BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking [redacted] Own Motion to Conduct a Comprehensive Examination of Investor [redacted] Rate Structures, the Transition to Time Varying and Dynamic Rates, and Other Statutory Obligations	**R. 12-06-013** (Filed June 21, 2012)

SIERRA CLUB OPENING COMMENTS ON RATE DESIGN PROPOSALS

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I. INTRODUCTION

[redacted]-Mail Ruling Amending Procedural Schedule filed June 24, 2013, Sierra Club respectfully submits the following Opening Comments on Rate Design Proposals in Rulemaking 12-06-013, Order Instituting Rulemaking [redacted] Other Statutory Obligations. [redacted] were prepared with the assistance of EcoShift Consulting, LLC.

[redacted] objectives. In formulating our proposed rate design, Sierra Club developed a methodology to evaluate the effect of a rate design on the adoption of distributed generation (**DG**) photovoltaic (**PV**) systems and energy efficiency (**EE**) upgrades in air conditioning (**AC**) systems. We applied this methodology to assess a range of potential rate designs and ultimately proposed a combined 3-tier/3-time-of-use (**TOU**) period [redacted] functions to maximize PV and EE outcomes while minimizing potential bill impacts. In these Opening Comments, Sierra Club applies this same methodology to assess the PV and EE impacts of rate design proposals of other parties. We found that a TOU rate structure with two-tiers and a high differential between tiers, such as proposed by SEIA, also results in positive outcomes for EE and DG. In contrast, rate design proposals that simply flatten the existing tiered rate structure, such as proposals by PG&E and SCE, would function to end Calif[redacted] national leadership in rooftop solar deployment by eliminating the economic incentive for rooftop solar for nearly all residential customers.

The threats posed by climate change to California are real and the need to transition to a carbon-free energy supply could not be more urgent. Any credible rate design must support [redacted],Executive Order S-3-05, and further clean energy policies like the Loading Order and Million Solar Roofs program. Importantly, A TOU rate structure with a significant baseline credit or tiered differential as proposed by SEIA, Sierra Club, and NRDC also furthers equity objectives. TOU better aligns costs to produce electricity with residential rates. Incorporation of a significant baseline credit ensures that basic electricity needs are affordable for all Californians and reflects the fairness and equity values of a civilized society.

Rate designs that are exclusively tiered or TOU fail to achieve both of these outcomes.

Sierra Club also modeled the impact of fixed charges on proposed rate design. Even a $5 fixed charge negatively impacts incentives for EE and rooftop solar. These impacts only become more severe as the fixed charge increases. Notably, the vast majority of parties in the proceeding did not include fixed charges in their proposed rate designs. Indeed, only the IOUs and CLECA proposed a fixed charge. As explained by numerous parties in their proposed rate designs, in addition to discouraging conservation, efficiency, and rooftop solar, fixed charges disproportionately impact low-income and low-energy users. Utility fixed costs are better recovered through customer usage, or minimum bill components.

Accordingly, Sierra Club urges the Commission to move forward with a combined TOU rate design that incorporates three tiers or a significant baseline credit and does not include fixed charges.

II. KEY FINDINGS

For a rate design to provide an incentive comparable to or better than current rates for customers to install PV and upgrade to efficient AC units, a TOU system with a sizable differential between TOU periods combined with a widely spread baseline credit (10-15 cents) is necessary. When these rate design elements are not included, the incentive for these energy efficient and conservation responses declines dramatically. For example, removing the baseline credit would largely halt rooftop solar installations in California because almost no customers would have a payback period of under 25 years. Some specific findings about rate proposals include:

- The SEIA proposal results in slightly lower, but comparable incentives for DG PV as the Sierra Club proposal. This shows that a 2-tiered system can achieve similar results as a 3-tiered system if there is a large enough baseline credit.

- The DRA and TURN proposals significantly reduce the incentive to install solar. In the case of DRA, this is because the baseline credit in the proposed TOU rate design is nominal. In the case of TURN, tiers are flattened somewhat as compared to the existing rate structure, but without incorporating a TOU element.

- The SCE, PG&E and CLECA proposals would remove the economic incentive to install solar for the vast majority of residential customers.

- An extremely wide spread in TOU rates without tiers, such as the rate component proposed by SDG&E, can replicate some of the benefit of adequately spaced tiers. However, the SDG&E proposal would still reduce DG PV and EE incentives to less than half that of the Sierra Club proposal.

- A wide spread between TOU periods, similar to what several parties including Sierra Club have proposed, will enhance the incentive for customers to install energy efficient AC units.

- Customer charges significantly reduce the incentive to install DG PV and AC efficiency upgrades.

- Flattening of tiers results in the highest income households paying significantly less for electricity. For example, the SCE Tiered proposal results in a 7% bill reduction for the wealthiest customers, assuming the CARE subsidy level continues.

III. IMPACT OF RATE DESIGN PROPOSALS ON ROOFTOP SOLAR AND ENERGY EFFICIENCY

In analyzing party rate design proposals, we used the same methodology used to evaluate [illegible], focusing on DG PV Break-Even Analysis and AC Efficiency Upgrade Analysis. This methodology is outlined in Appendices A and B and discussed more fully in Sierra Club[illegible]ate Design Proposal.[1] In the case of certain proposals, assumptions were necessary in order to conduct the analysis. We used the PG&E bill calculator to model effects of rate proposals (including proposals from the other IOUs) because the analysis model we built was based on the customer data sample and output of the PG&E bill calculator.

Using rate design summary forms, rate design proposal, and IOU bill calculator results, we estimated DG PV and EE impacts of proposed rate designs from the following parties: PG&E, SCE, SDG&E, TURN, DRA, CLECA, and SEIA. In some cases, we modeled effects of multiple proposals from these parties. In some instances, there was insufficient specification of proposed rate designs, and therefore we inferred specifications from actual rates submitted, attempting to come as close as possible to proposed rates given the limitations of the PG&E bill calculator. In all cases, the rate proposals we modeled were very similar if not exactly the same as those proposed by the parties. Therefore, any differences in the proposals should not cause significant differences in our results. Some additional rate variations used in the subsequent

[1] Sierra Club Residential Rate Proposal, Prepared by EcoShift Consulting, LLC, Rulemaking 12-06-013.

analysis are given in Appendix C. For some rates, bill calculator inputs were explicit, and below we describe our process to define bill calculator inputs for the IOU proposals we analyzed.

Proposals submitted by parties vary in the level of CARE subsidy. The comparison of the PV and EE results in our analysis will reflect these varying levels as part of each proposal as a whole. To analyze comparisons that accurately demonstrate the effects of TOU, tiers, and customer charges on DG PV and AC upgrades, we generated rates that control for the CARE subsidy to remain constant at 49% for the purpose of this analysis.

Table 1. Rate Proposals Modeled in Sierra Club Analysis

Non-CARE Rates, current and proposed

[redacted]

Table 2, CARE rates, current and proposed

[redacted]

PG&E provided two illustrative end-state rate designs, one tiered and one non-tiered TOU, and we modeled effects of both of these according to the specifications provided in the bill calculator output in their rate design proposal. The tiered rate was a two-tiered design with a 3% increase over current rates for both tiers 1 and 2, a $10 customer charge, a 20% differential [redacted] proposal. The non-tiered TOU rate involved 3 TOU periods, a 30% differential between peak and part-peak, a 30% differential between part-peak and off-peak, and an 85% ratio between summer and winter for both part-peak and off-peak rates.

SCE proposed two end-state rate designs, one tiered and one non-tiered TOU. We modeled effects of both of these proposals. For the SCE end-state tiered proposal, we used the rate specification given in their rate design proposal summary: a $5 per month fixed charge, a volumetric rate tier ratio of 1.2 to 1.0 (Tier 2 to Tier 1), and a CARE discount of 20% from the non-CARE rates. For the SCE end-state TOU proposal, since specifications were not given in the text, aside from fixed charges of $15 and $20 per month for non-CARE customers ($12 and $16 per month for CARE customers), with the higher fixed charge applied to customers whose demand exceeds 5 kW, we inferred rate specifications from the rates on the proposal form, and modeled a 60% differential between part-peak and peak, and a 20% differential between part-peak and off-peak, along with an 85% ratio between summer and winter for both part-peak and off-peak rates.

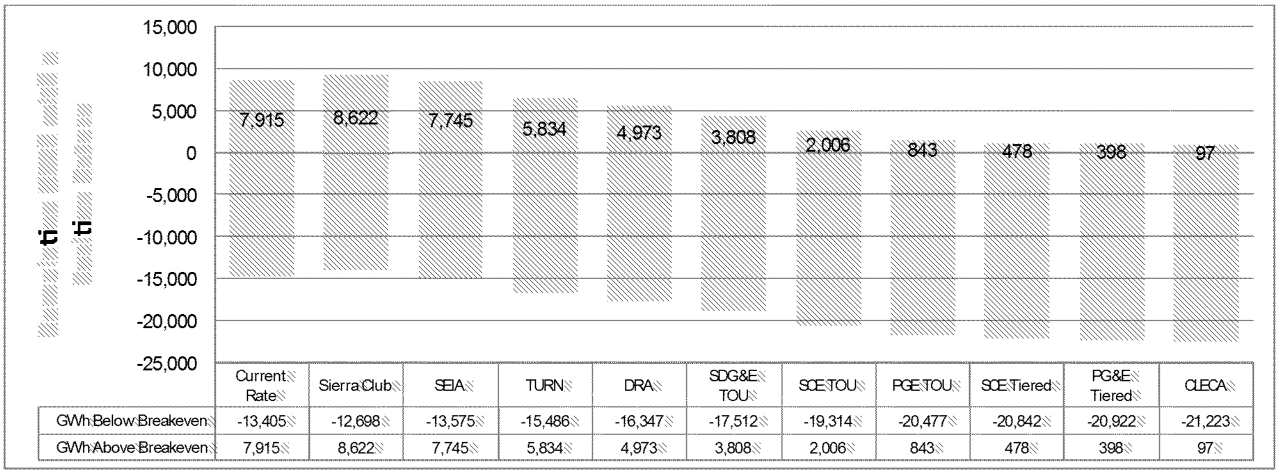
SDG&E proposed three end-state rate designs, all with 20% CARE discounts. In the first, volumetric charges are completely replaced with a fixed fee of $38.24 per customer. In the second, volumetric charges are completely replaced with a fixed fee that varies by demand, with break-points at 3 and 7 kW. In the third rate, three TOU periods were given, and we calculated a 270% differential between the peak and part-peak rates, a 32% differential between the part-peak and off-peak rates, and an 84% ratio between summer and winter for both the part-peak and off-peak rates. This proposal also included a winter peak rate, but the PG&E bill calculator did not have the capability of modeling this feature. It was not included in our modeling but likely would have had little impact because it is only 16% higher than the winter part-peak rate. Of these three proposals, we were able to test effects of only the first and the third, because the PG&E bill calculator, upon which our analysis is based, does not allow for demand charges with multiple break points.

1. Effects of Rate Design on Rooftop Solar

Rate design, particularly the use of tiered rates in combination with TOU rates, strengthens customer incentives to install rooftop solar. Conversely, flat rate design collapses customer incentives for DG PV.

Our results show the total GWh consumed in PG&E territory that is above and below the break-even point for each rate proposal analyzed, including current rates (Figure 3). To compute these figures, we summed the weighted GWh for each customer in the sample for whom the levelized cost of electricity (LCOE) of DG PV was lower than that of purchased electricity (the blue bar in Figure 3), and did the same for those for whom the LCOE of DG PV was higher than that of purchased electricity (the red bar in Figure 3). We computed the LCOE of purchased electricity under current and proposed rates using the customer sample data and the customer bill output of the PG&E bill calculator. We computed the LCOE of DG PV by sizing a system to the load of the customer provided in the PG&E bill calculator, and computing the amortized cost of the system. Methods are detailed in Appendix A. We only include results for non-CARE customers since, as in the analysis in our rate design proposal, under no scenario are any CARE customers above the break-even point.

Figure 3. Total Non-CARE GWh in PG&E territory with economic incentive to install DG PV under various proposed rates



	Current Rate	Sierra Club	SEIA	TURN	DRA	SDG&E TOU	SCE TOU	PGE TOU	SCE Tiered	PG&E Tiered	CLECA
GWh Below Breakeven	-13,405	-12,698	-13,575	-15,486	-16,347	-17,512	-19,314	-20,477	-20,842	-20,922	-21,223
GWh Above Breakeven	7,915	8,622	7,745	5,834	4,973	3,808	2,006	843	478	398	97

This analysis shows that only the Sierra Club proposal improves the cost-effectiveness of DG PV, and the only other proposal with similar effects is that of SEIA. While the DRA proposal incorporates TOU and tiers through a baseline credit, it would significantly reduce the incentive to install DG PV because the baseline credit is nominal and results in a small differential between tiers. The TURN proposal yields a similar outcome because it does not include TOU and retains three tiers with a reduced differential as compared to the current rate structure. Both the DRA and TURN proposals would likely cause a reduction in solar DG PV installations. The SCE and PG&E proposals do not incorporate TOU and flatten the existing tiers much more significantly than the TURN proposal. The SCE and PG&E proposals would function to **eliminate the economic incentive to install DG PV for nearly all residential customers.** The SDG&E proposal shows that an extremely wide spread in TOU rates without tiers can replicate some of the benefit of adequately spaced tiers, but the proposal results in less than half of incentivized GWh under current rates.

These results are due primarily to the flattening of tiers. This is because wider tier differentials cause overall bills to be higher for customers with higher energy usage. The higher marginal cost of energy consumed in upper tier consumption makes solar PV more cost competitive, but if tiers are flattened, this effect is diminished.

To illustrate the significance of this effect on customer decisions to utilize solar, we modeled the increase in installed cost equivalent to the incentives lost due to flattening tiers. We determined that flattening tiers is equivalent to increasing the cost per installed watt of solar by $2.50, from $6.06 to $8.56. This is about a 30% difference in the cost of solar, which is roughly equivalent to the 30% federal tax incentive for renewable energy. In other words, **if the CPUC were to adopt IOU proposals, the effect would be roughly the equivalent of canceling the federal tax incentive, which would be devastating to the solar industry and the expansion of DG PV.**

As further evidence of the potentially dramatic drop in solar PV installations, for those customers who do retain an economic incentive to install solar under the SCE Tiered proposal, the average payback period would increase to nearly 25 years for all customer types (see Table 4 for SCE Tiered proposal), meaning that the economic incentive to install DG PV for any residential customer would be very limited.

Table 4. Payback period for residential customers with economic incentive to install solar PV.[2]

Customer Type: Percent of baseline quantity consumed in at least 6 months	Current Rate	Sierra Club Proposal	SCE Tiered Proposal
Less than 100%	22.98	22.47	21.43
Greater than 100%	23.07	23.42	na
Greater than 130%	23.72	23.65	24.97
Greater than 200%	21.87	21.71	24.13
Greater than 250%	19.41	19.89	23.71
Greater than 300%	17.47	18.13	24.78
Greater than 400%	14.97	16.13	24.22
Greater than 500%	13.45	15.24	24.90

[2] Customers consuming between 100% - 130% in the SCE Tiered [illegible] because no one in that group is below the break-even point

B. Energy Efficiency – AC Upgrade

[redacted] would change under various proposed rates, we computed the payback period for purchasing a SEER 20 AC unit instead of a SEER 13 AC unit upon replacement of an old AC unit (hereafter [redacted] Appendix B. Our results show the cumulative GWh in PG&E territory with customers facing payback periods under 5 and 10 years for AC upgrades for various rate proposals (Figure 6). The cumulative GWh is the sum of weighted GWh for each customer in the sample with a payback period under 5 years and under 10 years.

Our results show that our proposed rate design roughly doubles the potential cumulative GWh savings with a payback period under 5 years, and increases by 50 percent the potential cumulative GWh savings with a payback period under 10 years (Figure 5). This is because AC use disproportionately occurs during the peak period, and therefore if peak prices go up as a part of TOU pricing, the overall cost of running an AC unit increases, shortening the payback period of upgrading to more efficient equipment. Since simple payback period is the upfront cost divided by yearly savings, when yearly savings goes up, the payback period decreases.

Figure 5. Cumulative GWh with a Simple Payback Under 5 and 10 years for an AC upgrade from SEER 13 to 20, for various rate proposals.

[redacted]

Our results also show that other rate proposals seem to offer much higher potential savings from AC upgrades. ***Depending on the proposal, much of the increase seen in these rate design proposals is due to the use of higher TOU differentials, but some of the increase is also related to the significant decrease in CARE subsidy and how this savings affects the rates of non-CARE customers in the proposed rate structure***. The SCE, PG&E, and SDG&E proposals all cut CARE discounts from the current overall 49% (as shown in the default settings in the PG&E bill calculator) to 20%, and the CLECA and SEIA proposals also include decreases in the CARE subsidy. In order to understand the effect of rate design proposals independent of changes in the CARE subsidy, we ran variations of two of the proposals — SEIA and SCE — keeping the CARE subsidy the same as under current rates.

[redacted] proposal, when controlling for a constant CARE subsidy, poorly incentivizes AC upgrades, resulting in fewer GWh with payback periods under 5 and 10 years than under current rates (Figures 6 and 7). This is because reducing the CARE subsidy results in lower rates for non-CARE customers. This occurs because less revenue is required of the non-CARE customers to provide the funding needed for the CARE subsidy. The lower revenue required from non-CARE customers results in lower rates, thus reducing their energy costs related to AC and increasing the payback period of an upgrade.

In sum, all of the rate design proposals, with the exception of the PG&E Tiered proposal and the SCE Tiered proposal, propose a TOU, tiered, or combined rate design that improves the incentive for customers to install highly efficient AC units. When the CARE subsidy reduction is removed from the SEIA proposal, the increase in customer incentive is still significantly improved compared to current rates, and similar to that of the Sierra Club proposal.

Figure 6. Cumulative GWh with a Simple Payback Under 5 Years for an AC upgrade from SEER 13 to 20, for various rate proposals, showing results with the CARE subsidy unchanged from current.

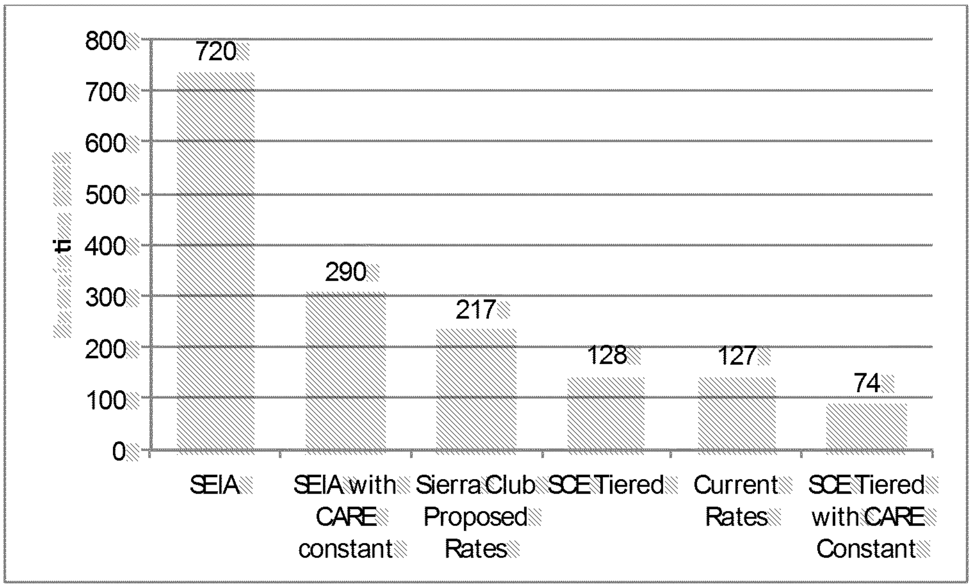
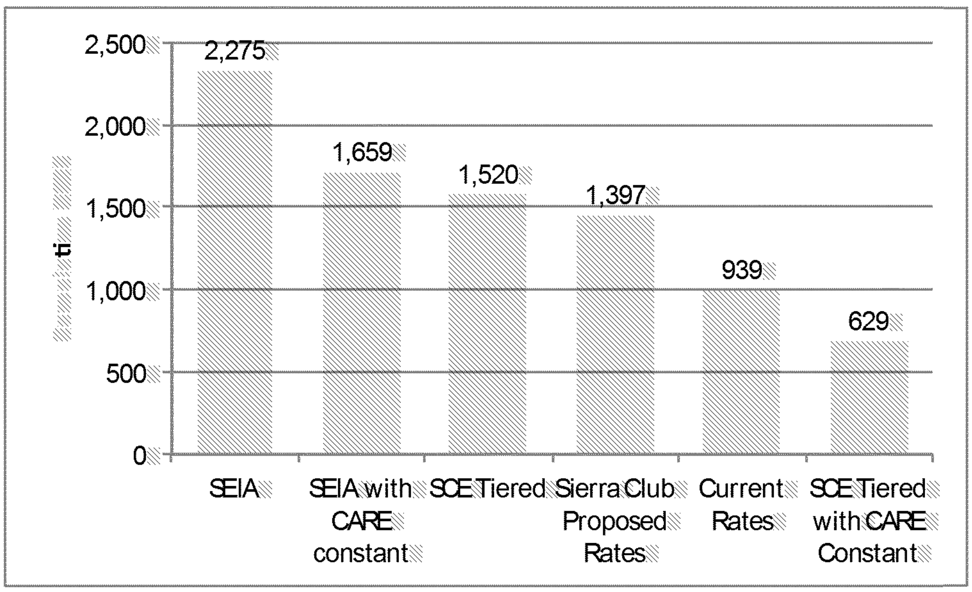


Figure 7. Cumulative GWh with a Simple Payback Under 10 Years for an AC upgrade from SEER 13 to 20, for various rate proposals, showing results with the CARE subsidy unchanged from current.



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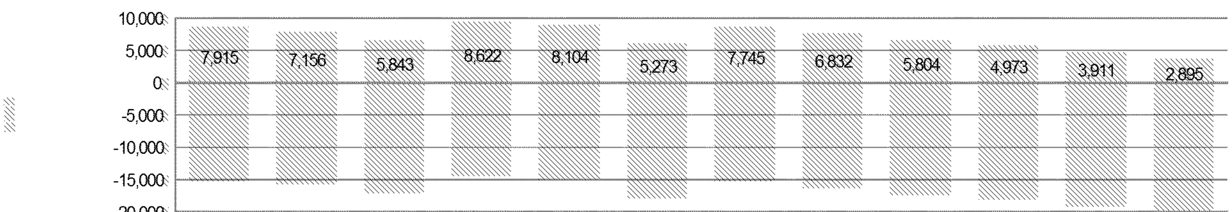
IV. CUSTOMER CHARGES HAVE SIGNIFICANT NEGATIVE IMPACTS ON DEPLOYMENT OF ROOFTOP SOLAR AND ENERGY EFFICIENCY

It is the position of the Sierra Club that fixed customer charges can have a highly detrimental effect on conservation and energy efficiency behavior. In order to show this effect, we ran scenarios of selected rate proposals that perform well for DG PV and EE, and added $5 and $10 customer charges for analysis purposes.

Our results show that DG PV would be much less incentivized when customer charges are included (Figure 8). Our results show between 6% and 21% less DG PV above the break-even point under a $5 customer charge, and between 25% and 42% less DGPV above the break-even point under a $10 customer change, depending on the rate design proposal entered in the model.

The effect of customer charges on AC upgrades is dramatic for a simple payback period under 5 years, with a large drop in the total potential GWh incentivized for efficiency, from 7%-22% for a $5 customer charge, and 24%-37% for a $10 customer charge (Figure 9).

Figure 8. Total Non-CARE GWh in PG&E territory with economic incentive to install DG PV under various rates with different customer charges.



	Current Rate	Current w/ $5 Cust. Charge	Current w/ $10 Cust. Charge	Sierra Club Proposed Rate	Sierra Club Proposed Rate w/ $5 Cust. Charge	Sierra Club Proposed Rate w/ $10 Cust. Charge	SEIA	SEIA w/ $5 Cust. Charge	SEIA w/ $10 Cust. Charge	DRA	DRA w/ $5 Cust. Charge	DRA w/ $10 Cust. Charge
GWh Below Breakeven	-13,405	-14,163	-15,476	-12,698	-13,216	-16,047	-13,575	-14,487	-15,516	-16,347	-17,408	-18,424
GWh Above Breakeven	7,915	7,156	5,843	8,622	8,104	5,273	7,745	6,832	5,804	4,973	3,911	2,895

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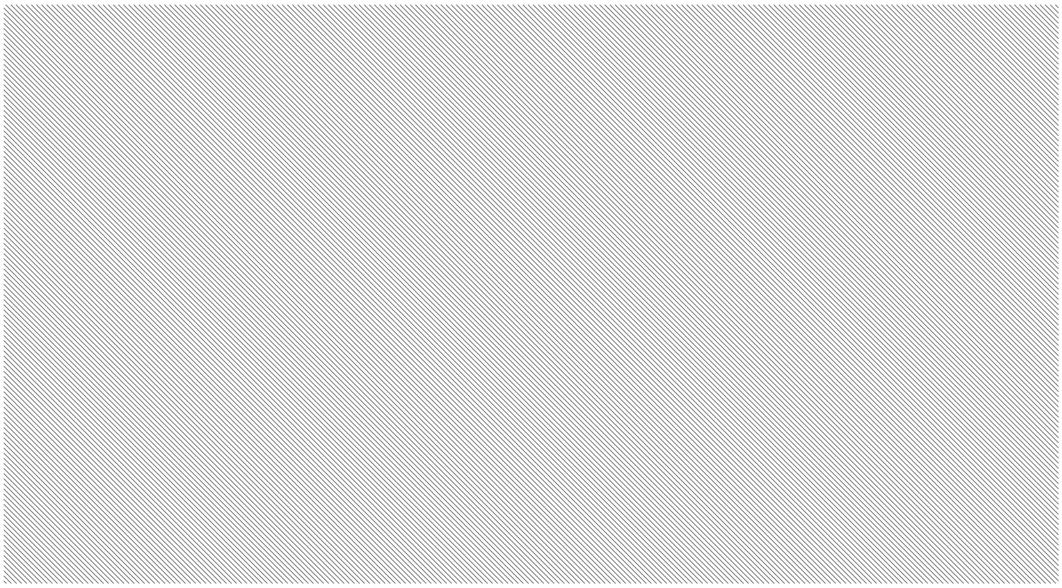
Figure 9. Cumulative GWh with a Simple Payback Under 5 Years for an AC upgrade from SEER 13 to 20, for various rate proposals, showing variatons with $5 and $10 customer charges.



V. FLATTENING TIERS LOWERS BILLS FOR UPPER INCOME CUSTOMERS

Rate designs that flatten tiers have equity implications, most significantly by reducing bills for the wealthiest customers. The IOU proposals simultaneously collapse tiers and reduce the CARE subsidy, and both of these effects will lower rates for wealthier families. Most obviously, by reducing the CARE subsidy, rates go up for non-CARE customers. We can see this in bill calculator output for the PGE TOU proposal and the SCE Tiered proposal (Tables 10 and 11), where rates for CARE customers doubled on average, and the rate for the wealthiest ratepayers decreased by almost 9%.[3]

However, we also found that the bill reduction seen by the wealthiest households is due to the collapsing of tiers, rather than the decrease of the CARE subsidy. We found this by running a variation of the SCE Tiered proposal that maintains CARE roughly at the current subsidy (Table 6), in which the wealthiest non-CARE customers still see a bill decrease of 7%, while the rest of the non-CARE customers see a slight increase.[4] ***Since the PG&E bill***

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[3] These results are from th e PG&E Bill Calculator.

[4] We came as close as we could given the difficult y of achieving this using the PG&E Bill Calculato r. The slight increase for the rest of no n-CARE customers is lik ely due to the fact that th e CARE subsidy is slight ly larger than

calculator shows that collapsing tiers results in a bill decrease for the wealthiest customers, it follows that the wealthiest customers are more likely to be the highest electricity users.

Table 10. PG&E TOU Proposal - Impacts by Income Group

Income Range	Non-CARE	CARE	All Customers
0 to 30K	8.8%	56.1%	34.6%
30K to 60K	7.9%	48.6%	18.0%
60K to 75K	-0.7%	40.8%	3.2%
75K to 100l	-1.8%	48.1%	1.3%
100K to 50(	-10.3%	36.7%	-9.1%
Average	-2.4%	50.8%	6.0%

Table 11. SCE Tiered Proposal - Impacts by Income Group

Income Range	Non-CARE	CARE	All Customers
0 to 30K	5.8%	53.3%	31.7%
30K to 60K	6.2%	49.3%	16.9%
60K to 75K	-0.4%	44.5%	3.8%
75K to 100K	-1.7%	49.4%	1.4%
100K to 500K	-8.8%	41.3%	-7.6%
Average	-2.3%	50.4%	6.0%

Table 12. Modified SCE Tiered Proposal with CARE Constant - Impacts by Income Group

Income Range	Non-CARE	CARE	All Customers
0 to 30K	10%	-1%	4%
30K to 60K	10%	-4%	7%
60K to 75K	3%	-8%	2%
75K to 100K	1%	-4%	1%
100K to 500K	-7%	-10%	-7%
Average	0.7%	-3%	0%

under current rates. However, this result remains consistent with our argument regarding the correlation of high income customers and electricity usage.

On the other hand Sierra Club[redacted] proposed rate design has a very minimal impact on all income groups. Because tiers are collapsed somewhat in our proposal, we still see a very small reduction of bills for the wealthiest customers, but this only a 0.7% reduction, or 1/10 of the effect that we found compared to the PG&E and SCE Tiered proposals, and the variation of the SCE Tiered proposal with CARE constant.

Table 13. Sierra Club Proposal - Impacts by Income Group

Income Range	Non-CARE	CARE	All Customers
0 to 30K	1.5%	0.3%	0.8%
30K to 60K	1.7%	0.0%	1.2%
60K to 75K	1.7%	-0.5%	1.5%
75K to 100K	0.9%	-0.1%	0.8%
100K to 500K	-0.7%	-1.6%	-0.7%
Average	0.5%	0.0%	0.4%

VI. CONCLUSION

Our analysis demonstrates how rate design can either [redacted] in pursuing a clean energy future or contribute to its collapse if customer incentives disappear. [redacted] minimizing potential bill impacts by combining use of tiered and TOU rate components. In contrast, IOU proposals that flatten the existing tiered rate structure, in combination with a fixed customer charge, would eliminate the economic incentive for rooftop solar for nearly all residential customers, and deal a major blow to the customer incentive to reduce electricity usage through energy efficiency, with the fixed customer charge component collapsing the potential for electricity consumption reductions through AC unit upgrades by 24% - 37%. Utility fixed costs are better recovered though means that do not discourage conservation, efficiency, and rooftop solar customer usage, or disproportionately impact low-income and low-usage customers.

California must continue to respond to the threat climate change poses to our environment with strong policies and innovative leadership. These policies include a residential rate design that promotes customer incentives reinforcing rooftop solar and the Big Bold Energy

Efficiency Strategies that support the Loading Order, Global Warming Solutions Act, and Executive Order S-3-05. The most effective rate design for meeting these objectives combines both tiered and TOU rate components, as proposed by Sierra Club, NRDC, and SEIA. Tiered rate structures not only reinforce rooftop solar, energy efficiency, and customer conservation responses, but better address equity and fairness across income groups as well.

Sierra Club urges the Commission to [redacted] customer incentives for renewable energy and energy efficiency by moving forward to combine TOU rates with tiered rates or a significant baseline credit, and rejecting a fixed customer charge.

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APPENDIX A

METHODLOGY FOR PV-BREAK EVEN ANALYSIS

The key metrics that inform PV adoption under a net metering policy regime are the levelized cost of energy (LCOE) from the utility versus the LCOE from PV over the life of the system. This is the basis for our model, which compares the average cost per kWh of purchased electricity from the utility PG&E, and the average cost of electricity per kWh generated through DG PV, both expressed as levelized costs of energy. While consumers may be motivated by various reasons to adopt PV, the economics fundamentally shape broad deployment patterns. If the LCOE from PV over the life of the modules is lower than the LCOE from the utility, then it makes economic sense for a resident to install PV. If the LCOE from PV is more expensive, customers will only install PV if they are willing to risk a net financial loss on PV energy production.

To make a comparison with the cost of DG PV, we calculated the cost of grid electricity over a 25-year time period to match the typical warranty of a PV module. The LCOE of electricity purchased from the grid is the net present value (NPV) of all electricity purchases by a household for 25 years divided by the total kWh consumed. To compute this figure, we used computed bills under current and proposed rates for each customer in the PG&E customer sample data. We calculated net present value of this bill over 25 years, and divided this by 25 times the current annual consumption. The result is an average real cost of electricity for the next 25 years, which c[redacted] We chose to assume no annual increase or decrease in consumption since this would be difficult to justify. In addition, some annual rate of increase in the cost of electricity should be assumed, and we used 2% for our baseline analysis.[5]

Similarly, we calculated the LCOE of DG PV energy, which is a product of the installed total cost of a PV system after rebates and the cost of financing, divided by the total kWh produced over the lifetime of the module. PV modules make up about a third of the system cost, while the balance is made up by system components, installation, operation and maintenance, and the cost of incremental electricity as module output slowly degrades over time. Almost all

[5] The standard number that CPUC and CEC studies use is 3% real escalation, plus 2% general inflation. We selected this as a very conservative assumption, so that the cost-effectiveness of DG PV would not be potentially inflated. However, we do believe that the future cost of fossil fuel electricity may be significantly higher.

PV installations require at least some financing, a major additional lifecycle cost component. Operating and maintaining PV is not a major cost, but the typical system needs an inverter replacement every ten to fifteen years, which also requires a visit from an electrical technician. It is also necessary to add the cost of some energy purchased from the grid to the LCOE from PV.

PV systems in California are currently designed to offset net utility bills in response to current net metering tariffs[6], but over time modules degrade in energy output at a rate of roughly 1% per year. Therefore, one must increasingly purchase electricity from the grid in order to make up for this decline in production over the mo[illegible] the modules will vary by climate region based on the amount of solar insolation the area receives; the greater the solar resource, the smaller the system required to balance energy demand. To account for this variation we computed solar insolation in kWh/kW using the National Renewable Energy Laboratories PVWatts2 Calculator. We calculated values for reference cities using default values for panel efficiency, aspect and tilt, and matched these values to the county and climate zone of each customer in the sample data. All of these factors play a significant role in shaping financial incentives for PV adoption and are included in our model.

We conducted our analysis of the LCOE from PG&E electricity and PV under current and proposed rates. Values for the LCOE from grid electricity were produced using data from PG&E on the average monthly bills faced by each of the customers in the sample, as computed by the PG&E bill calculator. Other parameters were taken from the relevant literature, and sensitivity analysis was used where an exact figure could not be attained. In our baseline model, we make the following assumptions, which we vary in the sensitivity analysis described in subsequent sections:

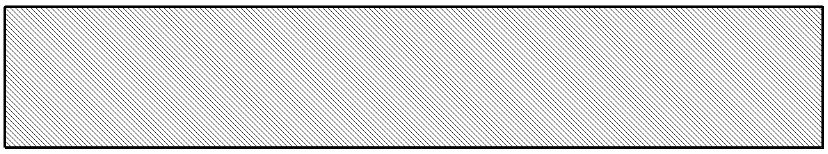
- 6% discount rate
- 5% finance rate
- 2% annual increase in cost of electricity[2]
- $6.06/W installed, system cost (see below for explanation)
- 30% federal tax incentive
- We assume no California Solar Initiative rebate, since this program is slated to end soon.

The parameter for the installed cost of PV was the estimated using the California Solar Initiative (CSI) database in the first quarter of 2013 (CSI 2013). We found the cost per installed watt for

[6] System sizing in California is driven by the NEM tariff, not best practice, which would be to maximize utilization of roof space. This is part of why installation costs in CA are more expensive than in Germany.

systems less than 10kWh, in the residential sector, under all ownership types combined (Table 4). While the price of installed PV has continued to decline over the past year, it is unclear whether such price declines will continue in the near term. While imports of PV from China have been an important driver of low prices for customers, it is also the case that many of the PV manufacturers have been selling below cost to liquidate inventory. Suntech is the latest example of a company that was selling below cost, and is now in bankruptcy (Bradsher 2013). PV panel inventory remains higher than demand (Kaften 2013). For these reasons the cost of PV modules will likely not fall further in the near-term and may even increase. However, there is potential for the soft costs of residential PV installations to decline, as evidenced by current installation costs in Germany (Seel et al. 2013). Therefore, we use the current average for installs in PG&E territory as an estimate the cost of PV installations.

Cost/Watt of DG PV - CSI Cost by Quarter Database



While several of our model assumptions could be subject to debate, modifying these assumptions would not alter our overall conclusions since these assumptions do not impact the relative impact of rate scenarios on the incentive to install DG PV.

To summarize the effects of a given rate design on adoption of PV, we summed the weighted yearly kWh consumption of all customers in the PG&E customer sample data with an LCOE of PV which is lower than the LCOE of electricity purchased from the utility. Using information the customer sample, we were also able to compute this figure for customers in different climate zones and with different levels of electricity consumption. Finally, we computed payback periods for customers at various levels of electricity usage.

APPENDIX B
METHOLOGY TO ASSESS RATE DESIGN IMPACT ON ENERGY EFFICEINCY

In analyzing rate design impacts on energy efficiency, we focused on AC as a proxy for other comprehensive energy efficiency upgrades because: (a) the literature shows that households in hotter climates and households with AC have higher elasticities under dynamic pricing schemes; and (b) AC units consume a large portion of household electricity.

Our model determined which customers in the sample data are likely users of AC units, based on cooling degree days (**CDD**) of a representative city matched to the county and climate zone given in the customer sample. For these customers, yearly kWh needed to run an AC of varying Seasonal Energy Efficiency Ratio (**SEER**) values (a standard rating of AC efficiency) was computed based on CDD and an assumption that AC units are used during 50% of CDD..[7]

Our calculation is based on the scenario in which a customer replaces an AC unit at end of life. It is not common for customers to replace AC units with higher efficiency units before end of life, and therefore our calculation estimates the simple payback period of replacing an AC unit with minimum Title 24 standard (SEER 13), versus a high efficiency AC unit (SEER 20). Under this scenario, we computed costs of running both the low and high efficiency units by allocating costs to the highest tier of usage of a given customer, assuming that 50% of AC usage is at the summer peak rate, and 30% is at the summer/winter part-peak rate, and 20% is at the summer/winter off peak rate..[8] These calculations were used to compute the payback period for a SEER 20 for each customer in the sample, as well as the total weighted kWh with a positive return under varying payback periods. In a similar fashion to our analysis of DG PV, several assumptions were necessary to arrive at our conclusions, and while discussion around these assumptions could improve accuracy of results, our conclusions would remain unchanged since our model does an excellent job *of comparing relative impacts on energy efficiency behavior across various rate scenarios,* rather than predicting an exact outcome of any one scenario.

[7] This is an estimate based on information in the 2009 California Residential Appliance Saturation Study: http://www.energy.ca.gov/2010publications/CEC-200-2010-004/CEC-200-2010-004-ES.PDF

[8] This is an estimate based on data from the National Climate Data Center for reference cities in climate zones where cooling is required. www.ncdc.noaa.gov/cdo-web/

Appendix C

RATE VARIATIONS USED IN ANALYSES

Table II. Rates used in analysis for variations with $5 and $10 customer charges.

		DRA	DRA with $5 cust charge	DRA with $10 cust charge	SEIA	SEIA with $5 cust charge	SEIA with $10 cust charge	Current	Current w/$5 cust charge	Current w/$10 cust charge
Non-CARE Tier 1	Summer Peak	0.3458	0.3298	0.3119	0.2892	0.2739	0.2586	0.1285	0.1285	0.1285
	Summer Part Peak	0.2327	0.2213	0.2085	0.1886	0.1772	0.1659	0.1285	0.1285	0.1285
	Summer Off Peak	0.1163	0.1096	0.1021	0.1140	0.1056	0.0972	0.1285	0.1285	0.1285
	Winter Off Peak	0.2327	0.2213	0.2085	0.1310	0.1220	0.1129	0.1285	0.1285	0.1285
	Winter Part Peak	0.1163	0.1096	0.1021	0.1140	0.1056	0.0972	0.1285	0.1285	0.1285
Non-CARE Tier 2	Summer Peak	0.3958	0.3798	0.3619	0.3882	0.3729	0.3576	0.1467	0.1467	0.1467
	Summer Part Peak	0.2827	0.2713	0.2585	0.2876	0.2762	0.2649	0.1467	0.1467	0.1467
	Summer Off Peak	0.1663	0.1596	0.1521	0.2130	0.2046	0.1962	0.1467	0.1467	0.1467
	Winter Off Peak	0.2827	0.2713	0.2585	0.2300	0.2210	0.2119	0.1467	0.1467	0.1467
	Winter Part Peak	0.1663	0.1596	0.1521	0.2130	0.2046	0.1962	0.1467	0.1467	0.1467
Customer Charge ($/Month)		$0	$5	$10	$0	$5	$10	$0	$5	$10
CARE Tier 1	Summer Peak	0.2248	0.2143	0.2027	0.1880	0.1780	0.1681	0.0832	0.0832	0.0832
	Summer Part Peak	0.1513	0.1438	0.1355	0.1226	0.1152	0.1078	0.0832	0.0832	0.0832
	Summer Off Peak	0.0756	0.0712	0.0663	0.0741	0.0687	0.0632	0.0832	0.0832	0.0832
	Winter Off Peak	0.1513	0.1438	0.1355	0.0852	0.0793	0.0734	0.0832	0.0832	0.0832
	Winter Part Peak	0.0756	0.0712	0.0663	0.0741	0.0687	0.0632	0.0832	0.0832	0.0832
CARE Tier 2	Summer Peak	0.2573	0.2468	0.2352	0.2717	0.2610	0.2504	0.0956	0.0956	0.0956
	Summer Part Peak	0.1838	0.1763	0.1680	0.2013	0.1934	0.1854	0.0956	0.0956	0.0956
	Summer Off Peak	0.1081	0.1037	0.0988	0.1491	0.1432	0.1374	0.0956	0.0956	0.0956
	Winter Off Peak	0.1838	0.1763	0.1680	0.1610	0.1547	0.1484	0.0956	0.0956	0.0956
	Winter Part Peak	0.1081	0.1037	0.0988	0.1491	0.1432	0.1374	0.0956	0.0956	0.0956
Customer Charge ($/Month)		$0	$3	$7	$0	$3	$7	$0	$4	$8

Table II. Rates used in analysis, for variations with CARE subsidy held at current rates.

		SCE Tiered	SCE Tiered CARE Constant	SEIA	SEIA with CARE constant
Non-CARE Tier 1	Summer Peak	0.1563	0.1614	0.2892	0.2943
	Summer Part Peak	0.1563	0.1614	0.1886	0.1924
	Summer Off Peak	0.1563	0.1614	0.1140	0.1168
	Winter Off Peak	0.1563	0.1614	0.1310	0.1341
	Winter Part Peak	0.1563	0.1614	0.1140	0.1168
Non-CARE Tier 2	Summer Peak	0.1875	0.1937	0.3882	0.3933
	Summer Part Peak	0.1875	0.1937	0.2876	0.2914
	Summer Off Peak	0.1875	0.1937	0.2130	0.2158
	Winter Off Peak	0.1875	0.1937	0.2300	0.2331
	Winter Part Peak	0.1875	0.1937	0.2130	0.2158
Customer Charge ($/Month)		$5	$5	$0	$0
CARE Tier 1	Summer Peak	0.1250	0.0807	0.1880	0.1472
	Summer Part Peak	0.1250	0.0807	0.1226	0.0962
	Summer Off Peak	0.1250	0.0807	0.0741	0.0584
	Winter Off Peak	0.1250	0.0807	0.0852	0.0670
	Winter Part Peak	0.1250	0.0807	0.0741	0.0584
CARE Tier 2	Summer Peak	0.1500	0.0968	0.2717	0.1967
	Summer Part Peak	0.1500	0.0968	0.2013	0.1457
	Summer Off Peak	0.1500	0.0968	0.1491	0.1079
	Winter Off Peak	0.1500	0.0968	0.1610	0.1165
	Winter Part Peak	0.1500	0.0968	0.1491	0.1079
Customer Charge ($/Month)		$4	$3	$0	$0