARE/FERA customers in all climate regions. 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.[37] Table 5-2 shows the target level of enrollment for targeted segments and treatments in SCE's hot climate region and Table 5-3 shows the target for all rate treatments across the three climate regions.

[37] For further discussion of sample sizes and target precision for each metric, see Section 3.3 of The Pilot Design Report and Appendices E, F and G of Appendix Volume I.

Table 5-2: Target Enrollment for Rate 2 in SCE's 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 5-3: 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

Prior to pulling the recruitment sample, selected customers were screened out from participating in the pilot. A detailed accounting of all exclusion criteria is contained in Section 2.1 of Appendix Volume I. Importantly, SCE excluded customers with less than 12 months of usage history, since these customers will not be defaulted to TOU rates in the future.[38] After applying all exclusion criteria to SCE's population of roughly 4.3 million residential customers, the eligible population was approximately 3.3 million.

5.2.1 Customer Recruitment

In order to avoid significant over or under recruitment and to better manage recruitment costs, SCE conducted a small pretest in January, 2016 to determine how response rates vary across selected customer segments, delivery channels, incentive payments and with and without the offer of bill protection. Based on these pretest results and those of PG&E and SDG&E, SCE decided to offer a "pay-to-play" incentive of $200 to each participant to be paid in three installments -- $100 at the time of enrollment and $50 upon completion of each of two surveys that were to be conducted over the course of the pilot. Even though the pretest results did not show a significant uptake in customer acceptance tied to the offer of bill protection, bill protection was included in the offer based on input from the TOU WG.

With input on acceptance rates from the pretest, SCE decided to make offers[39] to a sample of roughly 197,000 customers distributed across rates and customer segments as shown in the first row of Table 5-4. SCE sent out direct mail offers in 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

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

[39] Copies of the solicitation letter and all educational and outreach materials are contained in Section 2 of Appendix Volume 1.

the enrollment website.[40] The solicitation emphasized the importance of the study, the financial incentive participants would receive, what was expected from participants and what they could expect to occur 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 a business reply card, or by calling a toll free number.[41] Upon enrollment, customers were asked to complete a brief survey that gathered important data about income, age of household members, email addresses and a few other variables.

Table 5-4: SCE Offers and Acceptances by Partition and Strata

Category	Hot Climate Region						
				Non-Senior CARE		Senior	
	General	CARE[42]	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
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 Region		Cool Climate Region		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%

As seen in Table 5-4, the overall acceptance rate for the non-smart thermostat treatment groups was 14%. Acceptance rates for the tariff treatments varied from a low of 10% for seniors below 100% of the FPG to a high of 17% for seniors above 100% of FPG. In each climate region, CARE customers enrolled at a somewhat higher rate than non-CARE customers but the difference was not large.

The final column in Table 5-4 shows the offer and acceptance rates for customers that already had Nest smart thermostats. As mentioned previously, since Nest does not have names or addresses of households that own Nest thermostats, these solicitations were necessarily done via email. Nest

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

41 Note to SCE: I think people would be interested in knowing how many customers enrolled through each of the three options if you can provide that to us.

42 In this table and throughout this report, unless explicitly state otherwise, the CARE designation is meant to include participants in both the CARE and FERA programs.

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. The initial email contained significantly less information than the solicitation letter sent to the general population but recipients could click on a "Learn More" button in the email to connect to a microsite where more information could be found and through which customers could enroll online.

As seen in Table 5-4, 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 actually enrolled for reasons discussed in Section 5.2.2. There are several possible explanations for the much lower acceptance rate for smart thermostat owners. 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. Given this, 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.

5.2.2 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. There were several reasons why not all customers were enrolled. 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.[43] For example, a customer might have closed their account, become a 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 previously in Table 5-3, 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 targeted level of enrollees. Prior to enrollment, SCE set a maximum recruitment level for each test cell of 20% over and above the minimum goal (including attrition), for Rates 1 and 2. Due to the fact that Rate 3 had to be billed manually, no such over-recruitment for Rate 3 was allowed. Roughly 4,800 customers were declined participation due to over-enrollment. For each oversubscribed 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 letter that thanked them for their interest in the TOU study.

[43] All Rate 3 and FERA customers were transitioned to their pilot rate starting on June 23. As a result, it was July 23 before all Rate 3 customers were on the TOU tariff.

Table 5-5 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 (purchased from Acxiom). However, data on these key variables was collected from the vast majority of customers at the time of enrollment. 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 Table 5-5, 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 over subscription. No one dropped out after accepting the offer but prior to receiving a Welcome Kit and learning what rate they were assigned to. 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 (a peak time rebate program) and the smart thermostats were used to adjust settings on event days. SCE assigned 20,846[44] 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.

Following 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. Treated participants received a similar letter, which included information concerning bill protection. They also received a TOU rate plan information sheet, TOU time period reference cling film, cling for individual appliances, conservation reminder stickers, door hangers with recommended seasonal thermostat settings, as well as a pen and notepad. Examples of Welcome Kit information can be found in Section 2.4 of Appendix Volume I.

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

Table 5-5: Distribution of SCE Customers from Acceptance to Enrollment

Category	Hot Climate Zones, General	Hot Climate Zones, CARE Customers	Hot Climate Zones, Non-CARE Customers	Hot Climate Zones, Non-Senior CARE Customers below FPL	Hot Climate Zones, Non-Senior CARE Customers above FPL	Hot Climate Zones, Seniors below FPL	Hot Climate Zones, Seniors above FPL	Moderate Climate Zones, CARE Customers	Moderate Climate Zones, Non-CARE Customers	Cool Climate Zones, CARE Customers	Cool Climate Zones, Non-CARE Customers	Technology	Pre-Test	Total
Offers	37,500	11,458	11,458	5,200	7,700	14,433	10,433	23,958	23,958	23,958	23,958	0	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	938	498	27,429
Acceptance Rate	13%	15%	12%	14%	14%	10%	17%	14%	11%	16%	14%	#DIV/0!	16%	14%
Ineligible Prior to Rate Assignment	154	65	53	29	45	70	73	63	68	111	90	250	42	1,113
Moved	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Medical	0	1	0	2	1	0	0	2	2	4	2	0	0	14
NEM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Participation in Rate Program	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	154	64	53	27	44	70	73	61	66	107	88	250	42	1,099
Opt-Out Prior to Rate Assignment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Random Over Enrollment Declines	448	268	46	339	415	454	800	557	67	961	429	0	7	4,791
Assignments	4,166	1,358	1,272	347	586	932	891	2,763	2,476	2,861	2,747	688	447	21,534
Customers Assigned to a Pilot Rate	**4,491**	**1,371**	**1,321**	**338**	**493**	**767**	**809**	**2,874**	**2,637**	**2,871**	**2,874**	**688**		**21,534**
Rate 1	0	750	696	0	0	0	0	749	671	749	750	344		4,709
Rate 2	2,245	0	0	170	238	382	412	750	671	748	749	0		6,365
Rate 3	0	621	625	0	0	0	0	625	625	625	625	0		3,746
Control	2,246	0	0	168	255	385	397	750	670	749	750	344		6,714
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%			13
Customers Transitioned to a Pilot Rate	**4,410**	**1,315**	**1,263**	**325**	**477**	**755**	**792**	**2,797**	**2,576**	**2,800**	**2,812**	**673**		**20,995**
Difference from Target Enrollment	**660**	**65**	**13**	**13**	**15**	**129**	**166**	**297**	**76**	**300**	**312**	**673**		**2,719**

** 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"

5.2.3 Customer Attrition

Table 5-6 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 in December, 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 December 31.

Over this period, 2,787 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 seven months, this equates to approximately 186 customers moving each month, or an annual churn rate of 2,237, or about 11%. 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.

Nearly 1,000 customers actively dropped out of the pilot over this period. As would be expected, the vast majority of these (95%) 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 once customers have received several summer bills.

Table 5-6: Customer Attrition

Attrition Reason	Hot Climate Zones, General	Hot Climate Zones, CARE Customers	Hot Climate Zones, Non-CARE Customers	Hot Climate Zones, Non-Senior CARE Customers below FPL	Hot Climate Zones, Non-Senior CARE Customers above FPL	Hot Climate Zones, Seniors below FPL	Hot Climate Zones, Seniors above FPL	Moderate Climate Zones, CARE Customers	Moderate Climate Zones, Non-CARE Customers	Cool Climate Zones, CARE Customers	Cool Climate Zones, Non-CARE Customers	Technology	Total
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	688	21,534
Customers enrolled as of 12-31-2016	3,862	1,125	1,094	273	419	691	711	2,440	2,346	2,568	2,611	607	18,747
Customers transitioned to pilot rate (or control customers)	4,409	1,315	1,263	325	477	755	792	2,796	2,575	2,800	2,812	672	20,991
Ineligible Post-Rate Assignment	**227**	**78**	**87**	**17**	**29**	**29**	**36**	**165**	**120**	**93**	**77**	**40**	**998**
Ineligibles, Pre-Notification	4	2	5	0	3	2	4	6	6	7	0	6	45
Ineligibles, Pre-Rate Change	15	12	24	1	2	2	3	18	29	12	27	6	151
Ineligibles, Post-Rate Change	208	64	58	16	24	25	29	141	85	74	50	28	802
Moved Post-Rate assignment	**300**	**99**	**73**	**40**	**36**	**32**	**27**	**204**	**121**	**183**	**156**	**34**	**1,305**
Moves, Pre-Notification	39	8	7	7	5	6	3	22	12	21	13	1	144
Moves, Pre-Rate Change	12	23	16	4	3	1	2	25	10	18	13	1	128
Moves, Post-Rate Change	249	68	50	29	28	25	22	157	99	144	130	32	1,033
Opt-Out Post-Rate Assignment	**102**	**69**	**67**	**8**	**9**	**15**	**35**	**65**	**50**	**27**	**30**	**7**	**484**
Opt-Outs, Pre-Notification	3	0	2	0	3	0	2	1	2	0	2	1	16
Opt-Outs, Pre-Rate Change	9	5	4	1	0	1	3	2	3	5	6	1	40
Opt-Outs, Post-Rate Change	90	64	61	7	6	14	30	62	45	22	22	5	428
Total	**629**	**246**	**227**	**65**	**74**	**76**	**98**	**434**	**291**	**303**	**263**	**81**	**2,787**
Attrition rate	12%	14%	13%	15%	12%	8%	10%	13%	9%	8%	7%	9%	11%

Figures 5-4 through 5-6 show the cumulative opt-out rates over time for each test cell and climate region. The cumulative number of opt-outs is highest in the hot region, second highest in the moderate region and lowest in the cool region. The number of control customers dropping out is very low in all climate regions. The cumulative opt-out rate in the moderate and regions is below 4% and the cumulative opt-out rate in the cool regions is below 2%. The opt-out rates in the hot climate zones increase between July and August for Rates 1 and 2, and a bit later for Rate 3. This is likely due to the fact that enrollment in Rate 3 occurred later than it did for the other two rates. CARE/FERA customers in the hot climate region on Rate 1 had the greatest opt-out rate, reaching over 10% by the end of 2016. The opt-out rates generally level off after the summer season.

Figure 5-4: SCE Opt Outs by Month – Hot Climate Region

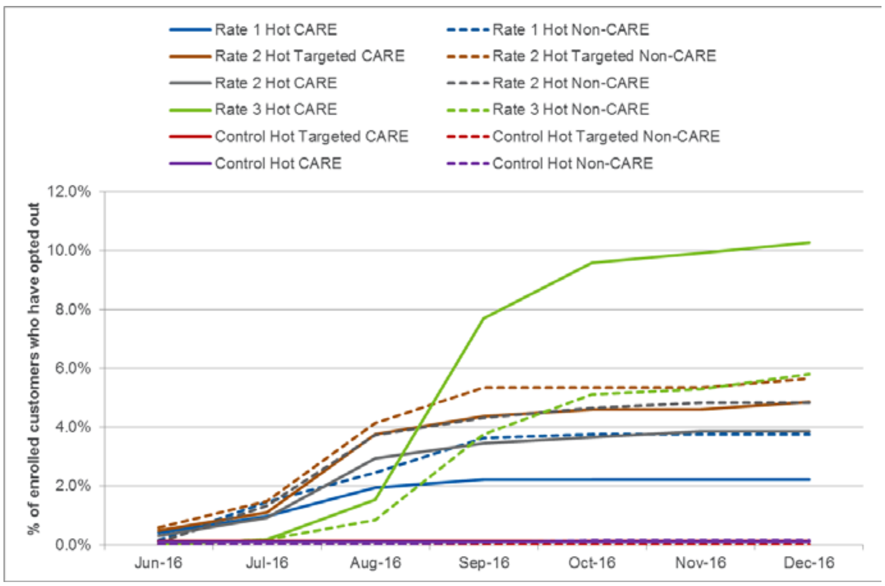


Figure 5-5: SCE Opt Outs by Month – Moderate Climate Region

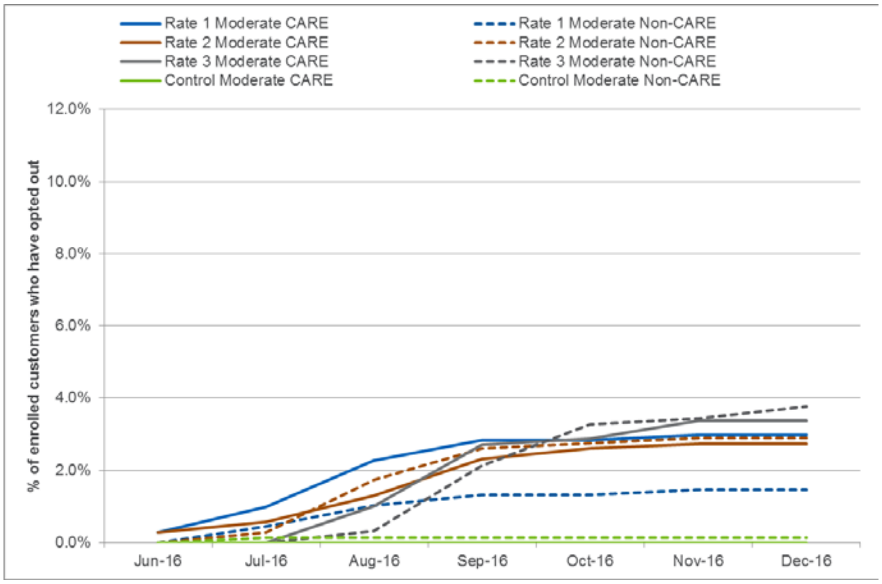
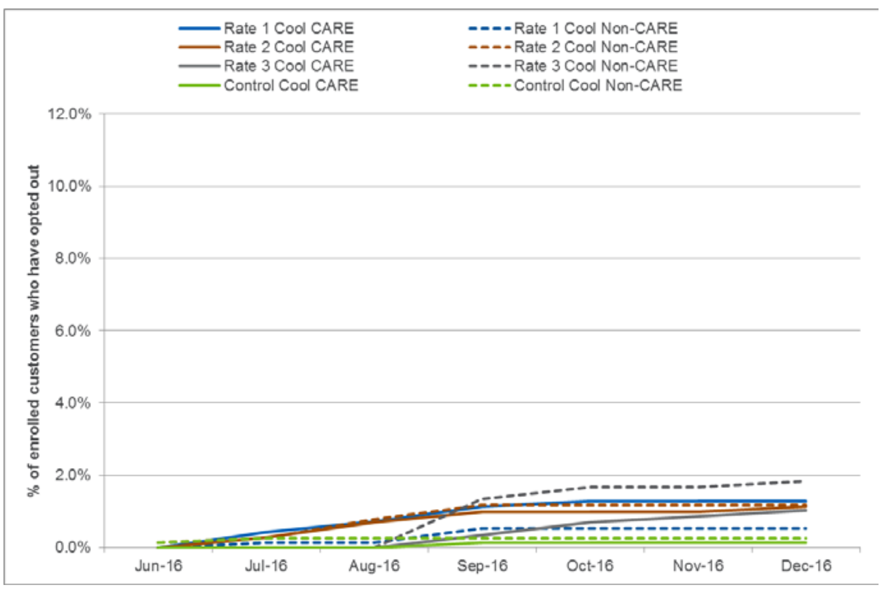


Figure 5-6: SCE Opt Outs by Month – Cool Climate Region



Figures 5-7 thorugh 5-9 show the overall attrition rate over time for each climate region, customer segment, and TOU rate. As seen in the figures, the cumulative attrition is quite constant over time in the moderate and cool cliamte regions, but not in the hot climate region. Much of the attrition among CARE/FERA Rate 3 customers in the hot climate region is attributable to opt-outs, and overall attrition rates for this group reach nearly 18% by the end of 2016. This is concerning, as this segment and rate had fewer than 600 participants at the start of the pilot period. Enrollment forecasting of Rate 3 customers indicates that CARE/FERA and non-CARE/FERA customers in the hot climate region may drop below the originally designed optimal enrollment levels for the billing impact analysis. However, more recent power analysis has shown that slightly lower numbers may still be acceptable. Therefore, it is likely there won't be issues in estimating statistically significant billing impacts for those segments.

Overall attrition rates are below 14% for the moderate climate region and 10% for the cool climate region. As seen in Table 5-6, most attrition in these segments is attributable to account closures rather than opt-outs and ineligibilty.

Figure 5-7: SCE Attrition by Month – Hot Climate Region

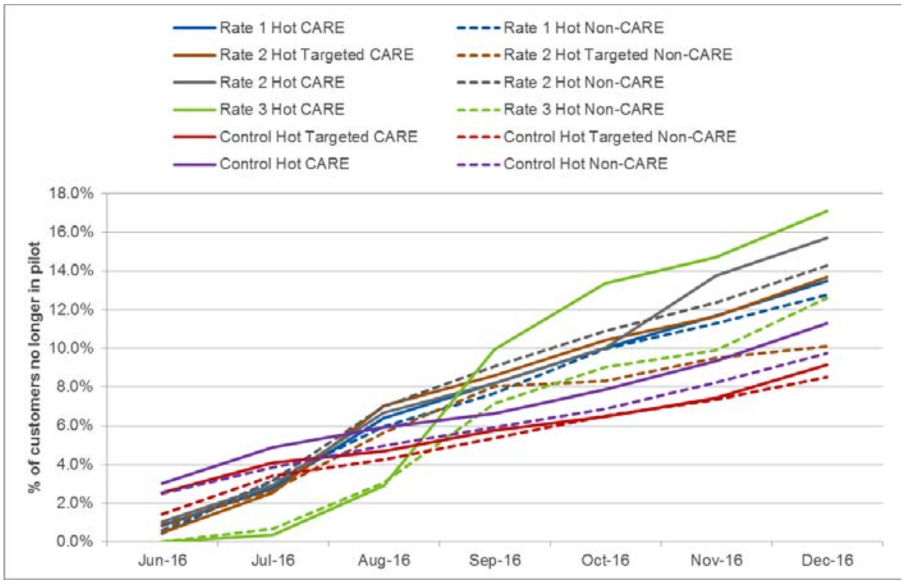


Figure 5-8: SCE Attrition by Month – Moderate Climate Region

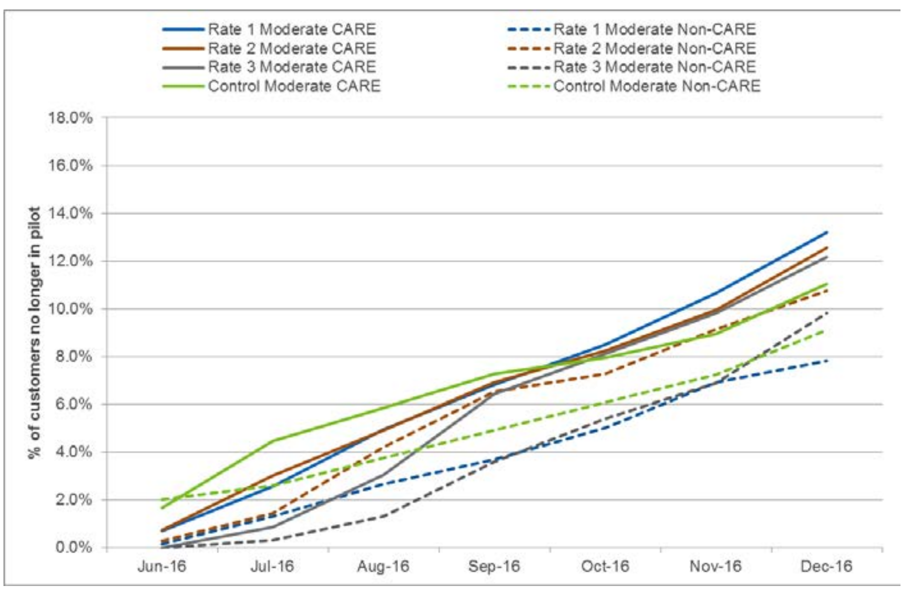
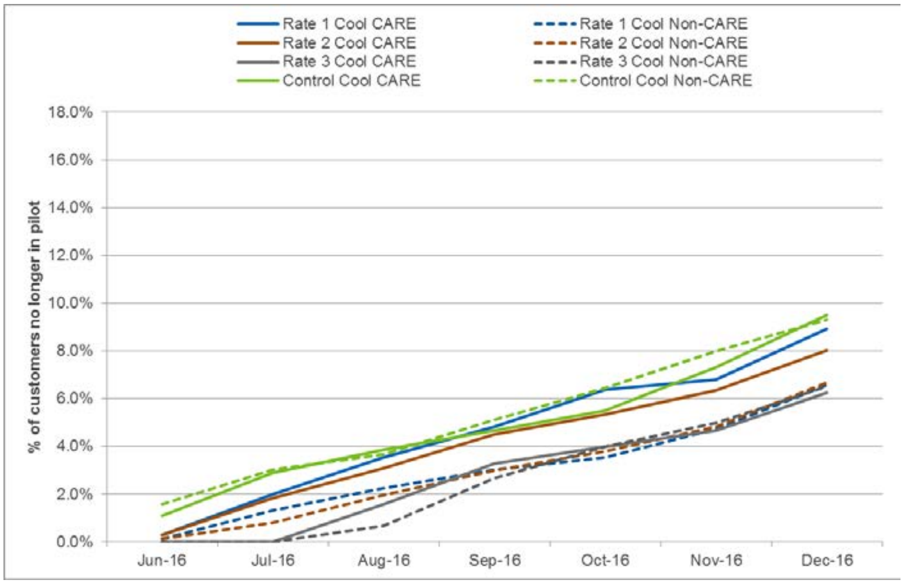


Figure 5-9: SCE Attrition by Month – Cool Climate Region



5.2.4 Pilot Outreach and Education

In late July, 2016, all TOU rate customers received a Seasonal Newsletter[45] tailored to their individual TOU rate plan, as well as to their household psychographic designation. “Green elites” and “connected” customers[46] received a postcard with a link to the online version of the Newsletter. The newsletters included a welcome message, timeline for 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 while Rate 3 customers were provided with more information on how to manage a three season TOU rate.

In addition, the 75% of customers chosen at random to receive the enhanced education treatment for each rate received a postcard at the end of August containing tips and reminders about their rate. Starting in Late September, the roughly 19% of participants in the enhanced education group who indicated at the time of enrollment that they were willing to receive information via text messages were sent additional reminders and tips via text message. So far, through early January, this group has been sent 8 text messages but nearly all of these messages were sent too late to influence behavior during the summer evaluation period.

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45 A second seasonal newsletter was sent in October indicating that winter rates were going into effect and providing additional tips for managing usage in the fall and winter periods. A third letter will be sent in March. The October newsletter was not sent in time to influence behavior in the summer period.

46 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 one 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. More details about these segments is contained in Appendix Volume I, Section 2.6.

Finally, in October, a social media event was conducted through Facebook encouraging customers to interact regarding their experiences on the rate and tips for managing usage. This social media event was rate specific and lasted for one week for each rate. Approximately 10% of customers were contacted about this event.

5.2.5 Operational Challenges and Lessons Learned

To be written by SCE.

5.3 Load Impacts

This section summarizes the load impact estimates for the three rate treatments tested by SCE. The CPUC resolution approving SCE's pilot requires that load impacts be estimated for the peak and off-peak periods and for daily energy use for the following rates, customer segments, and climate regions:

- Seniors, CARE/FERA customers, non-CARE/FERA customers and households with incomes below 100% of FPG in SCE's hot climate region for Rate 2;
- For all three rates for all customers in SCE's service territory as a whole and for all customers in SCE's hot and moderate climate regions; and
- For CARE/FERA and non-CARE/FERA customers on each rate across SCE's service territory as a whole.

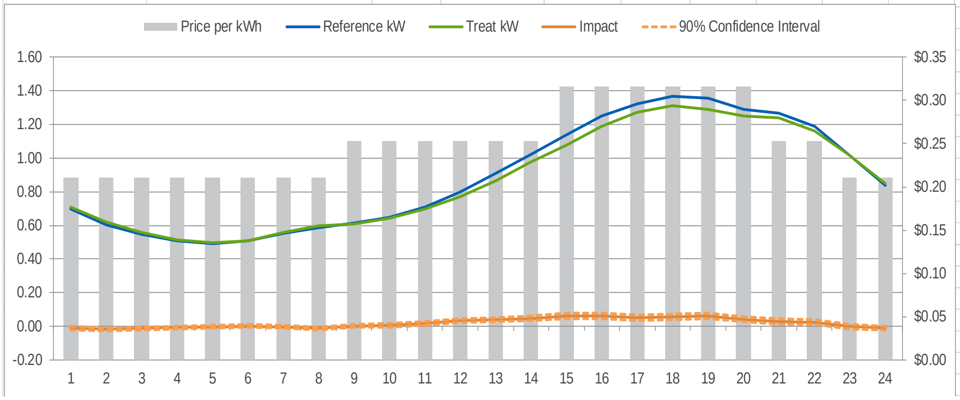
In addition to these required segments, Nexant estimated load impacts for CARE/FERA and non-CARE/FERA customers for each rate for each climate region. Load impacts are reported here for each rate period for the average weekday, average weekend and for the average monthly peak day for the summer months of July, August and September[47] for Rate 1 and Rate 2 and for August and September for Rate 3 (because of late enrollment for Rate 3), climate zone and customer segment summarized above. Underlying the values presented in the report are electronic tables that contain estimates for each hour of the day for each day type, segment and climate zone and for each month separately. These values are contained in Excel spreadsheets that are available upon request through the CPUC. Figure 5-10 shows an example of the content of these tables for SCE Rate 1 for all eligible customers in the service territory. Pull down menus in the upper left hand cover allow users to select different customer segments, climate regions, day types (e.g., weekdays, weekends, monthly peak day) and time period (individual months or the average of July, August and September).

[47] Estimates were not produced for the month of June for all three rates because enrollment changed dramatically from the beginning to the end of the month and the estimates would not be comparable to those for other months. July was excluded for Rate 3 for the same reason.

Figure 5-10: Example of Content of Electronic Tables Underlying Load Impacts Summarized in this Report (SCE Rate 1, Average Summer Weekday, All Customers)

Segment	All
Rate	Rate 1
Month	Summer 2016
Day Type	Average Weekday
Treated Customers	4,204

Period	Reference kW	Treat kW	Impact	Percent Impact	90% Confidence Interval	
Super On Peak	N/A	N/A	N/A	N/A	N/A	N/A
Peak	1.29	1.23	0.06	4%	0.05	0.06
Mid Peak	N/A	N/A	N/A	N/A	N/A	N/A
Off Peak	0.90	0.87	0.02	3%	0.02	0.03
Super Off Peak	0.64	0.64	-0.01	-1%	-0.01	0.00
Daily kWh	21.24	20.78	0.46	2%	0.40	0.52



Hour Ending	Reference kW	Treat kW	Impact	Percent Impact	90% Confidence Interval		Price	Period
1	0.70	0.71	-0.01	-2%	-0.02	0.00	$0.21	Super Off Peak
2	0.60	0.62	-0.02	-3%	-0.03	-0.01	$0.21	Super Off Peak
3	0.55	0.56	-0.01	-2%	-0.02	0.00	$0.21	Super Off Peak
4	0.51	0.52	-0.01	-1%	-0.01	0.00	$0.21	Super Off Peak
5	0.49	0.50	0.00	-1%	-0.01	0.00	$0.21	Super Off Peak
6	0.51	0.51	0.00	0%	-0.01	0.01	$0.21	Super Off Peak
7	0.55	0.56	0.00	-1%	-0.01	0.00	$0.21	Super Off Peak
8	0.58	0.60	-0.01	-2%	-0.02	0.00	$0.21	Super Off Peak
9	0.61	0.61	0.00	1%	-0.01	0.01	$0.25	Off Peak
10	0.65	0.64	0.01	1%	0.00	0.02	$0.25	Off Peak
11	0.71	0.70	0.02	2%	0.01	0.03	$0.25	Off Peak
12	0.80	0.77	0.03	4%	0.02	0.04	$0.25	Off Peak
13	0.91	0.87	0.04	4%	0.03	0.05	$0.25	Off Peak
14	1.02	0.98	0.05	5%	0.03	0.06	$0.25	Off Peak
15	1.14	1.08	0.06	5%	0.05	0.08	$0.32	Peak
16	1.25	1.19	0.06	5%	0.05	0.08	$0.32	Peak
17	1.32	1.27	0.05	4%	0.04	0.07	$0.32	Peak
18	1.37	1.31	0.06	4%	0.04	0.07	$0.32	Peak
19	1.35	1.29	0.06	5%	0.05	0.08	$0.32	Peak
20	1.29	1.25	0.04	3%	0.03	0.06	$0.32	Peak
21	1.27	1.24	0.03	2%	0.01	0.04	$0.25	Off Peak
22	1.19	1.16	0.03	2%	0.01	0.04	$0.25	Off Peak
23	1.02	1.02	0.00	0%	-0.01	0.01	$0.21	Super Off Peak
24	0.84	0.85	-0.01	-1%	-0.02	0.00	$0.21	Super Off Peak
Daily kWh	21.24	20.78	0.46	2%	0.40	0.52	N/A	N/A

Because of the targeting and oversampling that was done for selected subpopulations in the hot climate region for Rate 2 and for CARE/FERA customers in all climate regions for all rates, as described in Tables 5-2 and 5-3 above, when aggregating to higher segment levels, it is necessary to weight the data. For example, when presenting load impact estimates for each climate zone, it is necessary to apply weights to the enrolled population of CARE/FERA and non-CARE/FERA customers because CARE/FERA customers were oversampled in each climate region. Similarly, when reporting estimates at the service territory level, it is necessary to apply weights to the climate region level estimates because roughly equal sized samples were drawn in each climate region. And in the hot climate region for Rate 2 in SCE's service territory, customers with incomes below 100% of FPG, with incomes between 100 and 200% of FPG and senior households were all oversampled. As such, when reporting load impacts for CARE/FERA and non-CARE/FERA households in the hot region for Rate 2, it is necessary to apply weights to the subpopulations so that, for example, households with incomes below 100% of FPG are not over represented in the CARE/FERA segment.

Table 5-7 shows the weights used when aggregating CARE/FERA and non-CARE/FERA customers within each climate region and when aggregating across climate regions to produce estimates at the service territory as a whole. The weights are based on the eligible population contained in each customer segment and climate region.

Table 5-7: Weights Used for Aggregating up to Climate Region and Service Territory for SCE

Segment		Eligible for Pilot Participation	Population Weight	Climate Region Weight
Hot	CARE	149,365	4%	39%
	Non-CARE	238,306	7%	61%
Moderate	CARE	449,100	13%	33%
	Non-CARE	899,164	27%	67%
Cool	CARE	430,815	13%	27%
	Non-CARE	1,191,502	35%	73%
Total		3,358,252	100%	n/a

Table 5-8 shows the weights that were used to aggregate up from the customer subpopulations to the CARE/FERA populations in the hot climate region for each group of customers assigned to rate and control conditions. These weights are based on the number of customers that were enrolled into the study from the general population recruitment category in the hot climate region. Since customers in the sub-segments (e.g., below 100% of FPG, 100 to 200% of FPG, seniors) contained in this general population group were not over or under sampled, the shares of each sub-segment in this group are conceptually analogous to the shares in the CARE/FERA and non-CARE/FERA segments contained in other climate regions.

The remainder of this section is organized by rate treatment – that is, load impacts are presented for each relevant customer segment and climate region for each of the three rates. Following the summary for each rate, load impacts are compared across rates. This comparison is made only for the hours within each peak period that are common across all three rates (5 to 8 PM). Because the rates differ with respect to the length and timing of peak and off-peak periods, differences in load impacts across rates for any particular rate period may be due not only to differences in prices within the rate period but also due to differences in the length or timing of the rate periods.

As discussed at the outset of Section 5, in addition to the three rate treatments, 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. Those who enrolled were randomly assigned only to Rate 1 and to the control group. Load impacts for these customers are presented in Section 5.3.1.

Table 5-8: Weights Used to Aggregate Sub-segments into CARE/FERA and Non-CARE/FERA Segments in SCE's Hot Climate Region

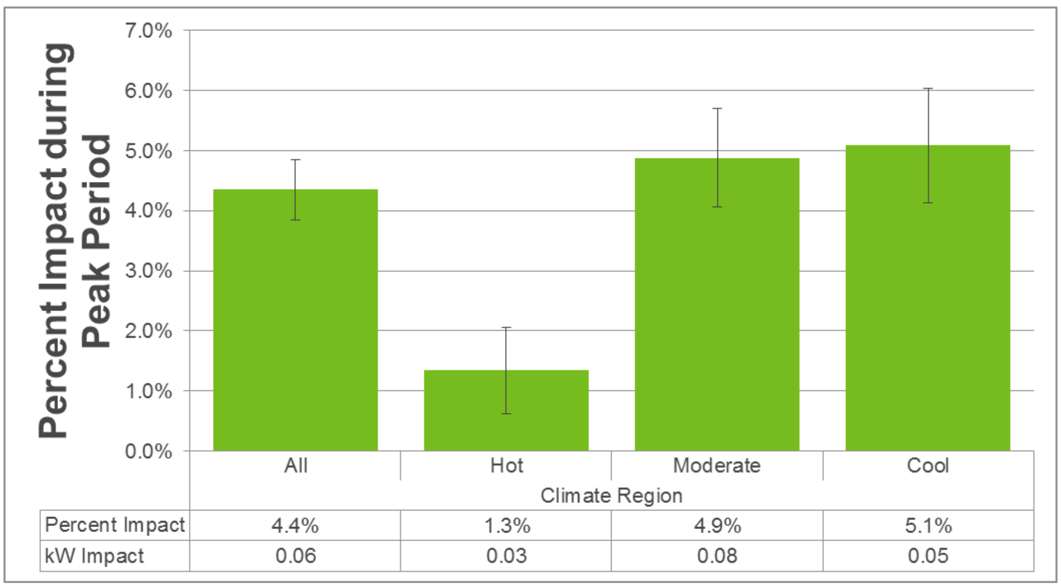
Assignment	FPG	Senior	CARE	Sample Proportion (SP)	Proportion in "General Population" (GP)	Weight (GP/SP)	Assignment	FPG	Senior	CARE	Sample Proportion (SP)	Proportion in "General Population" (GP)	Weight (GP/SP)
C	<100%	N	N	3.9%	5.7%	1.45	R2	<100%	N	N	3.9%	5.7%	1.46
			Y	15.2%	16.8%	1.10				Y	15.9%	16.8%	1.05
		Y	N	4.6%	2.5%	0.55			Y	N	4.6%	2.5%	0.55
			Y	12.0%	5.7%	0.48				Y	11.9%	5.7%	0.48
	100-200%	N	N	4.3%	5.8%	1.36		100-200%	N	N	3.9%	5.8%	1.48
			Y	11.6%	9.9%	0.85				Y	11.7%	9.9%	0.85
		Y	N	4.8%	4.9%	1.01			Y	N	5.1%	4.9%	0.96
			Y	9.0%	7.3%	0.81				Y	8.9%	7.3%	0.82
	200-250%	N	N	12.9%	19.8%	1.53		200-250%	N	N	13.4%	19.8%	1.48
			Y	3.2%	2.6%	0.82				Y	3.0%	2.6%	0.89
		Y	N	16.4%	16.8%	1.03			Y	N	15.0%	16.8%	1.12
			Y	2.0%	2.1%	1.05				Y	2.6%	2.1%	0.79
	>250%	N	N	12.9%	19.8%	1.53		>250%	N	N	13.4%	19.8%	1.48
			Y	3.2%	2.6%	0.82				Y	3.0%	2.6%	0.89
		Y	N	16.4%	16.8%	1.03			Y	N	15.0%	16.8%	1.12
			Y	2.0%	2.1%	1.05				Y	2.6%	2.1%	0.79
R1	<100%	N	N	4.2%	5.7%	1.37	R3	<100%	N	N	4.5%	5.7%	1.27
			Y	17.9%	16.8%	0.94				Y	19.0%	16.8%	0.88
		Y	N	2.4%	2.5%	1.04			Y	N	3.0%	2.5%	0.83
			Y	8.0%	5.7%	0.71				Y	8.0%	5.7%	0.72
	100-200%	N	N	6.3%	5.8%	0.92		100-200%	N	N	5.5%	5.8%	1.07
			Y	10.5%	9.9%	0.95				Y	9.7%	9.9%	1.02
		Y	N	3.7%	4.9%	1.31			Y	N	3.5%	4.9%	1.41
			Y	8.0%	7.3%	0.92				Y	7.4%	7.3%	0.99
	200-250%	N	N	16.6%	19.8%	1.19		200-250%	N	N	19.0%	19.8%	1.04
			Y	4.0%	2.6%	0.66				Y	2.9%	2.6%	0.92
		Y	N	16.1%	16.8%	1.05			Y	N	14.6%	16.8%	1.15
			Y	2.4%	2.1%	0.88				Y	3.0%	2.1%	0.69
	>250%	N	N	16.6%	19.8%	1.19		>250%	N	N	19.0%	19.8%	1.04
			Y	4.0%	2.6%	0.66				Y	2.9%	2.6%	0.92
		Y	N	16.1%	16.8%	1.05			Y	N	14.6%	16.8%	1.15
			Y	2.4%	2.1%	0.88				Y	3.0%	2.1%	0.69

5.3.1 Rate 1

SCE's Rate 1 is a three-period rate with a peak-period from 2 to 8 PM on weekdays. In summer, for electricity usage above the baseline quantity, prices equal roughly 34.5 ¢/kWh in the peak period, 27.6 ¢/kWh in the off-peak period and 23.0 ¢/kWh in the super off-peak period. Usage on the weekends is priced at the off-peak price from 8 AM to 10 PM and the super off-peak price from 10 PM to 8 AM. For usage below the baseline quantify, a credit of 9.9 ¢/kWh is applied.

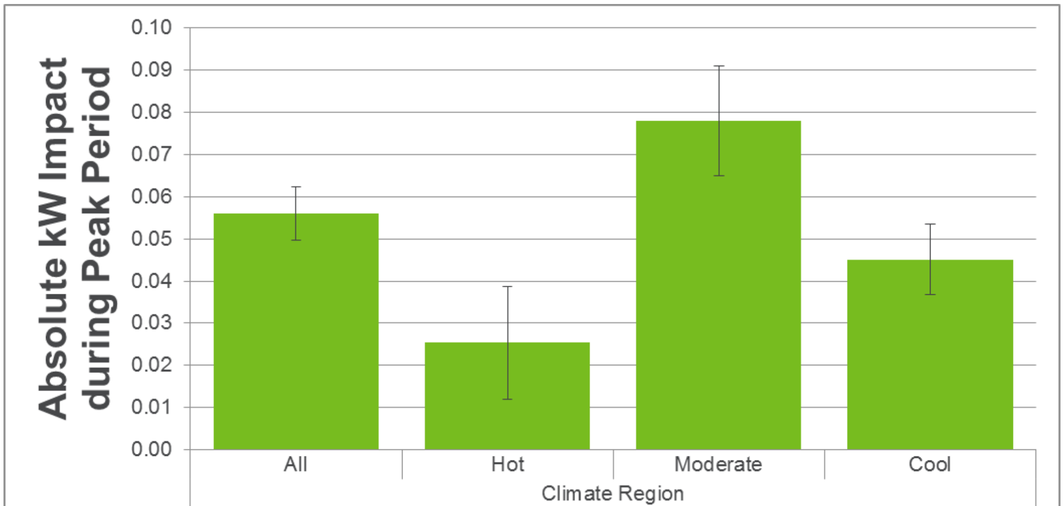
Figure 5-11 shows the average peak period load reduction in percentage terms for Rate 1 for SCE's service territory as a whole and for each climate region. Figure 5-12 shows the absolute load impacts for each region. The lines bisecting the top of each bar in the figures show the 90% confidence band for each estimate. If the confidence band includes 0, it means that the estimated load impacts are not statistically different from 0 at the 90% level of confidence. If the confidence bands for two bars overlap, as they do for the moderate and cool regions, it means that the observed difference in the load impacts across the two bars is not statistically significant.

Figure 5-11: Average Percent Load Impacts for Peak Period for SCE Rate 1 (Positive values represent load reductions)



	All	Hot	Moderate	Cool
Percent Impact	4.4%	1.3%	4.9%	5.1%
kW Impact	0.06	0.03	0.08	0.05

Figure 5-12: Average Absolute Load Impacts for Peak Period for SCE Rate 1 (Positive values represent load reductions)



	All	Hot	Moderate	Cool
Percent Impact	4.4%	1.3%	4.9%	5.1%
kW Impact	0.06	0.03	0.08	0.05

As seen in the figures, all of the average peak-period load impacts for the service territory as a whole and for each climate region are statistically significant at the 90% level of confidence. On average, pilot participants across SCE's service territory reduced peak-period electricity usage by 4.4%, or 0.06 kW, across the six-hour peak period from 2 to 8 PM. The average peak-period load reductions range from a high of 4.9% and 0.08 kW in the moderate climate region to a low of 1.3% and 0.03 kW in the hot climate region. In the cool climate region, load reductions equal 5.1% or 0.05 kW. The variation in absolute impacts across climate regions is much greater than the variation in percent impacts due in part to variation in electricity usage (e.g., the reference load) across regions.

There is a very significant difference in the pattern of load reductions across climate regions in SCE's service territory compared with PG&E's service territory. As discussed in Section 4.7.1, both the percentage and absolute impacts are significantly greater for PG&E's Rate 1 in the hot climate region than in the moderate and cool regions. Indeed, the absolute load impacts during the peak period on weekdays in PG&E's hot region are nearly three times larger than in the moderate region. In contrast, SCE's peak period load reductions in the hot region are roughly one third as large as in the moderate region.

A possible explanation for this strong contrast between the PG&E and SCE results may be the fact that SCE's Rate 1 is a three-period rate with the peak and shoulder periods spanning the hours from 8 AM until 10 PM, whereas PG&E's Rate 1 has the lowest prices in effect for 9 of those 14 hours. It is also the case that SCE's hot region is significantly hotter than PG&E's hot region. A population-weighted, three-year (2012, 2013 and 2014) average of the number of days with maximum temperatures above 98 degrees shows that SCE averaged 38.4 days a year with temperatures above this threshold while PG&E averaged 28.6 days, a 34% difference. Additional evidence comes from a comparison of reference loads for the two regions. SCE households in the hot climate region in the three months from July through September had an average load from 8 AM to 10 PM equal to 1.54 kW and an average from 2 to 8 PM (the peak period in SCE's Rate 1) equal to 1.84 kW. The reference values for PG&E's hot region for the same hours are 1.19 kW and 1.52 kW, respectively. SCE's reference loads are roughly 25% higher in the hot region compared with PG&E's reference loads. The higher loads combined with many more hot days suggest greater use of air conditioning in SCE's hot region compared with PG&E's hot region. The need for greater air conditioning use combined with the fact that higher prices are in effect from 8 AM until 10 PM might mean that SCE's Rate 1 customers weren't willing to adjust their thermostats to a higher level over such a long time period as PG&E's customers were willing to do for the much shorte, high-priced period.

Table 5-9 shows the average percent and absolute load impacts for each rate period for weekdays and weekends and for the average monthly system peak day for the SCE service territory as a whole and for the participant population in each climate region. The percent reduction equals the load impact in absolute terms (kW) divided by the reference load. Shaded cells in the table contain load impact estimates that are not statistically significant at the 90% confidence level. The percentage and absolute values in the first row of Table 5-9, which represent the load impacts in the peak period on the average weekday, equal the values shown in Figures 5-5 and 5-6, which were discussed above.

The reference loads shown in Table 5-9 represent estimates of what customers on the TOU rate would have used if they had not responded to the price signals contained in the TOU tariff. As seen in the table, average hourly usage during the peak period is roughly 1.29 kW for the service territory as a whole, and around 0.88 kW over the 24 hour average weekday. In the hot climate region, average usage in the peak period is nearly 50% larger at 1.89 kW. Average usage in the moderate climate region is 1.60 kW and in the cool region it is 0.89 kW.

As discussed in Section 4.7.1, when examining the change in usage across rate periods, it is important to keep in mind that a change in any period could be the result of an overall decrease or increase in end-use consumption or due to shifting usage from one rate period to another (or both). As seen in the Table 5-9, on the average weekday, there were small but statistically significant load increases in the super off-peak period in the service territory as a whole and in the hot and moderate climate regions. In the cool climate region, there was no statistically significant change in average electricity use in the super off-peak period. All three climate regions and the territory as a whole saw statistically significant demand reductions in the off-peak period during all three day types.

A reduction in daily electricity use (depicted by positive values in the row labeled Day in the table) means that the combination of changes in use across all rate periods resulted in less electricity use for the day as a whole. As seen in Table 5-9, for the service territory as a whole, there was a 2.2% reduction in daily electricity use on the average weekday. In the moderate and cool climate regions, the estimated conservation effect equals 2.6%. In the hot climate region, increase in use in the super off-peak period offsets the reduction in electricity use in the peak and off-peak periods so that the estimated daily reduction in electricity use is essentially zero and is not statistically significant.

While the daily reduction in electricity use for Rate 1 is small in percentage and absolute terms, this average is spread over 24 hours each day, so the average reduction in electricity use on weekdays equals roughly 0.46 kWh. Over three months, this adds up to about 28 kWh per customer. This is significantly greater than the PG&E estimate of roughly 16 kWh per household for the summer season. If this average conservation effect was provided under default conditions and, say, 90% of the eligible population of roughly 3.3 million customers in SCE's service territory remained on the rate, the total reduction in electricity use over the three month period would equal more than 95GWh.

The reduction in electricity use in the off-peak period[48] was roughly half what it was during the peak period in percentage terms and approximately two-thirds less than the peak period reduction in absolute terms. This change was statistically significant for the service territory as a whole and in each climate region. The reductions in average usage between 8 Am and 10 PM on weekends, which is priced at the same rate as the weekday off-peak period, are similar to the weekday off-peak reductions.

The monthly system peak day estimates represent the average across the three weekdays, one each in July, August, and September, when SCE's system peaked in 2016. Reference loads are higher on these days than on the average weekday. For the service territory as a whole, the percent reduction in peak period loads, 4.5%, is similar to that on the average weekday (4.4%) and the absolute load reduction, 0.08, kW is greater than on the average weekday (0.06 kW).

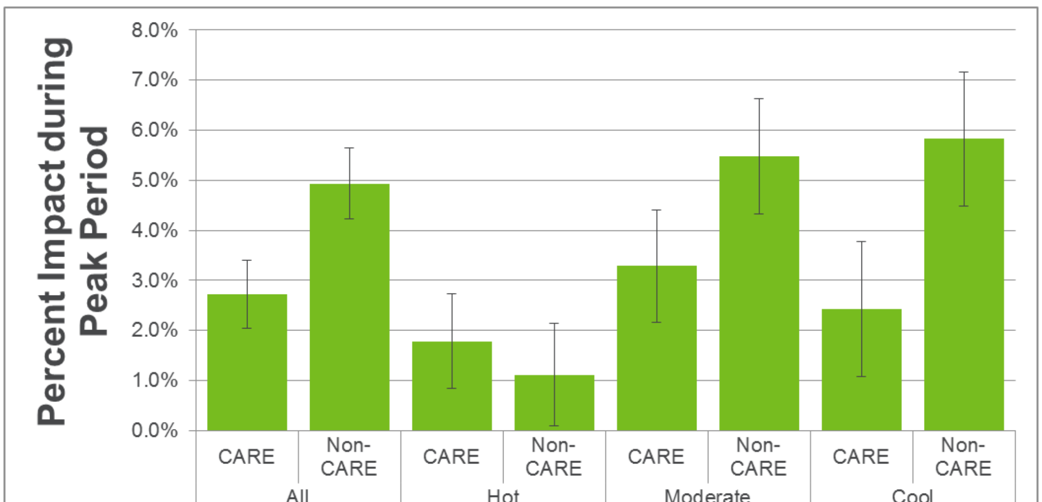
[48] Note that what SCE calls the off-peak period is the partial period in PG&E's three period rate and what SCE calls the super off-peak period is equivalent to PG&E's off-peak period.

Table 5-9: Rate 1 Load Impacts by Rate Period and Day Type
(Positive values represent load reductions, negative values represent load increases)

Rate 1														
Day Type	Period	Hours	All			Hot			Moderate			Cool		
			Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact
Average Weekday	Peak	2 PM to 8 PM	1.29	0.06	4.4%	1.89	0.03	1.3%	1.60	0.08	4.9%	0.89	0.05	5.1%
	Off Peak	8 AM to 2 PM, 8 PM to 10 PM	0.90	0.02	2.8%	1.29	0.01	0.9%	1.02	0.04	3.7%	0.70	0.02	2.6%
	Super Off Peak	10 PM to 8 AM	0.64	-0.01	-1.2%	0.86	-0.03	-3.2%	0.71	-0.01	-1.5%	0.52	0.00	0.0%
	Day	All Hours	0.88	0.02	2.2%	1.26	0.00	-0.1%	1.04	0.03	2.6%	0.67	0.02	2.6%
Average Weekend	Off Peak	8 AM to 10 PM	1.09	0.03	2.5%	1.62	0.01	0.9%	1.29	0.05	4.0%	0.80	0.01	1.2%
	Super Off Peak	10 PM to 8 AM	0.62	0.00	-0.6%	0.88	-0.02	-1.8%	0.70	0.00	0.0%	0.50	0.00	-0.6%
	Day	All Hours	0.90	0.01	1.6%	1.31	0.00	0.1%	1.04	0.03	2.9%	0.67	0.00	0.6%
Monthly System Peak Day	Peak	2 PM to 8 PM	1.74	0.08	4.5%	2.04	0.09	4.5%	2.24	0.09	4.0%	1.25	0.07	5.3%
	Off Peak	8 AM to 2 PM, 8 PM to 10 PM	1.17	0.04	3.4%	1.41	0.04	3.1%	1.43	0.03	2.3%	0.90	0.04	5.0%
	Super Off Peak	10 PM to 8 AM	0.75	-0.01	-0.7%	0.92	-0.03	-3.1%	0.88	-0.02	-1.9%	0.60	0.01	1.5%
	Day	All Hours	1.14	0.03	2.7%	1.36	0.03	1.9%	1.40	0.03	1.9%	0.86	0.04	4.1%

Figures 5-13 and 5-14, respectively, show the percentage and absolute peak period load impacts for Rate 1 for CARE/FERA and non-CARE/FERA customers for the service territory as a whole and for each climate region. In the moderate and cool climate regions, and the service territory as a whole, both the percent and absolute load impacts in the peak period are greater for non-CARE/FERA customers than for CARE/FERA customers. For example, in the cool climate region, the average weekday peak period reduction is 5.8% and 0.06 kW for non-CARE/FERA customers whereas for CARE/FERA customers, the average reduction is 2.4% or 0.02 kW, which is only about one third as much as for non-CARE/FERA customers. Load reductions in the hot climate region do not follow the same pattern and are much smaller than those in the cool and moderate climate regions, especially among non-CARE customers, with load reductions of 1.1% or 0.02 kW. In the hot region, there is no statistically significant difference in peak-period load reductions between CARE/FERA and non-CARE/FERA customers. Once again, this finding is quite different from what was seen in PG&E's service territory, where the contrast in load reductions between CARE/FERA and non-CARE/FERA customers was greatest in the hot climate region.

Figure 5-13: Average Percent Load Impacts for Peak Period for SCE Rate 1 for CARE/FERA and non-CARE/FERA Customers
(Positive values represent load reductions)



	All		Hot		Moderate		Cool	
	CARE	Non-CARE	CARE	Non-CARE	CARE	Non-CARE	CARE	Non-CARE
Percent Impact	2.7%	4.9%	1.8%	1.1%	3.3%	5.5%	2.4%	5.8%
Absolute Impact	0.03	0.07	0.03	0.02	0.04	0.10	0.02	0.06

Figure 5-14: Average Absolute Load Impacts for Peak Period for SCE Rate 1 for CARE/FERA and non-CARE/FERA Customers
(Positive values represent load reductions)

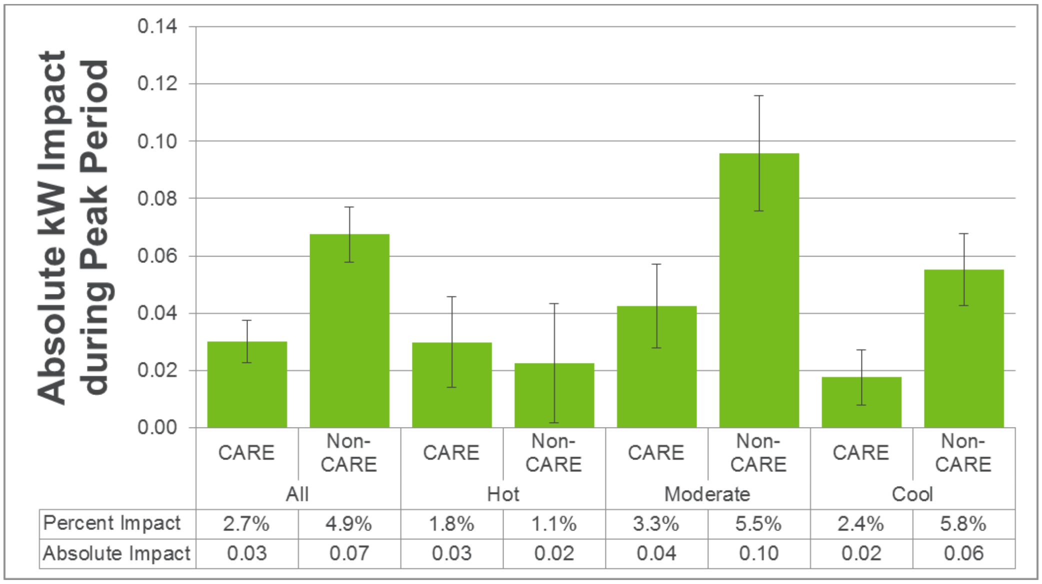


Table 5-10 shows the estimated load impacts for each rate period and day type by climate zone and for the service territory as a whole for non-CARE/FERA customers and Table 5-11 shows the estimated values for CARE/FERA customers. For the service territory as a whole, non-CARE/FERA customers have average peak period loads that are larger than CARE/FERA customers (1.37 kW for non-CARE/FERA and 1.11 kW for CARE/FERA). This pattern is consistent across all three climate regions and for daily electricity usage on average summer weekdays.

For the service territory as a whole, both customer segments reduced average daily usage on weekdays. Non-CARE/FERA customers reduced their average daily electricity use by 2.7% while CARE/FERA reduced it by 0.6%. On weekends, non-CARE/FERA customers reduced electricity use by 2.1%, but CARE/FERA did not reduce their overall usage at all. Both groups of customers in the cool climate region reduced their average daily usage on average weekdays and the monthly system peak day. In the hot climate region, both non-CARE/FERA and CARE/FERA customers did not make statistically significant reductions in their average weekday energy use.

Table 5-10: Rate 1 Load Impacts by Rate Period and Day Type – Non-CARE/FERA Customers (Positive values represent load reductions, negative values represent load increases)

Rate 1														
Day Type	Period	Hours	All, Non-CARE			Hot, Non-CARE			Moderate, Non-CARE			Cool, Non-CARE		
			Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact
Average Weekday	Peak	2 PM to 8 PM	1.37	0.07	4.9%	2.03	0.02	1.1%	1.75	0.10	5.5%	0.95	0.06	5.8%
	Off Peak	8 AM to 2 PM, 8 PM to 10 PM	0.95	0.03	3.5%	1.39	0.02	1.5%	1.11	0.05	4.6%	0.75	0.02	3.2%
	Super Off Peak	10 PM to 8 AM	0.67	-0.01	-0.9%	0.91	-0.04	-4.3%	0.76	0.00	-0.6%	0.54	0.00	-0.2%
	Day	All Hours	0.94	0.03	2.7%	1.35	0.00	-0.3%	1.13	0.04	3.5%	0.71	0.02	3.0%
Average Weekend	Off Peak	8 AM to 10 PM	1.17	0.03	2.9%	1.76	0.01	0.8%	1.42	0.07	4.6%	0.86	0.01	1.7%
	Super Off Peak	10 PM to 8 AM	0.65	0.00	0.0%	0.94	-0.02	-2.3%	0.75	0.01	1.5%	0.52	0.00	-0.8%
	Day	All Hours	0.95	0.02	2.1%	1.42	0.00	-0.1%	1.14	0.04	3.8%	0.72	0.01	0.9%
Monthly System Peak Day	Peak	2 PM to 8 PM	1.89	0.09	4.7%	2.19	0.11	5.0%	2.50	0.10	4.2%	1.36	0.07	5.4%
	Off Peak	8 AM to 2 PM, 8 PM to 10 PM	1.26	0.05	4.3%	1.54	0.05	3.2%	1.58	0.05	3.1%	0.97	0.06	6.0%
	Super Off Peak	10 PM to 8 AM	0.79	0.00	0.0%	0.98	-0.04	-4.3%	0.95	0.00	-0.5%	0.63	0.01	1.9%
	Day	All Hours	1.22	0.04	3.3%	1.47	0.03	1.8%	1.55	0.04	2.6%	0.93	0.04	4.6%

Table 5-11: Rate 1 Load Impacts by Rate Period and Day Type – CARE/FERA Customers (Positive values represent load reductions, negative values represent load increases)

Rate 1															
Day Type	Period	Hours	All, CARE			Hot, CARE			Moderate, CARE			Cool, CARE			
			Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact
Average Weekday	Peak	2 PM to 8 PM	1.11	0.03	2.7%	1.67	0.03	1.8%	1.29	0.04	3.3%	0.72	0.02	2.4%
	Off Peak	8 AM to 2 PM, 8 PM to 10 PM	0.77	0.00	0.6%	1.12	0.00	-0.3%	0.84	0.01	1.2%	0.57	0.00	0.4%
	Super Off Peak	10 PM to 8 AM	0.56	-0.01	-1.8%	0.76	-0.01	-1.2%	0.61	-0.02	-3.8%	0.45	0.00	0.5%
	Day	All Hours	0.77	0.00	0.6%	1.11	0.00	0.2%	0.86	0.00	0.5%	0.56	0.01	1.1%
Average Weekend	Off Peak	8 AM to 10 PM	0.92	0.01	1.2%	1.40	0.02	1.2%	1.04	0.02	2.3%	0.63	0.00	-0.8%
	Super Off Peak	10 PM to 8 AM	0.55	-0.01	-2.0%	0.78	-0.01	-0.9%	0.59	-0.02	-4.0%	0.43	0.00	0.0%
	Day	All Hours	0.77	0.00	0.0%	1.14	0.01	0.6%	0.85	0.00	0.5%	0.55	0.00	-0.5%
Monthly System Peak Day	Peak	2 PM to 8 PM	1.40	0.05	3.8%	1.80	0.07	3.7%	1.72	0.06	3.5%	0.94	0.04	4.5%
	Off Peak	8 AM to 2 PM, 8 PM to 10 PM	0.96	0.01	0.9%	1.21	0.04	2.9%	1.14	0.00	0.1%	0.70	0.01	1.2%
	Super Off Peak	10 PM to 8 AM	0.66	-0.02	-2.8%	0.81	-0.01	-0.8%	0.74	-0.04	-5.5%	0.51	0.00	0.2%
	Day	All Hours	0.95	0.01	0.9%	1.19	0.03	2.2%	1.12	0.00	-0.2%	0.68	0.01	2.1%

Table 5-12 shows the estimated load impacts for smart thermostat customers who were enrolled on Rate 1. As a reminder, these load reductions represent the total reduction for customers who had previously purchased smart thermostats and are on Rate 1 relative a control group of smart thermostat owners who are on the OAT. The impacts are not the incremental load impact of a smart thermostat for customers on a TOU rate relative to customers on a TOU rate who do not have a smart thermostat. These customers are distributed throughout the service territory and the vast majority are non-CARE/FERA customers. The average peak-period reference load for these households (1.98 kW) is more than 50% higher than the average for households in the service territory as a whole (1.29 kW). In spite of this much higher reference load, the average load reduction for smart thermostat households during the peak period, 3% or 0.06 kW, was very similar to the average for all households in the service territory (4.4% or 0.06 kW). Smart thermostat households reduced average daily use by 1.4%, or 0.02 kW and had comparable reductions in daily usage on weekends. Load reductions on the monthly system peak day were comparable to weekday reductions but were not statistically significant, primarily because of the much larger standard errors resulting from the small sample size combined with the small number of observations per customer for the monthly peak day.

Table 5-12: Rate 1 Load Impacts by Rate Period and Day Type – Technology Customers (Positive values represent load reductions, negative values represent load increases)

Rate 1					
Day Type	Period	Hours	Technology		
			Ref. kW	Impact kW	% Impact
Average Weekday	Peak	2 PM to 8 PM	1.98	0.06	3.0%
	Off Peak	8 AM to 2 PM, 8 PM to 10 PM	1.31	0.04	3.1%
	Super Off Peak	10 PM to 8 AM	0.92	-0.02	-2.6%
	Day	All Hours	1.32	0.02	1.4%
Average Weekend	Off Peak	8 AM to 10 PM	1.66	0.04	2.5%
	Super Off Peak	10 PM to 8 AM	0.89	-0.01	-0.7%
	Day	All Hours	1.34	0.02	1.6%
Monthly System Peak Day	Peak	2 PM to 8 PM	2.84	0.04	1.3%
	Off Peak	8 AM to 2 PM, 8 PM to 10 PM	1.75	0.03	2.6%
	Super Off Peak	10 PM to 8 AM	1.10	-0.02	-1.7%
	Day	All Hours	1.75	0.01	0.6%

5.3.2 Rate 2

SCE's Rate 2 differs from Rate 1 in several important ways. While both rates have three rate periods on summer weekdays, the Rate 2 peak period is only three hours long, from 5 to 8 PM, compared to the six-hour peak period for Rate 1. The Rate 2 peak period price is 53.3 ¢/kWh, which is much greater than the Rate 1 peak price of 34.5 ¢/kWh. The structures of Rate 1 and Rate 2 are identical on weekends, but Rate 2 has a lower super off-peak price at 17.3 ¢/kWh (compared to 23.0 ¢/kWh for Rate 1). The off-peak prices are similar between the two rates, 27.6 ¢/kWh for Rate 1 and 29.3 ¢/kWh for Rate 2. For usage below the baseline quantify, a credit of 9.9 ¢/kWh is applied in both cases.

Figures 5-15 and 5-16 show the percent and absolute load impacts for the weekday peak period for Rate 2 for SCE's service territory as a whole and for each climate region. Percent and absolute impacts for the service territory as a whole, 4.2% and 0.06 kW, are very similar to those for Rate 1 (4.4% and 0.6 kW) despite the fact that the Rate 2 peak period is half that of Rate 1. The average weekday peak-period load reduction for customers in the hot climate region on Rate 2, 3.1% and 0.06 kW, are over twice that for Rate 1. A possible explanation for this difference is that customers in this hot region are more willing to adjust their air conditioning usage during the shorter, Rate 2 peak period than in the longer Rate 1 peak period. Customers in the moderate and cool climate regions reduced their electricity usage by slightly less than their counterparts on Rate 1 but this difference is not statistically significant.

Table 5-13 contains load impact estimates for each rate period and day type for Rate 2. For the service territory as a whole, daily electricity usage was similar on average summer weekdays and weekends, 0.88 kW and 0.90 kW. Reductions in daily electricity use were quite similar on weekdays and weekends. Electricity use and impacts were the largest on monthly system peak days, with load reductions of about 2.4% or 0.03 kW.

Customers in every climate region provided statistically significant peak and off-peak demand reductions for Rate 2 during all three day types. Customers in the hot and moderate climate regions increased their electricity use during the super off-peak period on weekdays and weekends, which could indicate load shifting or increased consumption of selected end uses during the lower priced period.

Figure 5-15: Average Percent Load Impacts for Peak Period for SCE Rate 2 (Positive values represent load reductions)

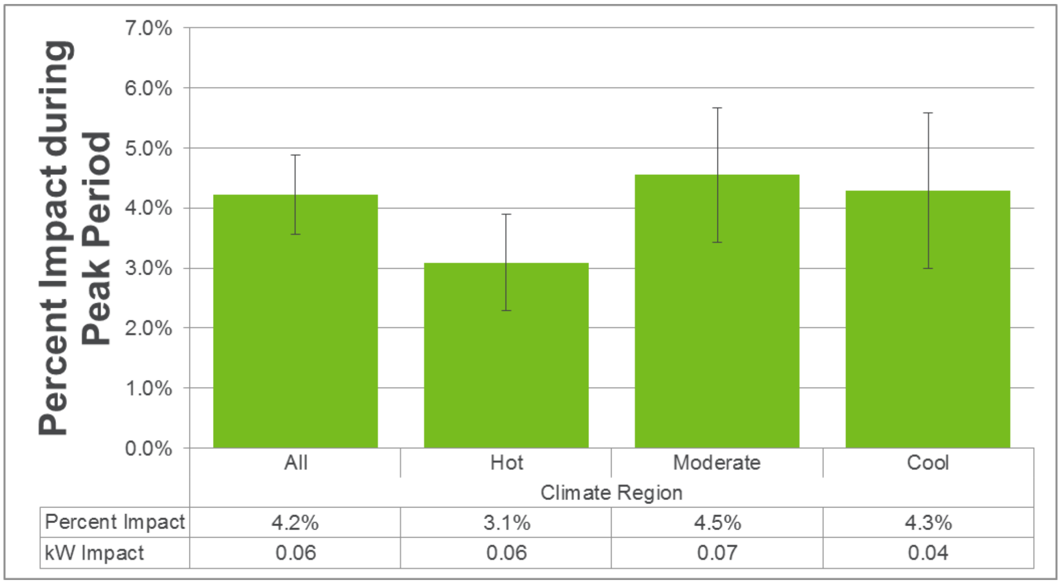


Figure 5-16: Average Absolute Load Impacts for Peak Period for SCE Rate 2 (Positive values represent load reductions)

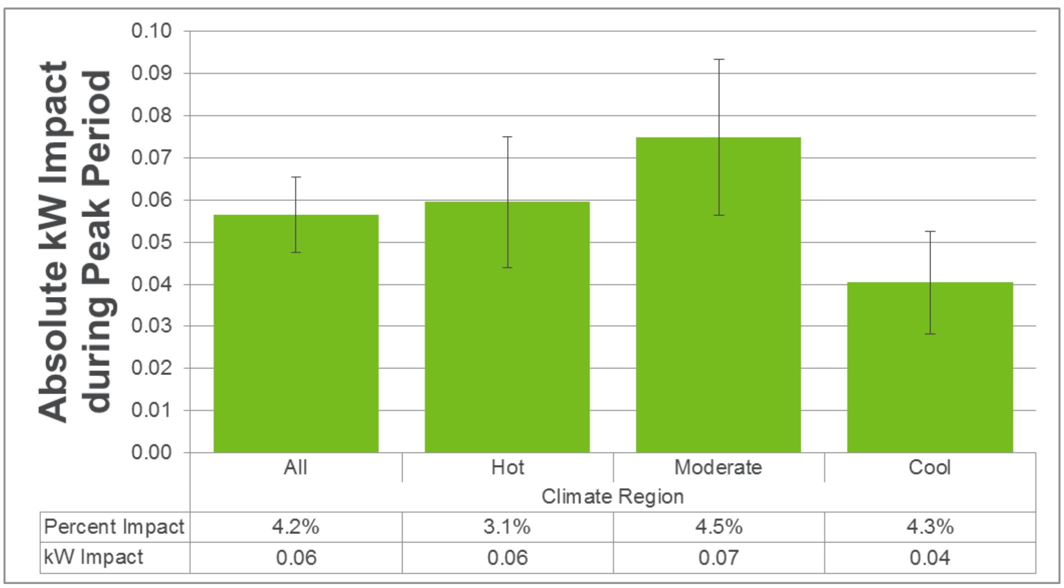
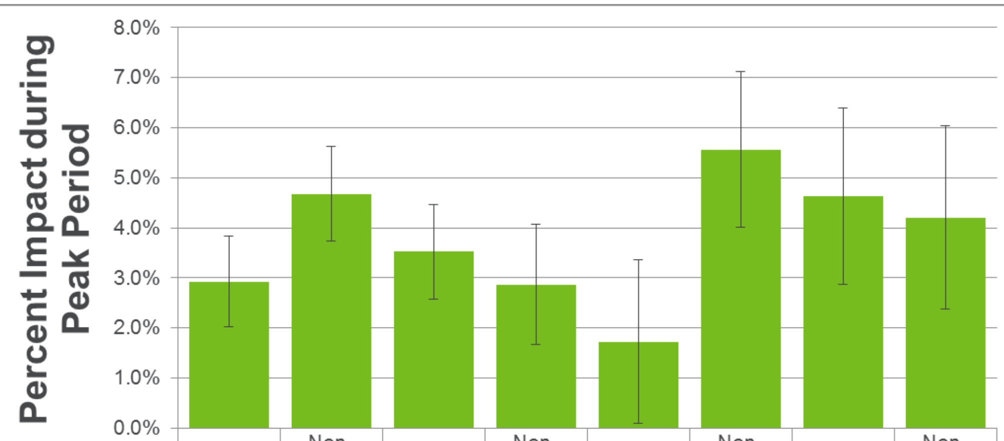


Table 5-13: Rate 2 Load Impacts by Rate Period and Day Type
(Positive values represent load reductions, negative values represent load increases)

Rate 2															
Day Type	Period	Hours	All			Hot			Moderate			Cool			
			Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact
Average Weekday	Peak	5 PM to 8 PM	1.34	0.06	4.2%	1.93	0.06	3.1%	1.65	0.07	4.5%	0.94	0.04	4.3%
	Off Peak	8 AM to 5 PM, 8 PM to 10 PM	0.99	0.03	2.6%	1.44	0.03	1.8%	1.16	0.04	3.0%	0.73	0.02	2.3%
	Super Off Peak	10 PM to 8 AM	0.64	-0.01	-1.9%	0.86	-0.01	-1.7%	0.71	-0.03	-3.7%	0.52	0.00	0.0%
	Day	All Hours	0.88	0.01	1.5%	1.26	0.01	1.0%	1.04	0.01	1.4%	0.67	0.01	1.9%
Average Weekend	Off Peak	8 AM to 10 PM	1.09	0.03	2.4%	1.62	0.02	1.2%	1.29	0.03	2.6%	0.80	0.02	2.8%
	Super Off Peak	10 PM to 8 AM	0.62	-0.01	-1.6%	0.88	-0.01	-1.2%	0.70	-0.02	-2.9%	0.50	0.00	-0.3%
	Day	All Hours	0.90	0.01	1.3%	1.31	0.01	0.5%	1.04	0.01	1.1%	0.67	0.01	1.8%
Monthly System Peak Day	Peak	5 PM to 8 PM	1.78	0.09	5.0%	2.08	0.09	4.2%	2.27	0.12	5.2%	1.31	0.07	5.1%
	Off Peak	8 AM to 5 PM, 8 PM to 10 PM	1.31	0.04	3.0%	1.57	0.04	2.4%	1.64	0.05	2.8%	0.98	0.03	3.5%
	Super Off Peak	10 PM to 8 AM	0.75	-0.01	-0.7%	0.92	-0.01	-1.6%	0.88	-0.03	-2.9%	0.60	0.01	2.3%
	Day	All Hours	1.14	0.03	2.4%	1.36	0.02	1.6%	1.40	0.03	1.8%	0.86	0.03	3.4%

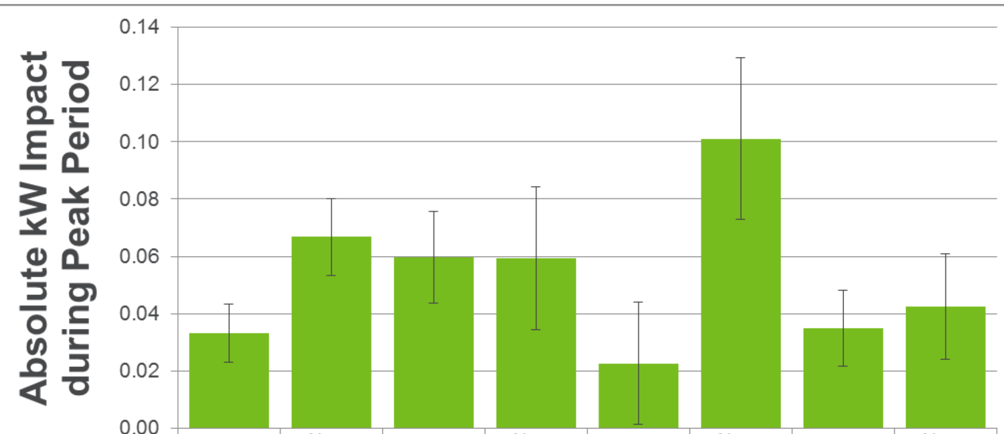
Figures 5-17 and 5-18 show the estimated peak period load impacts for Rate 2 for CARE/FERA and non-CARE/FERA households for the service territory as a whole and for each climate region. Except in the moderate climate region, there were no significant differences in load reductions between CARE/FERA and non-CARE/FERA customers. In the moderate climate region, non-CARE/FERA customers had the greatest reduction in peak-period energy use at 5.6% and 0.10 kW.

Figure 5-17: Average Percent Load Impacts for Peak Period for SCE Rate 2 for CARE/FERA and non-CARE/FERA Customers (Positive values represent load reductions)



	CARE	Non-CARE	CARE	Non-CARE	CARE	Non-CARE	CARE	Non-CARE
	All		Hot		Moderate		Cool	
Percent Impact	2.9%	4.7%	3.5%	2.9%	1.7%	5.6%	4.6%	4.2%
Absolute Impact	0.03	0.07	0.06	0.06	0.02	0.10	0.03	0.04

Figure 5-18: Average Absolute Load Impacts for Peak Period for SCE Rate 2 for CARE/FERA and non-CARE/FERA Customers (Positive values represent load reductions)



	CARE	Non-CARE	CARE	Non-CARE	CARE	Non-CARE	CARE	Non-CARE
	All		Hot		Moderate		Cool	
Percent Impact	2.9%	4.7%	3.5%	2.9%	1.7%	5.6%	4.6%	4.2%
Absolute Impact	0.03	0.07	0.06	0.06	0.02	0.10	0.03	0.04

Tables 5-14 and 5-15 show the load impacts for non-CARE/FERA and CARE/FERA customers, respectively, for each rate period and day-type. Once again, the values in the first row of each table are the same as those found in Figures 5-17 and 5-18. For the service territory as a whole, non-CARE/FERA customers have higher peak period usage, 1.43 kW, than CARE/FERA customers, 1.13 kW. Daily consumption is also greater for non-CARE/FERA customers than for CARE/FERA customers on Rate 2. However, both groups were able to reduce their average daily energy use by about 1% or more on weekends and weekdays. Both groups in each climate region were also able to reduce usage during the off-peak (e.g., shoulder) period and both increased usage during the super off-peak period.

Table 5-14: Rate 2 Load Impacts by Rate Period and Day Type – Non-CARE/FERA Customers (Positive values represent load reductions, negative values represent load increases)

Rate 2															
Day Type	Period	Hours	All, Non-CARE			Hot, Non-CARE			Moderate, Non-CARE			Cool, Non-CARE			
			Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact
Average Weekday	Peak	5 PM to 8 PM	1.43	0.07	4.7%	2.07	0.06	2.9%	1.82	0.10	5.6%	1.01	0.04	4.2%
	Off Peak	8 AM to 5 PM, 8 PM to 10 PM	1.05	0.03	2.6%	1.55	0.02	1.4%	1.27	0.04	3.3%	0.78	0.02	2.3%
	Super Off Peak	10 PM to 8 AM	0.67	-0.01	-1.8%	0.91	-0.02	-2.5%	0.76	-0.03	-3.5%	0.54	0.00	0.3%
	Day	All Hours	0.94	0.02	1.7%	1.35	0.01	0.6%	1.13	0.02	1.8%	0.71	0.01	2.0%
Average Weekend	Off Peak	8 AM to 10 PM	1.17	0.03	2.6%	1.76	0.01	0.7%	1.42	0.04	2.9%	0.86	0.03	2.9%
	Super Off Peak	10 PM to 8 AM	0.65	-0.01	-1.6%	0.94	-0.02	-1.9%	0.75	-0.02	-2.9%	0.52	0.00	-0.2%
	Day	All Hours	0.95	0.01	1.4%	1.42	0.00	0.0%	1.14	0.01	1.3%	0.72	0.01	2.0%
Monthly System Peak Day	Peak	5 PM to 8 PM	1.95	0.11	5.5%	2.23	0.09	4.2%	2.56	0.16	6.4%	1.43	0.07	4.8%
	Off Peak	8 AM to 5 PM, 8 PM to 10 PM	1.42	0.04	3.0%	1.70	0.04	2.6%	1.81	0.05	2.6%	1.06	0.04	3.6%
	Super Off Peak	10 PM to 8 AM	0.79	0.00	-0.5%	0.98	-0.03	-2.8%	0.95	-0.03	-3.2%	0.63	0.02	3.1%
	Day	All Hours	1.22	0.03	2.5%	1.47	0.02	1.4%	1.55	0.03	1.9%	0.93	0.03	3.7%

Table 5-15: Rate 2 Load Impacts by Rate Period and Day Type – CARE/FERA Customers (Positive values represent load reductions, negative values represent load increases)

Rate 2															
Day Type	Period	Hours	All, CARE			Hot, CARE			Moderate, CARE			Cool, CARE			
			Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	
Average Weekday	Peak	5 PM to 8 PM	1.13	0.03	2.9%	1.70	0.06	3.5%	1.30	0.02	1.7%	0.75	0.03	4.6%	
	Off Peak	8 AM to 5 PM, 8 PM to 10 PM	0.85	0.02	2.4%	1.26	0.03	2.4%	0.96	0.02	2.4%	0.60	0.01	2.4%	
	Super Off Peak	10 PM to 8 AM	0.56	-0.01	-2.2%	0.76	0.00	0.0%	0.61	-0.02	-4.0%	0.45	0.00	-0.9%	
	Day	All Hours	0.77	0.01	1.1%	1.11	0.02	1.9%	0.86	0.00	0.4%	0.56	0.01	1.7%	
Average Weekend	Off Peak	8 AM to 10 PM	0.92	0.02	2.0%	1.40	0.03	2.2%	1.04	0.02	1.8%	0.63	0.01	2.2%	
	Super Off Peak	10 PM to 8 AM	0.55	-0.01	-1.5%	0.78	0.00	0.3%	0.59	-0.02	-3.0%	0.43	0.00	-0.5%	
	Day	All Hours	0.77	0.01	0.9%	1.14	0.02	1.6%	0.85	0.00	0.4%	0.55	0.01	1.3%	
Monthly System Peak Day	Peak	5 PM to 8 PM	1.41	0.05	3.4%	1.84	0.07	4.0%	1.69	0.02	1.4%	0.97	0.06	6.6%	
	Off Peak	8 AM to 5 PM, 8 PM to 10 PM	1.08	0.03	3.1%	1.36	0.03	2.0%	1.30	0.05	3.5%	0.75	0.02	3.1%	
	Super Off Peak	10 PM to 8 AM	0.66	-0.01	-1.2%	0.81	0.01	0.9%	0.74	-0.02	-2.1%	0.51	0.00	-0.8%	
	Day	All Hours	0.95	0.02	1.9%	1.19	0.02	2.1%	1.12	0.02	1.5%	0.68	0.02	2.5%	

As discussed earlier in this section, certain groups were oversampled and assigned to Rate 2 in SCE's service territory. The Commission's Resolution approving SCE's pilots required that load impacts be estimated for Rate 2 in the hot climate region for senior households and for households with average incomes below 100% of FPG. Figure 5-19 shows the load reduction during the peak period on average weekdays for each of these customer segments and Figure 5-20 shows the load impacts in absolute terms. Table 5-16 shows the estimated values for other rate periods and day types for each segment.

The reduction in peak-period electricity use was similar for these two segments and the observed differences were not significantly significant even though, in absolute terms, seniors reduced load by 0.08 kW and the low income group reduced load by 0.05 kW. Load impacts for customers with incomes below 100% of FPG, 3.1% or 0.05 kW, were similar to those for the hot climate region population as a whole, 3.1% or 0.06 kW. It is worth noting in Table 5-16 that senior households had average peak period usage of 1.91 kW, which is nearly identical to the average usage for the population as a whole in the hot climate region (1.93 kW as seen in Table 5-13). Low income household reference loads during the peak period averaged 1.62 kW.

Senior households and households with incomes below 100% of FPG were both able to reduce weekday energy consumption by over 1%. Senior households have average daily demand (1.23 kW) on weekdays compared to customers with incomes below 100% of FPG (1.08 kW). Load reductions were significant in the off-peak periods on average weekdays and monthly system peak days for both groups. On the average weekend, customers with incomes below 100% of FPG did not significantly reduce their daily energy consumption due to their increased demand in the super off-peak period.

Figure 5-19: Average Percent Load Impacts in the Peak Period on Weekdays for SCE Rate 2 for Senior Households and Households with Incomes Below 100% of FPG (Positive values represent load reductions)

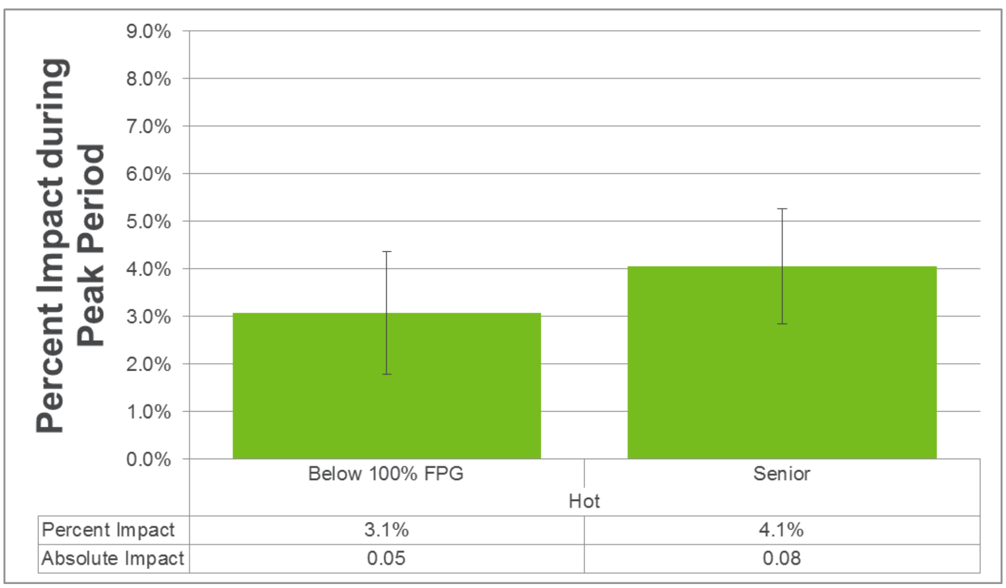


Figure 5-20: Average Absolute Load Impacts in the Peak Period on Weekdays for SCE Rate 2 for Senior Households and Households with Incomes Below 100% of FPG (Positive values represent load reductions)

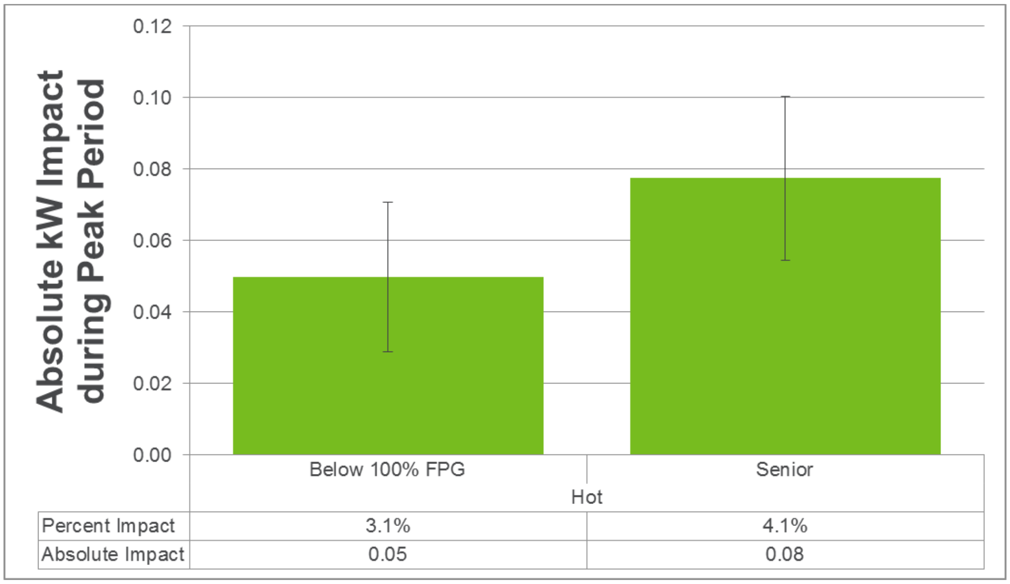


Table 5-16: Rate 2 Load Impacts by Rate Period and Day Type for SCE Rate 2 for Senior Households and Households with Incomes Below 100% of FPG (Positive values represent load reductions, negative values represent load increases)

Rate 2								
Day Type	Period	Hours	Hot, Below 100% FPG			Hot, Senior		
			Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact
Average Weekday	Peak	5 PM to 8 PM	1.62	0.05	3.1%	1.91	0.08	4.1%
	Off Peak	8 AM to 5 PM, 8 PM to 10 PM	1.22	0.03	2.3%	1.46	0.02	1.4%
	Super Off Peak	10 PM to 8 AM	0.77	-0.01	-1.6%	0.78	-0.01	-0.8%
	Day	All Hours	1.08	0.01	1.3%	1.23	0.02	1.4%
Average Weekend	Off Peak	8 AM to 10 PM	1.35	0.02	1.4%	1.60	0.02	1.4%
	Super Off Peak	10 PM to 8 AM	0.79	-0.01	-1.8%	0.80	0.00	0.0%
	Day	All Hours	1.12	0.00	0.4%	1.27	0.01	1.0%
Monthly System Peak Day	Peak	5 PM to 8 PM	1.74	0.07	4.1%	2.05	0.10	5.1%
	Off Peak	8 AM to 5 PM, 8 PM to 10 PM	1.31	0.04	3.4%	1.60	0.02	1.4%
	Super Off Peak	10 PM to 8 AM	0.82	-0.01	-0.6%	0.85	-0.01	-1.4%
	Day	All Hours	1.16	0.03	2.4%	1.34	0.02	1.4%

5.3.3 Rate 3

SCE's Rate 3 also has three rate periods on summer weekdays, and two rate periods on summer weekends. For this tariff, SCE refers to the highest price period during weekdays as the super peak period, which is five hours long, from 4 to 9 PM, with a price of 37.0 ¢/kWh for non-CARE/FERA customers. While this price is greater than the Tier 2 peak price for Rate 1 and smaller than the Tier 2 price for Rate 2 but these prices are not directly comparable because Rate 3 does not include a baseline credit like Rates 1 and 2. As such, average prices for Rate 3 may be higher for low use customers and lower for high use customers than Rate 1 and 2 average prices. The Rate 3 peak period (or shoulder period in this instance) runs from 11AM to 4 PM and 9 to 11 PM, which is significantly shorter than the Rate 2 shoulder period and is the same length as the Rate 1 shoulder period but covers different hours.

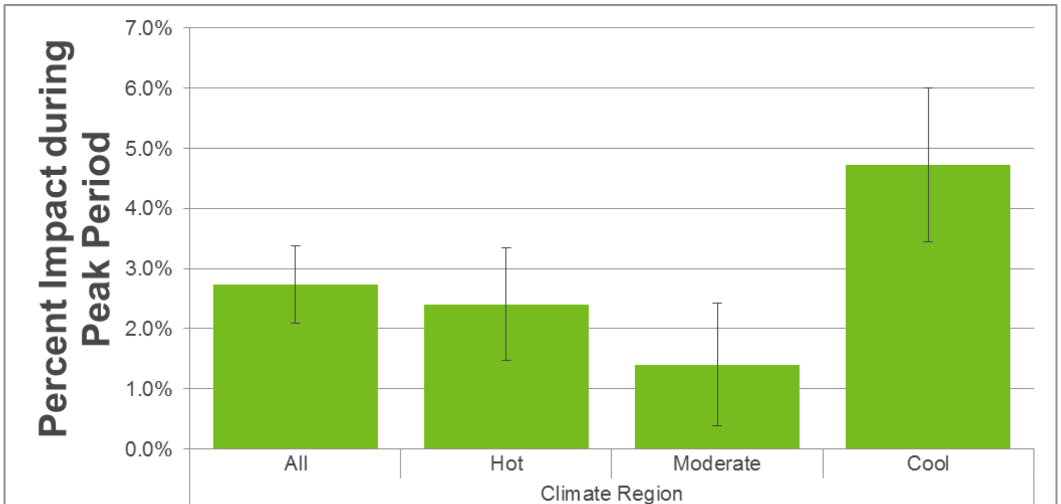
It should be noted that the load impacts for Rate 3 represent the average for the months of August and September only, not the July through September period underlying the Rate 1 and 2 analyses. This is because Rate 3 customers were enrolled roughly a month later than those assigned to Rates 1 and 2 due to the manual billing process required to produce bills for the more complex Rate 3. The shorter estimation period also means that the confidence bands around the load impact estimates are wider for Rate 3 than for the other rates. As such, it is harder to tell whether the estimate impacts, or the difference in impacts across climate regions and customer segments, are statistically significant.

Figures 5-21 and 5-22 show the super peak period load reductions on average weekdays for Rate 3. The load reductions for the SCE territory as a whole, 2.7% or 0.03 kW, are roughly half what they were for Rate 1 or Rate 2 even though average demand during the peak period was similar across the three rates (around 1.3 kW). Load impacts for customers in the hot and cool climate regions were identical in absolute terms (0.04 kW), but percentage reductions in the cool region were nearly double what they were in the hot region in percentage terms (4.7% versus 2.4%). Load reductions were smallest among customers in the moderate climate region, with impacts of only 1.4% or 0.02 kW. There was no statistically significant difference in the absolute load impacts in the super peak period across the three climate regions.

Table 5-17 contains estimates of load impacts for all relevant rate periods and day types. Super on peak demand was the smallest among customers in the cool climate region at 0.92 kW, but percent impacts were the greatest. The same was true on the average weekend in the summer period. Generally, customers did not reduce electricity use in the super peak period on the average monthly system peak day except in the cool climate region where the average reduction in daily electricity use equaled 3.4%, or 0.04 kW. As mentioned above, the lack of statistical significance could be due, in part, to the fact that July was excluded from the Rate 3 load impact analysis, limiting the number of observations, combined with the fact that Rate 3 had the smallest overall sample sizes for the test cells.

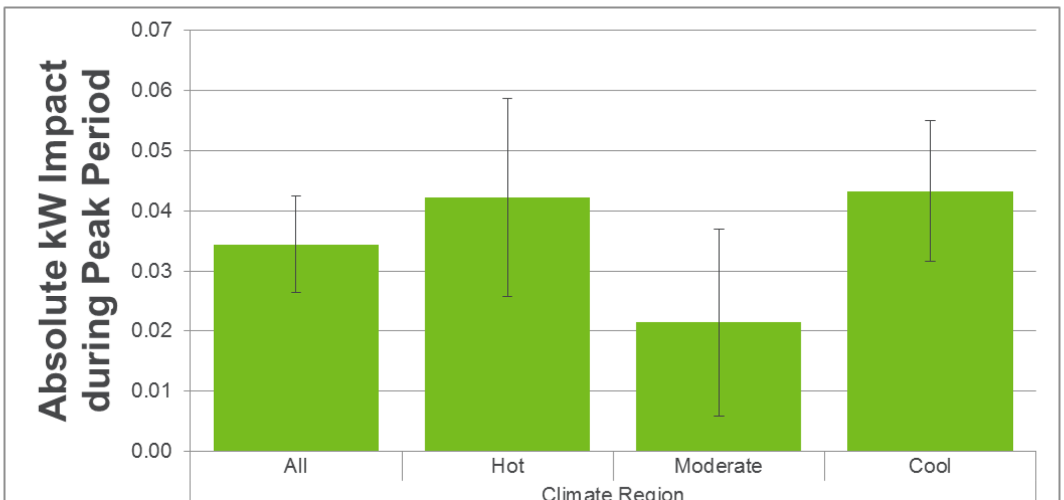
On weekdays, the average reduction in daily electricity use was statistically significant overall and in all three climate regions, ranging from a low of 0.6% in the moderate climate region to a high of 2.9% in the cool region. Reductions in daily usage were similar on weekends as on weekdays, except that the estimate for the moderate climate region was not statistically significant.

Figure 5-21: Average Percent Load Impacts for Super Peak Period for SCE Rate 3 (Positive values represent load reductions)



	All	Hot	Moderate	Cool
Percent Impact	2.7%	2.4%	1.4%	4.7%
kW Impact	0.03	0.04	0.02	0.04

Figure 5-22: Average Absolute Load Impacts for Super Peak Period for SCE Rate 3 (Positive values represent load reductions)



	All	Hot	Moderate	Cool
Percent Impact	2.7%	2.4%	1.4%	4.7%
kW Impact	0.03	0.04	0.02	0.04

Table 5-17: Rate 3 Load Impacts by Rate Period and Day Type
(Positive values represent load reductions, negative values represent load increases)

Rate 3															
Day Type	Period	Hours	All			Hot			Moderate			Cool			
			Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	
Average Weekday	Super On Peak	4 PM to 9 PM	1.26	0.03	2.7%	1.76	0.04	2.4%	1.53	0.02	1.4%	0.92	0.04	4.7%	
	Peak	11 AM to 4 PM, 9 PM to 11 PM	0.99	0.03	2.8%	1.40	0.03	1.9%	1.16	0.03	2.3%	0.74	0.03	3.8%	
	Off Peak	11 PM to 11 AM	0.59	0.00	-0.7%	0.79	-0.01	-0.7%	0.64	-0.01	-2.0%	0.50	0.00	0.6%	
	Day	All Hours	0.84	0.01	1.5%	1.17	0.01	1.2%	0.98	0.01	0.6%	0.66	0.02	2.9%	
Average Weekend	Mid Peak	4 PM to 9 PM	1.25	0.03	2.3%	1.78	0.03	1.7%	1.51	0.03	2.0%	0.90	0.03	3.1%	
	Off Peak	9 PM to 4 PM	0.74	0.01	1.0%	1.05	0.01	0.7%	0.83	0.00	-0.4%	0.59	0.02	2.7%	
	Day	All Hours	0.84	0.01	1.4%	1.20	0.01	1.0%	0.97	0.00	0.4%	0.65	0.02	2.8%	
Monthly System Peak Day	Super On Peak	4 PM to 9 PM	1.71	0.02	1.1%	1.90	0.00	0.2%	2.18	-0.01	-0.4%	1.27	0.04	3.4%	
	Peak	11 AM to 4 PM, 9 PM to 11 PM	1.34	0.05	3.5%	1.50	0.02	1.4%	1.66	0.06	3.4%	1.03	0.05	4.4%	
	Off Peak	11 PM to 11 AM	0.68	-0.01	-1.4%	0.84	-0.01	-1.1%	0.77	-0.03	-3.4%	0.56	0.00	0.7%	
	Day	All Hours	1.09	0.01	1.2%	1.25	0.00	0.2%	1.32	0.00	0.2%	0.85	0.02	2.9%	

Figures 5-23 and 5-24 show the super peak period load reductions on weekdays for non-CARE/FERA and CARE/FERA customers, respectively, and Tables 5-18 and 5-19 show the load impacts for each rate period and day type for the two segments. Load reductions were statistically significant for all customer segments and climate regions except for non-CARE/FERA customers in the moderate climate region. There was no statistically significant difference in either percentage or absolute terms between CARE/FERA and non-CARE/FERA customers in any climate region or in the service territory as a whole.

As seen in Tables 5-18 and 5-19, there are significant average weekday load reductions for both CARE/FERA and non-CARE/FERA customers in the SCE territory as a whole. Load reductions were also significant, and over 1%, for non-CARE/FERA customers on average weekends and monthly system peak days.

Figure 5-23: Average Percent Load Impacts for Super Peak Period for SCE Rate 3 for CARE/FERA and non-CARE/FERA Customers (Positive values represent load reductions)

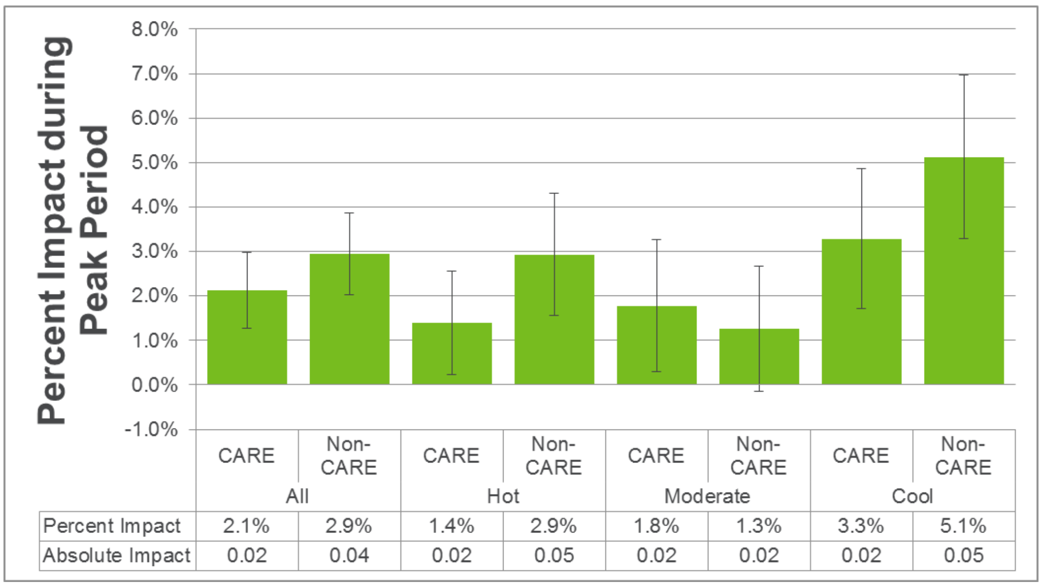
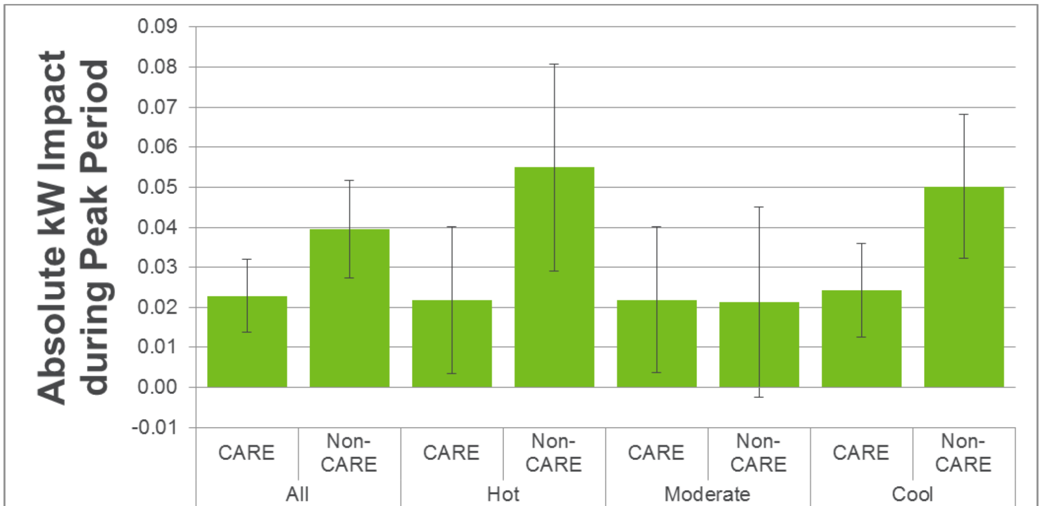


Figure 5-24: Average Absolute Load Impacts for Super Peak Period for SCE Rate 3 for CARE/FERA and non-CARE/FERA Customers (Positive values represent load reductions)



	All		Hot		Moderate		Cool	
	CARE	Non-CARE	CARE	Non-CARE	CARE	Non-CARE	CARE	Non-CARE
Percent Impact	2.1%	2.9%	1.4%	2.9%	1.8%	1.3%	3.3%	5.1%
Absolute Impact	0.02	0.04	0.02	0.05	0.02	0.02	0.02	0.05

Table 5-18: Rate 3 Load Impacts by Rate Period and Day Type – non-CARE/FERA Customers (Positive values represent load reductions, negative values represent load increases)

Rate 3														
Day Type	Period	Hours	All, Non-CARE			Hot, Non-CARE			Moderate, Non-CARE			Cool, Non-CARE		
			Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact
Average Weekday	Super On Peak	4 PM to 9 PM	1.34	0.04	2.9%	1.88	0.05	2.9%	1.68	0.02	1.3%	0.98	0.05	5.1%
	Peak	11 AM to 4 PM, 9 PM to 11 PM	1.04	0.03	2.7%	1.49	0.04	3.0%	1.26	0.02	1.4%	0.79	0.03	4.3%
	Off Peak	11 PM to 11 AM	0.62	0.00	-0.6%	0.85	0.00	-0.6%	0.69	-0.02	-2.4%	0.52	0.01	1.2%
	Day	All Hours	0.89	0.01	1.6%	1.25	0.02	1.8%	1.06	0.00	0.1%	0.70	0.02	3.4%
Average Weekend	Mid Peak	4 PM to 9 PM	1.34	0.03	2.5%	1.92	0.04	2.3%	1.66	0.03	1.6%	0.97	0.04	3.6%
	Off Peak	9 PM to 4 PM	0.78	0.01	1.6%	1.13	0.01	1.0%	0.90	0.00	-0.5%	0.63	0.02	4.0%
	Day	All Hours	0.90	0.02	1.8%	1.30	0.02	1.4%	1.06	0.00	0.2%	0.70	0.03	3.9%
Monthly System Peak Day	Super On Peak	4 PM to 9 PM	1.85	0.01	0.6%	2.00	-0.02	-1.0%	2.43	-0.02	-1.0%	1.38	0.04	3.2%
	Peak	11 AM to 4 PM, 9 PM to 11 PM	1.44	0.05	3.3%	1.59	0.05	3.1%	1.83	0.05	2.6%	1.11	0.05	4.2%
	Off Peak	11 PM to 11 AM	0.72	-0.01	-1.1%	0.90	-0.01	-1.1%	0.83	-0.03	-3.6%	0.60	0.01	1.6%
	Day	All Hours	1.17	0.01	1.1%	1.33	0.00	0.4%	1.46	-0.01	-0.4%	0.91	0.03	3.0%

Table 5-19: Rate 3 Load Impacts by Rate Period and Day Type –CARE/FERA Customers (Positive values represent load reductions, negative values represent load increases)

Rate 3															
Day Type	Period	Hours	All, CARE			Hot, CARE			Moderate, CARE			Cool, CARE			
			Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact
Average Weekday	Super On Peak	4 PM to 9 PM	1.07	0.02	2.1%	1.57	0.02	1.4%	1.23	0.02	1.8%	0.74	0.02	3.3%
	Peak	11 AM to 4 PM, 9 PM to 11 PM	0.86	0.03	2.9%	1.24	0.00	-0.1%	0.97	0.05	4.8%	0.61	0.01	2.0%
	Off Peak	11 PM to 11 AM	0.51	-0.01	-1.0%	0.69	-0.01	-1.0%	0.55	0.00	-0.8%	0.42	-0.01	-1.3%
	Day	All Hours	0.73	0.01	1.3%	1.03	0.00	0.1%	0.81	0.02	1.9%	0.54	0.01	1.1%
Average Weekend	Mid Peak	4 PM to 9 PM	1.04	0.02	2.0%	1.56	0.01	0.4%	1.19	0.04	3.0%	0.70	0.01	1.4%
	Off Peak	9 PM to 4 PM	0.64	0.00	-0.7%	0.92	0.00	-0.1%	0.69	0.00	0.0%	0.48	-0.01	-2.1%
	Day	All Hours	0.72	0.00	0.1%	1.05	0.00	0.0%	0.80	0.01	0.9%	0.53	-0.01	-1.1%
Monthly System Peak Day	Super On Peak	4 PM to 9 PM	1.39	0.03	2.4%	1.74	0.04	2.6%	1.67	0.02	1.3%	0.97	0.04	4.1%
	Peak	11 AM to 4 PM, 9 PM to 11 PM	1.11	0.05	4.3%	1.34	-0.02	-1.8%	1.33	0.08	5.7%	0.79	0.04	5.4%
	Off Peak	11 PM to 11 AM	0.59	-0.01	-2.2%	0.74	-0.01	-1.0%	0.65	-0.02	-2.7%	0.47	-0.01	-2.3%
	Day	All Hours	0.91	0.01	1.6%	1.12	0.00	-0.1%	1.06	0.02	1.7%	0.67	0.02	2.3%

5.3.1 Comparison Across Rates

Figures 5-25 and 5-26 show the absolute and percent load reductions for each of SCE's three pilot rates for the hours from 5 to 8 PM. These are the three hours that are common across all three tariffs. Using a common set of hours reduces differences in impacts across rates that might be due to differences in the number of hours included in the peak period or the timing of those hours. The hours from 5 to 8 PM define the peak period for SCE's Rate 2. Rate 1 has a six hour peak period, from 2 to 8 PM and Rate 3 has a five hour peak period from 4 to 9 PM. All three tariffs have three rate periods in summer. The peak and shoulder periods combined cover the same hours for Rates 1 and 2 (8 AM to 10 PM) while the two periods combined for Rate 3 cover fewer hours, from 11 Am to 11 PM. Recall that Rate 3 also differs from Rates 1 and 2 in that Rate 3 does not provide a baseline credit while Rates 1 and 2 do.

With a shorter peak period and a much higher Tier 2, peak period price (and lower Tier 2 super off-peak price), one might expect the peak period load reductions for Rate 2 to be higher than for Rate 1. As seen in the figures, for the service territory as a whole and for the moderate and cool climate regions, there are no statistically significant differences in the load reductions between Rates 1 and 2 in either percentage or absolute terms. However, in the hot climate region, the load reduction between 5 and 8 PM is significantly greater for Rate 2 compared with Rate 1. In percentage terms, the load reduction for Rate 2 is more than three times greater than for Rate 1. The difference between Rate 3 impacts and the other two rates is statistically significant in the moderate climate region but not in the other regions or in the service territory as a whole.

Figure 5-25: Average Percent Impacts from 5 to 8 PM Across Rates

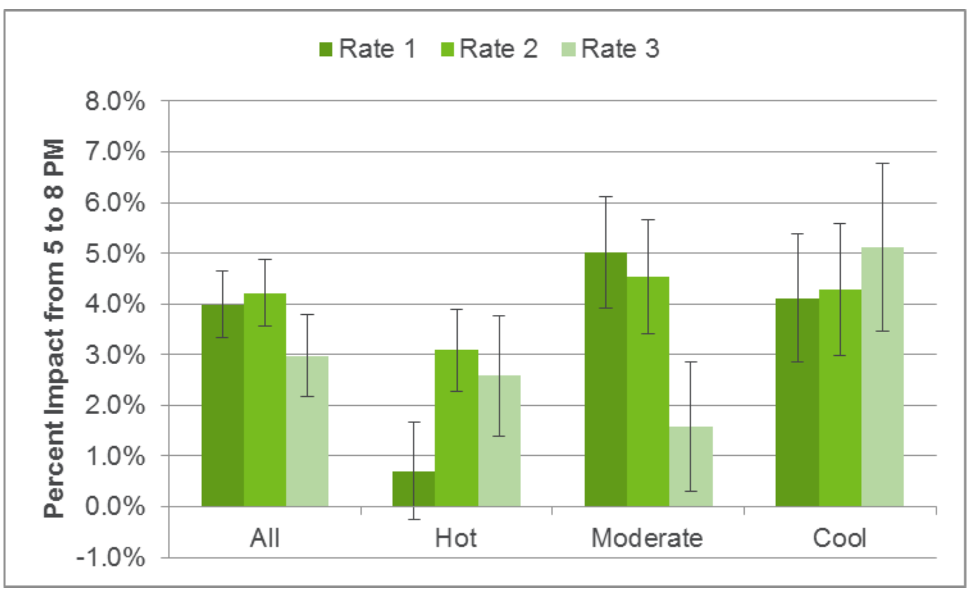
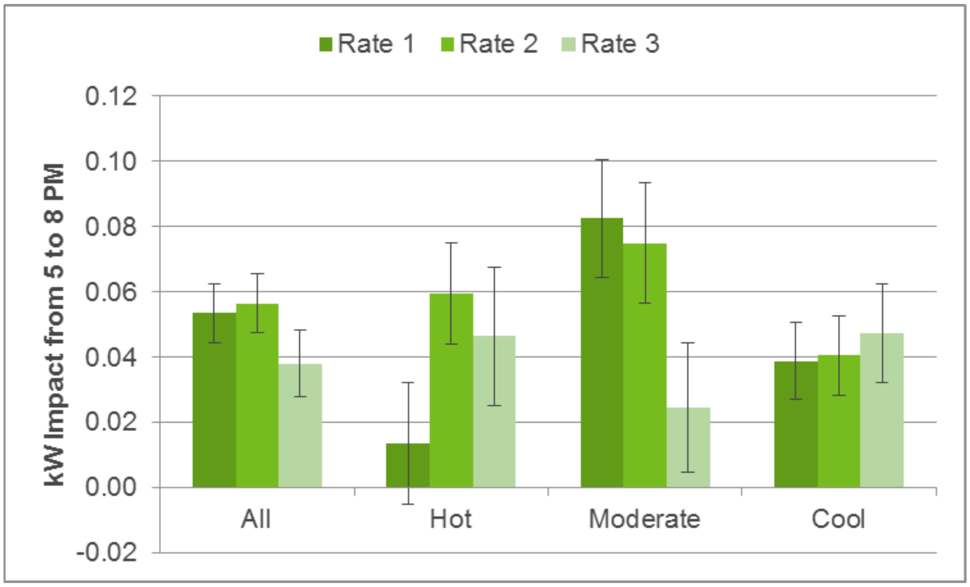


Figure 5-26: Average Absolute Impacts from 5 to 8 PM Across Rates



Figures 5-27 and 5-28 show the reductions in daily electricity use for the three rates for the service territory as a whole and for each climate region. Except for Rate 1 in the hot climate region, all load reductions are statistically significant. The reduction in daily electricity use is greater for Rate 1 than for the other two rates for the service territory as a whole and in the moderate climate region and these differences are statistically significant. However, in the hot region, there is no statistically significant reduction in electricity use for Rate 1, while there is for both Rates 2 and 3. None of the observed differences in daily electricity use between Rates 2 and 3 are statistically significant.

Figure 5-27: Average Percent Daily kWh Impacts Across Rates

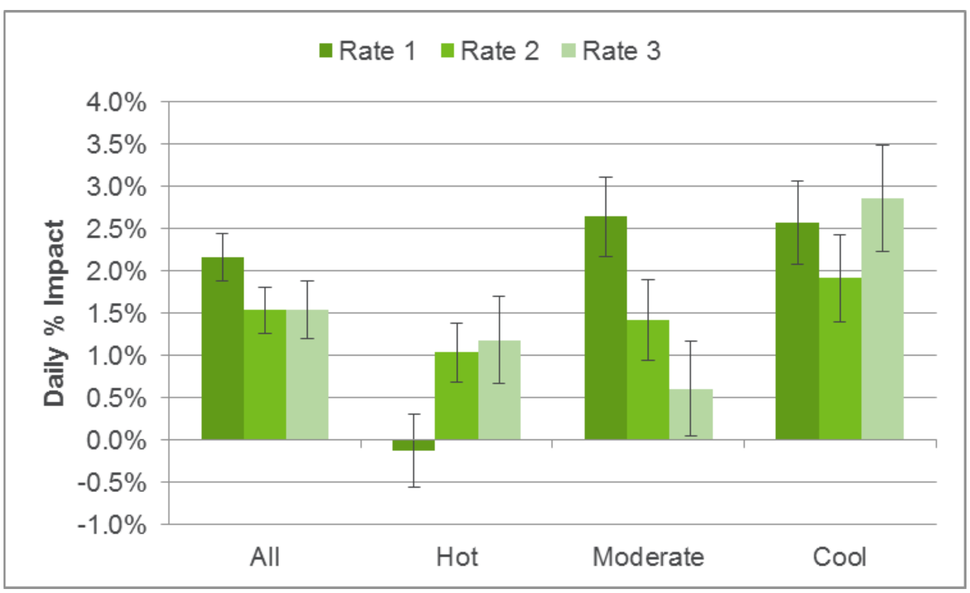
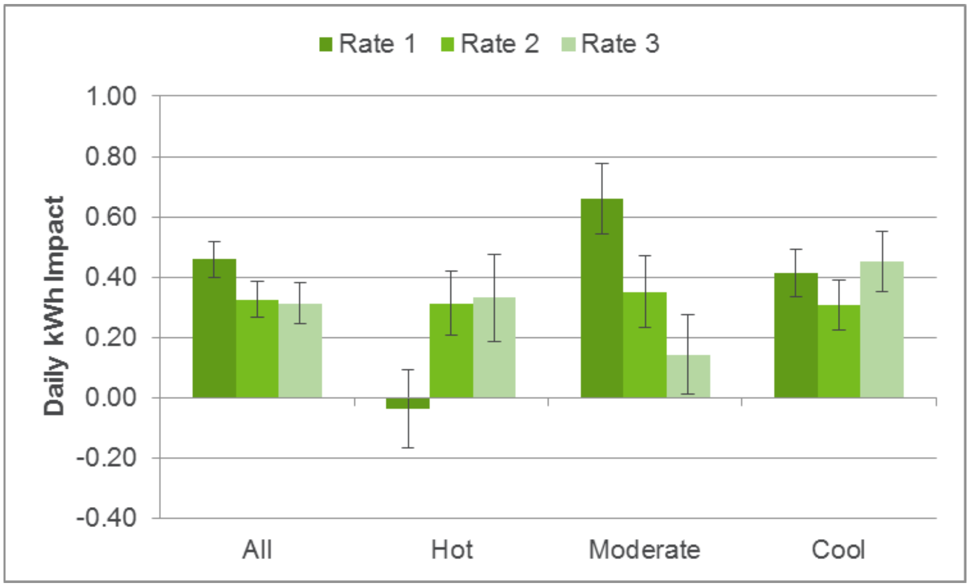


Figure 5-28: Average Absolute Daily kWh Impacts Across Rates



5.4 Bill Impacts

This section summarizes the bill impact estimates for the three rate treatments tested by SCE. The CPUC resolution approving SCE's pilot requires that bill impacts be estimated for the following rates, customer segments and climate regions:

- Seniors, CARE/FERA customers, non-CARE/FERA customers, households with incomes below 100% of FPG, and households with incomes between 100% and 200% of FPG in SCE's hot climate region for Rate 2; and

- For CARE/FERA and non-CARE/FERA customers on each rate across SCE's service territory as a whole and for each climate region.

In addition to these required segments, Nexant estimated bill impacts for seniors, households with incomes below 100% of FPG, and households with incomes between 100% and 200% of FPG in SCE's hot climate region for Rate 1 and Rate 3. Bill impacts are reported as the average monthly impact for the summer months of July, August and September[49] for each rate (however, July was not included for Rate 3 due to delayed enrollment), climate zone, and customer segment summarized above. As described in Section 4.8, the following four analyses were conducted:

- **Structural benefiter/non-benefiter analysis based on pretreatment usage-** Displaying the proportions of structural benefiters and non-benefiters for each rate and relevant customer segment based on pretreatment data on an annual and summer season basis;
- **Estimation of the average bill impact due to changes in usage-** Displaying the average bill impact resulting from changes in behavior in response to the new price signals for each rate and relevant customer segment (after controlling for exogenous factors);

49 Estimates were not produced for the month of June because enrollment changed dramatically from the beginning to the end of the month and the estimates would not be comparable to those for other months.

- **Estimation of the total bill impact due to both the difference in the tariffs (holding usage constant) and behavior change-** Displaying the bill impact for each rate and relevant customer segment due to structural differences in the rate mitigated by changes in behavior; and
- **Change in the distribution of bill impacts due to behavior change-** Displaying the distribution curves of bill impacts (percentage of customers with bill impacts within $10 incremental bins) with and without behavior change in the same graph to illustrate if the distribution for participants shifted to the left or changed shape compared with the distribution for control customers without behavior change.

A more detailed explanation of each type of analysis and how the analysis was conducted is contained in Section 3.7. The remainder of this section is organized according to the four analysis types summarized above – that is, bill impacts are presented for each rate, relevant customer segment, and climate region for each of the four analyses.

5.4.1 Structural Benefiter/Non-Benefiter Analysis Based on Pretreatment Usage

As with PG&E, the structural benefiter analysis was conducted for the summer and annual time periods using pretreatment data from the treatment group for each rate and relevant customer segment. Annual impacts were based on hourly load data from May 2015 through April 2016. Summer impacts were based on June 2015 through September 2015. Monthly bills were estimated for each treatment group customer on the OAT and TOU rate using the hourly load data. The difference in bills based on the TOU rate and the OAT determines if a customer is a structural benefiter, a structural non-benefiter, or falls in a neutral range defined as having a structural bill impact between ±$3.[50]

Final results from the structural benefiter / non-benefiter analysis are presented in column graphs and shown as percentages for the summer season and on an annual basis. For each rate and relevant segment, the percentage of customers who are non-benefiter, neutral (+/- $3), or benefiters based on their average monthly bills for the time period of interest are shown as individual columns. The three columns within each rate and segment combination total to 100%, thus showing the distribution of structural benefiters and non-benefiters for each rate and segment of interest.

Figure 5-29 presents the outcome of the structural benefiter analysis for Rate 1 at the aggregate level across climate regions for all customers as well as for CARE/FERA and non-CARE/FERA. The graph on the left presents the analysis on an annual basis, and the graph on the right presents the findings for the summer period. Nearly all customers are structural non-benefiters in the summer season, which was expected. A higher proportion of CARE/FERA customers are structural non-benefiters than non-CARE/FERA customers.

50 See section 3.2.1 for additional details on the methodology.

Figure 5-29: Rate 1 Structural Benefiter / Non-Benefiter Analysis
All | CARE/FERA | Non-CARE/FERA

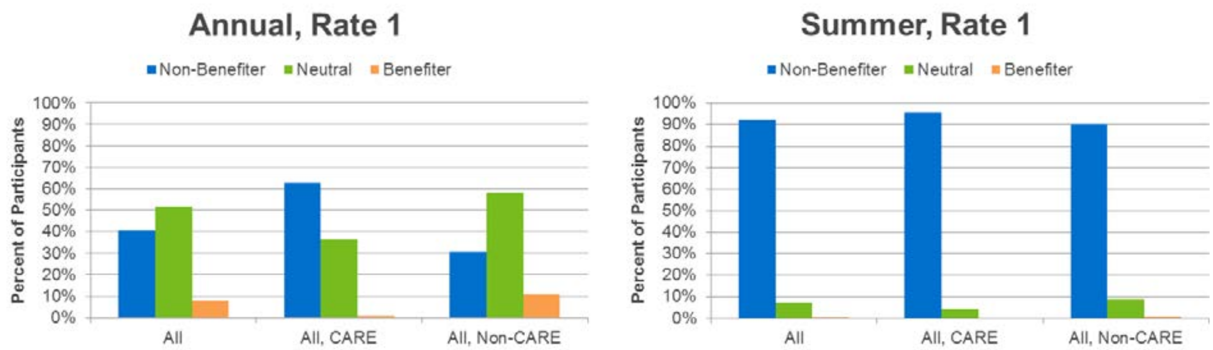


Figure 5-30 presents the outcome of the structural benefiter analysis for Rate 1 at the detailed segment level by climate region. The findings at the aggregate level still hold, with nearly all customers as structural non-benefiters in the summer season. The non-CARE/FERA segments in all three climate regions have a greater proportion of non-benefiters than the CARE/FERA segments on an annual basis. A majority of customers in senior households, households with incomes below 100% of FPG, and households with incomes between 100% and 200% of FPG are structural non-benefiters.

Figure 5-30: Rate 1 Structural Benefiter / Non-Benefiter Analysis
Detailed Segments by Climate Region

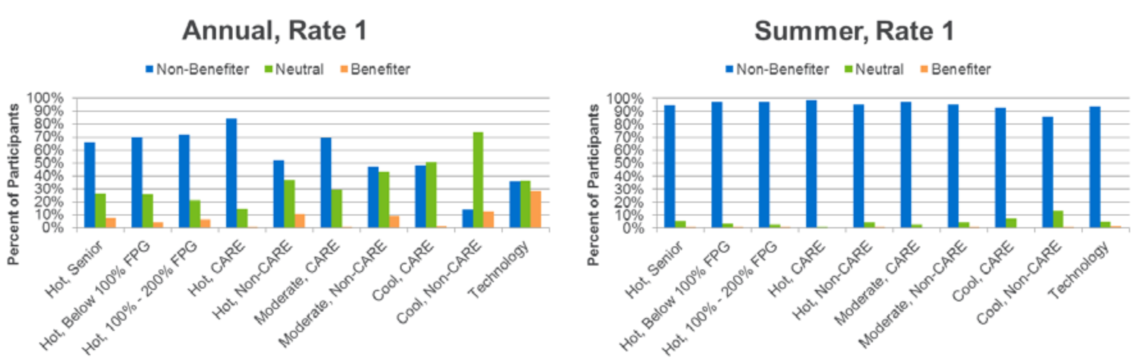


Figure 5-31 presents the outcome of the structural benefiter analysis for Rate 2 at the aggregate level across climate regions. SCE's Rate 2 differs from Rate 1 in several important ways. Both rates have three rate periods on summer weekdays, however the Rate 2 peak period is only three hours, from 5 to 8 PM, compared to six hours on Rate 1. Additionally, the peak period price is greater on Rate 2 (53 ¢/kWh versus $35 ¢/kWh). Overall, the general pattern of structural benefiters, non-benefiters, and neutrals is similar between Rate 1 and Rate 2. Nearly all customers are structural non-benefiters in the summer season, and there is a higher proportion of structural non-benefiters among CARE/FERA customers compared to non-CARE/FERA customers.

Figure 5-31: Rate 2 Structural Benefiter / Non-Benefiter Analysis
All | CARE/FERA | Non-CARE/FERA

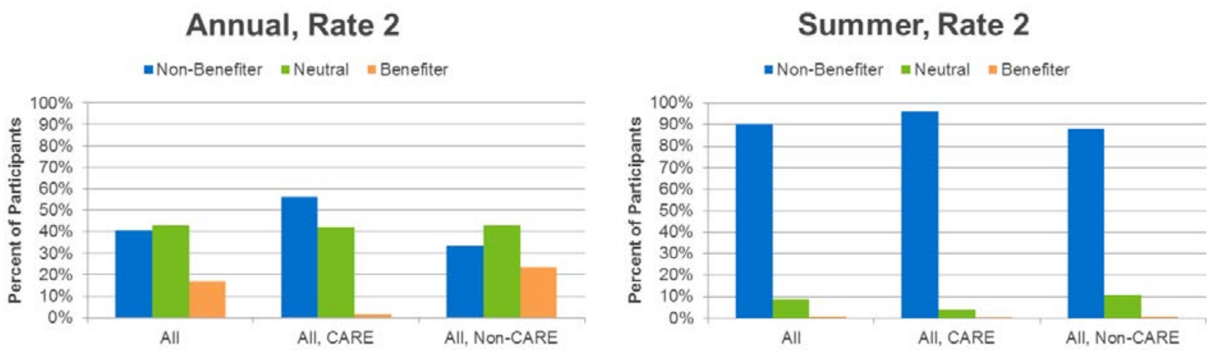


Figure 5-32 presents the structural benefiter analysis for Rate 2 at the detailed segment level by climate region. Once again, the findings at the aggregate level still hold, with nearly all customers as structural non-benefiters in the summer season. In the cool climate region, a larger portion of customers fall in the neutral category, while all other segments have a higher proportion of non-benefiters, on an annual basis.

Figure 5-32: Rate 2 Structural Benefiter / Non-Benefiter Analysis
Detailed Segments by Climate Region

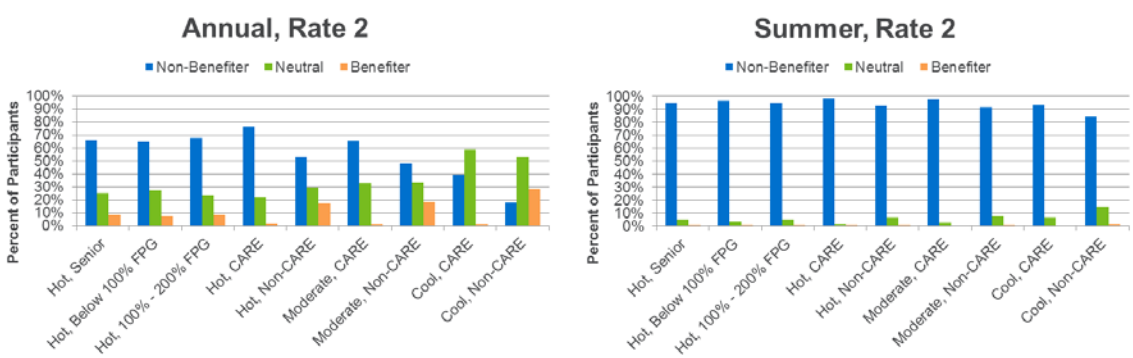
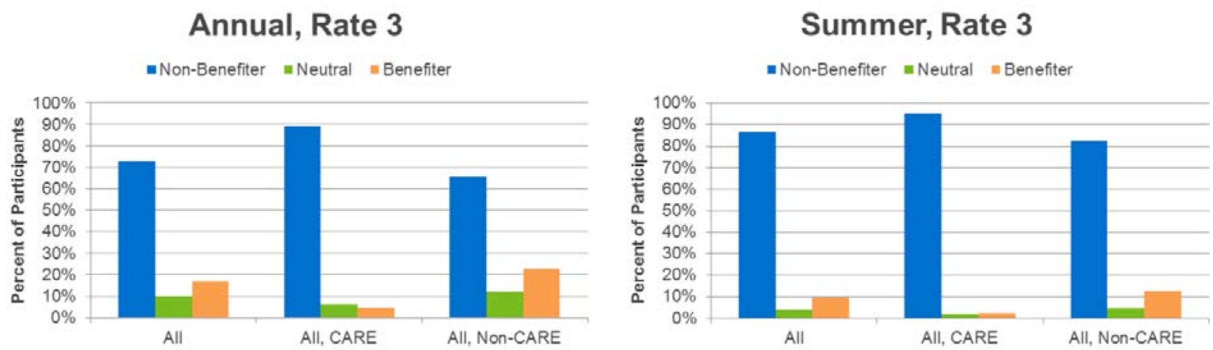


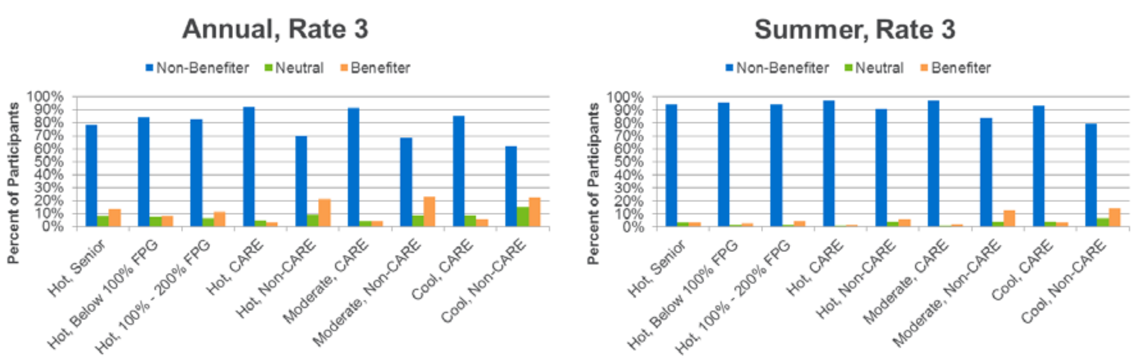
Figure 5-33 presents the distribution of structural benefiters, non-benefiters, and neutral customers for Rate 3 at the aggregate level across climate regions. SCE's Rate 3 has a later peak period than Rate 1 and Rate 2, but the peak period price is similar to Rate 1. The biggest difference between Rate 1 and Rate 2, compared to Rate 3 is that Rate 3 does not have a baseline credit. Unlike the previous two rates, a majority of customers are structural non-benefiters on Rate 3 on an annual basis, especially CARE/FERA customers. However, there are more benefiters in the summer season on Rate 3 than on the other two rates.

Figure 5-33: Rate 3 Structural Benefiter / Non-Benefiter Analysis
All | CARE/FERA | Non-CARE/FERA



This pattern holds true at the detailed segment level by climate region, as shown in Figure 5-34. Non-CARE/FERA customers in the hot and cool climate regions have the highest proportions of structural winners on an annual basis.

Figure 5-34: Rate 3 Structural Benefiter / Non-Benefiter Analysis
Detailed Segments by Climate Region



Overall, a general pattern of structural benefiters and non-benefiters emerged that was consistent across Rates 1 and Rate 2, while Rate 3 had a higher proportion of non-benefiters in nearly all customer segments on an annual basis. For all three rates, most customers are structural non-benefiters in the summer season.

The next section presents the analysis showing how much customers were able to reduce their bills as a result of behavior change. Section 5.4.3 combines the findings from the structural benefiter analysis with average bill impact findings to provide the full picture of how much of the structural loss customers were able to offset based on changing their energy usage behavior.

5.4.2 Estimation of the Average Bill Impact Due to Changes in Usage

As described in Section 3.7.2, the average bill impact due to customers changing their energy usage in response to the TOU rate was estimated by calculating the difference in bills calculated using the TOU rate and post-enrollment usage for both the control and treatment group minus the difference in bills on the TOU rate using pretreatment usage for both the control and treatment groups. The control group bill calculated on the TOU rate represents the bill that would be expected if a customer was billed on the TOU rate, but didn't change their energy use behavior. The bill for the treatment group customers on

TOU rate reflects any behavioral changes in response to being on the TOU rate. By subtracting the treatment group's average bill from the control group's average bill—and removing any pre-existing differences—we are able estimate the average bill impact attributable to the treatment group's change in behavior resulting from exposure to the pilot rate, after controlling for exogenous factors. [51] A positive impact indicates that customers successfully reduced their bills relative to the control group who did not respond to a TOU rate.

As they were in Section 4.8.2, bill impacts are presented on a column graph and shown as dollar impacts for the average summer monthly bill for July, August, and September 2016 for Rates 1 and Rate 2, and for August and September for Rate 3. The error bars on the graph represent the 90% confidence interval. Therefore, any impacts with error bars that cross below zero are not statistically significant at the 90% confidence level. Impacts are organized by rate, climate region, and segment. The bill impact in percentage terms that corresponds to the dollar amount is also included in the figure to provide context.

As with PG&E's bill impacts, aggregate level results were weighted following the same approach as used in the load impacts.[52] The weights are representative of the mix of customers eligible to participate in the pilot, not just those who enrolled. Consequently, some of the individual segments shown in the detailed findings section may have more or less weight than other segments when they are combined together to develop the aggregate results. It is important to note that small bill impacts do not necessarily indicate customers did not change their behavior. As seen in the load impact section, load reductions in peak or shoulder periods, which would lead to lower bills all other things equal, are sometimes offset by load increases in the off-peak period. Depending on the relative magnitude of each change, bill impacts could go up, down, or remain largely unchanged even though customers made significant changes in behavior. It is also important to note that the values shown here represent changes in bills due to change in behavior – they do not represent the total change in the bill (nearly all bills increased in the summer). The total changes in the bill will be presented in the next section.

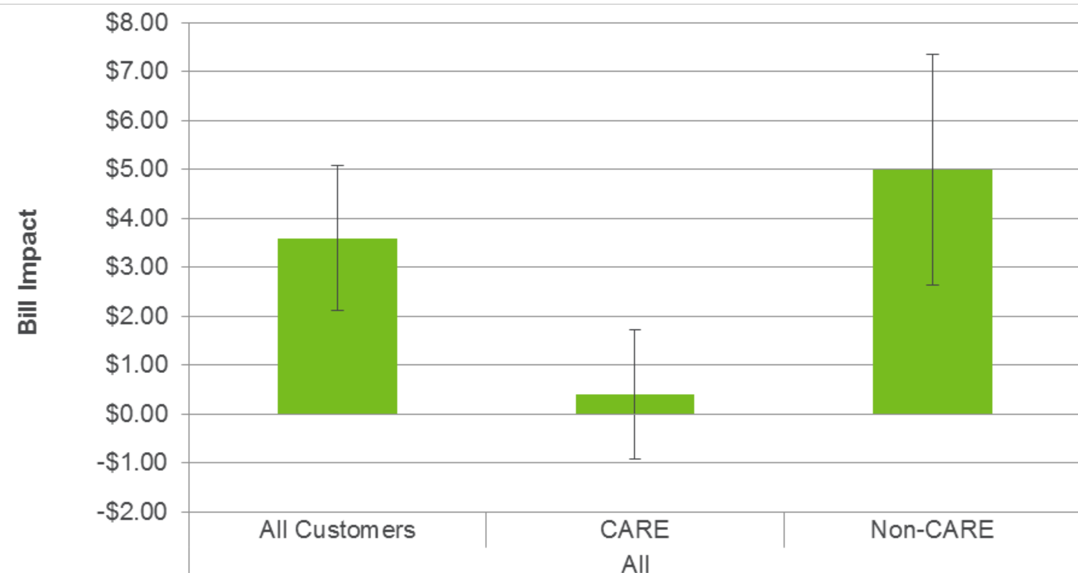
Figure 5-35 provides the overall results for customers on Rate 1. Through changing their energy use the average Rate 1 customer was able to reduce what their average monthly bill would have otherwise been by $3.59, or 2.7%. Though small, this result is statistically significant at the 90% confidence level. Average hourly peak period load impacts for Rate 1 customers were 4.4% or 0.06 kW. For the six hour peak period, the average daily energy savings is approximately 0.36 kWh (6 hours times 0.06 kWh). If we assume four weeks in a month, and five days a week, the result is twenty days where we would expect to observe the peak period reductions. Multiplying 20 days by the 0.36 kWh we expect to find about 7.2 kWh savings from the peak period per month. When factoring in both the CARE/FERA and non-CARE/FERA rates, the average summer weekday peak period price per kWh on Rate 1 is about $0.31. An impact of 7.2 kWh per month at $0.31 per kWh equals a total estimated peak period bill reduction of $2.22. When factoring in slight decreases in energy use during off-peak hours, the $3.59 monthly bill impact appears quite reasonable. Bill impacts for CARE/FERA customers much smaller than the territory-

[51] See section 3.2.2 for additional details on the methodology.

[52] See section 3.2.3 for a detailed discussion of the weighting approach.

wide average customer impact at $0.40 (0.5%) and were not statistically significant. Non-CARE/FERA customer bill impacts were statistically significant at $5.00 (3.2%) per month.

Figure 5-35: Rate 1 Average Bill Impacts from Behavior Change
All | CARE/FERA | Non-CARE/FERA
(Positive values represent bill reductions)

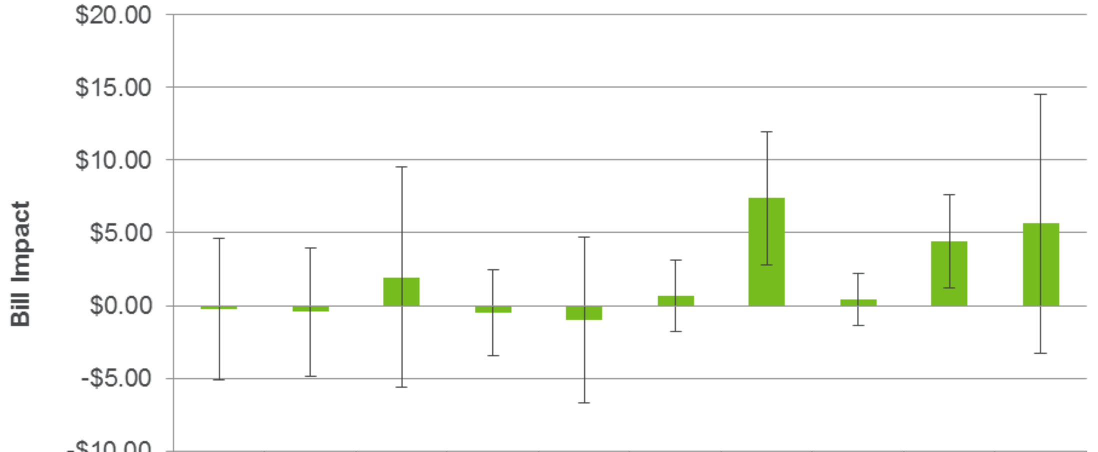


	All Customers	CARE	Non-CARE
Bill Impact	$3.59	$0.40	$5.00
Percent Impact	2.7%	0.5%	3.2%

Figure 5-36 provides the detailed results by climate region and segment for customers on Rate 1. Non-CARE/FERA customers in the moderate climate region exhibited the largest bill reduction due to changes in behavior at $7.38 per month (3.8%). Non-CARE/FERA customers were the only other segment to have statistically significant reductions in their bills due to changes in their behavior, at $4.42 per month (3.8%).

Figure 5-36: Rate 1 Average Bill Impacts from Behavior Change Detailed Segments by Climate Region

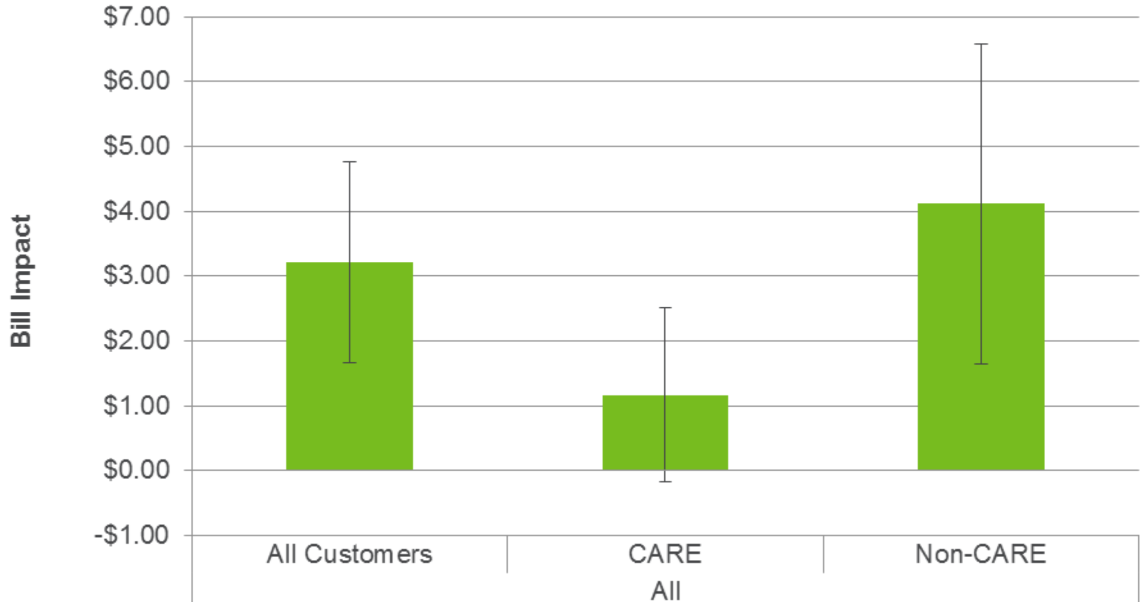
(Positive values represent bill reductions)



	Hot					Moderate		Cool		Technology
	Senior	Below 100% FPG	100% - 200% FPG	CARE	Non-CARE	CARE	Non-CARE	CARE	Non-CARE	
Bill Impact	-$0.25	-$0.45	$1.93	-$0.49	-$1.02	$0.70	$7.38	$0.40	$4.42	$5.65
Percent Impact	-0.1%	-0.3%	1.1%	-0.4%	-0.5%	0.7%	3.8%	0.7%	3.8%	2.6%

Figure 5-37 provides the overall results for customers on Rate 2, which are generally very similar to Rate 1. Through changes in behavior, the average Rate 2 customer was able to reduce what their average monthly bill would have otherwise been by $3.21 or 2.3%. This result is statistically significant at the 90% confidence level. Average hourly peak period load impacts for Rate 2 customers were 4.2% or 0.06 kW. Bill impacts for CARE/FERA customers were not statistically significant.

Figure 5-37: Rate 2 Average Bill Impacts from Behavior Change
All | CARE/FERA | Non-CARE/FERA
(Positive values represent bill reductions)

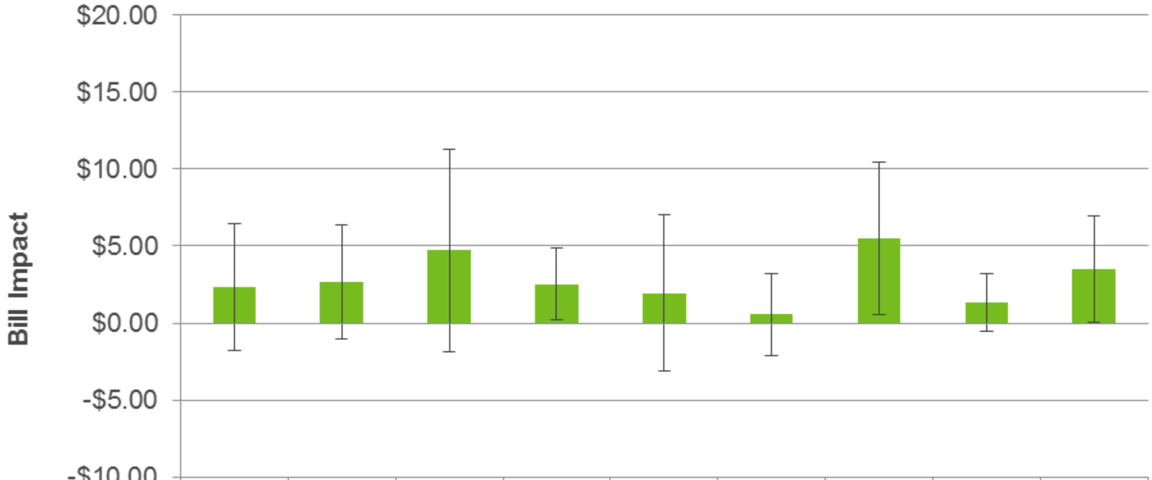


	All Customers	CARE	Non-CARE
Bill Impact	$3.21	$1.16	$4.11
Percent Impact	2.3%	1.3%	2.6%

Figure 5-38 presents the detailed results by climate region and segment for customers on Rate 2. Similar to Rate 1, only two segments were able to reduce their bills by a significant amount: non-CARE/FERA customers in the moderate and cool climate regions. Those in the moderate climate regions reduced their bills by $5.52 per month, or 2.9%, due to changes in their energy usage behavior.

Figure 5-38: Rate 2 Average Bill Impacts from Behavior Change Detailed Segments by Climate Region

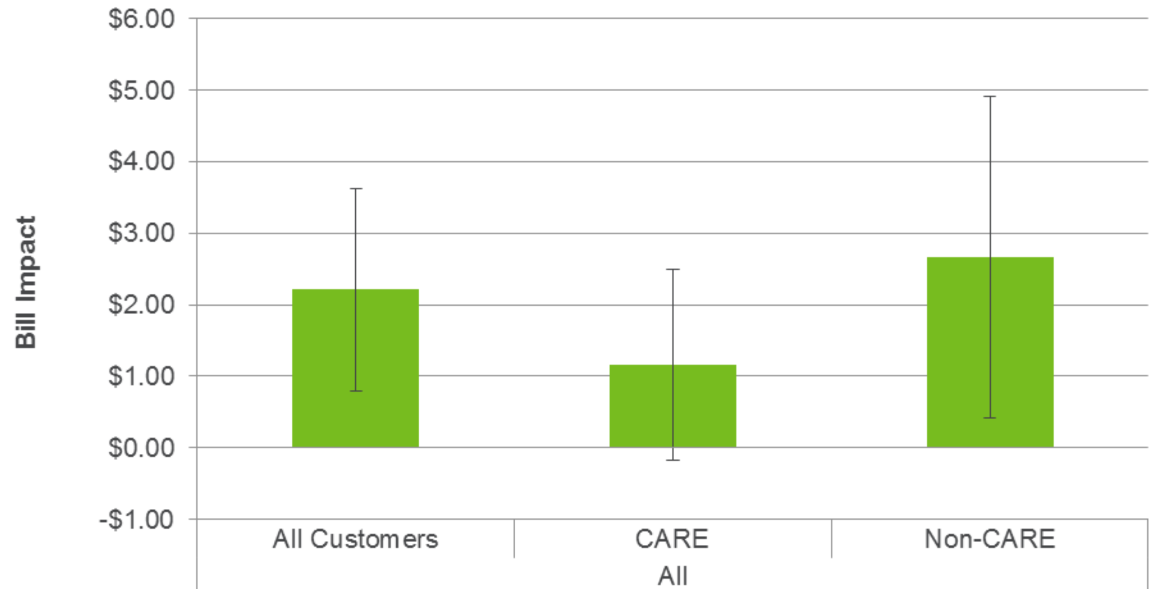
(Positive values represent bill reductions)



	Hot					Moderate		Cool	
	Senior	Below 100% FPG	100% - 200% FPG	CARE	Non-CARE	CARE	Non-CARE	CARE	Non-CARE
Bill Impact	$2.32	$2.67	$4.72	$2.54	$1.94	$0.55	$5.52	$1.32	$3.49
Percent Impact	1.2%	1.8%	2.8%	1.9%	0.9%	0.5%	2.9%	2.1%	2.7%

Figure 5-39 provides the overall results for customers on Rate 3. Bill reductions were slightly smaller on this rate compared to Rate 1 and Rate 2, with average reductions of about $2.21 per month, or 1.7%. This could be due to the lack of a baseline credit on Rate 3. Bill reductions by CARE/FERA customers were not statistically significant at the 90% level of confidence. Non-CARE/FERA customers reduced their bills by about $2.67 per month, or 1.7%.

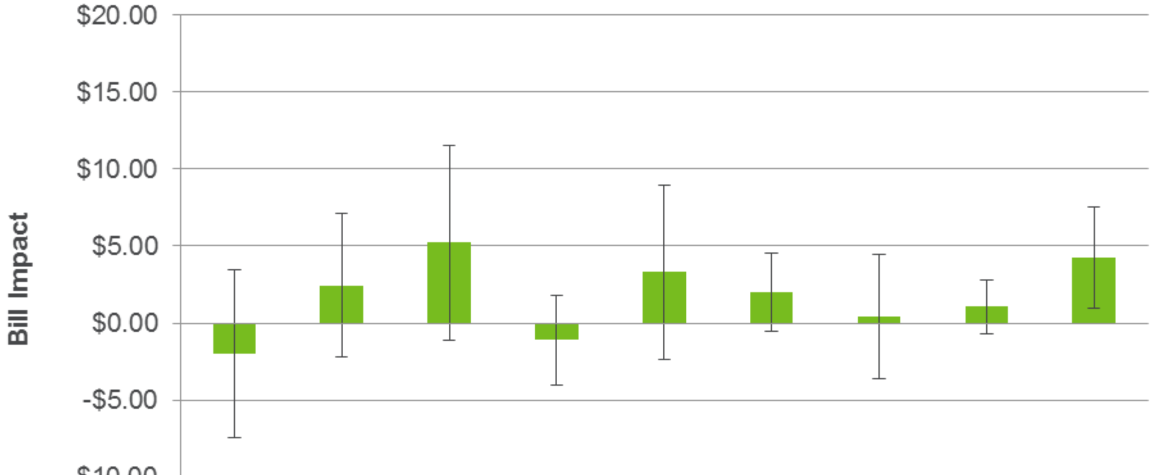
Figure 5-39: Rate 3 Average Bill Impacts from Behavior Change
All | CARE/FERA | Non-CARE/FERA
(Positive values represent bill reductions)



	All Customers	CARE	Non-CARE
Bill Impact	$2.21	$1.17	$2.67
Percent Impact	1.7%	1.4%	1.7%

Figure 5-40 presents the detailed level results by climate region and segment for customers on Rate 3. Only non-CARE/FERA customers in the cool climate region were able to reduce their bills with changes in behavior. Their bill reductions were equal to $4.24 or 3.5%. Some segments saw slight bill increases, but these results are not statistically significant.

Figure 5-40: Rate 3 Average Bill Impacts from Behavior Change Detailed Segments by Climate Region
(Positive values represent bill reductions)



	Hot					Moderate		Cool	
	Senior	Below 100% FPG	100% - 200% FPG	CARE	Non-CARE	CARE	Non-CARE	CARE	Non-CARE
Bill Impact	-$2.02	$2.43	$5.24	-$1.11	$3.29	$2.01	$0.42	$1.08	$4.24
Percent Impact	-1.2%	1.8%	3.3%	-0.9%	1.6%	2.1%	0.2%	1.7%	3.5%

Overall, bill impacts across all of the rates appear to have been largely driven by the non-CARE/FERA customers in the cool and moderate climate regions, except in Rate 3. Bill impacts for the other segments, rates, and climate regions were very small and not statistically significant.

5.4.3 Estimation of the Total Bill Impact Due to Differences in the Tariffs (Holding Usage Constant) and Behavior Change

Total bill impacts experienced by customers on a TOU rate can be decomposed into two components: the structural impact, and the behavioral impact. The structural impact represents the change in customer bills based solely on the change in the underlying structure of the rate. In this case, it is the change from the OAT to the time-differentiated TOU pilot rates. The behavioral impact represents how the customer changed their energy usage in response to the new pricing structure of the rate—which includes higher prices in the afternoon and evening and lower prices at other times of the day. During the summer period, nearly all customers on the TOU rates experienced a structural increase in their bills. However, customers also had an opportunity to offset that increase by changing their energy use behavior in response to the new price signals. As noted above, it is the combination of structural and behavioral bill impacts that produces the total bill impact experienced by the average study participant on each rate.

The results from this analysis represent the average monthly bill across the summer months of July (for Rate 1 and Rate 2 only), August, and September 2016. Three different bills were calculated for each customer segment:[53]

[53] See section 3.2.3 for additional details on the methodology.

- **No Change in Behavior or Tariff [1]:** This represents what the treatment group bills would have been in the post-treatment period if they were on the OAT and had not changed their behavior
- **No Change in Behavior, Change in Tariff [2]:** This represents what the treatment group bills would have been in the post-treatment period if they were on the TOU rate and had not changed their behavior
- **Change in Behavior and in Tariff [3]:** This represents what the treatment group bills were in the post-treatment period on the TOU rate with a change in behavior

Based off of components defined above, the following metrics were calculated:

- The difference between **[1]** and **[2]** is the structural bill impact (based on post-treatment usage after adjusting for any pretreatment difference between control and treatment customers);
- The difference between **[1]** and **[3]** is the bill impact due to structural differences in the rates, but mitigated by changes in behavior; and
- The difference between **[2]** and **[3]** is the amount customers were able reduce their bills by changing their behavior.

In the bill impact analysis, a major policy question was to better understand the relationship between the structural bill impacts, and how customers were able to respond. This relationship is represented by the “percentage of structural loss mitigated by change in behavior” shown in the data table at the bottom of the figures below. Put differently, this percentage represents how much of the bill increase from the TOU rate the average customer was able to offset. Results are organized by rate, climate region, and segment; similarly to the other bill impact analysis sections.

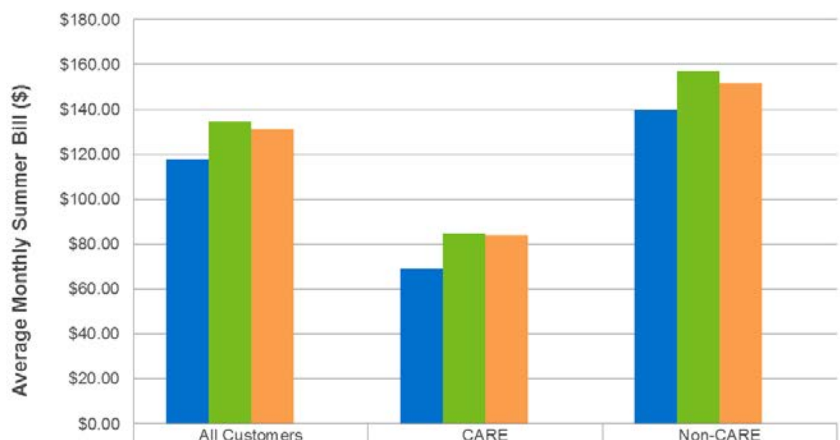
Figure 5-41 presents a set of three average monthly bills as defined above for all customers, CARE/FERA customers, and non-CARE/FERA customers on Rate 1. The blue bar represents a typical summer monthly bill for a customer still on the OAT and not responding to a TOU rate— noted as “No Change in Behavior or Tariff.” For the average customer on Rate 1, this dollar amount was $117.87 per month. The green bar represents what a typical summer monthly bill would be for a customer who was billed on a TOU rate, but didn’t change their energy use behavior— noted as “No Change in Behavior, Change in Tariff.” This dollar amount is $134.79 for the average Rate 1 customer. The difference between the two values, $16.92, is the average increase a customer would see in their bills by changing from the OAT to Rate 1, and not changing their energy use behavior; this is also referred to as the customer’s structural loss. The orange bar represents the average Rate 1 customer’s bill after factoring in the change in rate from the OAT to the Pilot Rate 1, and then also taking into account any changes in energy use behavior— noted as “With Change in Behavior and Tariff.” This bill amount averaged $131.20 for the typical Rate 1 customer. Based off these values, it is possible to estimate the total change in bills including both the change in tariff and in behavior, which was a bill increase of $13.33 per month (11%). The total change in bill is calculated by subtracting the blue ($117.87) from the orange ($131.20).

An additional important metric is the percent of the structural loss—increase in the bills due strictly to the change in tariff—that can be offset or mitigated by customers changing their energy use behavior. As noted above, the average structural loss for Rate 1 customers was $16.92. The amount customers were able to reduce their bills by changing their behavior—compared to what it would have been without any behavior change—is obtained by subtracting the orange bar ("With Change in Behavior and Tariff": $131.20) from the green bar ("No Change in Behavior, Change in Tariff": $134.79), which equals $3.59. Based on these values, customers were able to offset $3.59 out of the $16.92 structural loss, or 21.2%. This value is provided at the bottom of the data table in each figure for convenience.

CARE/FERA customers experienced an average structural loss of $15.69 (23%). Through changes in energy use behavior they were able to offset $0.40 (2.5%), resulting in a total monthly bill increase of $15.29 (22%) after factoring in both changes in the tariff and behavior. It should be noted that the behavior change for CARE/FERA customers on Rate 1 was not statistically significant. Given the small dollar amount to begin with, and the lack of statistical significance, the key take away from this analysis is that the average CARE/FERA customer on Rate 1 did not change their energy use behavior sufficiently to mitigate any of the structural loss.

Conversely, non-CARE/FERA customers were able to mitigate some of their structural loss by a larger portion at 28.7% ($5.00). The average structural loss for non-CARE/FERA customers was $17.46 (12.5%), resulting in a total monthly bill increase of $12.46 (8.9%) after factoring in changes in the tariff and behavior.

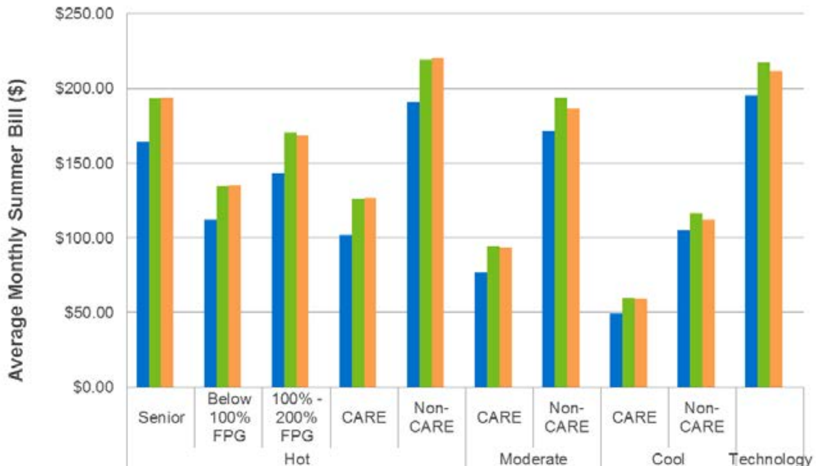
Figure 5-41: Rate 1 Total Bill Impact Due to Differences in the Tariff and Behavior Change All | CARE/FERA | Non-CARE/FERA



All	All Customers	CARE	Non-CARE
No Change in Behavior or Tariff	$117.87	$68.92	$139.51
No Change in Behavior, Change in Tariff	$134.79	$84.61	$156.97
With Change in Behavior and Tariff	$131.20	$84.21	$151.97
% of structural loss mitigated by change in behavior	21.2%	2.5%	28.7%

Figure 5-42 presents the three sets of average monthly bills as defined above for the detailed segments by climate region on Rate 1. Non-CARE/FERA customers in the cool and moderate climate regions offset their structural bill increase by more than 30% through behavior change. Behavioral offsets for the other customer segments were less than 5% and not statistically. Customers with smart thermostats offset their summer bill increases by about 26.1%, but this reduction was also not statistically significant.

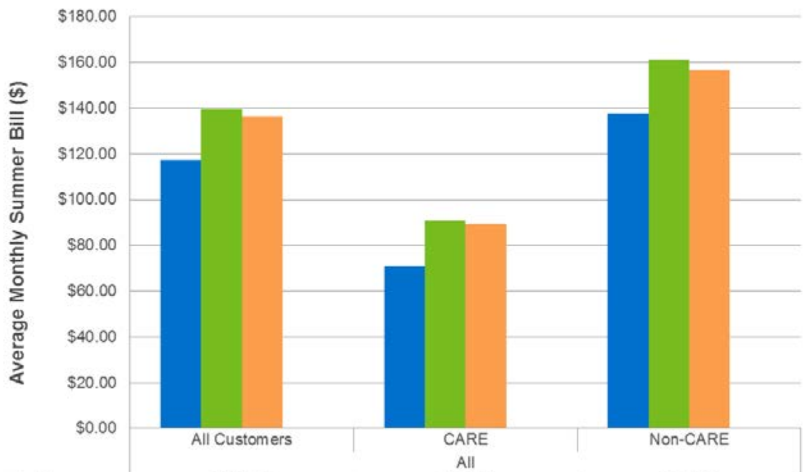
Figure 5-42: Rate 1 Total Bill Impact Due to Differences in the Tariff and Behavior Change Detailed Segments by Climate Region



	Hot					Moderate		Cool		Technology
	Senior	Below 100% FPG	100% - 200% FPG	CARE	Non-CARE	CARE	Non-CARE	CARE	Non-CARE	
No Change in Behavior or Tariff	$164.43	$112.57	$143.37	$101.89	$190.93	$76.74	$171.28	$49.33	$105.25	$195.66
No Change in Behavior, Change in Tariff	$193.50	$134.66	$170.42	$126.34	$219.16	$94.55	$193.90	$59.78	$116.66	$217.27
With Change in Behavior and Tariff	$193.75	$135.11	$168.49	$126.84	$220.18	$93.85	$186.52	$59.38	$112.25	$211.63
% of structural loss mitigated by change in behavior	-0.8%	-2.0%	7.1%	-2.0%	-3.6%	3.9%	32.6%	3.8%	38.7%	26.1%

Figure 5-43 presents the three sets of average monthly bills for all customers, CARE/FERA customers, and non-CARE/FERA customers on Rate 2, which were similar in nature to Rate 1. The average Rate 2 customer experienced a structural loss of $22.15 (19%). Through changes in energy use behavior, they were able to offset about $3.21 (14.5%), resulting in a total monthly bill increase of $18.94 (16%) after factoring in both changes in the tariff and behavior. CARE/FERA customers experienced an average structural loss of $19.44 (27%). They were able to mitigate this loss by about 6.0%, which is more than those on Rate 1 (however, their structural losses were much larger). Non-CARE/FERA customers were able to reduce their structural loss of $23.36 by 17.6%, resulting in a monthly bill increase of $19.24.

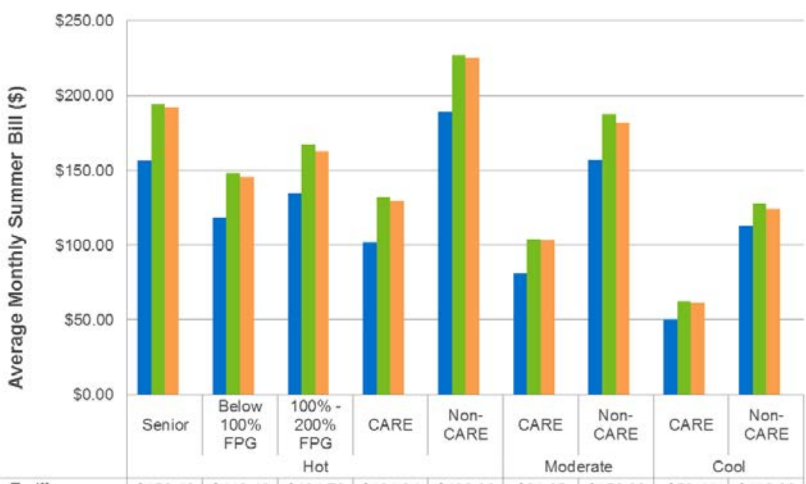
Figure 5-43: Rate 2 Total Bill Impact Due to Differences in the Tariff and Behavior Change All | CARE/FERA | Non-CARE/FERA



	All Customers	CARE	Non-CARE
		All	
No Change in Behavior or Tariff	$117.36	$71.24	$137.74
No Change in Behavior, Change in Tariff	$139.51	$90.68	$161.10
With Change in Behavior and Tariff	$136.30	$89.51	$156.98
% of structural loss mitigated by change in behavior	14.5%	6.0%	17.6%

Figure 5-44 presents the three sets of average monthly bills for the detailed segments by climate region on Rate 2. Non-CARE/FERA customers in the moderate and cool climate region were able to offset their structural bill increase by 18% and 23.5%, respectively. Customers in households making between 100% and 200% of FPG reduced their structural loss by nearly 15%, however their bill reduction due to behavior change was not statistically significant.

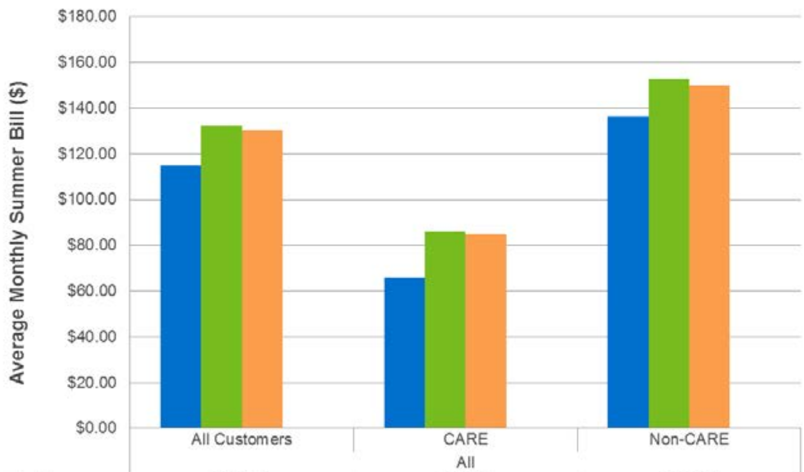
Figure 5-44: Rate 2 Total Bill Impact Due to Differences in the Tariff and Behavior Change Detailed Segments by Climate Region



	Senior	Below 100% FPG	100% - 200% FPG	CARE	Non-CARE	CARE	Non-CARE	CARE	Non-CARE
	Hot					Moderate		Cool	
No Change in Behavior or Tariff	$156.49	$118.40	$134.79	$101.84	$189.00	$81.05	$156.90	$50.41	$113.03
No Change in Behavior, Change in Tariff	$194.46	$148.24	$167.19	$132.18	$227.07	$103.85	$187.62	$62.55	$127.88
With Change in Behavior and Tariff	$192.14	$145.57	$162.46	$129.64	$225.13	$103.30	$182.11	$61.23	$124.39
% of structural loss mitigated by change in behavior	6.1%	8.9%	14.6%	8.4%	5.1%	2.4%	18.0%	10.9%	23.5%

Figure 5-45 presents the three sets of average monthly bills for all customers, CARE/FERA customers, and non-CARE/FERA customers on Rate 3. For the average Rate 3 customer, the three sets of bills were all slightly lower than their Rate 1 and Rate 2 counterparts, but the percent reduction in structural losses was also a bit smaller. Customers on Rate 3 face an average structural bill increase of $17.53 (15%) but are able to reduce that to $15.33 (13%) through changes in behavior. Non-CARE/FERA customers were the most successful and were able to reduce their structural bill increases by 16.4%.

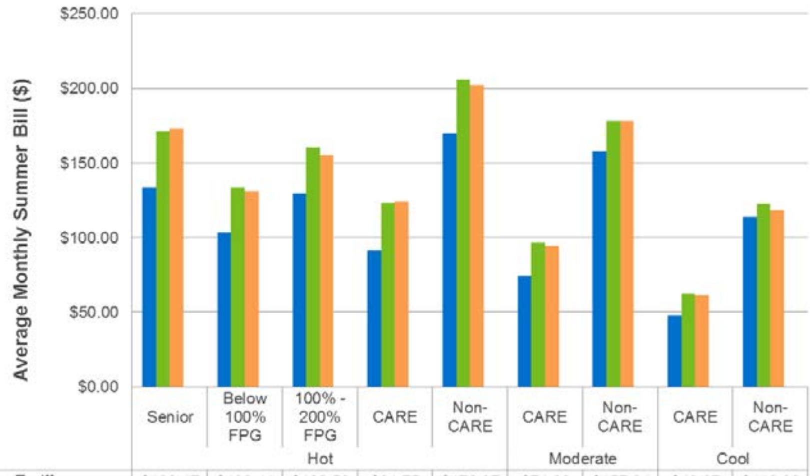
Figure 5-45: Rate 3 Total Bill Impact Due to Differences in the Tariff and Behavior Change All | CARE/FERA | Non-CARE/FERA



	All Customers	CARE	Non-CARE
No Change in Behavior or Tariff	$114.88	$65.89	$136.53
No Change in Behavior, Change in Tariff	$132.41	$86.17	$152.85
With Change in Behavior and Tariff	$130.20	$85.00	$150.18
% of structural loss mitigated by change in behavior	12.6%	5.8%	16.4%

Figure 5-46 presents the three sets of average monthly bills for the detailed segments by climate region on Rate 3. Customers in senior households and CARE/FERA customers in the hot climate zone were not able to reduce their bill increases with changes in behavior, but these results were not statistically significant.

Figure 5-46: Rate 3 Total Bill Impact Due to Differences in the Tariff and Behavior Change Detailed Segments by Climate Region



	Hot: Senior	Hot: Below 100% FPG	Hot: 100% - 200% FPG	Hot: CARE	Hot: Non-CARE	Moderate: CARE	Moderate: Non-CARE	Cool: CARE	Cool: Non-CARE
No Change in Behavior or Tariff	$133.47	$103.41	$129.58	$91.75	$170.07	$74.38	$157.94	$48.07	$113.66
No Change in Behavior, Change in Tariff	$170.82	$133.54	$160.83	$123.30	$205.70	$96.77	$178.45	$62.25	$122.95
With Change in Behavior and Tariff	$172.84	$131.11	$155.60	$124.41	$202.40	$94.76	$178.04	$61.17	$118.71
% of structural loss mitigated by change in behavior	-5.4%	8.1%	16.8%	-3.5%	9.2%	9.0%	2.0%	7.6%	45.7%

Overall, the average customer across each of the rates was able to offset a small portion of the structural bill impact by over 10%. However, the offsets were largely driven by the non-CARE/FERA customers in the moderate and cool climate regions. For the most part, the other segments were not able to offset much of their structural loss and many of the observed behavioral impacts were not statistically significant.

5.4.4 Change in the Distribution of Bill Impacts Due to Behavior Change

The fourth analysis presents the distribution of bill impacts for customers with and without behavioral change, and is designed to show how the distribution shifts when customers respond to the rates by changing behavior. Similar to the other analyses, impact distributions are based on the average summer monthly bills for July (for Rate 1 and Rate 2 only), August, and September. Bill impacts were estimated for two cases—with and without behavior change. Customers were segmented into ranges of bill impacts. The percentage of customers in each $10 increment from negative $100 to positive $100 per month (with and without behavior change) was determined with and without behavior change. The underlying calculations used to develop the distributions are based off of a difference-in-differences approach that compares the treatment and control customers based on both pre- and post-treatment bill impacts.54

The two distributions are presented on a line graph, with the height of the line at any given $10 increment representing the percentage of customers experiencing a bill impact of the corresponding dollar amount. In this case, the bill impact is measured as the difference between the TOU bill and the OAT bill. If the line for the group with changes in behavior is to the left of the line representing the group with no change in behavior, it shows that at least some customers were able to modify their energy usage such that they had lower bill impacts compared to if they had not changed their behavior.

54 See section 3.2.4 for additional details on the methodology.

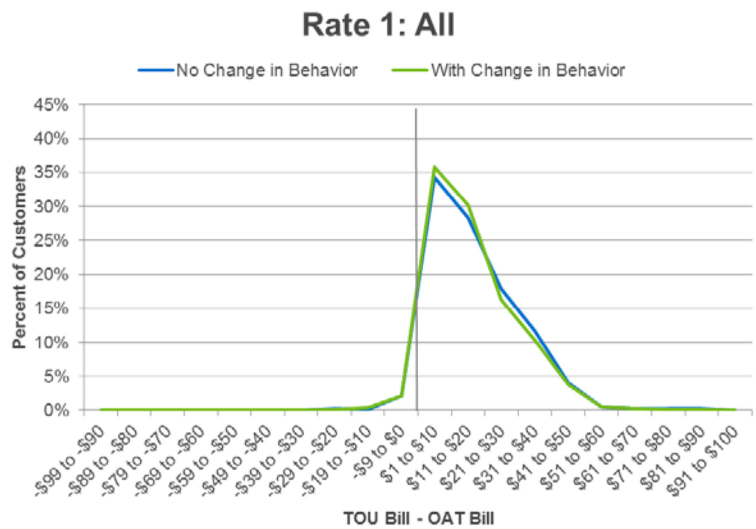
Figure 5-47 presents the distribution of bill impacts with and without energy use behavior change. The blue line represents the structural bill impacts that result when customers are billed on the TOU rate and do not change their energy use behavior. The green line shows the bill impacts when customers have responded to the TOU rate and, in some cases, changed their energy use behavior. Bill impacts are calculated as the difference between the TOU bill and the OAT bill. Each point along the line graph represents the percentage of customers within a specific bill impacts bin or range. For example, on Rate 1, approximately 18% of the customers have structural bill impact of $21 to $30 per month—the blue line. In other words, approximately 18% of the Rate 1 customers would experience an increase of $21 to $30 per month on Rate 1 compared to the OAT without changing their behavior. The green line represents the bill impacts when customers have had the opportunity to respond to the TOU rate. In this case, the percent of customers experiencing an increase of $21 to $30 per month on Rate 1 compared to the OAT is 16%, showing a slight decrease.

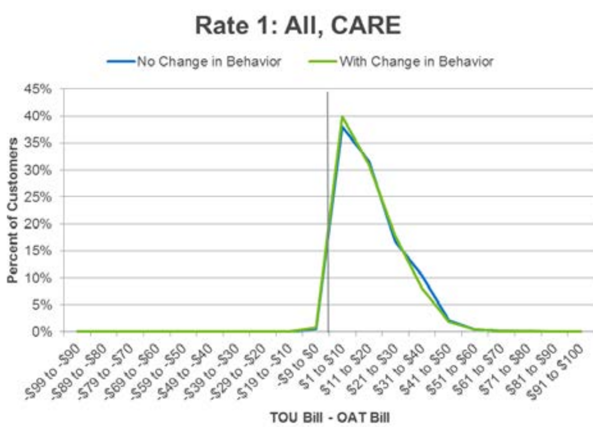
It is important to note that customers could move up or down through the incremental impact bins, and could potentially move more than one bin—meaning that a customer could potentially experience a bill increase due to their behavioral response, or they could jump down several bins and go from a $21 to $30 per month bill impact down to $11 to $20 impact, for example. In the case of the average Rate 1 customers, there is an increase in the percent of customers with a bill impact of between $11 and $20 per month. With no change in behavior, 28% of customers were in this bin and with behavior change 30% of customers are now in this bin. Looking at the shape of the distributions and the table reporting the percentages, it is clear that with behavior change there were fewer customers in the $31 to $40 range, and in the$21 to $30 range. While it isn’t clear exactly where those customers moved, it is clear that ultimately some customers were able to make changes in their energy use behavior that resulted in offsetting some of the structural loss, as covered in the previous sections. While the percentage of customers in the $11 to $20 bin increased, it was because they were originally in higher bill impact ranges and have since transitioned down to a lower bin.

As noted in the previous section, CARE/FERA customers on average did not offset any of the structural loss through behavior change. This is also apparent in the graph below, where there is very little separation between the green and blue lines, especially in the lower bill impact bins. On the other hand, the non-CARE/FERA customers were able to slightly offset the structural bill impacts, and this can be observed in the graph where sections of the green line are to the left of or below the blue line. It’s also important to note that instances where the green line is to the right of or above the blue line in the lower bill impact ranges indicate more customers have moved into that bin, likely from higher impact bins. This is the case where there is a higher percentage of non-CARE/FERA customers in the $11 to $20 range after behavior change compared to before behavior change.

Figure 5-47: Rate 1 Change in the Distribution of Bill Impacts Due to Behavior Change All | CARE/FERA | Non-CARE/FERA

Pilot Bill - Tiered Bill	No Change in Behavior	With Change in Behavior
-$99 to -$90	0%	0%
-$89 to -$80	0%	0%
-$79 to -$70	0%	0%
-$69 to -$60	0%	0%
-$59 to -$50	0%	0%
-$49 to -$40	0%	0%
-$39 to -$30	0%	0%
-$29 to -$20	0%	0%
-$19 to -$10	0%	0%
-$9 to $0	2%	2%
$1 to $10	34%	36%
$11 to $20	28%	30%
$21 to $30	18%	16%
$31 to $40	12%	10%
$41 to $50	4%	4%
$51 to $60	1%	0%
$61 to $70	0%	0%
$71 to $80	0%	0%
$81 to $90	0%	0%
$91 to $100	0%	0%





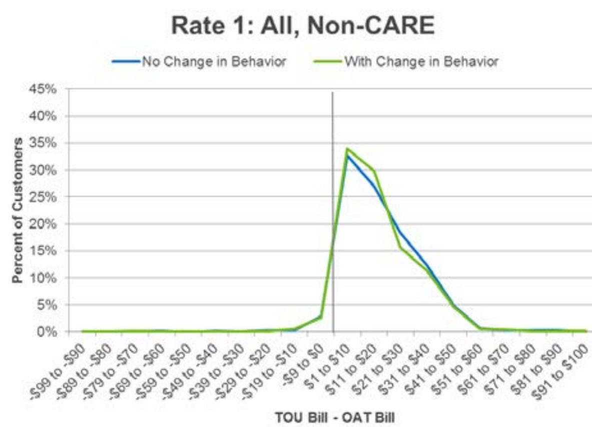
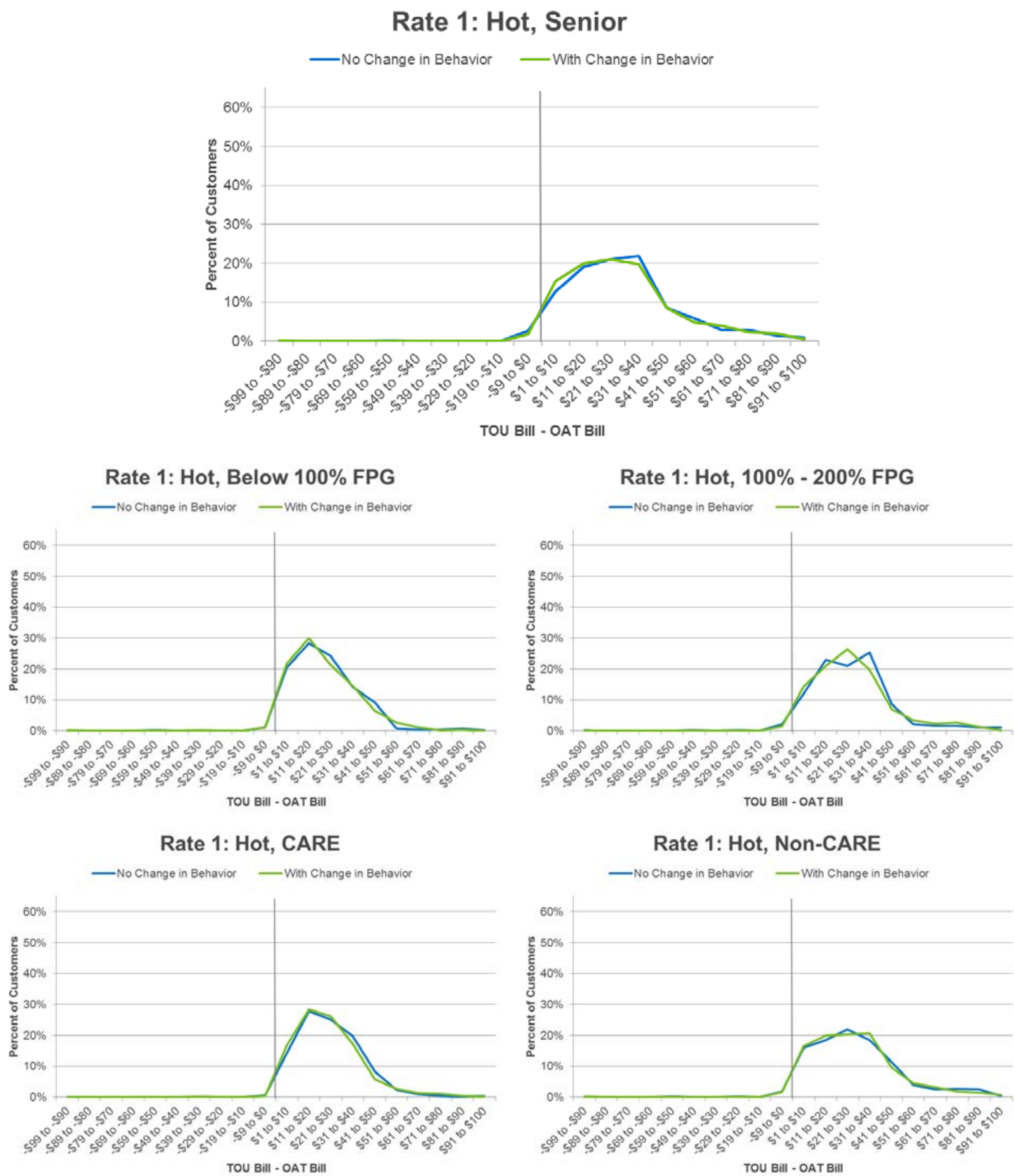


Figure 5-48 provides the distribution of bill impacts for the detailed segments by climate zone. As noted above in section 5.4.2, the only Rate 1 segments with statistically significant bill impacts were non-CARE/FERA customers in the moderate and cool climate regions. In each of those segments, it is possible to see how the distribution has shifted slightly. It's also worth noting that there are instances where there weren't statistically significant bill impacts. However, it's clear some shifting took place. Nevertheless, based on the outcomes it is apparent that not all of the shifting was into lower bill impact ranges given that the overall outcome for that segment was near zero and not statistically significant.

Figure 5-48: Rate 1 Change in the Distribution of Bill Impacts Due to Behavior Change Detailed Segments by Climate Region



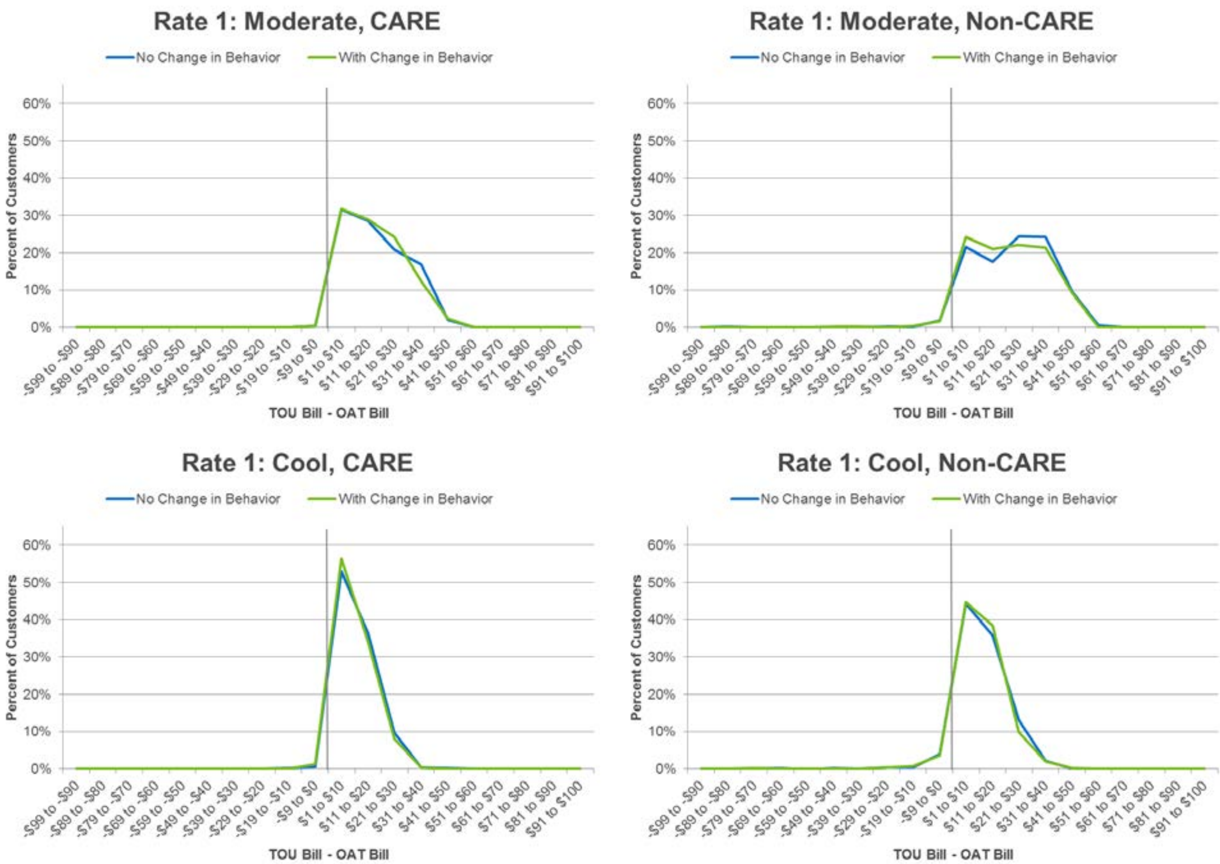
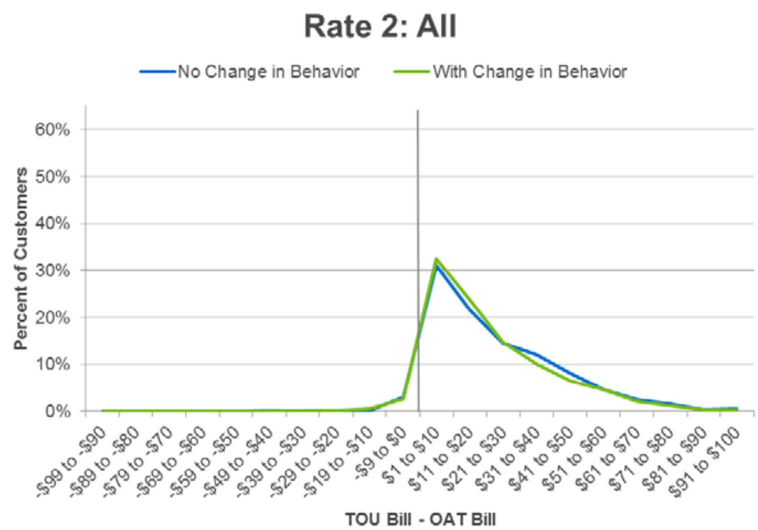
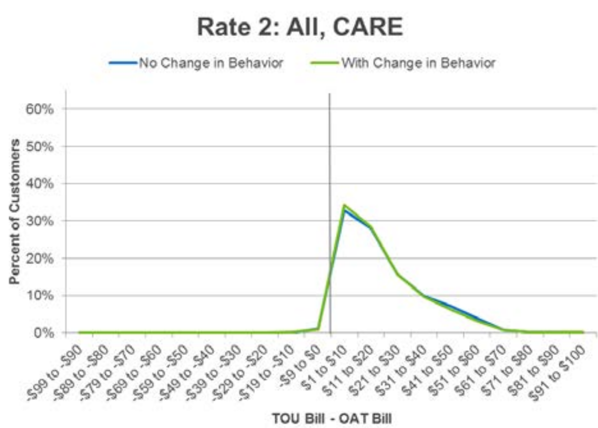


Figure 5-49 provides the distributions of bill impacts for all customers and CARE/FERA and non-CARE/FERA customers on Rate 2. The average Rate 2 customer was able to offset approximately $3.21 of the structural loss through behavior change. Based on the graph, some customers with larger impacts in the $41 to $50 range were able to transition down to lower bins. On average, Rate 2 CARE/FERA customers were not able to offset any of the structural loss. This is further illustrated with the very small shifts in the distributions of bill impacts with and without change in behavior. As with Rate 1, non-CARE/FERA customers show the largest behavioral bill impacts. This is shown where there is a notable reduction in the $31 to $40 per month bill impact range, and growth in the lower impact ranges.

Figure 5-49: Rate 2 Change in the Distribution of Bill Impacts Due to Behavior Change
All | CARE/FERA | Non-CARE/FERA

Pilot Bill - Tiered Bill	No Change in Behavior	With Change in Behavior
-$99 to -$90	0%	0%
-$89 to -$80	0%	0%
-$79 to -$70	0%	0%
-$69 to -$60	0%	0%
-$59 to -$50	0%	0%
-$49 to -$40	0%	0%
-$39 to -$30	0%	0%
-$29 to -$20	0%	0%
-$19 to -$10	0%	1%
-$9 to $0	4%	4%
$1 to $10	30%	32%
$11 to $20	19%	22%
$21 to $30	14%	14%
$31 to $40	13%	10%
$41 to $50	8%	7%
$51 to $60	5%	5%
$61 to $70	3%	3%
$71 to $80	2%	2%
$81 to $90	0%	1%
$91 to $100	1%	1%





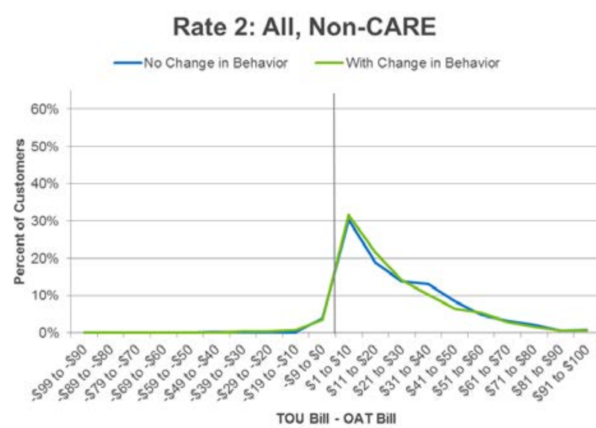
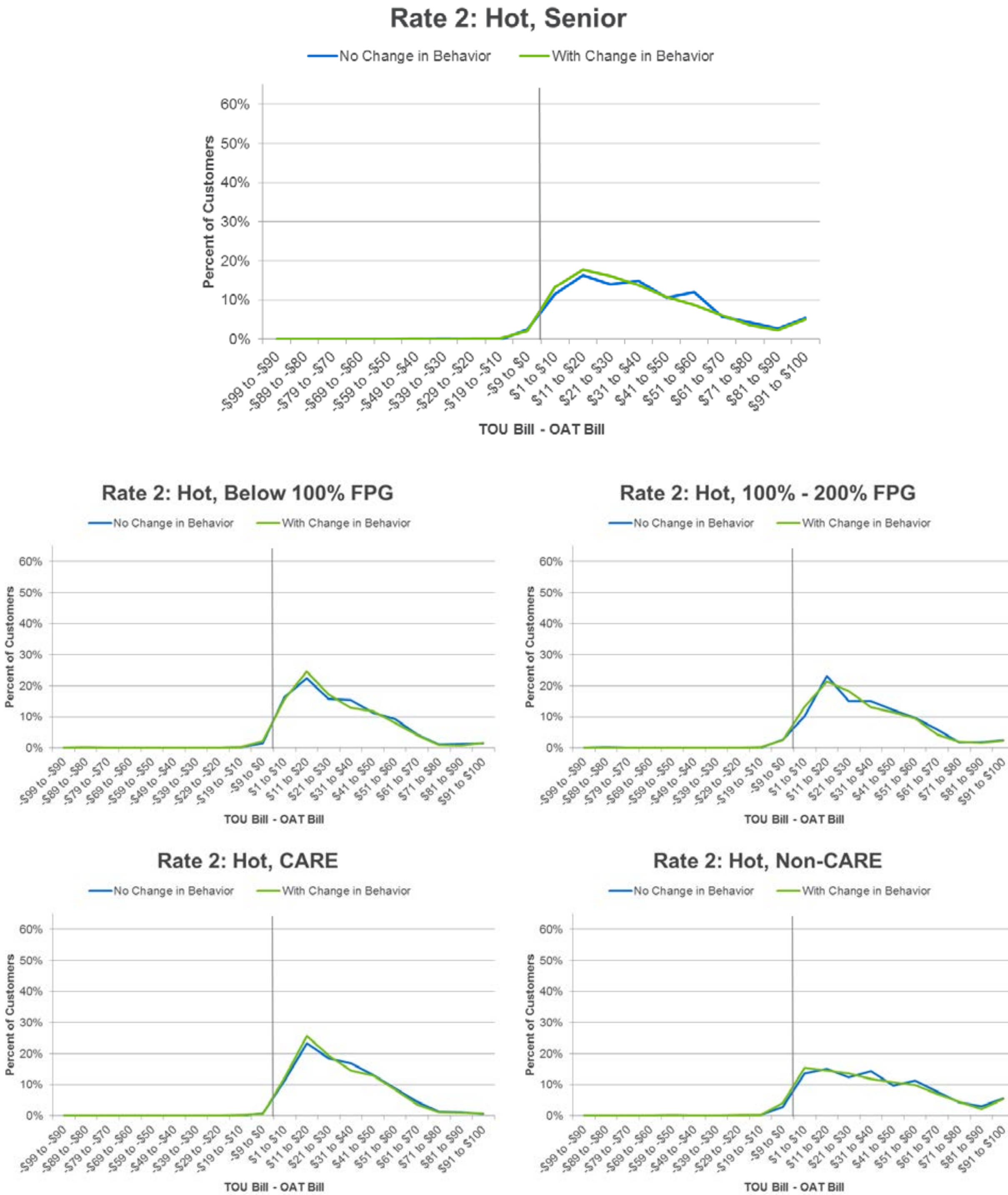


Figure 5-50 shows the distribution of bill impacts for the detailed segments by climate zone for Rate 2. As noted above, the only Rate 2 segments with statistically significant bill impacts were non-CARE/FERA customers in the cool and moderate climate regions. The non-CARE/FERA customers in the moderate climate region show a dramatic shift in the distribution of bill impacts with and without behavior change. Some of the other segments show changes in the distribution. However, the bill impacts for the remaining segments were not statistically significant. This indicates that while on average there were no bill impacts, there are customers within the segments that are experiencing meaningful bill impacts.

Figure 5-50: Rate 2 Change in the Distribution of Bill Impacts Due to Behavior Change Detailed Segments by Climate Region



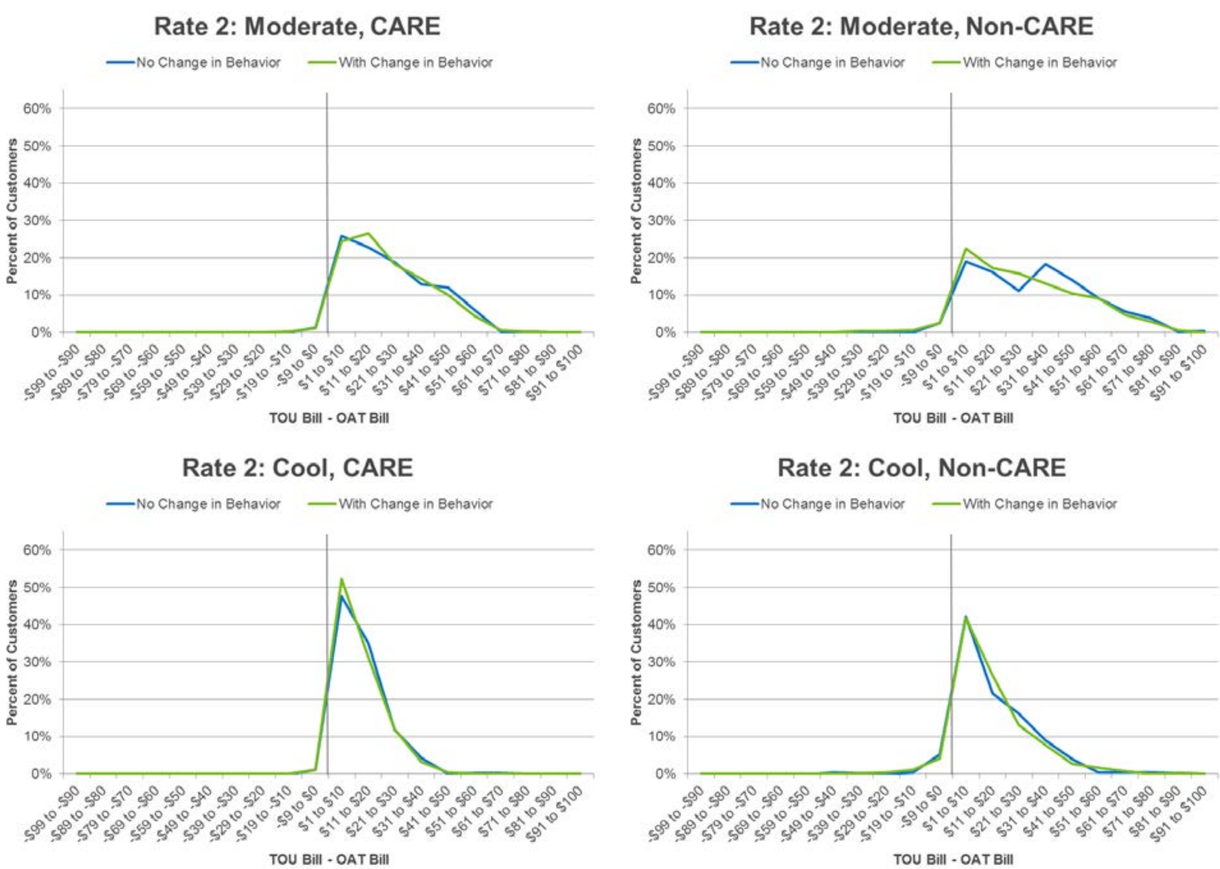
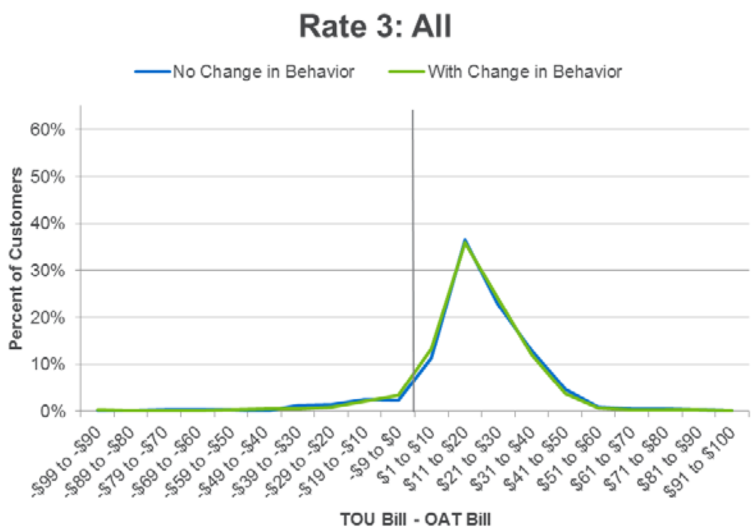
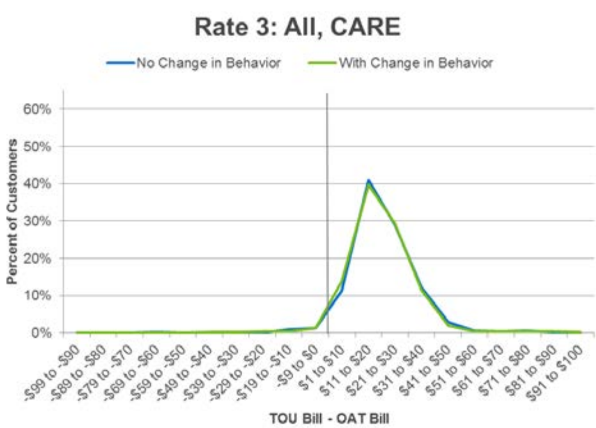


Figure 5-51 shows the distribution of bill impacts for al customers and for CARE/FERA and non-CARE/FERA customers on Rate 3. The average Rate 3 customers was able to offset approximately $2.21 (12.6%) of the structural loss. Based on the graph, it appears that some customers who were very close to being structural benefiters were able to shift into that category with changes in behavior. As with Rates 1 and 3, CARE/FERA customers were not able to offset any of their structural loss. Non-CARE/FERA customers were the segment with the largest behavioral bill impacts – the shift from the $11 to $20 to the $1 to $10 range is quite clear.

Figure 5-51: Rate 3 Change in the Distribution of Bill Impacts Due to Behavior Change All | CARE/FERA | Non-CARE/FERA

Pilot Bill - Tiered Bill	No Change in Behavior	With Change in Behavior
-$99 to -$90	0%	0%
-$89 to -$80	0%	0%
-$79 to -$70	0%	0%
-$69 to -$60	1%	0%
-$59 to -$50	1%	0%
-$49 to -$40	0%	1%
-$39 to -$30	2%	1%
-$29 to -$20	2%	1%
-$19 to -$10	3%	3%
-$9 to $0	3%	4%
$1 to $10	11%	13%
$11 to $20	35%	34%
$21 to $30	20%	22%
$31 to $40	13%	12%
$41 to $50	6%	5%
$51 to $60	1%	1%
$61 to $70	1%	0%
$71 to $80	1%	0%
$81 to $90	0%	0%
$91 to $100	0%	0%





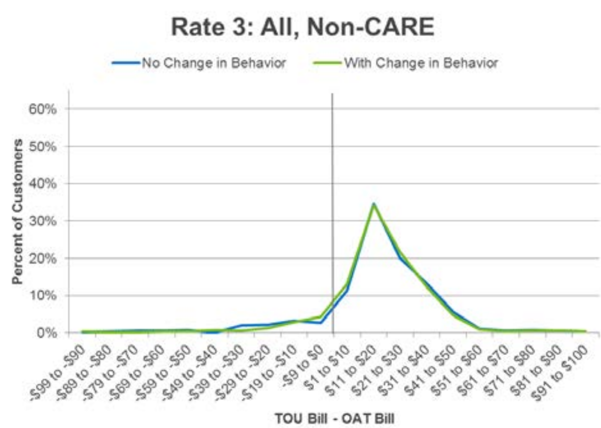
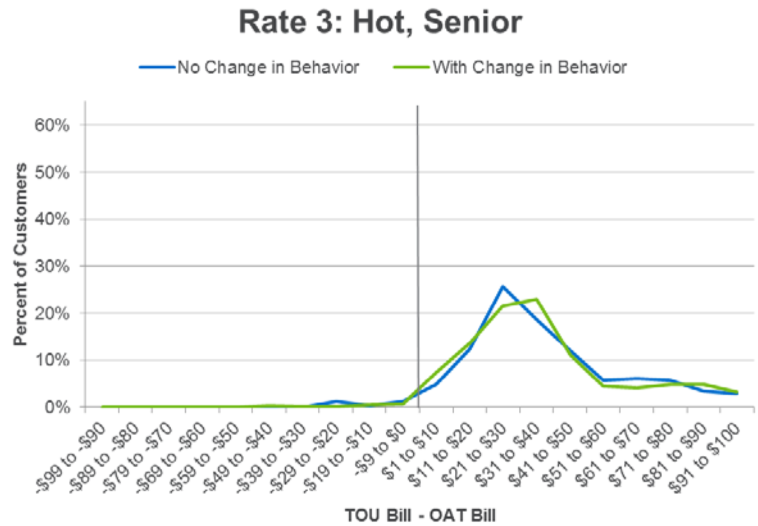
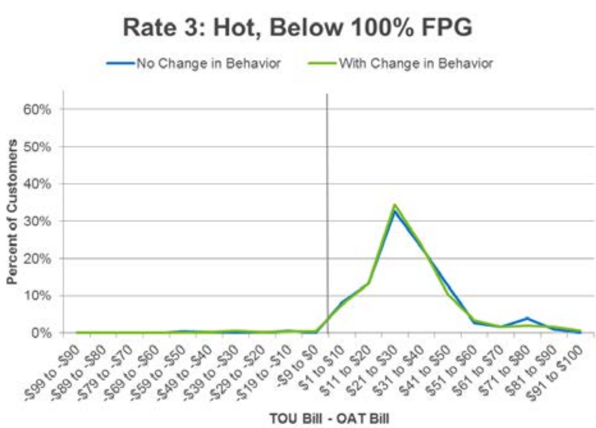
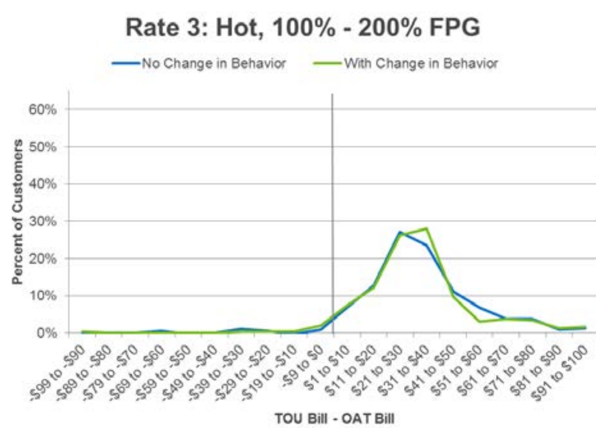


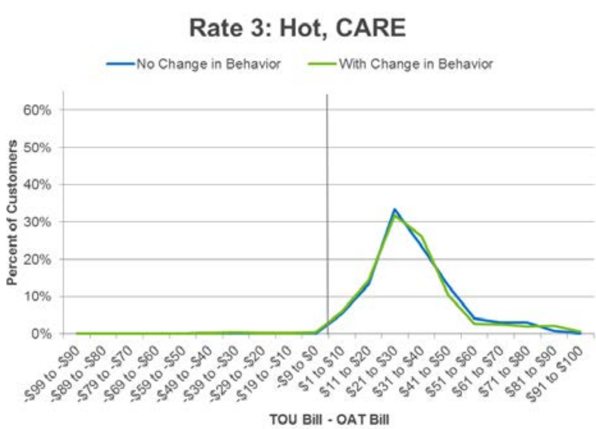
Figure 5-52 shows the distribution of bill impacts for the detailed segments by climate zone for Rate 3. As noted above in Section 5.4.2, the only Rate 3 segment with statistically significant bill impacts was non-CARE/FERA customers in the cool climate region. This segment shows a shift in the smaller bill impact bins, but the shift is not immediately obvious in the higher impact bins.

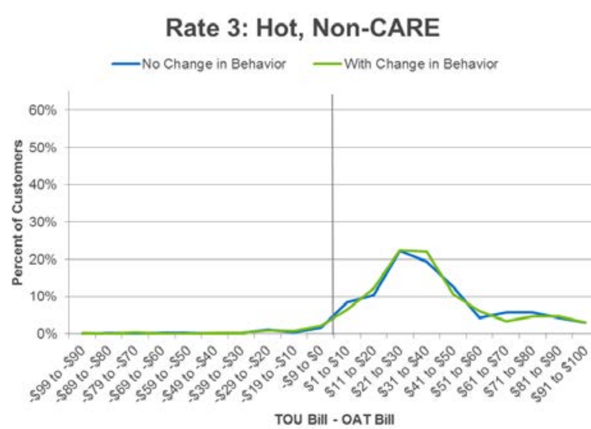
Figure 5-52: Rate 3 Change in the Distribution of Bill Impacts Due to Behavior Change Detailed Segments by Climate Region

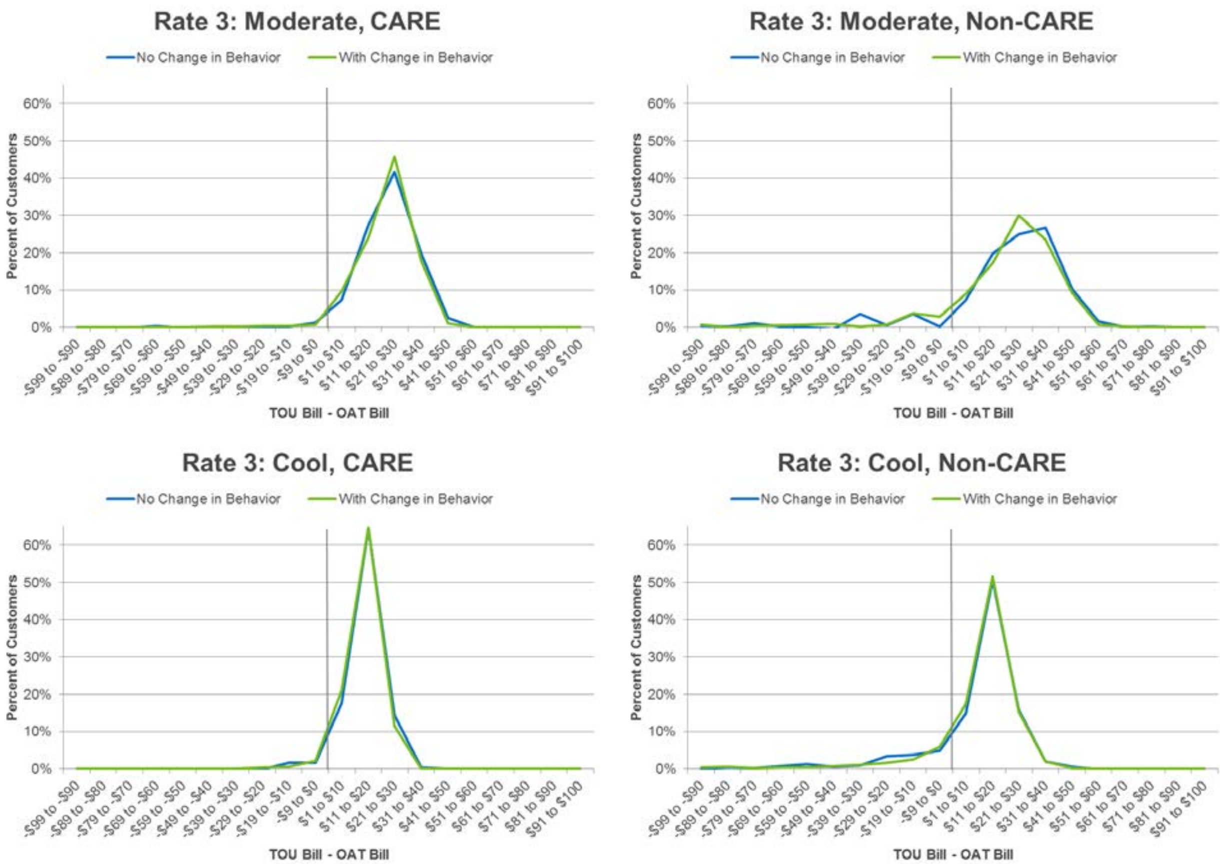












5.5 Survey Findings

To be added

5.6 Synthesis

To be added

6 SDG&E Evaluation

This report section summarizes the design and evaluation of the SDG&E pilot. It begins with a summary of the rate and other treatments that were tested in the pilot. This is followed by a brief overview of the pilot implementation process, which includes a discussion of enrollment rates and customer attrition. Section 6.3 presents the load impact estimates for each rate and complementary treatment and Section 6.4 summarizes the bill impacts. Section 6.5 presents the survey results, including key findings regarding hardship for selected customer segments. The final section contains a high level summary and synthesis of the survey and impact findings.

6.1 Pilot Treatments

SDG&E filed its TOU Pilot Plan advice letter on December 30, 2015.[55] 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 submitted on January 22, 2016[56]. SDG&E's pilot plan was approved with modifications on March 17, 2016.[57]

SDG&E's pilot primarily focused on recruiting customers onto one of two rate options, summarized in Table 6-1 and Figures 6-1 and 6-2. 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 6-1: 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

55 Advice Letter 2835-E

56 Advice Letter 2835-E-A.

57 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 6-1: 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¢)		

Figure 6-2: 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 2 has the same peak period, from 4 to 9 PM, as Rate 1 and the peak period prices are also the same as Rate 1. The peak period and peak period prices are the same all year. In summer, the peak-to-off-peak price ratio for Rate 2 is roughly 1.7 to 1.

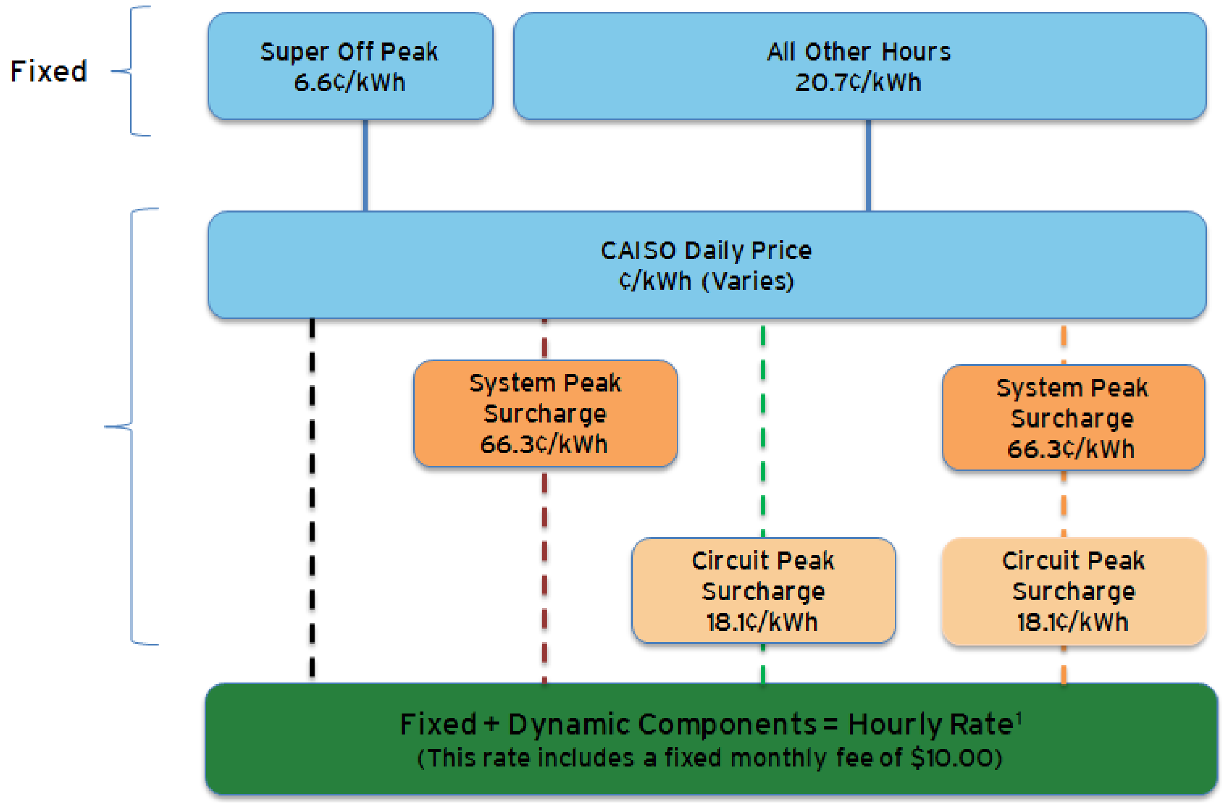
Rates 1 and 2 have baseline credits to reflect the tiered structure of the standard rate. The credits for up to 130% of baseline are 20.32¢ and 18.64¢ for the summer and winter seasons respectively. This credit significantly reduces average prices, especially for lower usage customers. For reference, Table 6-2 shows the tiered rate that control customers were placed on.

Table 6-2: 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 6-3 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, 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. Recruitment onto Rate 3 did not start until September. As such, load impacts for this rate are not included in this report.

Figure 6-3: SDG&E Rate 3



In addition to the above rate options, SDG&E's pilot is testing the impact of weekly usage alerts, known as Weekly Alert Emails (WAE), on demand response under TOU rates. The WAE used in summer 2016 provided weekly emails to participants that report the prior week's electricity usage by rate period. A new WAE was launched in mid-October. This version includes a bill-to date forecast, an updated usage chart displaying usage by peak period, and a doughnut chart illustrating the total amount of usage by peak period for the billing period. A random sample of 2,500 Rate 2 customers was chosen to receive the WAEs on a default basis. SDG&E had email addresses on just over 70% of this sample, so WAE's actually were delivered to roughly 1,775 customers out of the target group of 2,500.

A final test being done by SDG&E will assess the take rate for smart thermostats by customers who are already on a TOU rate. SDG&E offered two different rebates, $100 and $200, to both TOU treatment and control customers who purchase a smart thermostat. Marketing for this treatment began on October 1 and ran through the end of December.

6.2 Implementation Summary

The targeting and sampling plan for SDG&E's pilot 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 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 6-3 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/FERA and non-CARE/FERA 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.[58]

Table 6-3: 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 conducted a pretest to determine expected acceptance rates under different marketing materials, incentive levels, delivery channels and with and without bill protection. The test was conducted in March. 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. 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 bill protection. SDG&E also concluded from the pretest that it would be cost effective to initially use email solicitation for 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.

Prior to pulling the recruitment sample for Pilot Rates 1 and 2, selected customers were screened out from participating in the pilot.[59] A detailed accounting of all exclusion criteria is contained in Section 4.1

[58] See power analysis memo in Appendix G of Appendix Volume 1. 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.

[59] 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.

of Appendix Volume 1. After applying the exclusions, the eligible population equaled roughly 820,000, or about 64% of SDG&E's 1.3 million residential customers.

6.2.1 Customer Recruitment

Recruitment for SDG&E's pilot began on April 19 with an 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.

The emails and letters prominently displayed the $200 incentive that participants could earn by being in the study. They 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 was also discussed.

Table 6-4 shows the number of customers that received solicitations, the number who accepted and the acceptance rate for each target 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 regions. The acceptance rate in the hot climate region, 9%, was actually higher than in the other two climate regions.

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

Category	Hot Climate Region	Moderate Climate Region		Cool Climate Region		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 WAEs 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)

SDG&E's goal for Rate 3, which is 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, non-employee, customers included those who have a smart thermostat installed, have previously participated in SDG&E energy efficiency programs, on a residential rate, and have a valid email address on file. A concurrent, non-related, effort around enabling technology was conducted by a third party and has contributed an additional number of HourX participants.

Overall, SDG&E reached out to 435 customers. 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)[60]. 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 has a microsite and smart app feature that provide HourX specific information. It includes the day ahead forecasted pricing, and tips and tools to help save energy while on the dynamic rate.

As mentioned above, SDG&E also tested whether being on a TOU rate increases the acceptance rate for smart thermostats based on two different incentive levels. Two random samples were drawn from the Rate 1 and Rate 2 treatment groups and from the control group. Initial solicitations were sent on October 1 with follow up communications sent on December 1. If SDG&E had an email address, the solicitations were sent via email – if not, they were sent via direct mail. A total of 14,224 solicitations were sent out, split almost evenly between an offer for a $200 rebate and an offer for a $100 rebate. For the $200 rebate, 2.6% of customers submitted applications for the rebate and incentives were paid to 165 customers (almost 90% of those who applied). The majority of those declined did not qualify and the second largest group were rejected due to duplication of enrollment. For the $100 incentive group, the application rate was 1.4%, roughly half that for the $200 incentive group, and incentives were paid to 82 customers after turning down those that don't qualify. The application rates for each rate group and for the control group were nearly identical. Put another way, customers on one of the TOU rates did not apply for a smart thermostat incentive at a higher rate than those who remained on the OAT. It should also be noted that the smart thermostat purchase rate nearly doubled when a $200 incentive was offered compared with a $100 incentive.

6.2.2 Rate Assignment and Enrollment

Not all customers who agreed to participate in the pilot were actually enrolled. Table 6-5 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 when 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.

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

As seen in Table 6-5, almost a thousand customers were deemed to be ineligible after accepting the recruitment offer but before being assigned to a treatment. This high number 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, as PG&E and SCE did, thereby avoiding this exclusion post acceptance. However, during the recruitment process, SDG&E realized this screen had not been applied 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.

Table 6-5: Distribution of SDG&E 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

By far the most significant reason why customers were not enrolled in the study was due to over recruitment. As seen in Table 6-5, SDG&E targeted to enroll roughly 15,000 customers but had almost 31,000 accept the offer. Due to the compressed recruitment schedule (SDG&E started recruiting customers later than PG&E and SCE), a large number of reply cards had not been received and processed prior to a determination to send 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 region, 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 region customers were received and processed after the enrollment cut-off date, resulting in these customers being declined from participating 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. 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. Unlike the control groups for the other rates, the control group in the hot region was not surveyed nor given an enrollment incentive since they were not officially enrolled in the pilot.

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.[61]

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. The letters also indicated that more details would follow and reminded participants 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.

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 5th indicating the prices being charged in each rate period. The letters indicated that welcome kits

[61] **1 SDG&E AL 2890-E-D; SDG&E AL 2861-E-A**

would be arriving soon. 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.

6.2.3 Customer Attrition

Table 6-6 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 December 31, 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 December 31, 2016.

Over this period, 1,178 customers left the pilot due either to ineligibility, moving or proactively dropping out. Of this total, roughly 65% left because they moved location. Only 248 customers, or roughly 2%, 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 6-6: 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 12-31-2016	399	3,313	3,642	3,527	3,745	14,626
Ineligible Post-Rate Assignment	**7**	**26**	**71**	**13**	**50**	**167**
Ineligibles, Pre-Notification	0	7	12	0	15	34
Ineligibles, Pre-Rate Change	2	3	14	2	3	24
Ineligibles, Post-Rate Change	5	16	45	11	32	109
Moved Post-Rate assignment	**12**	**208**	**144**	**235**	**164**	**763**
Moves, Pre-Notification	7	91	53	87	68	306
Moves, Pre-Rate Change	0	26	2	29	1	58
Moves, Post-Rate Change	5	91	89	119	95	399
Opt-Out Post-Rate Assignment	**14**	**63**	**89**	**33**	**49**	**248**
Opt-Outs, Pre-Notification	0	11	6	8	9	34
Opt-Outs, Pre-Rate Change	0	0	2	0	0	2
Opt-Outs, Post-Rate Change	14	52	81	25	40	212
Total	33	297	304	281	263	1,178
Attrition rate	8%	8%	8%	7%	7%	7%

Figures 6-4 through 6-6 show the cumulative opt-out rates over time for each test cell and climate region. The cumulative number of opt-outs is similar in the hot and moderate climate regions, between 2.5% and 3.5%. The control group in the hot climate region is made up of customers who were turned away from the pilot, therefore they cannot opt out. The opt-out rate in the cool climate region is very low for all customer segments, only reaching about 1.5% by the end of 2016. In the moderate and cool climate regions, non-CARE/FERA customers had slightly higher opt-out rates than CARE/FERA customers. Opt-out rates appear to level off near the beginning of November, when customers were transitioned to the winter rate period.

Figure 6-4: SDG&E Opt Outs by Month – Hot Climate Region

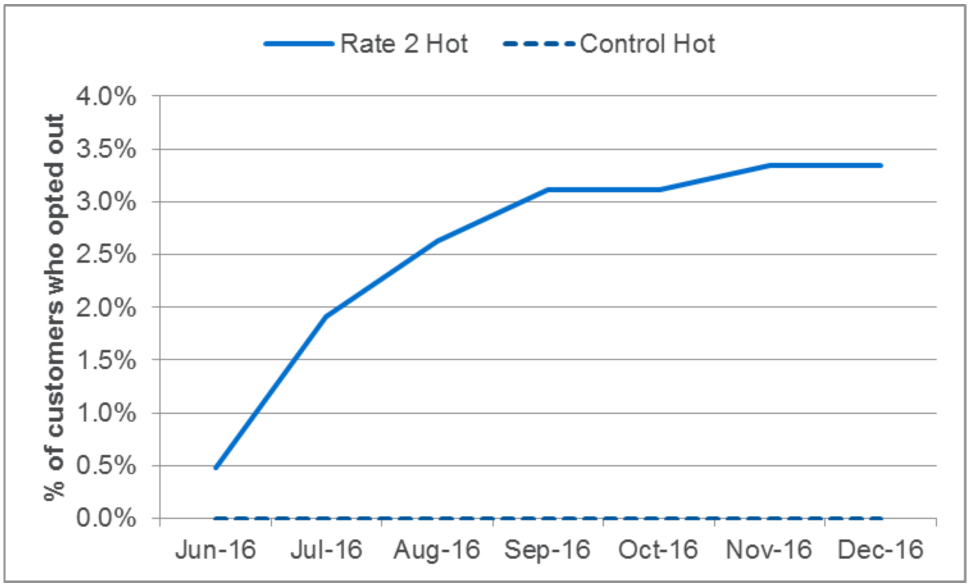


Figure 6-5: SDG&E Opt Outs by Month – Moderate Climate Region

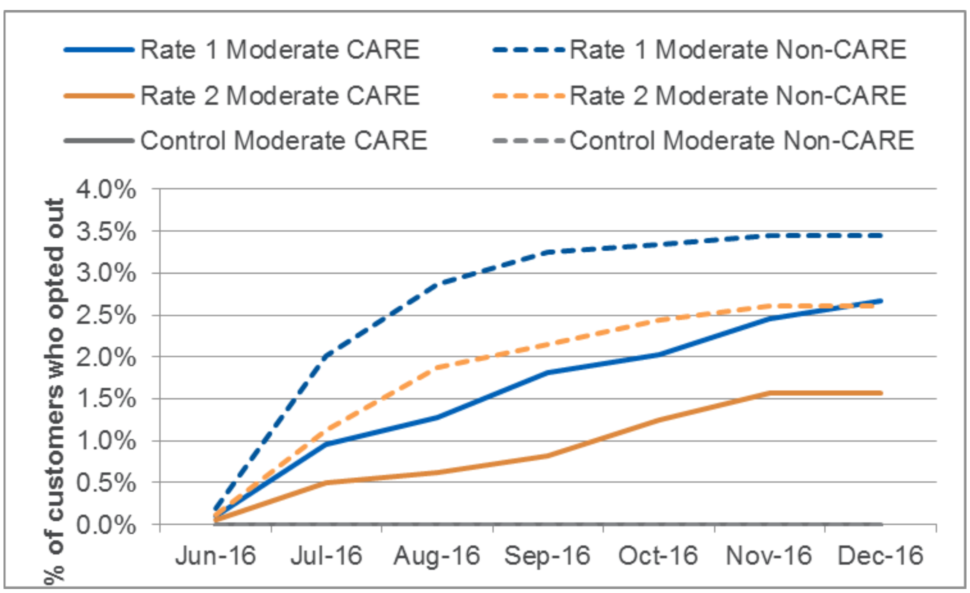
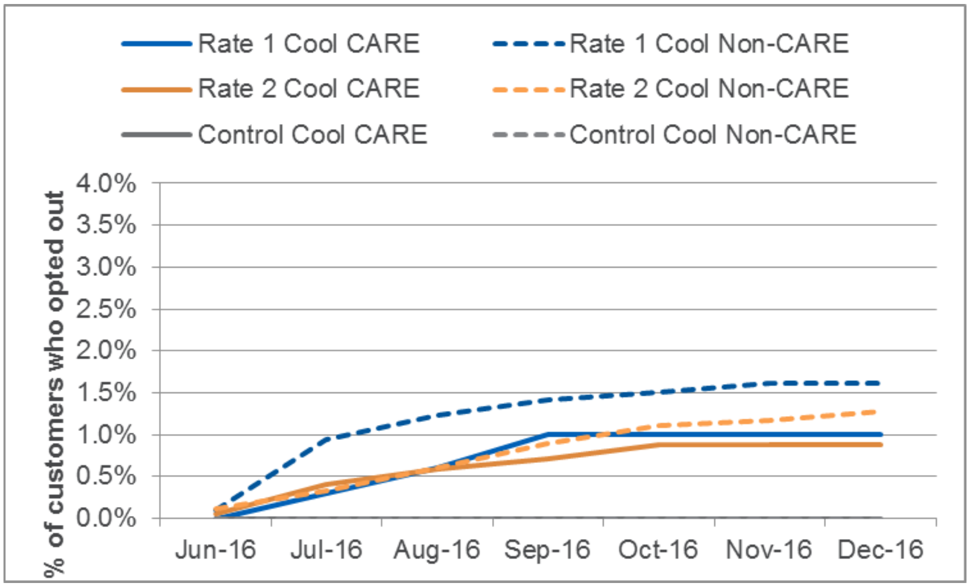


Figure 6-6: SDG&E Opt Outs by Month – Cool Climate Region



Figures 6-7 through 6-9 show the overall attrition rate over time for each climate region, customer segment, and TOU rate. Generally attrition rates are fairly steady in the time period between June 2016 and December 2016. Attrition rates are greatest among the control groups in the moderate and cool climate regions because account closure data is currently not complete for Rate 1 and Rate 2 customers. Among treated customers, those in the moderate and hot climate region have similar attrition rates. Attrition rates are lowest in the cool climate region.

Figure 6-7: SDG&E Attrition by Month – Hot Climate Region

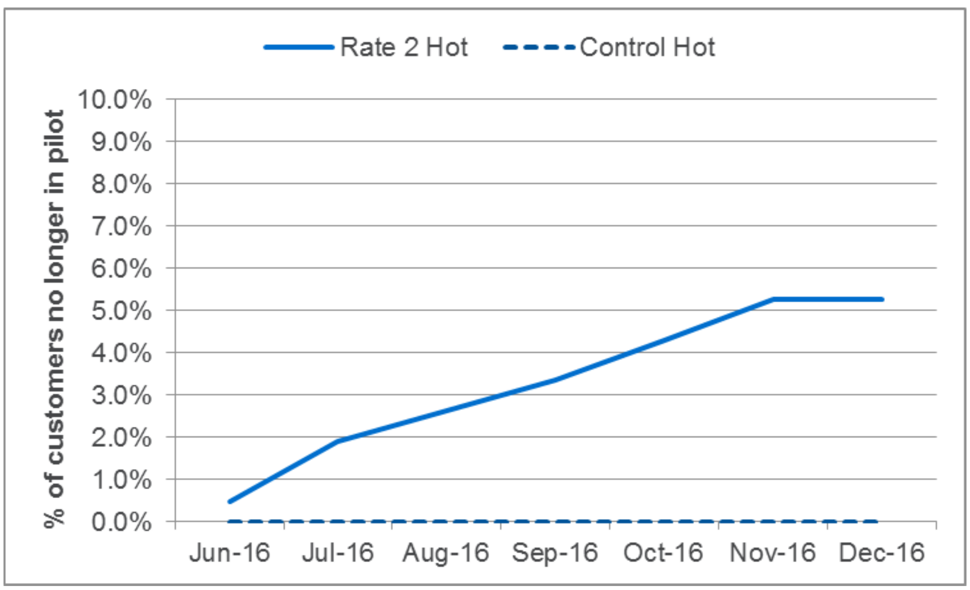


Figure 6-8: SDG&E Attrition by Month – Moderate Climate Region

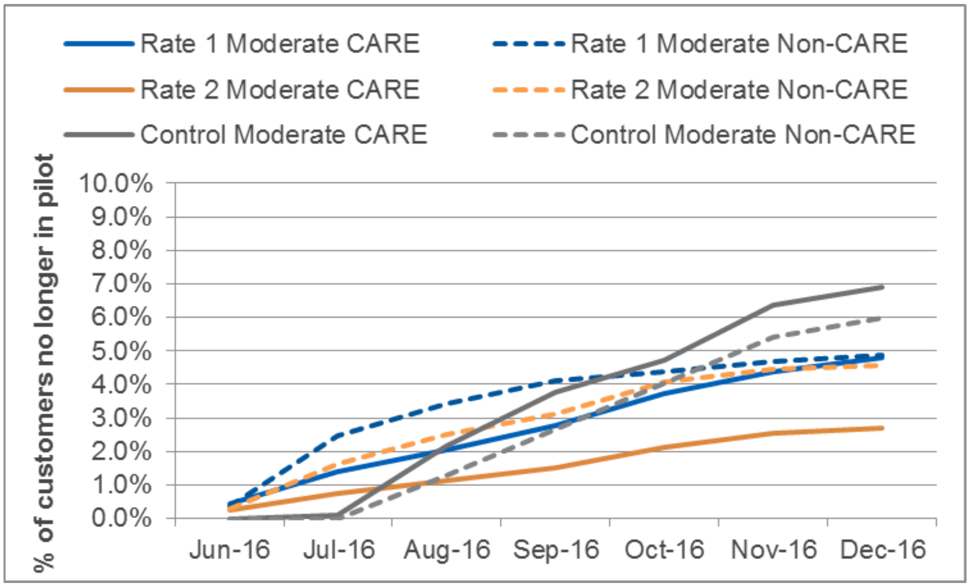
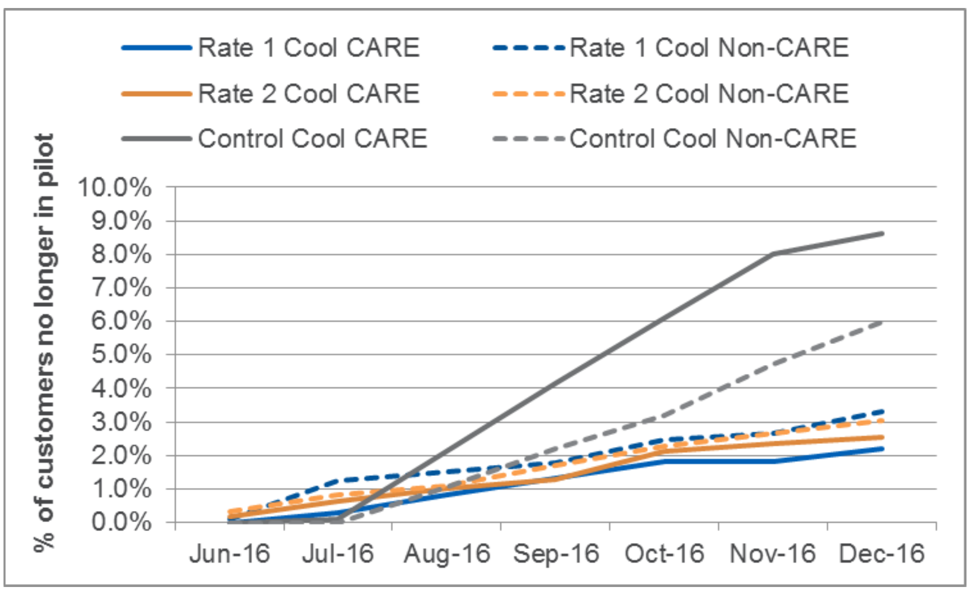


Figure 6-9: SDG&E Attrition by Month – Cool Climate Region



6.2.4 Pilot Outreach and Education

This section needs further input from SDG&E and will be rewritten for the next draft.

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 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 6-8 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 has implemented an option for pilot customers to subscribe to receive push notifications from their smartphone app to remind them of TOU period changes. In the 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.

SDG&E is undergoing a refresh of its residential segmentation – due to be 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.

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.

6.2.5 Operational Challenges and Lessons Learned

To be written by SDG&E and included in next draft.

6.3 Load Impacts

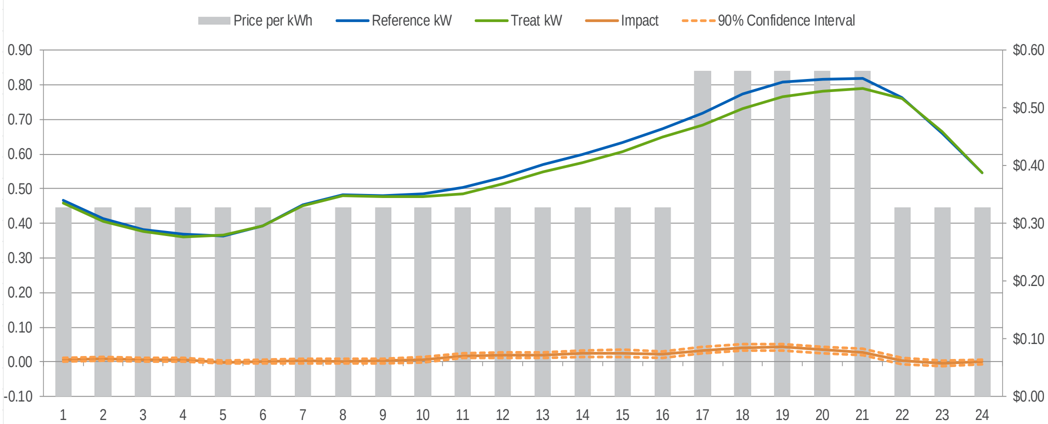
This section summarizes the load impact estimates for the two rate treatments tested by SDG&E. Load impacts are reported for each rate period for the average weekday, average weekend, and for the average monthly peak day for the summer months of July, August, September, and October for CARE/FERA and non-CARE/FERA customers in SDG&E's moderate and cool climate regions. As discussed previously, SDG&E's hot climate region is quite small and the sample of customers recruited into the pilot is not large enough to support estimation of load impacts separately for CARE/FERA and non-CARE/FERA customers nor to support segmentation of the sample into seniors or various income groups as was done in the hot regions for PG&E and SCE. All customers in the hot region were placed on Rate 2 or were in the control group.

As with PG&E and SCE, electronic tables that contain estimates for each hour of the day for each day type and climate zone and for each month separately are also available upon request through the CPUC. Figure 6-10 shows an example of the content of these tables for SDG&E Rate 2 for all eligible customers in the service territory. Pull down menus in the upper left hand corner allow users to select different climate regions, day types (e.g., weekdays, weekends, monthly peak day) and time period (individual months or the average of July through October).

Figure 6-10: Example of Content of Electronic Tables Underlying Load Impacts Summarized in this Report (SDG&E Rate 2, Average Summer Weekday, All Customers)

Segment	All
Rate	Rate 2
Month	Summer 2016
Day Type	Average Weekday
Treated Customers	7,206

Period	Reference kW	Treat kW	Impact	Percent Impact	90% Confidence Interval	
Peak	0.79	0.75	0.036	4.6%	0.032	0.040
Partial Peak	N/A	N/A	N/A	N/A	N/A	N/A
Off-Peak	0.51	0.51	0.01	1.8%	0.007	0.011
Super Off-Peak	N/A	N/A	N/A	N/A	N/A	N/A
Daily kWh	13.71	13.36	0.35	2.6%	0.317	0.391



Hour Ending	Reference kW	Treat kW	Impact	Percent Impact	90% Confidence Interval		Price	Period
1	0.47	0.46	0.01	1.4%	0.00	0.01	$0.33	Off-Peak
2	0.41	0.41	0.01	2.2%	0.00	0.01	$0.33	Off-Peak
3	0.38	0.38	0.01	1.7%	0.00	0.01	$0.33	Off-Peak
4	0.37	0.36	0.01	1.7%	0.00	0.01	$0.33	Off-Peak
5	0.36	0.37	0.00	-0.1%	0.00	0.00	$0.33	Off-Peak
6	0.39	0.39	0.00	0.1%	0.00	0.01	$0.33	Off-Peak
7	0.45	0.45	0.00	0.6%	0.00	0.01	$0.33	Off-Peak
8	0.48	0.48	0.00	0.5%	0.00	0.01	$0.33	Off-Peak
9	0.48	0.48	0.00	0.7%	0.00	0.01	$0.33	Off-Peak
10	0.49	0.48	0.01	1.4%	0.00	0.01	$0.33	Off-Peak
11	0.50	0.49	0.02	3.5%	0.01	0.02	$0.33	Off-Peak
12	0.53	0.51	0.02	3.8%	0.01	0.03	$0.33	Off-Peak
13	0.57	0.55	0.02	3.5%	0.01	0.03	$0.33	Off-Peak
14	0.60	0.58	0.02	4.0%	0.02	0.03	$0.33	Off-Peak
15	0.63	0.61	0.02	3.9%	0.02	0.03	$0.33	Off-Peak
16	0.67	0.65	0.02	3.2%	0.01	0.03	$0.33	Off-Peak
17	0.72	0.68	0.03	4.7%	0.02	0.04	$0.56	Peak
18	0.77	0.73	0.04	5.4%	0.03	0.05	$0.56	Peak
19	0.81	0.77	0.04	5.2%	0.03	0.05	$0.56	Peak
20	0.82	0.78	0.03	4.3%	0.03	0.04	$0.56	Peak
21	0.82	0.79	0.03	3.5%	0.02	0.04	$0.56	Peak
22	0.76	0.76	0.00	0.3%	-0.01	0.01	$0.33	Off-Peak
23	0.66	0.66	0.00	-0.5%	-0.01	0.00	$0.33	Off-Peak
24	0.55	0.55	0.00	0.1%	-0.01	0.01	$0.33	Off-Peak
Daily kWh	13.71	13.36	0.35	2.6%	0.32	0.39	N/A	N/A

As was true for PG&E and SCE, when aggregating across CARE/FERA and non-CARE/FERA customers within a climate region to produce regional values, or when aggregating across climate regions to produce service territory level estimates, weights representing the share of each segment or region among pilot eligible customers were constructed. Table 6-7 shows the weights population counts and weights that were used for aggregating across segments and climate regions.

Table 6-7: Weights Used for Aggregating up to Climate Region and Service Territory

Segment		Eligible for Pilot Participation	Population Weight	Climate Region Weight
Hot		9,141	1%	100%
Moderate	CARE	75,910	9%	24%
	Non-CARE	243,241	30%	76%
Cool	CARE	78,756	10%	17%
	Non-CARE	398,139	49%	83%
Total		805,187	100%	n/a

The remainder of this section is organized by rate treatment – that is, load impacts are presented for each relevant climate region and each customer segment for each of the two rates. Following the summary for each rate, load impacts are compared across rates.

As discussed at the outset of Section 6, in addition to the two rate treatments, SDG&E tested the incremental impact of Weekly Alert Emails (WAEs) sent to customers on a default basis. Results of this analysis are presented in Section 6.7.3.

6.3.1 Rate 1

SDG&E's Rate 1 is a three-period rate with a peak period from 4 to 9 PM on weekdays and weekends. On weekdays, the off-peak (or shoulder) period runs from 6 Am to 4 PM and 9 PM to midnight. On weekends, this period is much shorter, running from 2 to 4 PM and 9 PM to midnight. In summer, for electricity usage above 130% of the baseline quantity, prices equal roughly 56.6 ¢/kWh in the peak period, 34.9 ¢/kWh in the off-peak (or shoulder) period and 29.7 ¢/kWh in the super off-peak period. For usage below 130% the baseline quantity, a credit of 20.3 ¢/kWh is applied.

Figure 6-11 below shows the average peak-period load reduction in percentage terms for Rate 1 for customers in the moderate and cool climate regions, separately and combined. Figure 6-12 shows the absolute load impacts for each region. As with the other IOUs, the lines bisecting the top of each bar in the figures show the 90% confidence band for each estimate.

Figure 6-11: Average Percent Load Impacts for Peak Period for SDG&E Rate 1 (Positive values represent load reductions)

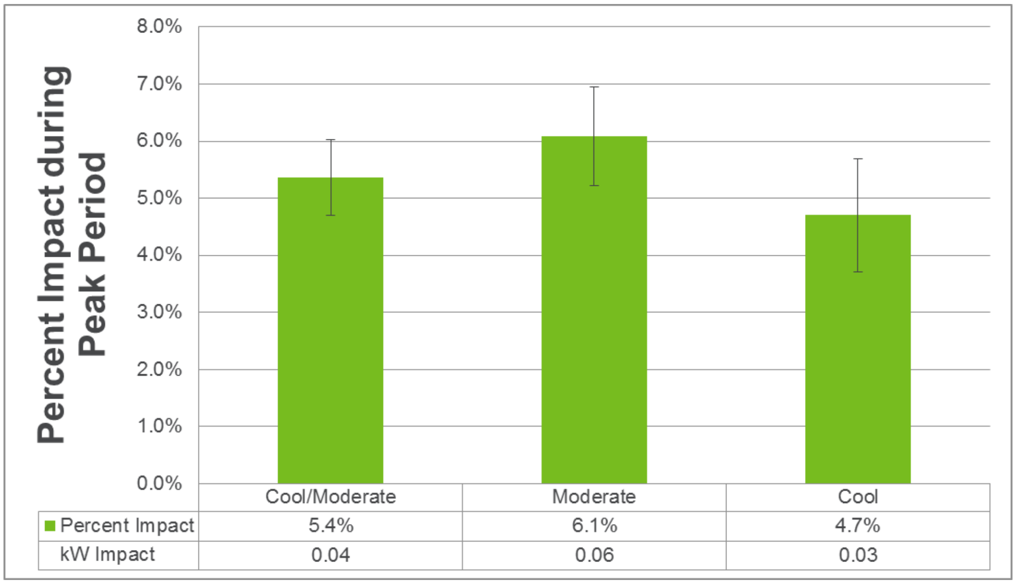
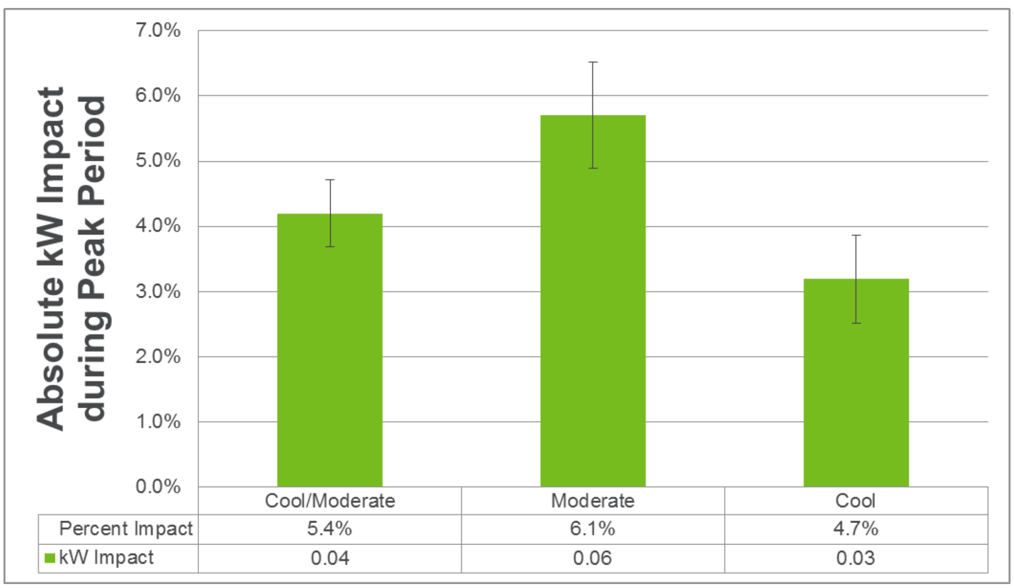


Figure 6-12: Average Absolute Load Impacts for Peak Period for SDG&E Rate 1 (Positive values represent load reductions)



As seen in the figures, the average peak load impacts for the cool and moderate climate regions, separately and combined, are statistically significant at the 90% level of confidence in both percentage and absolute terms. On average, pilot participants in both climate regions combined reduced electricity use by 5.4% or 0.04 kW across the five hour peak period from 4 to 9 PM. Customers in the moderate climate region reduced their usage by 6.1% or 0.06 kW, which is an absolute impact twice as large as the cool climate region. This difference is statistically significant at the 90% confidence level in absolute terms although not in percentage terms.

Table 6-8 shows the average percent and absolute load impacts for Rate 1 for each rate period for weekdays and weekends and for the average monthly system peak day for the cool and moderate climate regions. The percent reduction equals the load impact in absolute terms (kW) divided by the reference load. Shaded cells in the table contain load impact estimates that are not statistically significant at the 90% confidence level. The percentage and absolute values in the first row of Table 6-8, which represent the load impacts in the peak period on the average weekday, equal the values shown in Figures 6-11 and 6-12, which were discussed above.

The reference loads shown in Table 6-8 represent estimates of what customers on the TOU rate would have used if they had not responded to the price signals contained in the TOU tariff. As seen in the table, average hourly usage during the peak period is roughly 0.78 kW for the moderate and cool climate regions combined and around 0.57 kW for the 24 average weekday. In the moderate climate region, average usage in the peak period is larger at 0.94 kW than in the cool climate region (0.68 kW).

As seen in Table 6-8, on the average weekday, there were statistically significant reductions in usage during the peak and off-peak periods and for the day for both climate regions, and statistically significant increases in usage in the super-off-peak period from midnight to 6 AM on weekdays and the monthly system peak day. On weekends, there was decrease in super off-peak usage in the moderate climate region and an increase in usage in the cool region. For the two regions combined, the change in usage in the super off-peak period was not statistically significant. Load impacts were greatest for customers in the moderate climate region during the peak period on monthly system peak days, at 6.5% or 0.09 kW.

For the moderate and cool climate regions combined, there was a 2.4% reduction in daily electricity use on the average weekday. In the moderate climate region it is 3.3% and in the cool climate region it is 1.6%. While the daily reduction in energy use for Rate 1 is small in percentage and absolute terms, this average is spread over 24 hours each day, so the average reduction in electricity use on weekdays equals roughly 0.24 kWh. Over four months, this adds up to about 19 kWh per customer.

Table 6-8: Rate 1 Load Impacts by Rate Period and Day Type
(Positive values represent load reductions, negative values represent load increases)

Rate 1											
Day Type	Period	Hours	Cool/Moderate			Moderate			Cool		
			Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact
Average Weekday	Peak	4 PM to 9 PM	0.78	0.04	5.4%	0.94	0.06	6.1%	0.68	0.03	4.7%
	Off-Peak	6 AM to 4 PM, 9 PM to 12 AM	0.56	0.01	2.1%	0.65	0.02	3.4%	0.51	0.01	1.0%
	Super Off-Peak	12 AM to 6 AM	0.40	-0.01	-1.6%	0.44	-0.01	-1.8%	0.37	0.00	-1.4%
	Day	**All Hours**	0.57	0.01	2.4%	0.66	0.02	3.3%	0.51	0.01	1.6%
Average Weekend	Peak	4 PM to 9 PM	0.78	0.04	5.6%	0.93	0.05	5.9%	0.68	0.04	5.4%
	Off-Peak	2 PM to 4 PM, 9 PM to 12 AM	0.67	0.01	1.6%	0.79	0.01	1.9%	0.60	0.01	1.3%
	Super Off-Peak	12 AM to 2 PM	0.48	0.00	0.4%	0.54	0.01	1.8%	0.44	0.00	-0.8%
	Day	**All Hours**	0.58	0.01	2.1%	0.67	0.02	3.0%	0.52	0.01	1.4%
Monthly System Peak Day	Peak	4 PM to 9 PM	1.12	0.05	4.2%	1.40	0.09	6.5%	0.92	0.02	1.8%
	Off-Peak	6 AM to 4 PM, 9 PM to 12 AM	0.72	0.02	2.7%	0.87	0.03	3.8%	0.63	0.01	1.6%
	Super Off-Peak	12 AM to 6 AM	0.44	-0.01	-1.7%	0.49	-0.01	-2.0%	0.40	-0.01	-1.4%
	Day	**All Hours**	0.73	0.02	2.5%	0.88	0.03	3.9%	0.63	0.01	1.2%

Figures 6-13 and 6-14, respectively, show the percentage and absolute peak period load impacts for Rate 1 for CARE/FERA and non-CARE/FERA customers for the moderate and cool climate regions combined and separately. In the combined region, both the percent and absolute load impacts were greater for non-CARE/FERA customers than for CARE/FERA customers and the differences are statistically significant. The difference between the two segments is statistically significant in absolute terms in both climate regions but the difference in percentage terms is not statistically significant in the moderate region. The largest load reduction came from non-CARE/FERA customers in the moderate climate region, with impacts of 6.3% or 0.06 kW, while the impact for CARE/FERA customers in the same region was equal to 5.2% or 0.04 kW.

Figure 6-13: Average Percent Load Impacts for Peak Period for SDG&E Rate 1 for CARE/FERA and non-CARE/FERA Customers
(Positive values represent load reductions)

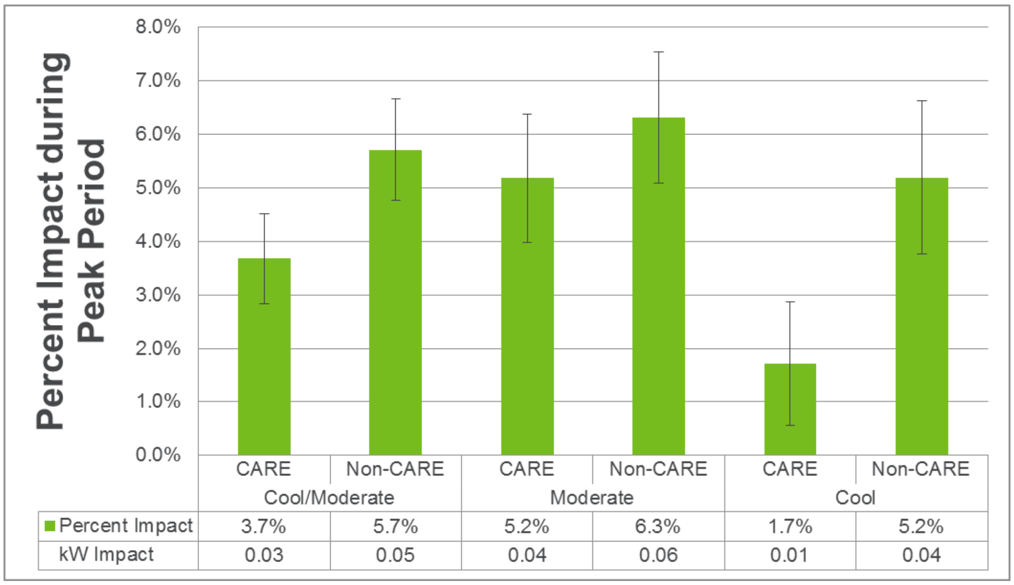
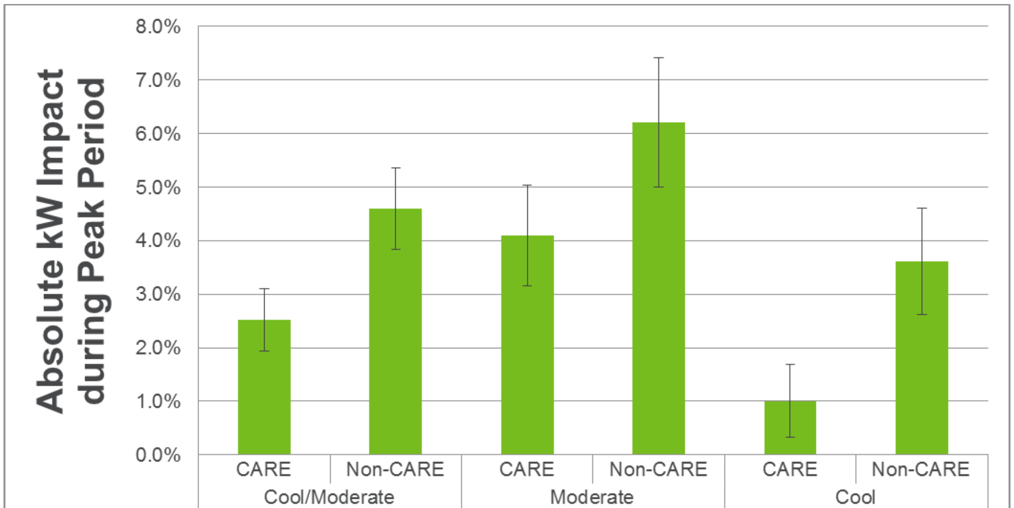


Figure 6-14: Average Absolute Load Impacts for Peak Period for SDG&E Rate 1 for CARE/FERA and non-CARE/FERA Customers
(Positive values represent load reductions)



	Cool/Moderate CARE	Cool/Moderate Non-CARE	Moderate CARE	Moderate Non-CARE	Cool CARE	Cool Non-CARE
Percent Impact	3.7%	5.7%	5.2%	6.3%	1.7%	5.2%
kW Impact	0.03	0.05	0.04	0.06	0.01	0.04

Table 6-9 shows the estimated load impacts for each rate period and day type for the moderate and cool climate zones separately and combined for non-CARE/FERA customers. Table 6-10 shows the same but for CARE/FERA customers. For both climate regions, non-CARE/FERA customers have greater peak period demand than non-CARE/FERA customers. For example, on the average weekday in the two climate zones combined, peak period demand is equal to 0.81 kW for non-CARE/FERA customers and 0.68 kW for CARE/FERA customers. Average overall weekday consumption is similar between the two groups, 0.58 kW and 0.52 kW for non-CARE/FERA and CARE/FERA customers, respectively. This indicates that non-CARE/FERA customers have a higher concentration of electricity use in the peak period, which may have made it easier to reduce their consumption during that time.

Customers in the CARE/FERA and non-CARE/FERA segments had load impacts of 2.1% during the off-peak period on average weekdays, and 1.9% and 1.5% (respectively) on the average weekend. Both non-CARE/FERA and CARE/FERA customers were able to reduce their overall daily consumption on all three day types by about 2% or more. In the moderate climate region, CARE/FERA and non-CARE/FERA customers reduced their average weekend electricity consumption by 3% (about 0.02 kW).

Table 6-9: Rate 1 Load Impacts by Rate Period and Day Type – Non-CARE/FERA
(Positive values represent load reductions, negative values represent load increases)

Rate 1												
Day Type	Period	Hours	Cool/Moderate, Non-CARE			Moderate, Non-CARE			Cool, Non-CARE		
			Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact
Average Weekday	Peak	4 PM to 9 PM	0.81	0.05	5.7%	0.98	0.06	6.3%	0.70	0.04	5.2%
	Off-Peak	6 AM to 4 PM, 9 PM to 12 AM	0.58	0.01	2.1%	0.67	0.02	3.7%	0.52	0.00	0.9%
	Super Off-Peak	12 AM to 6 AM	0.40	-0.01	-1.7%	0.45	-0.01	-2.4%	0.37	0.00	-1.3%
	Day	**All Hours**	0.58	0.01	2.5%	0.68	0.02	3.5%	0.52	0.01	1.7%
Average Weekend	Peak	4 PM to 9 PM	0.80	0.05	6.1%	0.98	0.06	6.2%	0.70	0.04	6.0%
	Off-Peak	2 PM to 4 PM, 9 PM to 12 AM	0.69	0.01	1.5%	0.82	0.01	1.6%	0.61	0.01	1.5%
	Super Off-Peak	12 AM to 2 PM	0.49	0.00	0.3%	0.56	0.01	1.7%	0.45	0.00	-0.8%
	Day	**All Hours**	0.60	0.01	2.2%	0.70	0.02	3.0%	0.54	0.01	1.6%
Monthly System Peak Day	Peak	4 PM to 9 PM	1.16	0.05	4.0%	1.49	0.10	6.5%	0.96	0.02	1.7%
	Off-Peak	6 AM to 4 PM, 9 PM to 12 AM	0.74	0.02	2.9%	0.90	0.04	4.4%	0.64	0.01	1.6%
	Super Off-Peak	12 AM to 6 AM	0.44	-0.01	-1.5%	0.50	-0.01	-1.7%	0.41	-0.01	-1.3%
	Day	**All Hours**	0.75	0.02	2.6%	0.92	0.04	4.2%	0.65	0.01	1.2%

Table 6-10: Rate 1 Load Impacts by Rate Period and Day Type –CARE/FERA
(Positive values represent load reductions, negative values represent load increases)

Rate 1											
Day Type	Period	Hours	Cool/Moderate, CARE			Moderate, CARE			Cool, CARE		
			Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact
Average Weekday	Peak	4 PM to 9 PM	0.68	0.03	3.7%	0.79	0.04	5.2%	0.58	0.01	1.7%
	Off-Peak	6 AM to 4 PM, 9 PM to 12 AM	0.52	0.01	2.1%	0.58	0.01	2.6%	0.45	0.01	1.6%
	Super Off-Peak	12 AM to 6 AM	0.37	0.00	-0.8%	0.41	0.00	0.0%	0.34	-0.01	-1.8%
	Day	**All Hours**	0.52	0.01	2.0%	0.58	0.02	2.9%	0.45	0.00	1.0%
Average Weekend	Peak	4 PM to 9 PM	0.67	0.02	3.4%	0.78	0.04	4.7%	0.57	0.01	1.7%
	Off-Peak	2 PM to 4 PM, 9 PM to 12 AM	0.60	0.01	1.9%	0.70	0.02	3.0%	0.52	0.00	0.4%
	Super Off-Peak	12 AM to 2 PM	0.44	0.00	0.9%	0.49	0.01	2.1%	0.39	0.00	-0.4%
	Day	**All Hours**	0.52	0.01	1.8%	0.59	0.02	3.0%	0.46	0.00	0.3%
Monthly System Peak Day	Peak	4 PM to 9 PM	0.93	0.05	5.2%	1.11	0.08	7.0%	0.74	0.02	2.6%
	Off-Peak	6 AM to 4 PM, 9 PM to 12 AM	0.64	0.01	1.9%	0.75	0.01	1.9%	0.53	0.01	1.9%
	Super Off-Peak	12 AM to 6 AM	0.41	-0.01	-2.4%	0.46	-0.01	-2.9%	0.36	-0.01	-1.9%
	Day	**All Hours**	0.64	0.01	2.2%	0.76	0.02	2.7%	0.54	0.01	1.4%

6.3.2 Rate 2

SDG&E's Rate 2 differs from Rate 1 in that it is a two-period rate, rather than a three-period rate. Like Rate 1, the peak period is from 4 to 9 PM on weekdays and weekends. In summer, for electricity usage above 130% of the baseline quantity, prices equal roughly 56.6 ¢/kWh in the peak period and 32.9 ¢/kWh in the off-peak period. Like Rate 1, a credit of 20.3 ¢/kWh is applied to usage below 130% the baseline quantity.

Figures 6-15 and 6-16 show the percent and absolute load impacts for the weekday peak period for Rate 2 for SDG&E's service territory as a whole and for each climate region. For the service territory as a whole, load impacts were equal to 4.6% or 0.04 kW. Like Rate 1, customers in the moderate climate region had greater peak-period load reductions, at 5.1% or 0.05 kW, than customers in the cool climate region (4.1% and 0.03 kW). The differences were statistically significant in absolute terms but not in percentage terms. Customers in the hot climate region had the greatest load impacts, 6.8% or 0.08 kW. Although the confidence bands in the hot region are significantly larger than in the moderate or cool regions, the absolute impacts in the hot region were still statistically significantly larger than in the moderate or cool regions.

Figure 6-15: Average Percent Load Impacts for Peak Period for SDG&E Rate 2 (Positive values represent load reductions)

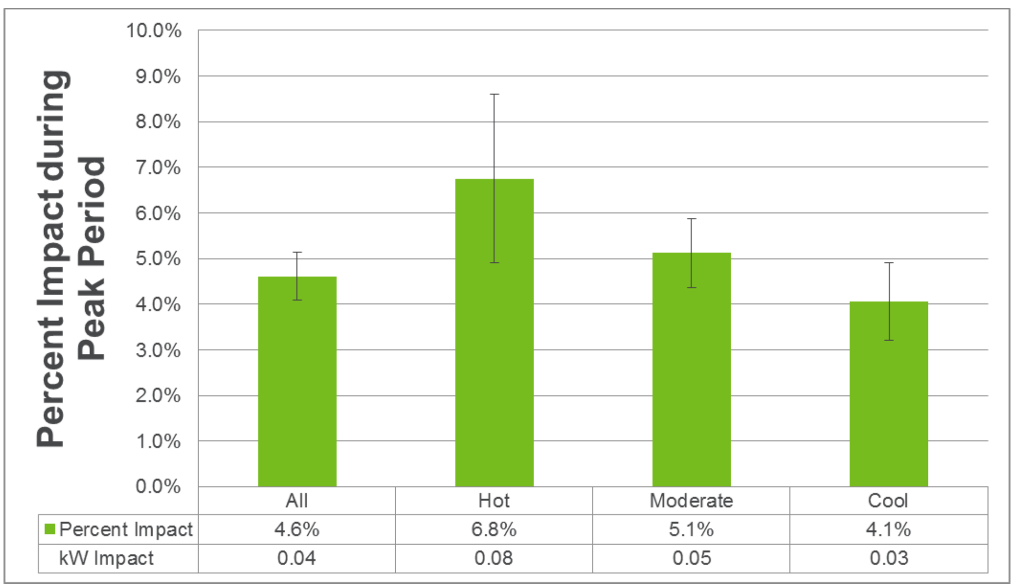


Figure 6-16: Average Percent Load Impacts for Peak Period for SDG&E Rate 2 (Positive values represent load reductions)

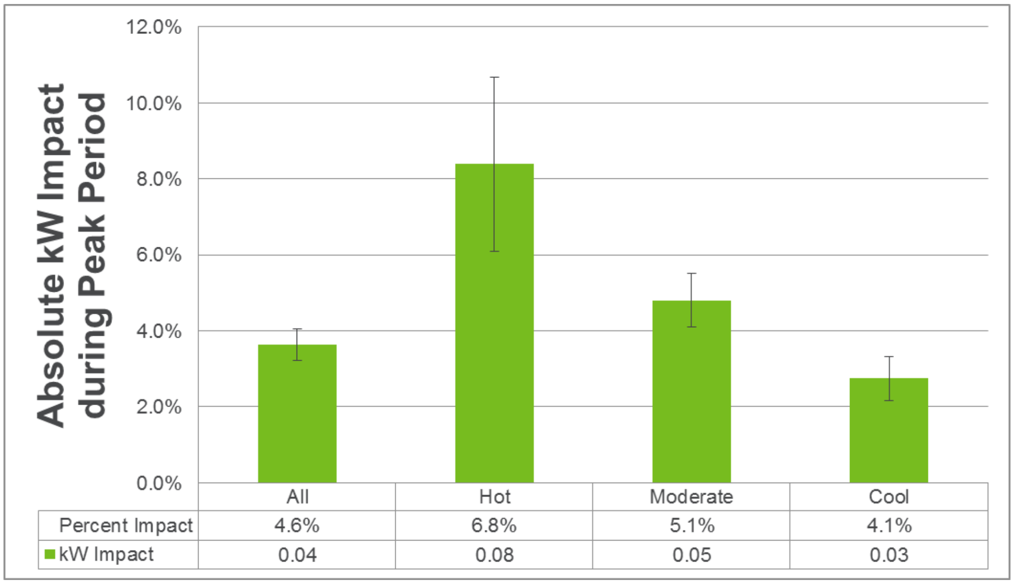


Table 6-11 contains estimates of load impacts for all relevant rate periods and day types. Reference loads and load impacts in each rate period and over the course of the day were similar between weekends and weekdays for the service territory as a whole and also for each climate region. The overall conservation effect (e.g., the reduction in daily usage) was between 2.5% and 3.0% in nearly all regions. This conservation affect applied in the off-peak period in all regions. In the hot climate region, customers did not reduce their weekend off-peak electricity consumption by a significant amount.

Table 6-11: Rate 2 Load Impacts by Rate Period and Day Type
(Positive values represent load reductions, negative values represent load increases)

Rate 2															
Day Type	Period	Hours	All			Hot			Moderate			Cool			
			Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact
Average Weekday	Peak	4 PM to 9 PM	0.79	0.04	4.6%	1.24	0.08	6.8%	0.94	0.05	5.1%	0.68	0.03	4.1%
	Off-Peak	12 AM to 4 PM, 9 PM to 12 AM	0.51	0.01	1.8%	0.78	0.02	2.0%	0.58	0.01	1.5%	0.47	0.01	1.9%
	Day	**All Hours**	0.57	0.01	2.6%	0.87	0.03	3.4%	0.66	0.02	2.6%	0.51	0.01	2.5%
Average Weekend	Peak	4 PM to 9 PM	0.79	0.04	5.1%	1.29	0.10	7.5%	0.93	0.05	5.3%	0.68	0.03	4.8%
	Off-Peak	12 AM to 4 PM, 9 PM to 12 AM	0.53	0.01	2.2%	0.81	0.01	1.0%	0.60	0.01	2.0%	0.48	0.01	2.5%
	Day	**All Hours**	0.59	0.02	3.0%	0.91	0.03	3.0%	0.67	0.02	3.0%	0.52	0.02	3.1%
Monthly System Peak Day	Peak	4 PM to 9 PM	1.12	0.04	3.6%	1.49	0.13	8.4%	1.40	0.06	4.6%	0.92	0.02	2.5%
	Off-Peak	12 AM to 4 PM, 9 PM to 12 AM	0.63	0.01	1.6%	0.89	0.03	3.0%	0.75	0.01	1.4%	0.55	0.01	1.6%
	Day	**All Hours**	0.74	0.02	2.2%	1.02	0.05	4.7%	0.88	0.02	2.5%	0.63	0.01	1.9%

Figures 6-17 and 6-18 show the peak period load reductions on weekdays for non-CARE/FERA and CARE/FERA customers and Tables 6-12 and 6-13 show the load impacts for each rate period and day type for the two segments. There are not enough customers in the hot climate region to segment between CARE/FERA and non-CARE/FERA, so these tables only include customers in the moderate and cool climate regions, separately and combined.

Like Rate 1, non-CARE/FERA customers in the cool climate region had greater impacts (4.3% and 0.03 kW) than their CARE/FERA counterparts (2.6% and 0.02 kW). This is not the case in the moderate climate region, where load impacts for CARE/FERA and non-CARE/FERA customers were very similar. For both regions, however, the differences between the two groups were not statistically significant.

As seen in Table 6-12 and 6-13, non-CARE/FERA customers had greater on-peak and average weekday demand than CARE/FERA customers. Both groups reduced their overall consumption as well as their off-peak demand. For example, non-CARE/FERA customers in the moderate and cool climate regions combined reduced their average weekday electricity demand by 2.4% or 0.01 kW. CARE/FERA customers reduced their average weekday electricity demand by 3.1% or 0.02 kW. Reductions in daily electricity use were similar on weekends.

Figure 6-17: Average Percent Load Impacts for SDG&E Rate 2 for CARE/FERA and non-CARE/FERA Customers (Positive values represent load reductions)

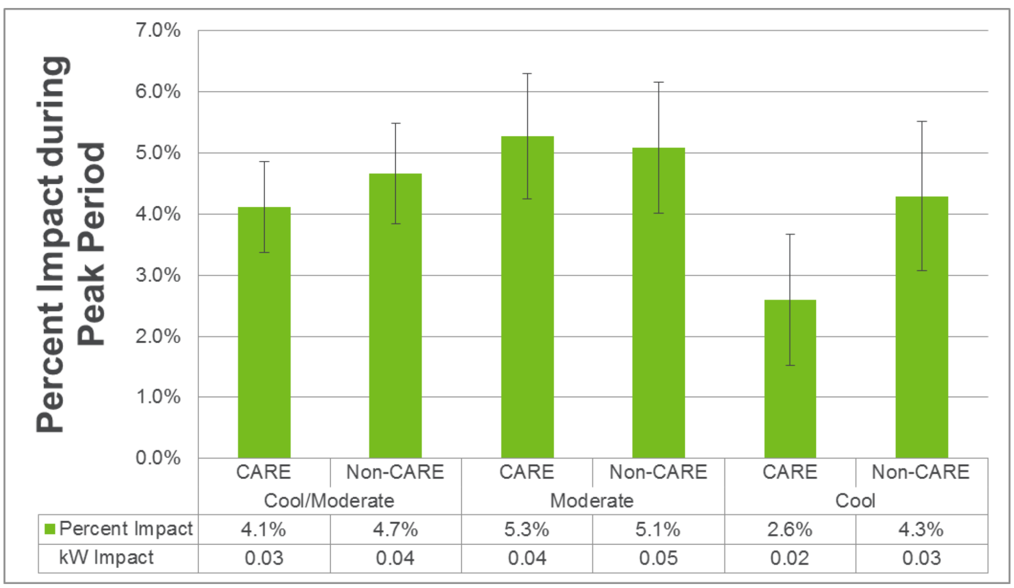
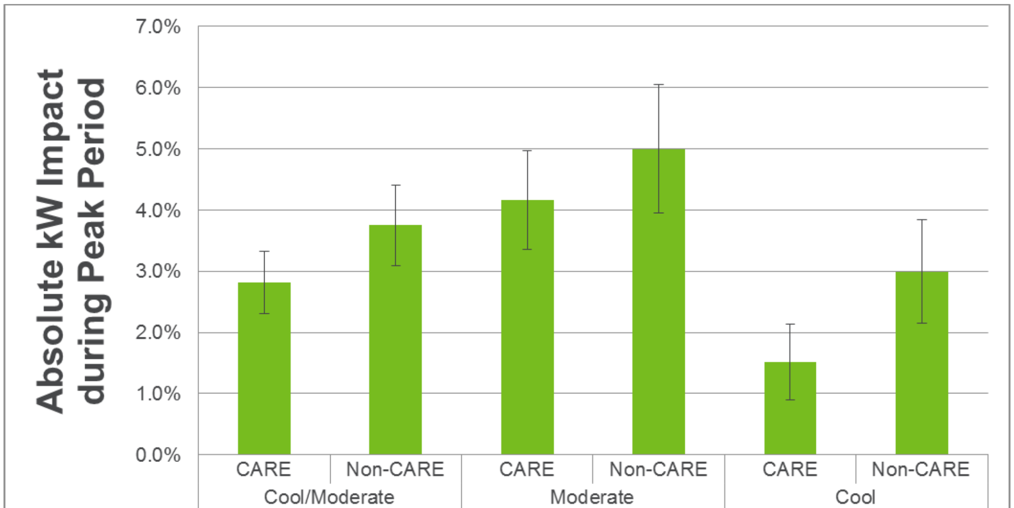


Figure 6-18: Average Absolute Load Impacts for SDG&E Rate 2 for CARE/FERA and non-CARE/FERA Customers (Positive values represent load reductions)



	Cool/Moderate		Moderate		Cool	
	CARE	Non-CARE	CARE	Non-CARE	CARE	Non-CARE
Percent Impact	4.1%	4.7%	5.3%	5.1%	2.6%	4.3%
kW Impact	0.03	0.04	0.04	0.05	0.02	0.03

Table 6-12: Rate 2 Load Impacts by Rate Period and Day Type – Non-CARE/FERA Customers (Positive values represent load reductions, negative values represent load increases)

Rate 2											
Day Type	Period	Hours	Cool/Moderate, Non-CARE			Moderate, Non-CARE			Cool, Non-CARE		
			Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact
Average Weekday	Peak	4 PM to 9 PM	0.81	0.04	4.7%	0.98	0.05	5.1%	0.70	0.03	4.3%
	Off-Peak	12 AM to 4 PM, 9 PM to 12 AM	0.52	0.01	1.5%	0.60	0.01	1.1%	0.47	0.01	1.9%
	Day	**All Hours**	0.58	0.01	2.4%	0.68	0.02	2.3%	0.52	0.01	2.5%
Average Weekend	Peak	4 PM to 9 PM	0.80	0.04	5.2%	0.98	0.05	5.2%	0.70	0.04	5.2%
	Off-Peak	12 AM to 4 PM, 9 PM to 12 AM	0.54	0.01	2.1%	0.62	0.01	1.5%	0.49	0.01	2.5%
	Day	**All Hours**	0.60	0.02	3.0%	0.70	0.02	2.6%	0.54	0.02	3.2%
Monthly System Peak Day	Peak	4 PM to 9 PM	1.16	0.04	3.5%	1.49	0.07	4.4%	0.96	0.03	2.6%
	Off-Peak	12 AM to 4 PM, 9 PM to 12 AM	0.65	0.01	1.5%	0.78	0.01	1.3%	0.57	0.01	1.6%
	Day	**All Hours**	0.75	0.02	2.1%	0.92	0.02	2.3%	0.65	0.01	1.9%

Table 6-13: Rate 2 Load Impacts by Rate Period and Day Type –CARE/FERA Customers (Positive values represent load reductions, negative values represent load increases)

Rate 2											
Day Type	Period	Hours	Cool/Moderate, CARE			Moderate, CARE			Cool, CARE		
			Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact	Ref. kW	Impact kW	% Impact
Average Weekday	Peak	4 PM to 9 PM	0.68	0.03	4.1%	0.79	0.04	5.3%	0.58	0.02	2.6%
	Off-Peak	12 AM to 4 PM, 9 PM to 12 AM	0.47	0.01	2.8%	0.53	0.02	3.0%	0.42	0.01	2.4%
	Day	**All Hours**	0.52	0.02	3.1%	0.58	0.02	3.7%	0.45	0.01	2.4%
Average Weekend	Peak	4 PM to 9 PM	0.67	0.03	4.3%	0.78	0.05	5.9%	0.57	0.01	2.3%
	Off-Peak	12 AM to 4 PM, 9 PM to 12 AM	0.48	0.02	3.2%	0.54	0.02	4.0%	0.43	0.01	2.1%
	Day	**All Hours**	0.52	0.02	3.5%	0.59	0.03	4.5%	0.46	0.01	2.2%
Monthly System Peak Day	Peak	4 PM to 9 PM	0.93	0.04	3.9%	1.11	0.06	5.3%	0.74	0.01	1.8%
	Off-Peak	12 AM to 4 PM, 9 PM to 12 AM	0.57	0.01	1.9%	0.66	0.01	1.9%	0.48	0.01	1.9%
	Day	**All Hours**	0.64	0.02	2.5%	0.76	0.02	2.9%	0.54	0.01	1.9%

6.3.3 Weekly Alert Emails

As mentioned earlier in this section, SDG&E's pilot tested whether offering Weekly Alert Emails increased load reductions for customers on TOU rates. These emails were offered on a default basis to the roughly 70% of customers for whom SDG&E had email addresses. Although customers could opt-out from receiving the alerts, almost no one did. The incremental impact was estimated by using the subset of customers on the TOU rates for whom SDG&E had email addresses but who did not receive the WAE's as the control group for those who do. Table 6-14 shows peak period impacts for customers who are not receiving alerts ("controls") and those who are ("recipients") and Table 6-15 contains estimated impacts for all rate periods and day types. As seen, the incremental impacts during the peak period were very small and, as shown by the fact that the 90% confidence interval includes 0, none of the incremental impacts were statistically significant. It is worth noting that the incremental impact for the combined cool/moderate climate region is very close to being statistically significant at the 90% confidence level and certainly would be significant based on an 90% confidence level. It should also be noted that, although the % increase in the impact is large in percentage terms, this is a bit misleading since the estimated values are based on a very small impact to begin with. That is, the denominator in the calculation is quite small so that even very small incremental effects represent a reasonably large percent of the impact.

As seen in Table 6-15, there are small but statistically significant increases in electricity use during the off-peak period in the cool/moderate regions combined on both weekdays and weekends and also in the cool region. In the moderate region, there is a slight decrease in usage in the off-peak period on weekdays and small decrease in the same period on weekends.

In October, SDG&E modified the WAE content and formatting. This new format may be more effective in impacting customer behavior.

Table 6-14: Incremental Impacts of SDG&E Weekly Alert Emails

Climate Zone	Number of Customers		kW Impact during Peak Period					% Increase in Impact
	Controls	Recipients	Controls	Recipients	Incremental	90% Confidence Interval		
Cool	1,784	953	0.023	0.028	0.005	-0.004	0.013	21%
Moderate	1,647	864	0.051	0.057	0.007	-0.004	0.017	13%
Cool/Moderate	3,431	1,816	0.034	0.040	0.006	-0.001	0.012	16%

Table 6-15: Incremental Impacts of SDG&E Weekly Alert Emails by Rate Period and Day Type

Rate 2											
Day Type	Period	Hours	WAE - Cool/Moderate			WAE - Moderate			WAE - Cool		
			Non-WAE Impact	Inc. Impact	% Inc. Impact	Non-WAE Impact	Inc. Impact	% Inc. Impact	Non-WAE Impact	Inc. Impact	% Inc. Impact
Average Weekday	Peak	4 PM to 9 PM	0.034	0.006	16.0%	0.051	0.007	12.9%	0.023	0.005	20.6%
	Off-Peak	12 AM to 4 PM, 9 PM to 12 AM	0.011	-0.004	-32.4%	0.008	0.004	55.8%	0.014	-0.009	-65.0%
	Day	**All Hours**	0.016	-0.002	-10.7%	0.017	0.005	28.3%	0.016	-0.006	-38.4%
Average Weekend	Peak	4 PM to 9 PM	0.039	-0.003	-6.5%	0.052	0.002	3.6%	0.029	-0.005	-18.7%
	Off-Peak	12 AM to 4 PM, 9 PM to 12 AM	0.015	-0.008	-54.5%	0.014	-0.005	-36.8%	0.015	-0.010	-65.2%
	Day	**All Hours**	0.020	-0.007	-35.0%	0.022	-0.004	-16.7%	0.018	-0.009	-49.6%
Monthly System Peak Day	Peak	4 PM to 9 PM	0.041	-0.005	-13.2%	0.075	-0.022	-28.5%	0.019	0.005	28.2%
	Off-Peak	12 AM to 4 PM, 9 PM to 12 AM	0.013	-0.004	-34.8%	0.013	-0.003	-21.8%	0.013	-0.006	-44.0%
	Day	**All Hours**	0.019	-0.005	-24.9%	0.026	-0.007	-25.8%	0.014	-0.003	-23.7%

6.3.4 Comparison Across Rates

SDG&E's two pilot rates have the same peak period, from 4 to 9 PM, and the same peak-period prices. The primary difference between the two rates is that Rate 1 is a three period rate, with a shoulder period from 6 Am to 4 PM and 9 PM to midnight while Rate 2 is a two-period rate. Prices in the shoulder period for Rate 2 are 2 ¢/kWh higher than the off-peak price for Rate 2 and the super-off-peak price for Rate 1 is roughly 3 ¢/kWh less than the off-peak price for Rate 2. Given these differences, one might expect to see more load shifting away from the peak-period for Rate 2 than for Rate 1, since it should be easier to shift most loads in the hours surrounding the peak period than to shift from the peak to the super-off-peak period or from the shoulder to the super-off-peak period.

The comparisons across rates and climate regions is complicated for SDG&E because customers were placed on Rate 2 in all three climate regions but Rate 1 customers are only present in the moderate and cool regions. As such, when all participants are combined, Rate 2 impacts are based on customers in all three climate regions whereas Rate 1 impacts are only based on the moderate and cool regions combined. Having said that, the number of customers in SDG&E's hot region is so small relative to the other regions, when the hot region is combined with the moderate and cool regions using population weights, the impact of the hot region is minimal. As such, there is little bias in comparing the impacts for all participants combined for Rate 2 with the impacts for participants in the moderate/cool regions combined in the figures below.

As seen in Figures 6-19 and 6-20, the hypothesis that there would be more load shifting for Rate 2 compared with Rate 1 is not born out by the evidence. Indeed, the observed difference is in the other direction, although none of the differences are statistically significant.

Figure 6-19: Average Percent Peak Period Impacts Across Rates

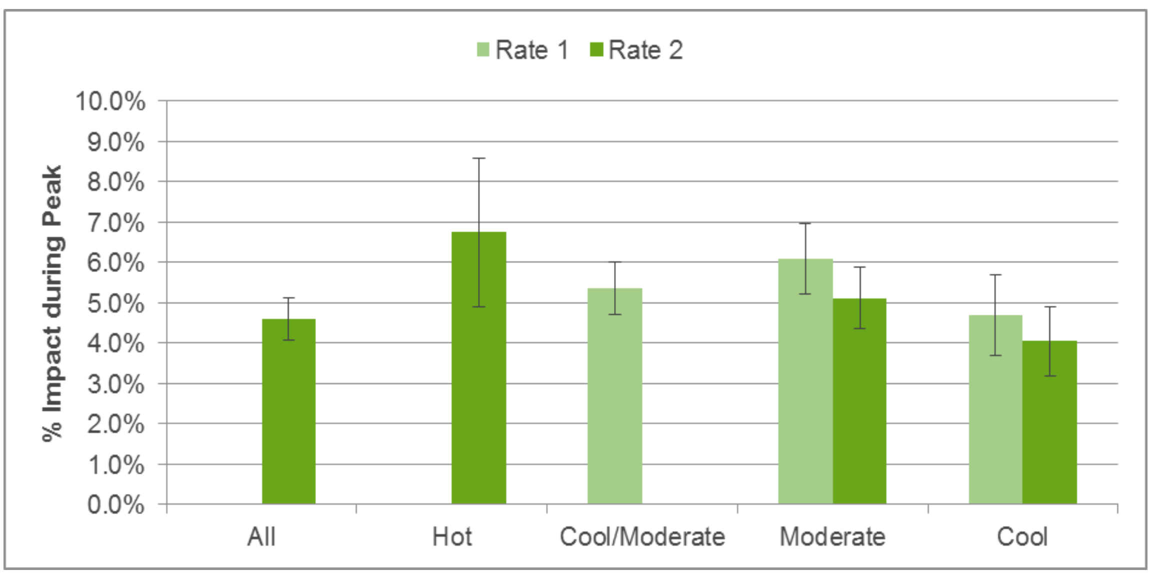
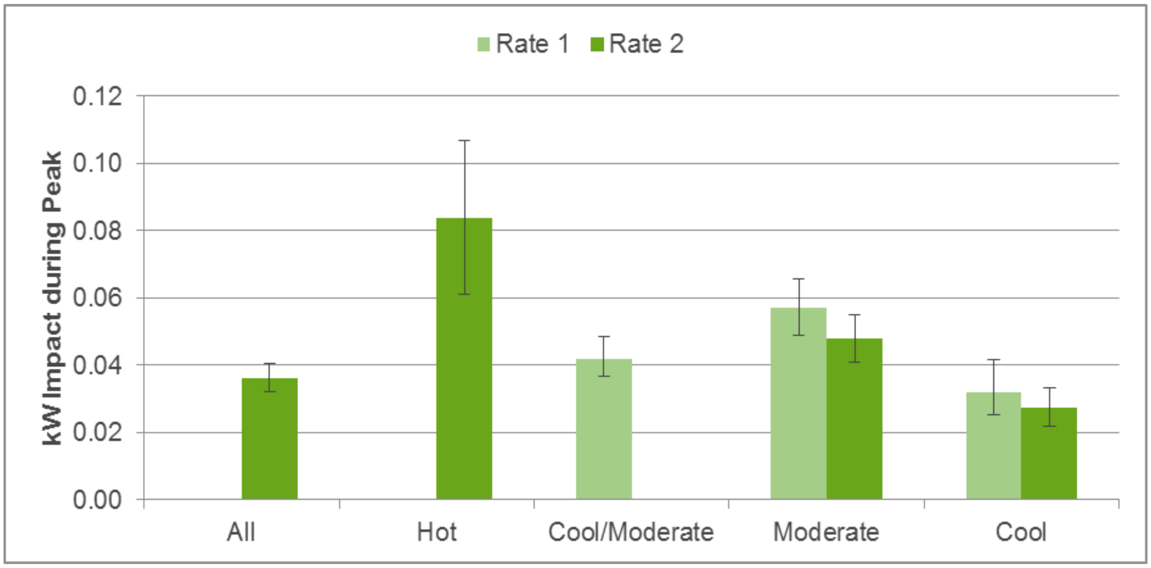


Figure 6-20: Average Absolute Peak Period Impacts Across Rates



Figures 6-21 and 6-22 show the reduction in daily electricity use under each rate option by climate region and for the service territory as a whole. As with the peak period impacts, none of the observed differences are statistically significant.

Figure 6-21: Average Percent Daily kWh Impacts Across Rates

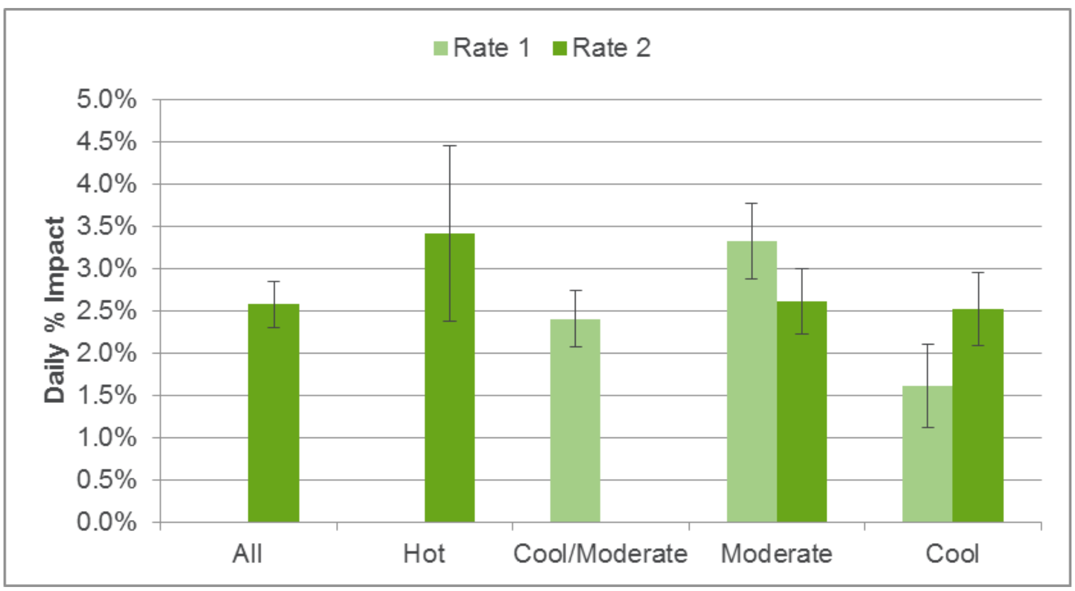
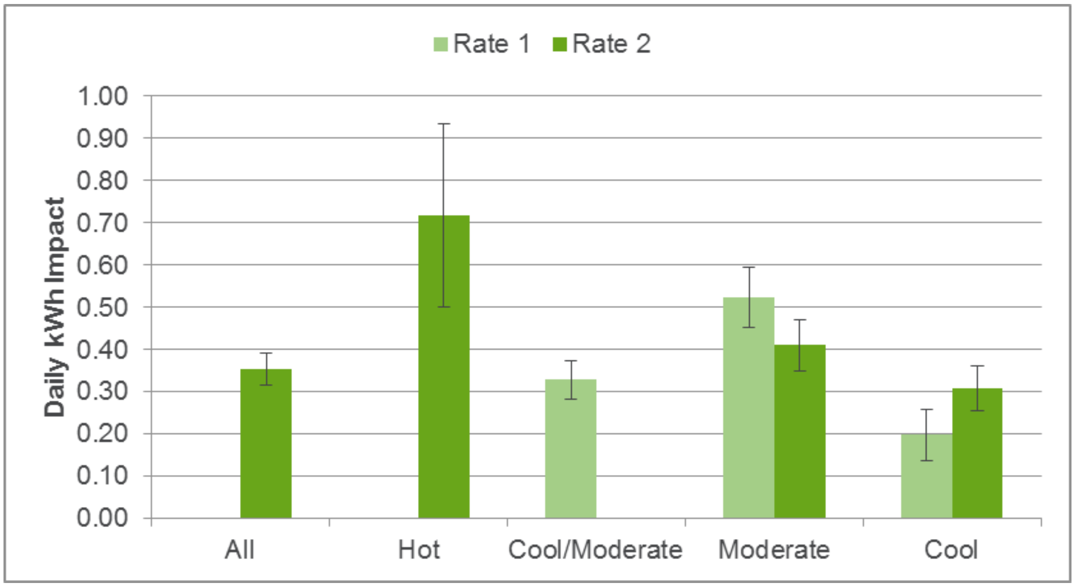


Figure 6-22: Average Absolute Daily kWh Impacts Across Rates



6.4 Bill Impacts

This section summarizes the bill impact estimates for the two rate treatments tested by SDG&E. Bill impacts are reported for each climate region separately and combined, and for CARE/FERA and non-CARE/FERA customers in the moderate and cool climate regions. As discussed previously, SDG&E's hot climate region is quite small and the sample of customers recruited into the pilot is not large enough to support estimation of load impacts separately for CARE/FERA and non-CARE/FERA customers not to support segmentation of the sample into seniors or various income groups as was done in the hot regions for PG&E and SCE. All customers in the hot region were placed on Rate 2 or were in the control group.

Bill impacts are reported as the average monthly impact for the summer months of July, August, September and October[62] for each rate, climate zone, and customer segment summarized above. As described in Section 3.2, the following four analyses were conducted:

- **Structural benefiter/non-benefiter analysis based on pretreatment usage-** Displaying the proportions of structural benefiters and non-benefiters for each rate and relevant customer segment based on pretreatment data on an annual and summer season basis;
- **Estimation of the average bill impact due to changes in usage-** Displaying the average bill impact resulting from changes in behavior in response to the new price signals for each rate and relevant customer segment (after controlling for exogenous factors);
- **Estimation of the total bill impact due to both the difference in the tariffs (holding usage constant) and behavior change-** Displaying the bill impact for each rate and relevant customer segment due to structural differences in the rate mitigated by changes in behavior; and
- **Change in the distribution of bill impacts due to behavior change-** Displaying the distribution curves of bill impacts (percentage of customers with bill impacts within $10 incremental bins)

62 Estimates were not produced for the month of June because enrollment changed dramatically from the beginning to the end of the month and the estimates would not be comparable to those for other months.

with and without behavior change in the same graph to illustrate if the distribution for participants shifted to the left or changed shape compared with the distribution for control customers without behavior change.

A more detailed explanation of each type of analysis and how the analysis was conducted is contained in Section 3.2. The remainder of this section is organized according to the four analysis types summarized above – that is, bill impacts are presented for each rate, relevant customer segment, and climate region for each of the four analyses.

6.4.1 Structural Benefiter/Non-Benefiter Analysis Based on Pretreatment Usage

As with PG&E and SCE, the structural benefiter analysis was conducted for the summer and annual time periods using pretreatment data from the treatment group for each rate and relevant customer segment. Annual impacts were based on hourly load data from May 2015 through April 2016. Summer impacts were based on June 2015 through October 2015. Monthly bills were estimated for each treatment group customer on the OAT and TOU rate using the hourly load data. The difference in bills based on the TOU rate and the OAT determines if a customer is a structural benefiter, a structural non-benefiter, or falls in a neutral range defined as having a structural bill impact between ±$3.[63]

Final results from the structural benefiter / non-benefiter analysis are presented in column graphs and shown as percentages for the summer season and on an annual basis. For each rate and relevant segment, the percentage of customers who are non-benefiter, neutral (+/- $3), or benefiters based on their average monthly bills for the time period of interest are shown as individual columns. The three columns within each rate and segment combination total to 100%, thus showing the distribution of structural benefiters and non-benefiters for each rate and segment of interest.

Figure 6-23 presents the outcome of the structural benefiter analysis for Rate 1 for the cool and moderate climate regions combined for all customers as well as for CARE/FERA and non-CARE/FERA customers. The graph on the left presents the analysis on an annual basis, and the graph on the right presents the findings for the summer period. In the two climate regions combined, a large proportion of customers are in the neutral category and very few are benefiters. Nearly 90% of CARE/FERA customers in the cool and moderate climate regions have bill impacts in the neutral range. The pattern is similar on a summer basis, which is quite different from what was seen in the other utilities, where most customers were non-benefiters in the summer time frame.

[63] See section 3.2.1 for additional details on the methodology.

Figure 6-23: Rate 1 Structural Benefiter / Non-Benefiter Analysis
All | CARE/FERA | non-CARE/FERA

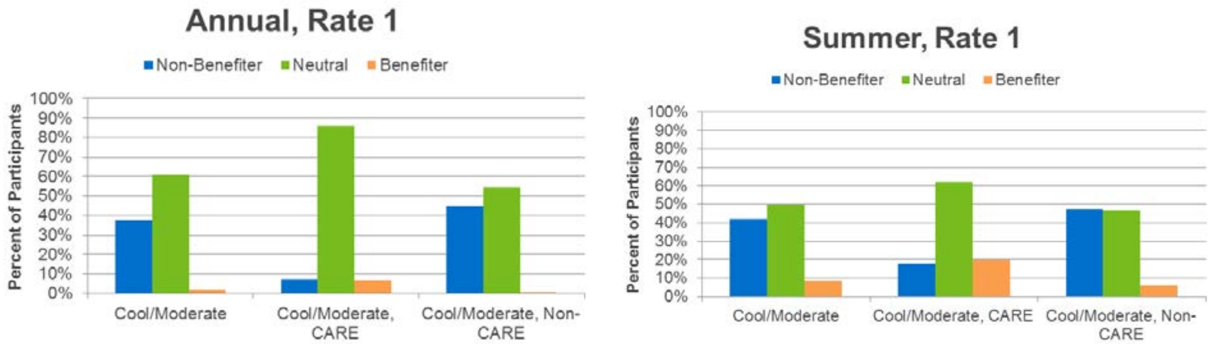


Figure 6-24 presents the outcome of the structural benefiter analysis for Rate 1 at the detailed segment level for the cool and moderate climate regions, separately. The findings at the aggregate level still hold, with most CARE/FERA customers in the neutral category, and a very small percentage non-CARE/FERA customers in the benefiter category on an annual basis. About 20% of CARE/FERA customers in the cool and moderate climate regions are benefiters in the summer period, which is surprising.

Figure 6-24: Rate 1 Structural Benefiter / Non-Benefiter Analysis
Detailed Segments by Climate Region

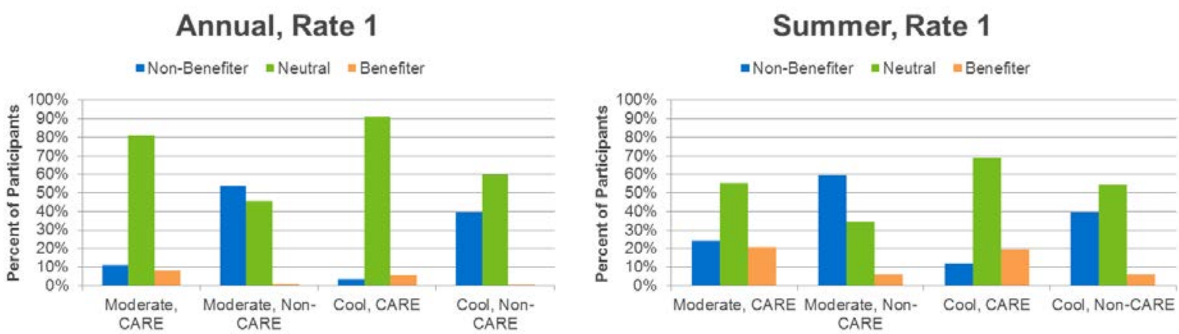


Figure 6-25 presents the outcome of the structural benefiter analysis for Rate 2 at the aggregate level across climate regions, and by CARE/FERA and non-CARE/FERA for the cool and moderate climate regions combined. The results are nearly identical to those for Rate 1. Once again, most CARE/FERA customers in the cool and moderate climate regions are in the neutral category on an annual basis, and about 20% are benefiters in the summer period. About half of non-CARE/FERA customers fall into the neutral band during the summer period, and about 45% fall into the non-benefiter category. The outcome is similar in the summer period.

Figure 6-25: Rate 2 Structural Benefiter / Non-Benefiter Analysis
All | CARE/FERA | Non-CARE/FERA

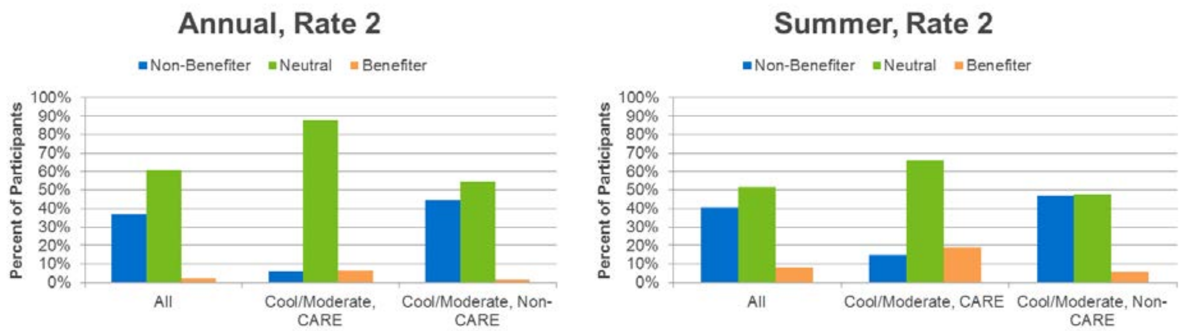
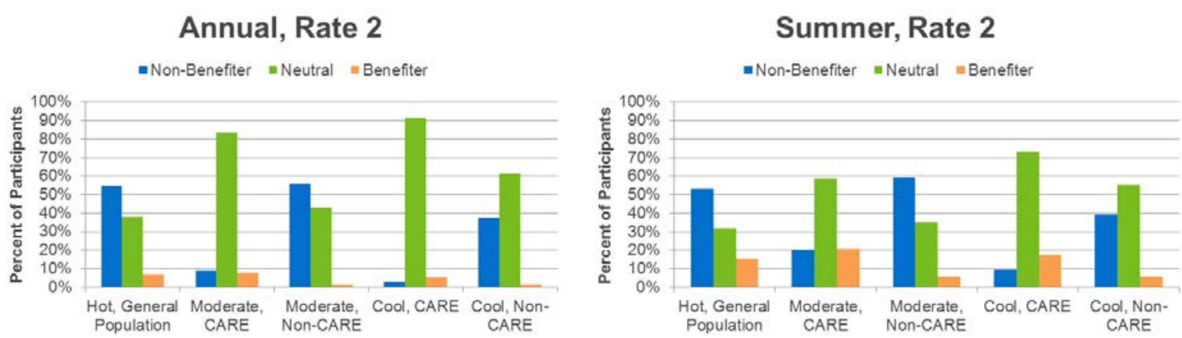


Figure 6-26 presents the outcome of the structural benefiter analysis for Rate 2 at the detailed segment level by climate region. As mentioned previously, the hot climate region is too small to segment by CARE/FERA status. Just over 50% of customers in the hot climate region are non-benefiters in the summer and annual time frames. As with Rate 1, most CARE/FERA customers in the cool and moderate climate regions fall into the neutral category on an annual and summer basis.

Figure 6-26: Rate 2 Structural Benefiter / Non-Benefiter Analysis
Detailed Segments by Climate Region



Overall, a general pattern of structural benefiters and non-benefiters emerged that was constant across rates. Generally, CARE/FERA customers tend to have very small bill impacts compared to non-CARE/FERA customers, as shown by their larger share of customers in the neutral category on an annual and summer basis. These results stand in contrast to those from PG&E and SCE who had very large proportions on non-benefiters in nearly all customer segments during the summer period.

The next section presents the analysis showing how much customers were able to reduce their bills as a result of behavior change. Section 6.4.3 combines the findings from the structural benefiter analysis with the average bill impact findings to provide the full picture of how much of the structural loss customers were able to offset based on changing their energy usage behavior.

6.4.2 Estimation of the Average Bill Impact Due to Changes in Usage

As described in Section 3.7.2, the average bill impact due to customers changing their energy usage in response to the TOU rate was estimated by calculating the difference in bills calculated using the TOU rate and post-enrollment usage for both the control and treatment group minus the difference in bills on the TOU rate using pretreatment usage for both the control and treatment groups. The control group bill calculated on the TOU rate represents the bill that would be expected if a customer was billed on the TOU rate, but didn't change their energy use behavior. The bill for the treatment group customers on TOU rate reflects any behavioral changes in response to being on the TOU rate. By subtracting the treatment group's average bill from the control group's average bill—and removing any pre-existing differences—we are able estimate the average bill impact attributable to the treatment group's change in behavior resulting from exposure to the pilot rate, after controlling for exogenous factors. [64] A positive impact indicates that customers successfully reduced their bills relative to the control group who did not respond to a TOU rate.

Bill impacts are presented on a column graph and shown as dollar impacts for the average summer monthly bill for July, August, September, and October 2016 for Rates 1 and Rate 2. The error bars on the graph represent the 90% confidence interval. Therefore, any impacts with error bars that cross below zero are not statistically significant at the 90% confidence level. Impacts are organized by rate, climate region, and segment. The bill impact in percentage terms that corresponds to the dollar amount is also included in the figure to provide context.

As with PG&E and SCE's bill impacts, aggregate level results were weighted following the same approach as used in the load impacts.[65] The weights are representative of the mix of customers eligible to participate in the pilot, not just those who enrolled. Consequently, some of the individual segments shown in the detailed findings section may have more or less weight than other segments when they are combined together to develop the aggregate results. As described earlier, it is important to note that small bill impacts do not necessarily indicate customers did not change their behavior. As seen in the load impact section, load reductions in peak or shoulder periods, which would lead to lower bills all other things equal, are sometimes offset by load increases in the off-peak period. Depending on the relative magnitude of each change, bill impacts could go up, down, or remain largely unchanged even though customers made significant changes in behavior. It is also important to note that the values shown here represent changes in bills due to change in behavior – they do not represent the total change in the bill (nearly all bills increased in the summer). The total changes in the bill will be presented in the next section.

Figure 6-27 provides the overall results for customers in the cool and moderate climate regions on Rate 1. Through changing their energy use the average Rate 1 customer was able to reduce what their average monthly bill would have otherwise been by $2.97, or 2.8%. Though small, this result is statistically significant at the 90% confidence level. Average hourly peak period load impacts for Rate 1 customers were 5.4% or 0.04 kW. For the five hour peak period, the average daily energy savings is approximately 0.2 kWh (5 hours times 0.04 kWh). If we assume four weeks in a month, and five days a week, the result is twenty days where we would expect to observe the peak period reductions. Multiplying 20 days by the 0.2 kWh we expect to find about 4 kWh savings from the peak period per month. When factoring in both the CARE/FERA and non-CARE/FERA rates, the average summer weekday peak period price per kWh on Rate 1 is about $0.56. An impact of 4 kWh per month at $0.56 per kWh equals a total estimated peak period bill reduction of $2.24. When factoring in slight decreases in energy

64 See section 3.2.2 for additional details on the methodology.

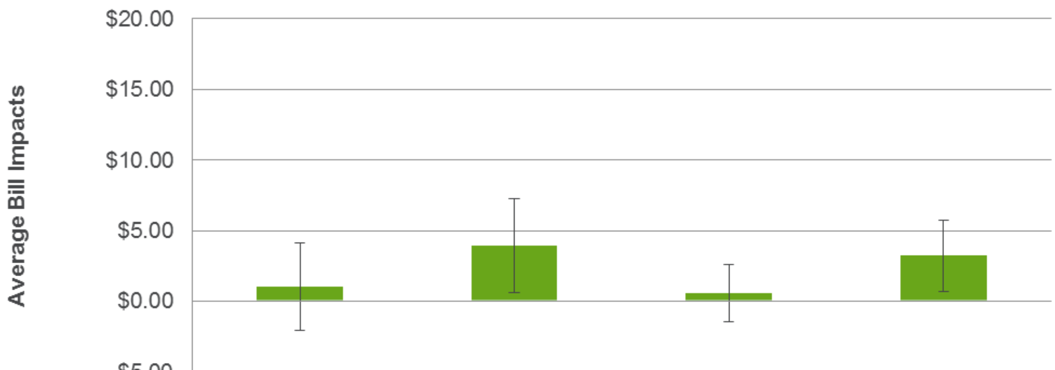
65 See section 3.1 for a detailed discussion of the weighting approach.

use during off-peak hours, the $2.97 monthly bill impact appears quite reasonable. Bill impacts for CARE/FERA customers much smaller than the territory-wide average customer impact at $0.80 (0.9%) and were not statistically significant. Non-CARE/FERA customer bill impacts were statistically significant at $3.49 (3.1%) per month.

Figure 6-27: Rate 1 Average Bill Impacts from Behavior Change
All | CARE/FERA | Non-CARE/FERA
(Positive values represent bill reductions)

Figure 6-28 presents the detailed results by climate region and segment for customers on Rate 1. CARE/FERA customers did not have significant bill reductions between the months of July and October in the cool and moderate climate regions. Non-CARE/FERA customers in the cool and moderate climate regions exhibited similar bill reductions of about 3% ($3.22 and $3.94, respectively).

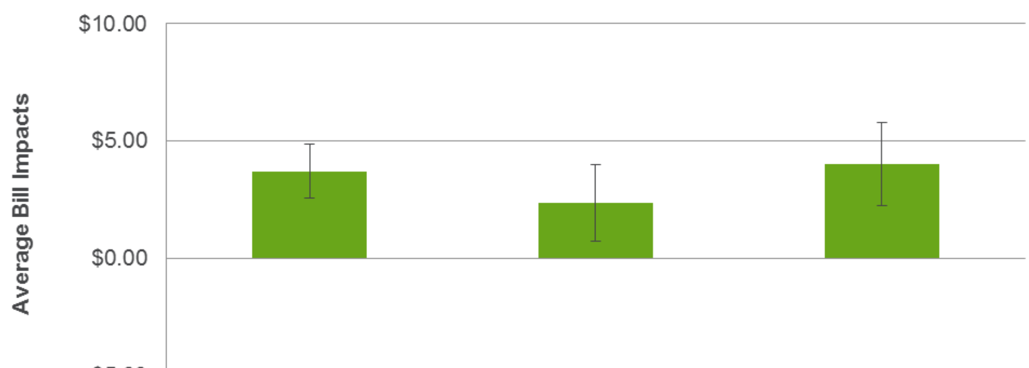
Figure 6-28: Rate 1 Average Bill Impacts from Behavior Change
Detailed Segments by Climate Region
(Positive values represent bill reductions)



	Moderate		Cool	
	CARE	Non-CARE	CARE	Non-CARE
Bill Impact	$1.05	$3.94	$0.56	$3.22
Percent Impact	1.0%	3.0%	0.8%	3.2%

Figure 6-29 provides the overall results for customers on Rate 2, which includes customers in the hot climate region. Non-CARE/FERA customers in the moderate and cool climate regions exhibited similar bill impacts to those on Rate 1, with reductions of $4.02 or 3.5% attributable to behavior change. The bill reductions for CARE/FERA customers in the cool and moderate climate regions were statistically significant for customers on Rate 2 and were equal to $2.37 or 2.7%.

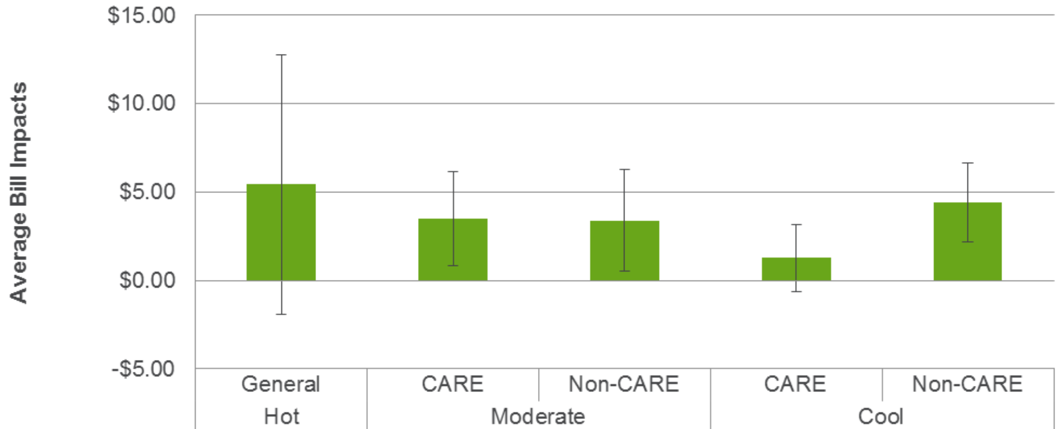
Figure 6-29: Rate 2 Average Bill Impacts from Behavior Change
All | CARE/FERA | Non-CARE/FERA
(Positive values represent bill reductions)



	All Customers All Climates	CARE Cool/Moderate	Non-CARE Cool/Moderate
Bill Impact	$3.72	$2.37	$4.02
Percent Impact	3.4%	2.7%	3.5%

Figure 6-30 provides the detailed level results by climate region and CARE/FERA status for customers on Rate 2. Customers in the hot climate region exhibited large bill reductions of over $5, however these reductions were not statistically significant, likely due to the small sample size of customers in that region. Similar to what was seen on Rate 1, CARE/FERA customers in the cool climate region did not reduce their bills by a significant amount due to behavior change. The two segments in the moderate climate region exhibited similar bill reductions on an absolute basis, $3.51 for CARE/FERA customers and $3.39 for non-CARE/FERA customers.

Figure 6-30: Rate 2 Average Bill Impacts from Behavior Change Detailed Segments by Climate Region
(Positive values represent bill reductions)



	General	CARE	Non-CARE	CARE	Non-CARE
	Hot	Moderate		Cool	
Bill Impact	$5.42	$3.51	$3.39	$1.27	$4.42
Percent Impact	3.5%	3.4%	2.5%	1.8%	4.3%

Generally speaking, non-CARE/FERA customers exhibited larger bill reductions due to changes in energy usage behavior, compared to CARE/FERA customers. Bill reductions fell between about 1% and 4.3% across all customer segments and rates, but many were not statistically significant.

6.4.3 Estimation of the Total Bill Impact Due to Differences in the Tariffs (Holding Usage Constant) and Behavior Change

Total bill impacts experienced by customers on a TOU rate can be decomposed into two components: the structural impact, and the behavioral impact. The structural impact represents the change in customer bills based solely on the change in the underlying structure of the rate. In this case, it is the change from the OAT to the time-differentiated TOU pilot rates. The behavioral impact represents how the customer changed their energy usage in response to the new pricing structure of the rate—which includes higher prices in the afternoon and evening and lower prices at other times of the day. During the summer period, many customers on the TOU rates experienced a structural increase in their bills. However, customers also had an opportunity to offset that increase by changing their energy use behavior in response to the new price signals. As noted above, it is the combination of structural and behavioral bill impacts that produces the total bill impact experienced by the average study participant on each rate.

The results from this analysis represent the average monthly bill across the summer months of July, August, September, and October 2016. Three different bills were calculated for each customer segment:[66]

[66] See section 3.2.3 for additional details on the methodology.

- **No Change in Behavior or Tariff [1]:** This represents what the treatment group bills would have been in the post-treatment period if they were on the OAT and had not changed their behavior
- **No Change in Behavior, Change in Tariff [2]:** This represents what the treatment group bills would have been in the post-treatment period if they were on the TOU rate and had not changed their behavior
- **Change in Behavior and in Tariff [3]:** This represents what the treatment group bills were in the post-treatment period on the TOU rate with a change in behavior

Based off of components defined above, the following metrics were calculated:

- The difference between **[1]** and **[2]** is the structural bill impact (based on post-treatment usage after adjusting for any pretreatment difference between control and treatment customers);
- The difference between **[1]** and **[3]** is the bill impact due to structural differences in the rates, but mitigated by changes in behavior; and
- The difference between **[2]** and **[3]** is the amount customers were able reduce their bills by changing their behavior.

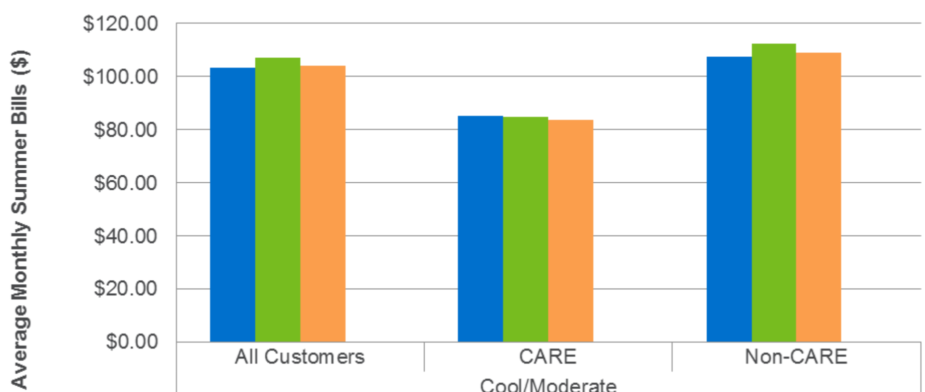
In the bill impact analysis, a major policy question was to better understand the relationship between the structural bill impacts, and how customers were able to respond. This relationship is represented by the "percentage of structural loss mitigated by change in behavior" shown in the data table at the bottom of the figures below. Put differently, this percentage represents how much of the bill increase from the TOU rate the average customer was able to offset. Results are organized by rate, climate region, and segment; similarly to the other bill impact analysis sections.

Figure 6-31 presents a set of three average monthly bills as defined above for all customers, CARE/FERA customers, and non-CARE/FERA customers on Rate 1 in the cool and moderate climate regions combined. The blue bar represents a typical summer monthly bill for a customer still on the OAT and not responding to a TOU rate— noted as "No Change in Behavior or Tariff." For the average customer on Rate 1, this dollar amount was $103.21 per month. The green bar represents what a typical summer monthly bill would be for a customer who was billed on a TOU rate, but didn't change their energy use behavior— noted as "No Change in Behavior, Change in Tariff." This dollar amount is $106.94 for the average Rate 1 customer. The difference between the two values, $3.73, is the average increase a customer would see in their bills by changing from the OAT to Rate 1, and not changing their energy use behavior; this is also referred to as the customer's structural loss. The orange bar represents the average Rate 1 customer's bill after factoring in the change in rate from the OAT to the Pilot Rate 1, and then also taking into account any changes in energy use behavior— noted as "With Change in Behavior and Tariff." This bill amount averaged $103.98 for the typical Rate 1 customer. Based off these values, it is possible to estimate the total change in bills including both the change in tariff and in behavior, which was a bill increase of $0.76 per month (less than 1%). The total change in bill is calculated by subtracting the blue ($103.31) from the orange ($103.98).

An additional important metric is the percent of the structural loss—increase in the bills due strictly to the change in tariff—that can be offset or mitigated by customers changing their energy use behavior. As noted above, the average structural loss for Rate 1 customers was $3.73. The amount customers were able to reduce their bills by changing their behavior—compared to what it would have been without any behavior change—is obtained by subtracting the orange bar ("With Change in Behavior and Tariff": $103.98) from the green bar ("No Change in Behavior, Change in Tariff": $106.94), which equals $2.97. Based on these values, customers were able to offset $2.97 out of the $3.73 structural loss, or 79.6%. This value is provided at the bottom of the data table in each figure for convenience.

Non-CARE/FERA customers were able to avoid nearly all of their structural loss, which was equal to about $4.75. The structural losses experienced by customers in SDG&E's Rate 1 are much smaller than those experienced by participants in PG&E and SCE's pilots. As such, the percent of structural loss mitigated by changes in behaviors are quite large (over 70%) even though the dollar amounts are rather small. In fact, CARE/FERA customers experienced an average structural gain of $0.50, but this value was not statistically significant.

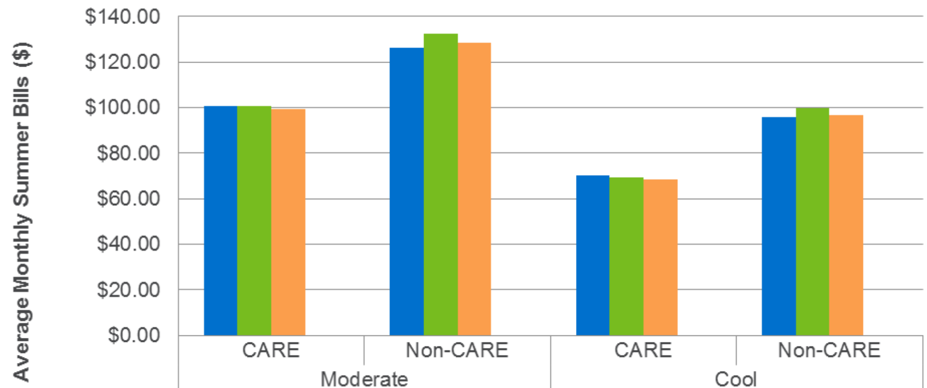
Figure 6-31: Rate 1 Total Bill Impact Due to Differences in the Tariff and Behavior Change All | CARE/FERA | Non-CARE/FERA



	All Customers	CARE	Non-CARE
No Change in Behavior or Tariff	$103.21	$85.13	$107.57
No Change in Behavior, Change in Tariff	$106.94	$84.63	$112.32
With Change in Behavior and Tariff	$103.98	$83.82	$108.84
% of structural loss mitigated by change in behavior	79.6%	-159.1%	73.5%

Figure 6-32 presents the three sets of average monthly bills as defined above for the detailed segments for the cool and moderate climate regions on Rate 1. CARE/FERA customers in the moderate climate region were able to completely avoid any structural loses with changes in behavior – however the structural loss these customers faced was very small and not statistically significant. CARE/FERA customers in the cool climate region experienced a structural gain and were able to gain even more by changing their energy usage behavior, but again these results were not statistically significant.

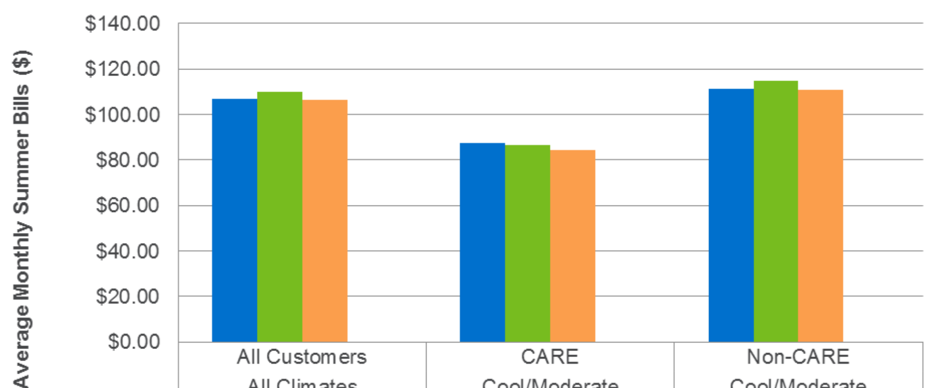
Figure 6-32: Rate 1 Total Bill Impact Due to Differences in the Tariff and Behavior Change Detailed Segments by Climate Region



	Moderate		Cool	
	CARE	Non-CARE	CARE	Non-CARE
No Change in Behavior or Tariff	$100.52	$126.45	$70.30	$96.04
No Change in Behavior, Change in Tariff	$100.63	$132.58	$69.20	$99.95
With Change in Behavior and Tariff	$99.58	$128.64	$68.64	$96.73
% of structural loss mitigated by change in behavior	922.2%	64.2%	-50.7%	82.3%

Figure 6-33 presents the three sets of average monthly bills for all customers, and for CARE/FERA and non-CARE/FERA customers in the cool and moderate climate region combined. On average, customers on Rate 2 faced a structural bill increase of $3.01 or 2.8%. Rate 2 customers were able to completely avoid the structural losses through changes in behavior and reduced their bills from $110.02 to $106.29. Non-CARE/FERA customers in the moderate and cool climate region were able to do the same, and reduced their structural loss of $3.87 to a gain of $0.15.

Figure 6-33: Rate 2 Total Bill Impact Due to Differences in the Tariff and Behavior Change All | CARE/FERA | Non-CARE/FERA

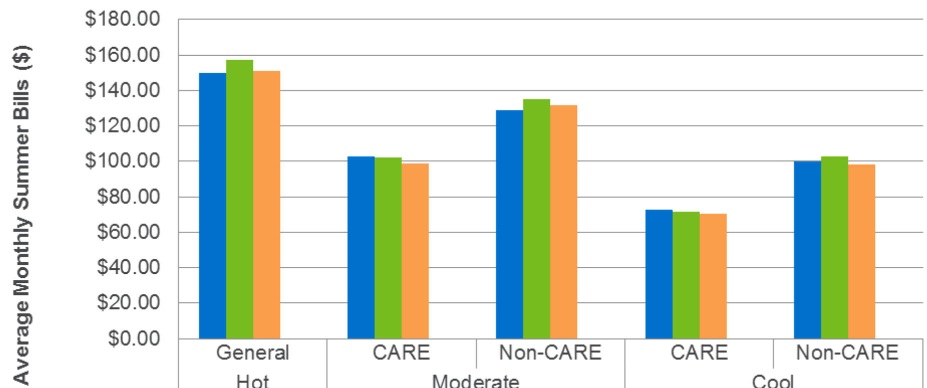


	All Customers All Climates	CARE Cool/Moderate	Non-CARE Cool/Moderate
No Change in Behavior or Tariff	$107.01	$87.50	$111.11
No Change in Behavior, Change in Tariff	$110.02	$86.69	$114.98
With Change in Behavior and Tariff	$106.29	$84.32	$110.95
% of structural loss mitigated by change in behavior	123.9%	-292.9%	103.9%

Figure 6-34 presents the three sets of average monthly bills for the detailed segments by climate region on Rate 2. Customers in the hot climate region experienced the largest potential structural losses, $7.14 or 4.8%. Through behavior change, these customers were able to reduce their TOU bills from $157.10 to

$151.03, which was an 85% reduction of their structural loss. CARE/FERA customers in the cool and moderate climate regions were able to avoid structural losses completely, even without changes in behavior.

Figure 6-34: Rate 1 Total Bill Impact Due to Differences in the Tariff and Behavior Change Detailed Segments by Climate Region



	General	CARE	Non-CARE	CARE	Non-CARE
	Hot	Moderate		Cool	
No Change in Behavior or Tariff	$149.96	$103.00	$129.15	$72.56	$100.09
No Change in Behavior, Change in Tariff	$157.10	$102.41	$135.09	$71.55	$102.69
With Change in Behavior and Tariff	$151.03	$98.90	$131.71	$70.27	$98.27
% of structural loss mitigated by change in behavior	85.0%	-589.0%	56.9%	-125.4%	169.5%

Generally, structural losses were very small for customers on SDG&E's Rate 1 and Rate 2. This is very different from what customers in the other two utilities' pilots experienced. Structural bill impacts for customers in PG&E and SCE's pilots were closer to $20, while those in SDG&E's pilot are generally just over $3.00. Because of this, many customers in SDG&E's pilot were able to save money by moving to a TOU tariff and changing their behavior.

6.4.4 Change in the Distribution of Bill Impacts Due to Behavior Change

The fourth analysis presents the distribution of bill impacts for customers with and without behavioral change, and is designed to show how the distribution shifts when customers respond to the rates by changing behavior. Similar to the other analyses, impact distributions are based on the average summer monthly bills for July, August, September, and October. Bill impacts were estimated for two cases—with and without behavior change. Customers were segmented into ranges of bill impacts. The percentage of customers in each $10 increment from negative $100 to positive $100 per month (with and without behavior change) was determined with and without behavior change. The underlying calculations used to develop the distributions are based off of a difference-in-differences approach that compares the treatment and control customers based on both pre- and post-treatment bill impacts.[67]

The two distributions are presented on a line graph, with the height of the line at any given $10 increment representing the percentage of customers experiencing a bill impact of the corresponding dollar amount. In this case, the bill impact is measured as the difference between the TOU bill and the OAT bill. If the line for the group with changes in behavior is to the left of the line representing the

[67] See section 3.2.4 for additional details on the methodology.

group with no change in behavior, it shows that at least some customers were able to modify their energy usage such that they had lower bill impacts compared to if they had not changed their behavior.

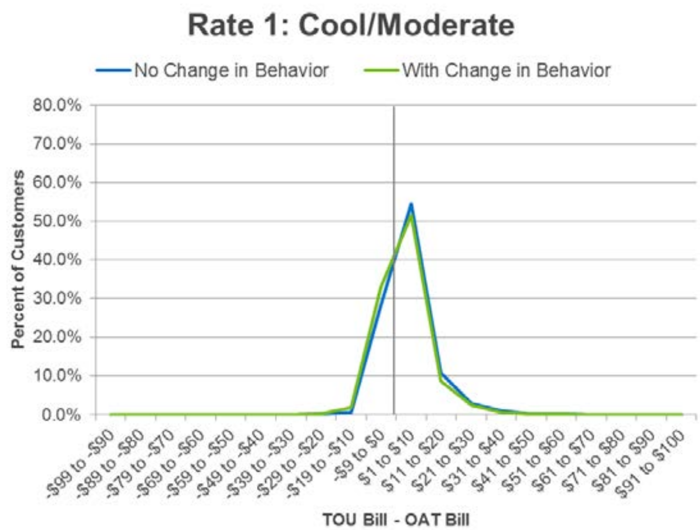
Figure 6-35 presents the distribution of bill impacts with and without energy use behavior change. The blue line represents the structural bill impacts that result when customers are billed on the TOU rate and do not change their energy use behavior. The green line shows the bill impacts when customers have responded to the TOU rate and, in some cases, changed their energy use behavior. Bill impacts are calculated as the difference between the TOU bill and the OAT bill. Each point along the line graph represents the percentage of customers within a specific bill impacts bin or range. For example, on Rate 1, approximately 3% of the customers have structural bill impact of $21 to $30 per month—the blue line. In other words, approximately 3% of the Rate 1 customers would experience an increase of $21 to $30 per month on Rate 1 compared to the OAT without changing their behavior. The green line represents the bill impacts when customers have had the opportunity to respond to the TOU rate. In this case, the percent of customers experiencing an increase of $21 to $30 per month on Rate 1 compared to the OAT is 2.5%, showing a slight decrease.

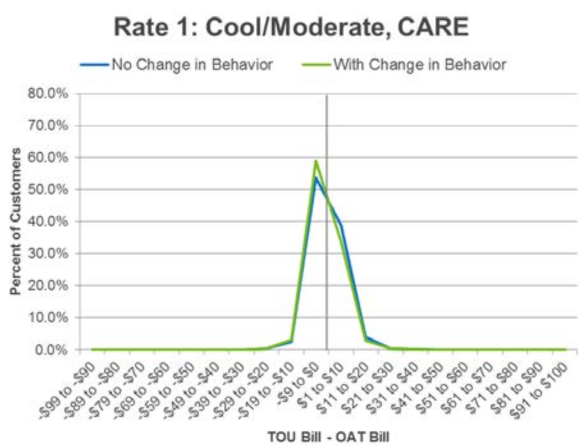
It is important to note that customers could move up or down through the incremental impact bins, and could potentially move more than one bin—meaning that a customer could potentially experience a bill increase due to their behavioral response, or they could jump down several bins and go from a $21 to $30 per month bill impact down to $11 to $20 impact, for example. In the case of the average Rate 1 customers, there is an increase in the percent of customers with a bill decrease of between $0 and $9 per month. With no change in behavior, 28% of customers were in this bin and with behavior change 33% of customers are now in this bin.

As noted in the previous section, most customers did not face large structural bill increases. This is also apparent in the graph below, where the distribution is very narrow compared to those for PG&E and SCE. The shifts are also rather small compared to the other two utilities. It’s important to remember that instances where the green line is to the right of or above the blue line in the lower bill impact ranges indicate more customers have moved into that bin, likely from higher impact bins.

Figure 6-35: Rate 1 Change in the Distribution of Bill Impacts Due to Behavior Change
All | CARE/FERA | Non-CARE/FERA

Pilot Bill - Tiered Bill	No Change in Behavior	With Change in Behavior
-$99 to -$90	0.0%	0.0%
-$89 to -$80	0.0%	0.0%
-$79 to -$70	0.0%	0.0%
-$69 to -$60	0.0%	0.0%
-$59 to -$50	0.0%	0.0%
-$49 to -$40	0.0%	0.0%
-$39 to -$30	0.0%	0.0%
-$29 to -$20	0.2%	0.3%
-$19 to -$10	0.7%	1.9%
-$9 to $0	28.2%	32.9%
$1 to $10	54.5%	51.6%
$11 to $20	10.8%	8.6%
$21 to $30	3.1%	2.5%
$31 to $40	1.1%	0.6%
$41 to $50	0.1%	0.2%
$51 to $60	0.1%	0.2%
$61 to $70	0.1%	0.0%
$71 to $80	0.0%	0.0%
$81 to $90	0.0%	0.0%
$91 to $100	0.0%	0.0%





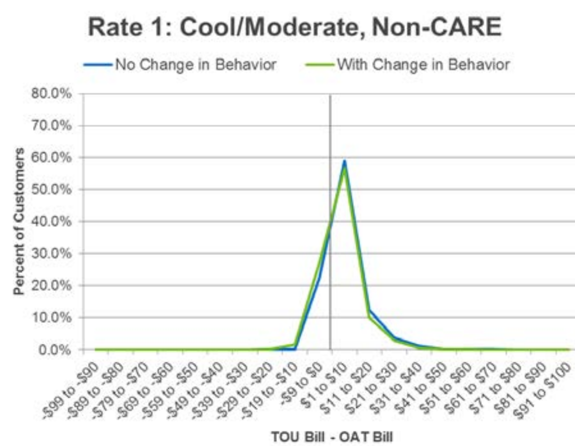


Figure 6-36 provides the dsitribution of bill impacts for the detailed segmetns by climate zone. It is interesting to note that most of the distribution of bill impacts for CARE/FERA customers in the cool climate region falls to the left of the gray line, indicating that most customers are structural benefiters of the TOU rate. This is in line with what was presented in Section 6.4.1, where most customers in this segment were in the nuetral or structural benefiter category. The opposite is true for non-CARE/FERA customers in both climate region, which shows that most customers are non-benefiters, although there bill impacts are quite small, both with and without changes in behavior.

Figure 6-36: Rate 1 Change in the Distribution of Bill Impacts Due to Behavior Change Detailed Segments by Climate Region

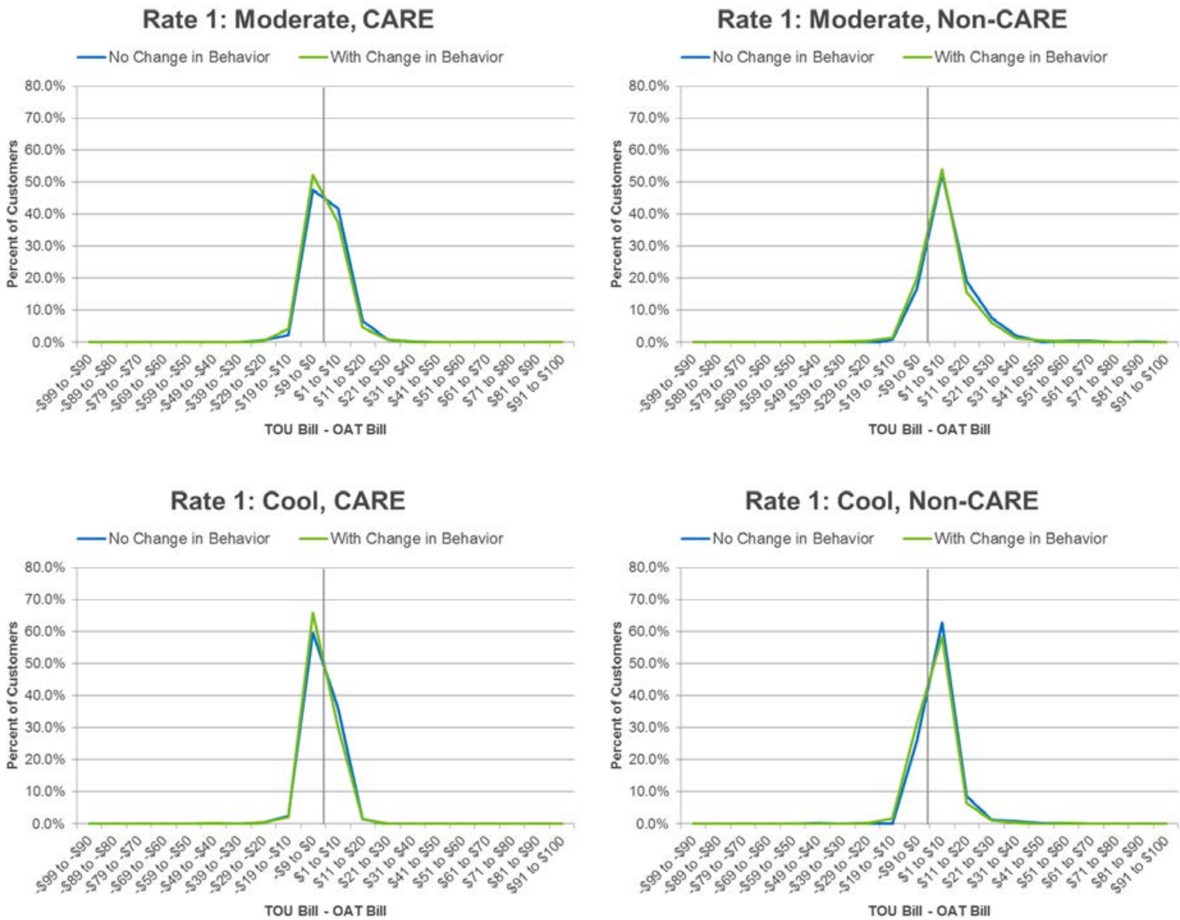
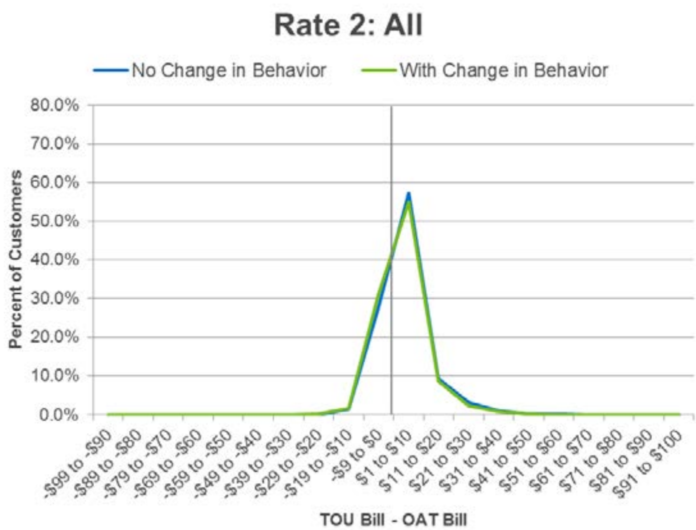
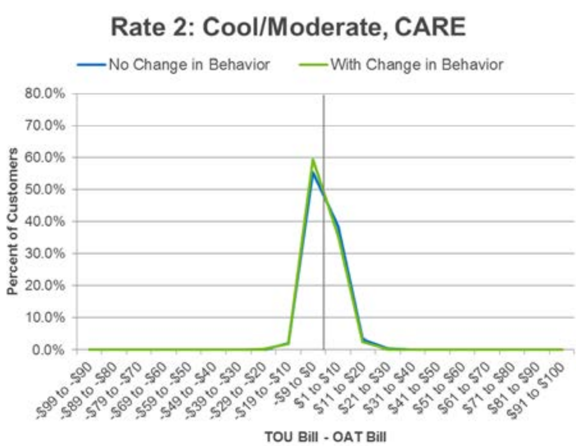


Figure 6-37 provides the distribution of bill impacts for all customers and CARE/FERA and non-CARE/FERA customers in the moderate and cool climate regions on Rate 2. Without changes in behavior, 57% of customers faced bill impacts between $1 and $10. With changes in behavior, this was reduced to 55% of customers. A similar shift occurred in the $11 to $20 range. The distributions of bill impacts for CARE/FERA and non-CARE/FERA customers in the cool and moderate climate regions are very similar to those for Rate 1.

Figure 6-37: Rate 2 Change in the Distribution of Bill Impacts Due to Behavior Change
All | CARE/FERA | Non-CARE/FERA

Pilot Bill - Tiered Bill	No Change in Behavior	With Change in Behavior
-$99 to -$90	0.0%	0.0%
-$89 to -$80	0.0%	0.0%
-$79 to -$70	0.0%	0.0%
-$69 to -$60	0.0%	0.0%
-$59 to -$50	0.0%	0.0%
-$49 to -$40	0.0%	0.0%
-$39 to -$30	0.1%	0.0%
-$29 to -$20	0.0%	0.2%
-$19 to -$10	1.5%	1.6%
-$9 to $0	27.6%	31.1%
$1 to $10	57.2%	55.1%
$11 to $20	9.2%	8.6%
$21 to $30	3.1%	2.3%
$31 to $40	0.9%	0.8%
$41 to $50	0.1%	0.2%
$51 to $60	0.1%	0.1%
$61 to $70	0.0%	0.0%
$71 to $80	0.0%	0.0%
$81 to $90	0.0%	0.0%
$91 to $100	0.0%	0.0%





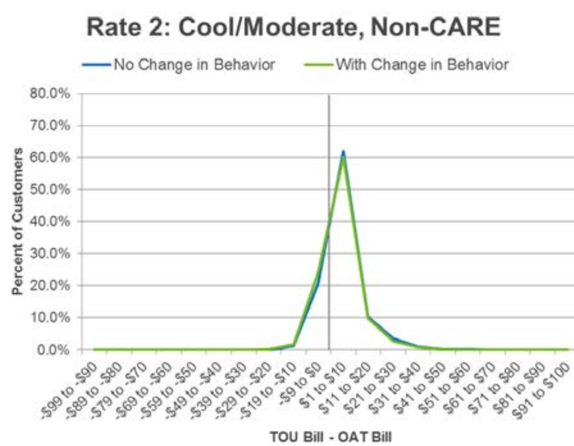
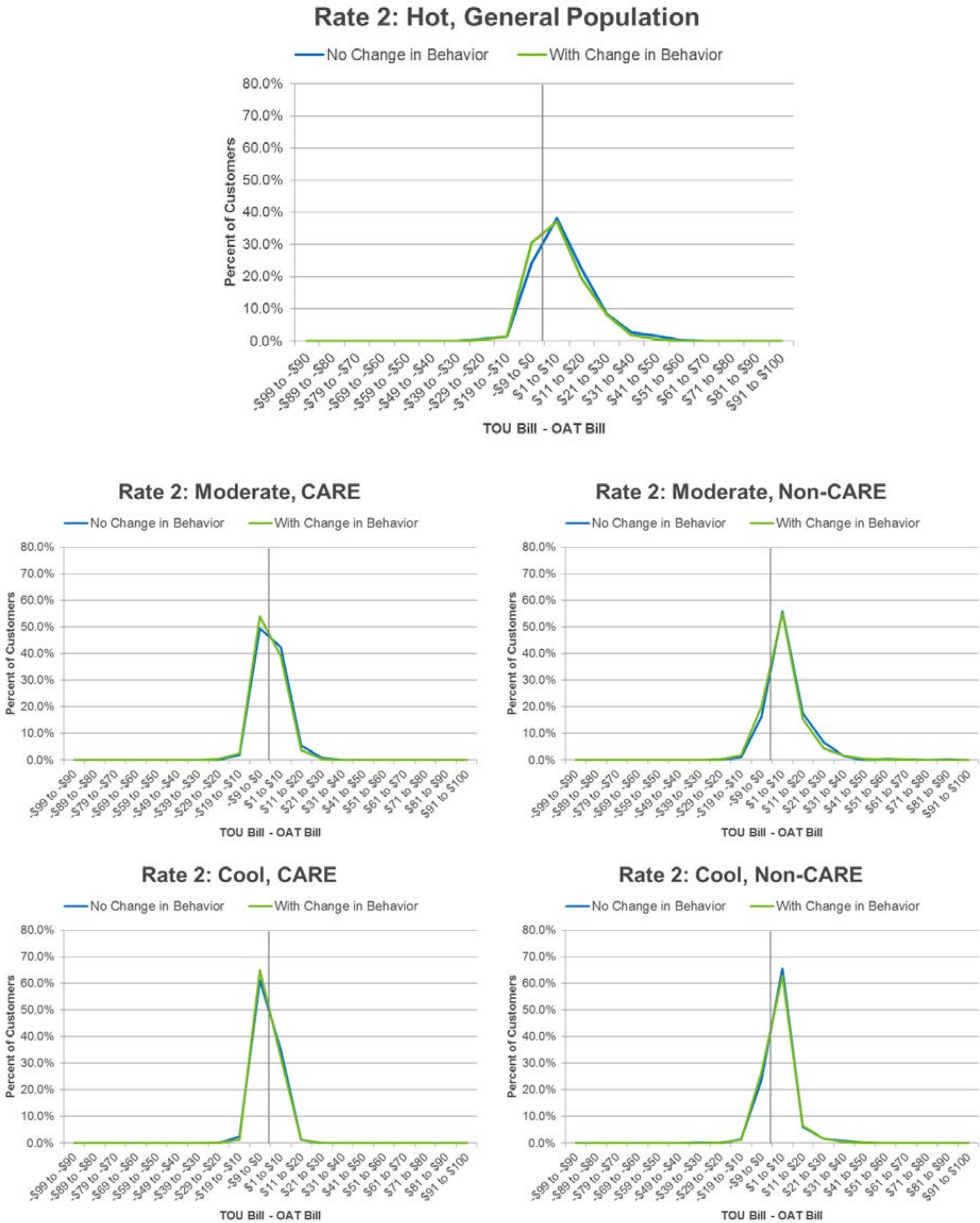


Figure 6-38 shows the distributions of bill impacts for the detailed segments by climate region for Rate 2. In the hot climate region, the percent of customers facing bill decreases of $0 to $9 increased from 24% to 31%. The shifts in the cool climate region were very small for CARE/FERA and non-CARE/FERA customer. With and without behavior change, over 60% of non-CARE/FERA customers in the cool climate region faced bill impacts of $1 to $10, which is rather small.

Figure 6-38: Rate 2 Change in the Distribution of Bill Impacts Due to Behavior Change Detailed Segments by Climate Region



6.5 Survey Findings

To be added

6.6 Synthesis

To be added

7 Overall Summary and Conclusions

To be added.