



Load and Billing Impact Findings from California Residential Opt-in TOU Pilots

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AGENDA

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 - Pilot background
 - Rate descriptions
 - Experimental design

- Load impact estimates
 - Brief summary of methodology
 - Findings

- Bill impact estimates
 - Objectives
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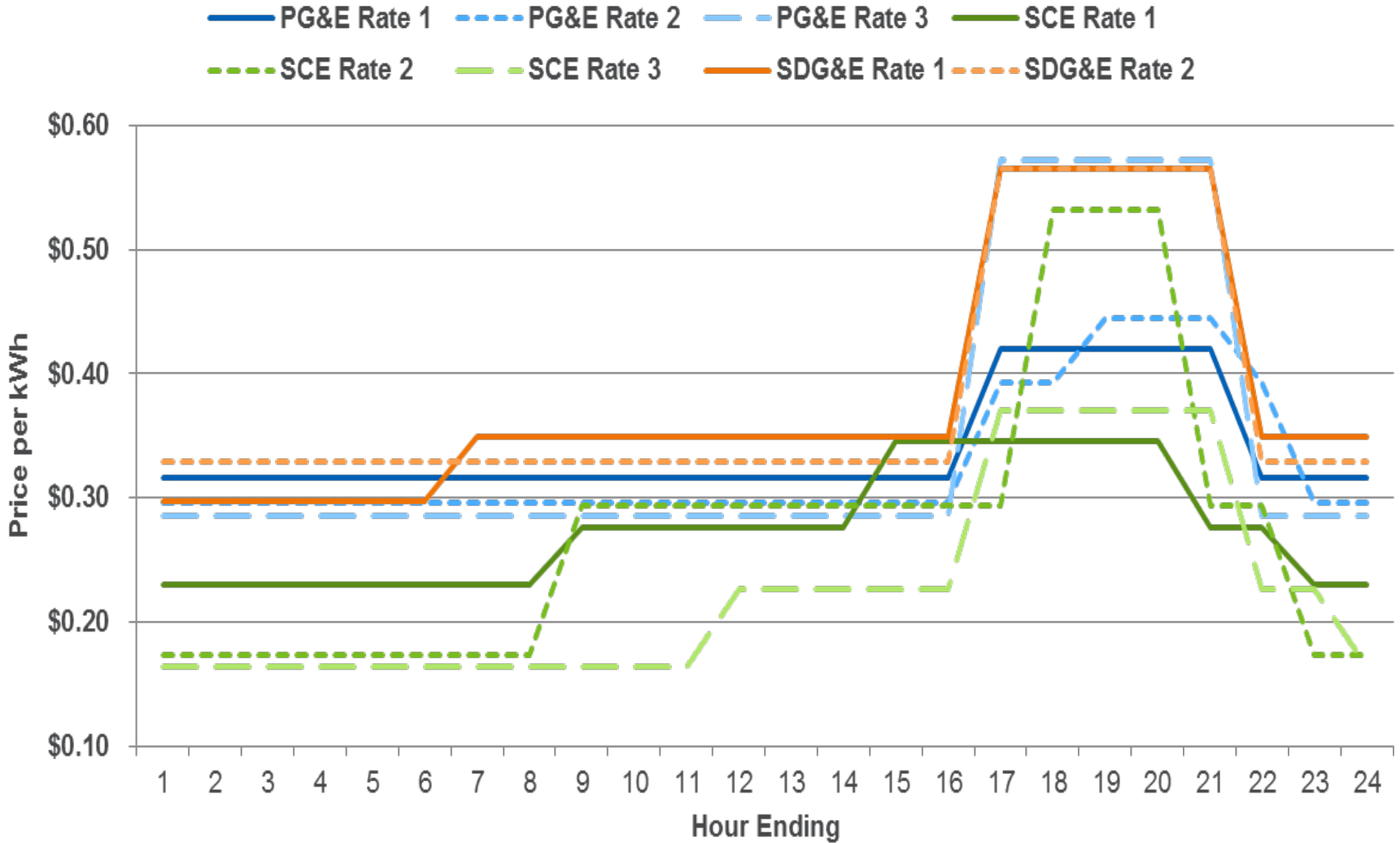
Pilot background

- In Decision 15-07-001, the California Public Utilities 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 beginning in summer 2016.
- Key Objectives:
 - Develop insights that will guide the IOUs applications to be filed in January 2018 proposing the implementation of default TOU pricing for all residential electricity customers.
 - Determine the change in electricity use in different time periods for different customer segments from each rate treatment and in response to various technology and information treatments.
 - Estimate the distribution of bill impacts associated with each rate option both before and after enrolling on the TOU rates.
 - Assess the extent to which TOU rates cause unreasonable hardship among seniors and economically vulnerable customers in hot climate areas.
 - Determine satisfaction with and perceptions about, understanding of and reported changes in behavior associated with different treatment options.

Rate descriptions

- During the first summer, 8 different TOU rates were tested.
 - Three rates at PG&E and SCE, and two rates at SDG&E.
- 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.
 - 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.
- 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.

TOU rate comparison – Summer Weekday



Experimental design

- A key challenge for the TOU pilots was the desire to obtain insights from opt-in pilots that would be applicable to default rates.
 - Legislation in CA prohibits defaulting customers onto TOU rates prior to 2018.
 - Default enrollment is comprised of three customer types:
 - Always takers – customers who would enroll on an opt-in basis and would not opt out under default pricing.
 - Complacents – customers who would not enroll on an opt-in basis but would not opt out under default pricing.
 - Unaware customers – customers who do not realize their rates have changed.
- Customers were offered financial incentives tied to enrollment and completion of two surveys and were randomly assigned to one of the treatment options or to the control condition.
 - This RCT design ensures internal validity of impact estimates.
 - It was hoped that the “pay-to-play” incentives would encourage more “complacents” to enroll compared with a traditional opt-in enrollment scheme.

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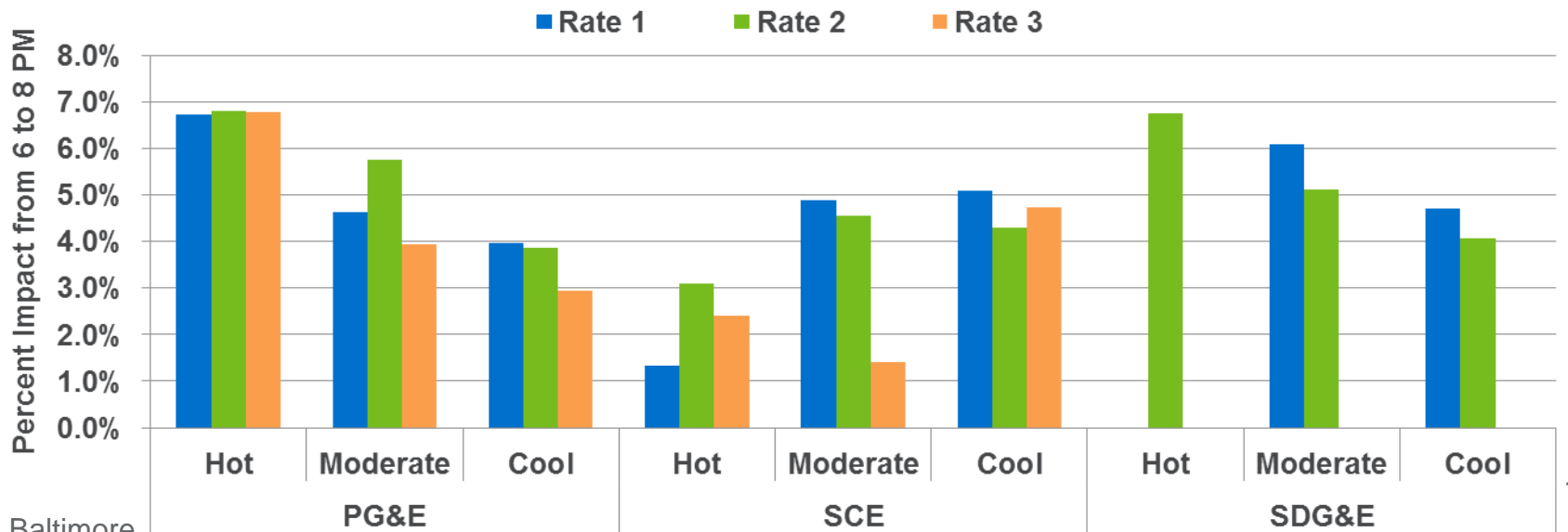
Estimating load impacts for rate treatments

- Load impacts for each rate were estimated using a “difference-in-differences analysis” which takes the difference in loads between treatment and control customers in the treatment period and subtracts off any difference in load in the pretreatment period to ensure that there is no bias in the estimated impact due to random chance.
- When applied to data collected through an RCT design, DiD analysis produces the most accurate load impact estimates possible through experimental research.
- Analysis for standard rate treatments was based on a fixed effects, difference-in-differences (DiD) model analyzed as a randomized encouragement design (RED) to allow for differing opt-out rates in the treatment versus control group.

Customers do respond in the evening, but impacts vary significantly by climate

- For PG&E and SDG&E, load reductions in both percentage and absolute terms are highest in the hot climate region, next highest in the moderate region and lowest in the cool region.
- Differences across regions in percentage terms are not always statistically significant, but are significant in all cases for PG&E and SDG&E in absolute terms.
- The pattern of peak period load reductions is different for SCE, where in some instances, the load reductions are smallest in the hot region and in one case, are largest in the cool region.

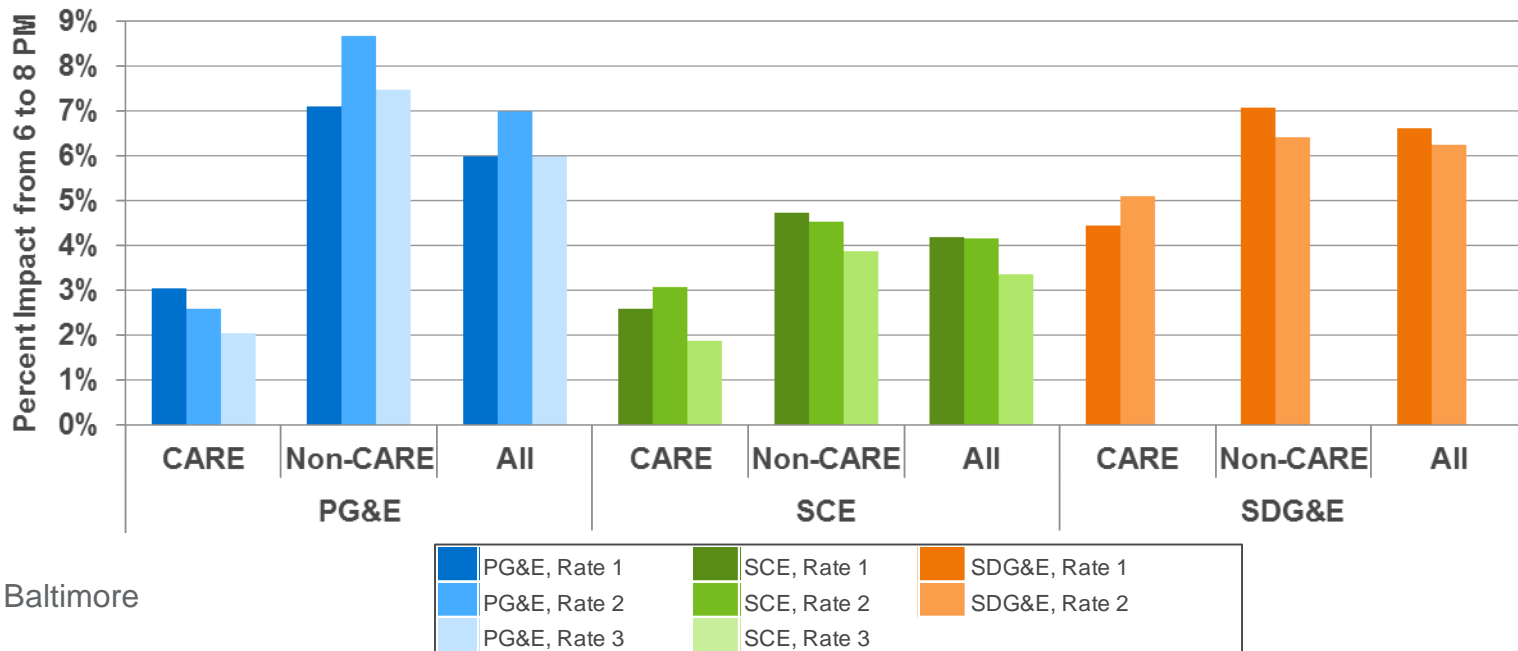
Load Reductions from 6 to 8 PM (Common Hours) by Climate Region for the “All” Customer Segment, Average August and September Weekdays



Impacts vary significantly by customer segment

- For nearly all climate regions and tariffs, load reductions by CARE (low income) customers are significantly less than for non-CARE customers.
- Senior households in the hot SCE and PG&E regions had load reductions that were comparable to the hot region population as a whole.
- Households with incomes below 100% of the Federal Poverty Guideline (FPG) in the hot climate regions did not reduce loads in PG&E’s service territory but had load reductions similar to the population as a whole in SCE’s territory.

**Load Reductions from 6 to 8 PM (Common Hours)
Average August and September Weekdays**



Overall findings for load impacts

- The average weekday peak period load reduction for each IOU service territory ranged from a low of 2.7% to a high of 6.1%.
 - Residential customers were willing and able to reduce load during peak periods that extend into or completely coincide with evening hours.
 - Peak period reductions were also observed for rates that have peak prices on weekends.
- For most rates and most customer segments/climate regions, there is a small but statistically significant conservation effect (1% to 3%).
- For three-period rates, load reductions were statistically significant in the shoulder period and equaled half or less than the load reductions in the peak period.
- For most rates, there were small increases in off-peak electricity use.

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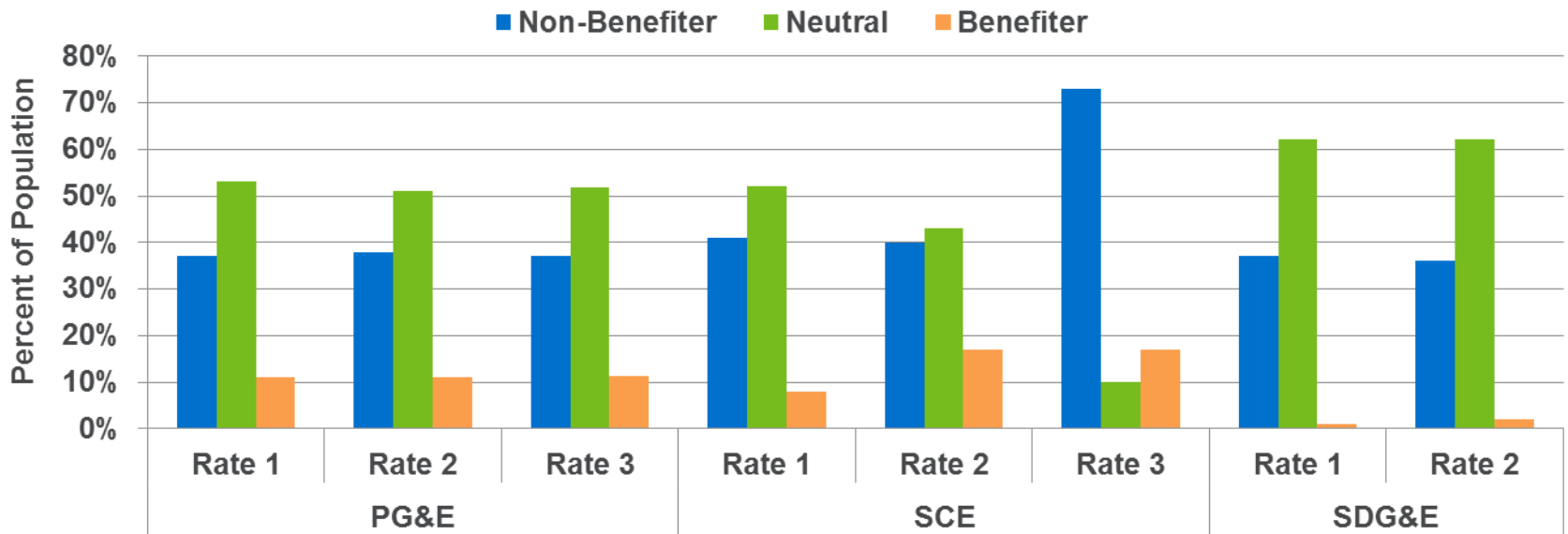
Bill impact analysis

- The bill impact analysis had several objectives.
 - Determine how customers' bills differ on the TOU rate and the OAT.
 - Determine how much, if any, structural loss customers were able to mitigate through behavior change in response to the time-varying price signals.
 - Determine the total bill impact including both tariff and behavioral changes.
- Several types of analyses were conducted to address the research objectives.
 - Structural benefiter/non-benefiter analysis based on pretreatment usage.
 - Estimation of the average bill impact due to changes in energy usage.
 - Estimation of the total bill impact due to differences in the tariffs (holding usage constant) and behavior change.

Structural benefiter/non-benefiter analysis

- Nearly all customers were structural non-benefiters in the summer. On an annual basis:
 - Largest proportion of customers are in the neutral category (+/- \$3 per month) and range from approximately 40% to 60% of the respective populations except for SCE’s rate 3.
 - The next largest proportion of customers consists of non-benefiters, which generally includes 35% to 40% of the population.
 - Benefiters are generally around 10% of the population, but range from a high of 17% on SCE’s rates 2 and 3 to a low of 1% on SDG&E’s rate 1.

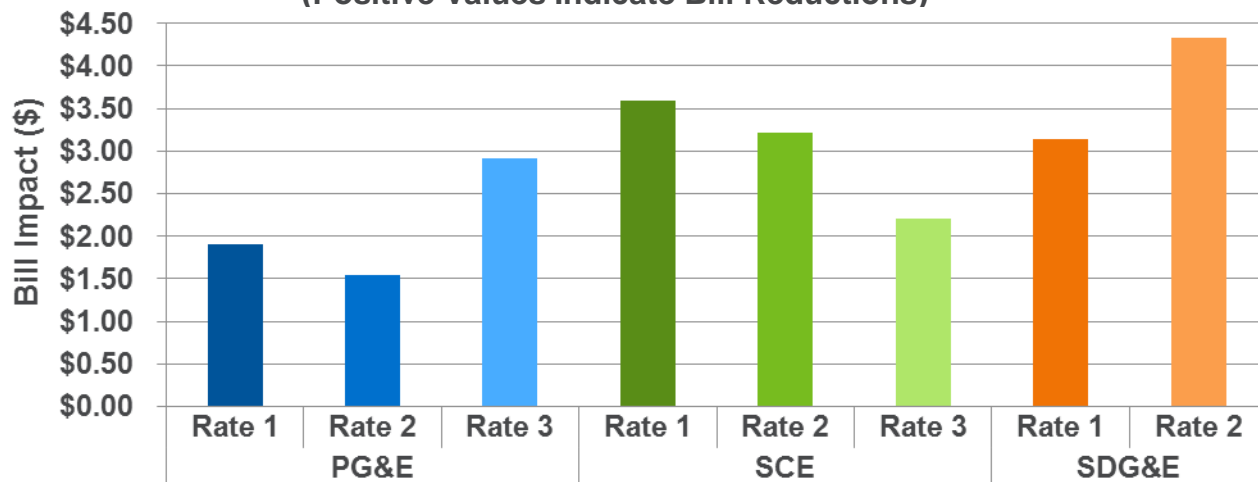
Pretreatment Structural Benefitters and Non-Benefiters (Annual)



Average bill impact due to changes in usage

- Behavioral bill impacts were small and didn't offset a significant portion of the structural bill increase. Through changing their energy use, the average customer was able to reduce what their average monthly bill would have otherwise been by up to:
 - \$2.92 or 2.4% at PG&E
 - \$3.59 or 2.7% at SCE
 - \$4.33 or 4.1% at SDG&E
- At SDG&E the structural increases were very small and some customers even experienced structural bill decreases.

Average Monthly Behavioral Bill Impacts Across Utility Specific Summer Periods
(Positive Values Indicate Bill Reductions)

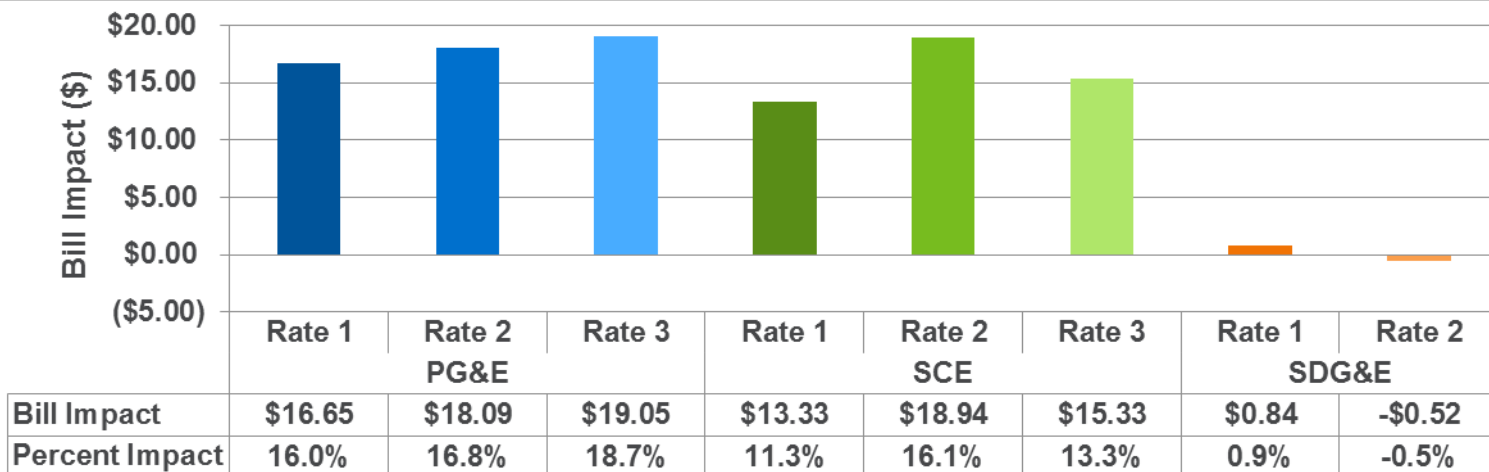


Behavioral Bill Impact	\$1.90	\$1.54	\$2.92	\$3.59	\$3.21	\$2.21	\$3.14	\$4.33
% of Structural Loss Mitigated by Change in Behavior	10.3%	7.9%	13.3%	21.2%	14.5%	12.6%	78.9%	113.5%

Total bill impacts

- Across the three utilities, average monthly bill impacts over three summer months ranged from a slight bill decrease to as much as a \$40 increase depending on the climate region and rate.
 - For the service territory as a whole, the largest total bill impact was an increase of \$19.05 or 18.7% for the average customer on Rate 3 at PG&E, and the smallest total bill impact was actually a slight bill reduction of \$0.52 or 0.5% for Rate 2 at SDG&E.
 - In SDG&E’s service territory, the bill impacts were much smaller and some segments actually saw very small bill reductions compared to the OAT because both the OAT and TOU rates were seasonally differentiated.
 - It is important to keep in mind that these summer bill increases for PG&E and SCE are likely to be offset, at least in part, by bill reductions in the winter period for reasons discussed above.

Average Monthly Total Bill Impacts Across Utility Specific Summer Periods
(Positive Values Indicate Bill Increases)





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