USING CALIFORNIA'S CAP-AND-TRADE REVENUE TO LOWER ELECTRICITY PRICES

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INTRODUCTION

California has some of the highest electricity prices in the country. These high costs make it harder for people to afford their energy bills and discourage the switch to cleaner electric options like electric cars, heat pumps, and other appliances. In fact, even when considering the climate and air pollution damages created by electricity generation, California's electricity still costs more than it should (Borenstein and Bushnell, 2022).

This policy brief examines a proposal to reduce California's retail electricity prices: volumetric subsidies (i.e., per kWh) on retail electricity prices funded by revenue from the state's greenhouse gas (GHG) cap-and-trade (C&T) program.

Authorized by AB 32 in 2006 and implemented since 2013, the C&T program is designed to meet California's ambitious climate goals in a manner that is least costly (and thus most affordable) to the California economy. The program has driven down GHG and local air pollution emissions and their disparities between disadvantaged and other communities (Hernandez Cortes and Meng, 2023). It has also created the world's second largest carbon market, valued at $7.4 billion in 2023, covering 80% of California's GHG emissions.

Sales from emissions permits under the program have generated over $50 billion in revenue since 2013 (California Air Resources Board, 2025). This revenue has been used to meet various state fiscal and climate priorities including efforts to maintain industrial competitiveness, to fund specific emissions reduction and transportation projects, and to address environmental justice concerns. In total, $6.3 billion was spent from C&T revenue in 2023.

This revenue has also funded the residential California Climate Credit (CCC), which distributes two payments annually to electricity users served by the state's investor owned utilities (hereafter just utilities) to offset residential electricity bills. In 2023, the value of those payments totaled $1.2 billion across Pacific Gas and Electric Company (PG&E), San Diego Gas & Electric Company (SDG&E), and Southern California Edison Company (SCE), California's three largest electric utilities serving a total of 11.3 million households.[1]

RESULTS

We first examine how much reallocating the $1.2 billion in C&T funding from the residential CCC program to directly subsidizing retail electricity rates (as opposed to annual payments) could lower prices for PG&E, SCE, and SDG&E customers. To do this, we use the 2023 retail electricity price and consumption for each utility and determine the corresponding subsidy for reducing electricity prices under each utility's 2023 CCC budget allocation. In 2023, the estimated budget allocation was 35.4 percent to PG&E, 13 percent to SDG&E, and 50.1 percent to SCE.

[1] Between 2014 and 2015, PG&E, SCE, and SDG&E used a portion of their auction proceeds to reduce volumetric residential electricity rates and offset C&T compliance costs that had been passed onto households. CPUC phased out these volumetric rate subsidies at the end of 2015. Our analysis would consider volumetric subsidies that would exceed the C&T compliance cost passed through to customers.

Our analysis takes into account that lower electricity prices would increase electricity consumption (see methods for details).

Table 1 shows the 2023 average retail electricity price, total electricity consumption, and number of households for each utility across all households served and just low-income households as defined by the California Alternate Rates for Energy (CARE) program. Between 25-30 percent of households served by the utilities are in the CARE program. These households use between 18-24 percent of residential electricity consumed overall in each utility.

Table 2 examines how much CCC budget for each utility, totaling $1.2 billion in 2023, can lower retail electricity prices across utilities and under different subsidy designs. We explore three different subsidy designs: (1) a subsidy applied to all households and months, (2) a subsidy applied to all households during the energy intensive summer months, and (3) a subsidy applied to CARE households during all months. Subsidy design 1 is similar to the current annual payments in that it applies to all households, with the budget allocated in terms of volumetric rate reductions rather than as lump-sum payments. For our benchmark analysis, we use -0.36 from Buchsbaum (2022) as the short-run price elasticity of demand, which likely omits changes in household adoption of durable goods (i.e., air conditioning, EV, appliances, etc).

We find that the reallocated CCC budget towards an electricity price subsidy can lower prices by 4-7% if applied to all households and months; by 13-19% if applied to all households during only July-September summer months when electricity usage is highest; or by 27-44% if applied to only CARE households during all months. These effects are smaller if we apply a long-run price elasticity of demand of -2.4 from Buchsbaum (2022) that incorporates changes in household durable goods investments in response to price changes. Effects are bigger if we assume households do not change electricity consumption under lower prices.[2]

TABLE 1 - Retail Electricity Prices and Consumption in 2023 Across Utilities

Utility	Customer Group	Price ($ / kWh)	Households*	Annual Electricity Consumption (kWh)
PG&E	All	0.31	5,520,724	34,248,095,772
	CARE*	0.19	1,402,942	7,895,757,576
SCE	All	0.27	4,365,243	33,907,902,674
	CARE*	0.15	1,289,493	8,201,175,480
SDG&E	All	0.39	1,373,944	7,657,903,426
	CARE*	0.27	336,819	1,430,807,112

* estimated values

[2] *A related study from Stanford's Woods Institute (Smith et al., 2024) and forthcoming from NRDC assume that consumers do not change consumption in response to price changes.*

TABLE 2 - Retail Price Changes Across Utilities and Subsidy Designs

Utility	Subsidy Design	Percentage Change in Retail Price		
		Short-run Elasticity (Benchmark)	Long-run Elasticity	No Quantity Response
PG&E	All	-4.0%	-3.8%	-4.1%
	All (Summer Months)	-13.4%	-11.1%	-14.0%
	CARE	-27.3%	-20.2%	-30.0%
SCE	All	-6.7%	-6.0%	-6.9%
	All (Summer Months)	-19.3%	-15.1%	-20.7%
	CARE	-44.0%	-29.8%	-51.0%
SDG&E	All	-5.4%	-4.9%	-5.5%
	All (Summer Months)	-17.7%	-14.1%	-18.9%
	CARE	-37.0%	-25.9%	-42.0%
Elasticity		-0.36	-2.4	0

Other streams of C&T permit value can also be used to reduce electricity prices. Table 3 includes the largest programs that draw on C&T permit value. The table shows what the corresponding budget would be if these programs were redirected and reallocated among the three utilities, illustrating examples of additional funding that could be allocated to further reduce electricity prices.[3] These other categories include the residential California Climate Credit for natural gas, the Small Business California Climate Credit, free allowances for industrial emitters, and the Greenhouse Gas Reduction Fund (GGRF). Furthermore, the budget used to reduce electricity prices can come from any state funds, even those outside of the C&T program.

In Figure 1, we extend our analysis to characterize how different budget amounts translate to electricity price reductions for each utility. Each line characterizes a different subsidy design. The blue line provides monthly subsidies to all households. The maroon line provides subsidies for all households but only during the summer months of July, August, and September. And the yellow line provides monthly subsidies only for CARE households. The red dot indicates the social marginal cost from generating electricity which includes both the private costs of generation and associated social climate and air pollution damages, representing the socially optimal electricity price.[4] This flexible modeling tool can be used to explore price reductions for a broad range of budget allocations. Additional scenarios can be explored in our Online Calculator (https://emlab-ucsb.shinyapps.io/cap-and-trade-tool/). All code and underlying data is available through GitHub (https://github.com/emlab-ucsb/CA-CT-affordability).

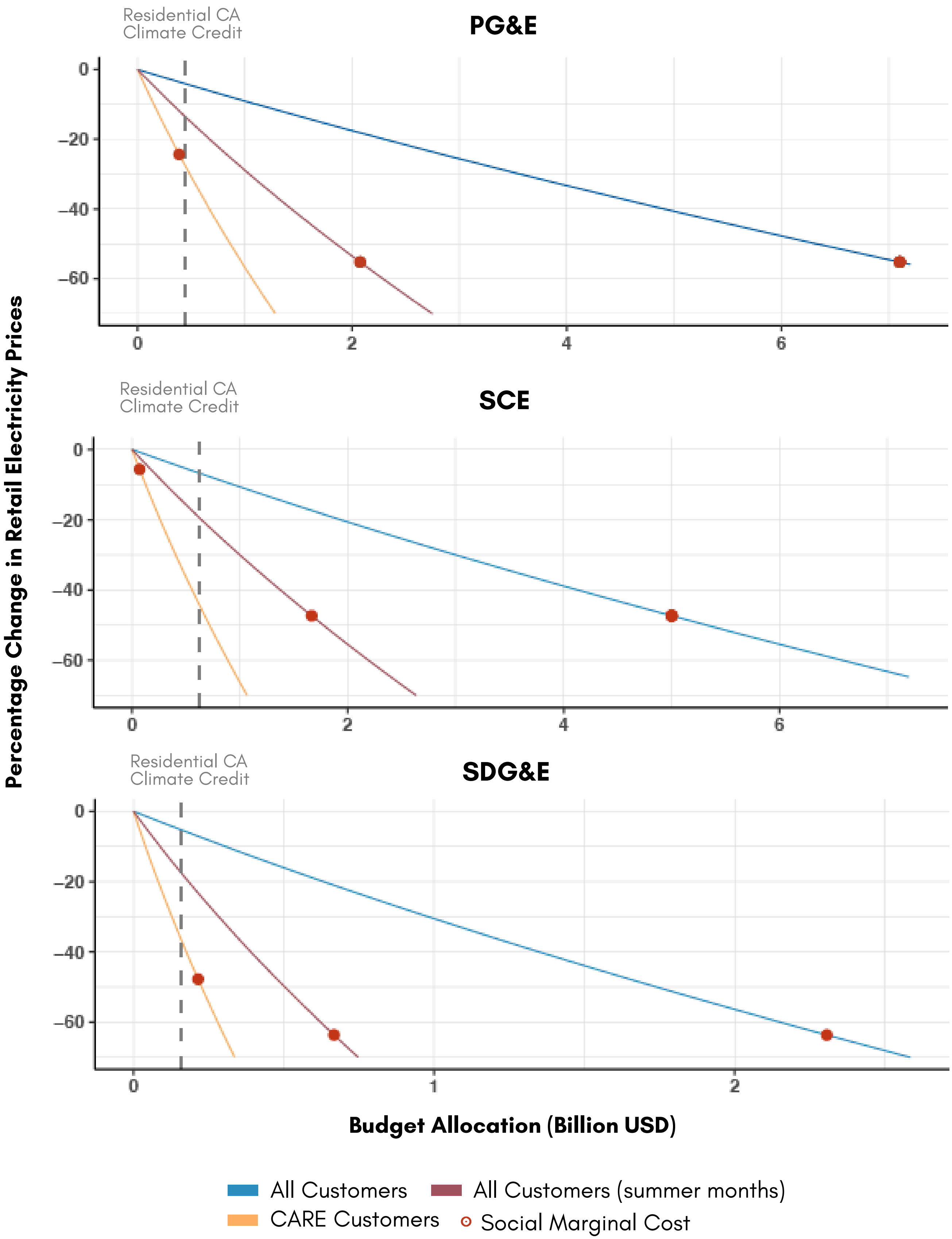
Generally, for a fixed total budget, subsidies applied to all households and months results in the smallest decrease in electricity prices. Limiting subsidies to summer months leads to larger price reductions, and targeting CARE households throughout the year yields even greater price reductions. However, some reductions put prices below the social marginal cost which would reduce electricity prices too much relative to what is socially optimal.

TABLE 3 - Budget Across Cap-and-trade Revenue Spending Programs

Utility	Residential California Climate Credit (Electricity)	Residential California Climate Credit (Natural gas)	Small Business California Climate Credit	Industry Allowances (Estimated)	Greenhouse Gas Reduction Fund (GGRF)
PG&E	$438,499,015	$270,504,888	$46,373,683	$384,333,109	$1,421,657,851
SCE/SoCalGas	$620,253,158	$325,061,169	$65,595,184	$141,196,840	$2,010,923,038
SDG&E	$161,096,387	$48,983,757	$17,036,829	$543,635,941	$522,290,668
TOTAL	$1,219,848,560	$644,549,814	$129,005,696	$1,069,165,890	$3,954,871,557

[3] For every C&T budget except the natural gas CCC, we allocate total reported budgets from each program to each utility based on their 2023 electricity CCC share. For the natural gas CCC, we report the actual 2023 PG&E, SoCalGas, and SDG&E values. We combine SCE and SoCalGas (which is only relevant for the natural gas CCC) into one row for visual conciseness, noting that SCE and SoCalGas have similar, though not entirely identical, service areas.
[4] We use a 2023 social marginal cost estimate for PG&E of $0.14/kWh from the 2024 IEMAC report and apply it to all three utilities. An earlier study shows that social marginal costs differ only slightly across the three utilities between 2010-2019 (Next 10 & Energy Institute at the UC Berkeley Haas School of Business, 2021).

FIGURE 1: Retail Electricity Price Decreases Under Different Budget Allocations



DISCUSSION

Our analysis shows how permit revenue from California's GHG cap-and-trade program - or from any state funds - can be reallocated to address the current too-high electricity prices across the state. These price reductions are meaningful. The current $1.2 billion C&T revenue allocated to the residential California Climate Credit alone can lower prices by 4-7% if allocated across all households every month, by 13-19% if allocated across all households during summer months, or by 27-44% if allocated across CARE households every month. Price reductions can be greater or affect more households and periods if more funds - from C&T permit revenue or other state revenue sources - are used to lower electricity prices.

Other subsidy designs beyond the ones considered here can also be explored. For example, rather than provide subsidies to CARE customers, one can use household incomes or proxies for income as a basis for varying volumetric subsidies. Alternatively, subsidies can target specific geographic areas, such as parts of California with higher temperatures and thus greater need for cooling.

Finally, we note that these calculations are based on recent 2023 data and should not be interpreted as projections of future possible electricity price changes. Accurate projections require, among other things, forecasts of future electricity prices, consumption patterns, and the C&T permit price and overall cap - all of which are highly uncertain. Instead, our analysis is intended to illustrate the potential scale of electricity price reductions that subsidies could achieve under current conditions.

CITATIONS

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APPENDIX

This appendix details our methods and data. All code and data is publicly available on GitHub (https://github.com/emlab-ucsb/CA-CT-affordability).

I. METHODS

We are interested in determining the extent that retail electricity prices can be subsidized given the availability of cap-and-trade revenue funds, taking into account that lower prices lead to increased consumption of electricity.

Let p_0 and q_0 denote the current retail electricity price and consumption for an electric utility. We assume that the marginal cost of supplying electricity is constant. For initial price p_0 and subsidy level s, the resulting electricity consumption is characterized by the demand curve for electricity $q_0 = q(p_0 - s)$. A first order Taylor expansion of the demand curve around p_0 yields $q_1 \approx q_0 - sq'$, where $q' = dq/dp$ is the slope of the demand curve.

We can relate the budget B to the subsidy via:

$$B = sq_0 = s(q_0 - sq') \qquad (1)$$

Taking the derivative of B with respect to s, we can show that the subsidy level is always increasing in the budget:

$$\frac{\partial s}{\partial B} = \frac{1}{q_0 - (2sq')} > 0 \qquad (2)$$

Taking the cross derivative, the subsidy response to budget with respect to the slope of the demand curve is:

$$\frac{\partial(\frac{\partial S}{\partial B})}{\partial q'} = \frac{2s}{(q_0 - 2sq)^2} > 0 \qquad (3)$$

Which is always positive: with more price sensitive households, the subsidy that can be achieved for any budget falls, as evident in the Supplementary Figure.

Finally, for initial consumption q_0, demand curve slope q', the subsidy level s that spends budget B is characterized by the root of the quadratic equation form of Eq. (1).

$$-q's^2 + q_0 s - B = 0 \qquad (4)$$

In all our calibrations, only one root of Eq. (4) results in positive prices, $p_1 = p_0 - s > 0$. We report that root. From Eq. 4, observe that an analysis that assumes perfectly inelastic demand, or $q'=0$, would have $s = B/q_0$.

II. DATA

Our analysis combines multiple data sources to obtain electricity prices, households, CARE participation, and revenue distribution across California's three major investor-owned utilities - Pacific Gas and Electric Company (PG&E), San Diego Gas & Electric Company (SDG&E), Southern California Edison Company (SCE).

We obtain the cap-and-trade allowance allocation data for 2023 from CARB's Form 9-4,[5] focusing on the six utilities. These six utilities received 48 million permits—nearly 69% of the total permits allocated to Electrical Distribution Utilities (EDUs). CARB publishes data on the total value of the California Climate Credit (CCC) across the six utilities but not at the individual utility level. To estimate CCC value at the utility level, the total CCC value ($1.2 billion) was distributed to each utility based on its share of free allowances. We calculate the number of households served by each utility using publicly available 2023 climate credit per-household payment data from CPUC.[6] Natural gas credits disbursed to customers by the utilities were incorporated using 2023 CPUC data.[7] For the purpose of this analysis, SoCalGas proceeds were allocated to SCE.

CARE customer data—household counts, average monthly bills, and electricity usage—were obtained from Low Income Oversight Board (LIOB) annual reports.[8] These inputs were used to calculate an effective per-kWh price for CARE customers and to estimate total CARE electricity consumption by utility. For SCE, 2022 usage values were used due to anomalies in 2023 data. 2023 bundled system average rates were used for residential electricity prices for all customers and were sourced from CPUC's AB 67 annual report.[9] Similarly, consumption values were obtained from the California Energy Commission's electricity dashboards and aggregated by utility service area and month.[10] Summer-specific consumption totals were computed for July through September.

A key part of this analysis involves estimating the proportion of any affordability-related budgetary allocation that can be expected to go to each utility. In 2023, total auction revenue expended by utilities amounted to $1.5 billion (includes all C&T programs, administrative, and outreach expenses). Dividing this by the 48 million total number of allowances received by utilities yields an estimated average value of around $31 per allowance. Separately, the proportion of allowances received by each utility was calculated by dividing the number of allowances allocated to that utility by the total allocated to all utilities. This proportion was then used to estimate the dollar value of each C&T program at the utility level and combined with the natural gas proceeds for the three large utilities. Industries in California also received allocations to maintain competitiveness, totaling 34 million allowances in 2023.[11]

The estimated values calculated above were summed at the utility level to determine the estimated total value that can be allocated to the three utilities from the C&T system, around $7.2 billion. These utility-level totals were then divided by the overall total to estimate the proportion of expected proceeds for each utility. The final proportion represents the share of any statewide budgetary allocation for affordability purposes that is estimated to reach each utility for reduction in retail prices.

[5] *https://ww2.arb.ca.gov/sites/default/files/2022-12/nc-v2023%20Public%20Allocation%20Summary.pdf*
[6] *https://www.cpuc.ca.gov/climatecredit*
[7] *https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/office-of-governmental-affairs-division/reports/2024/2023-ab-67-report.pdf*
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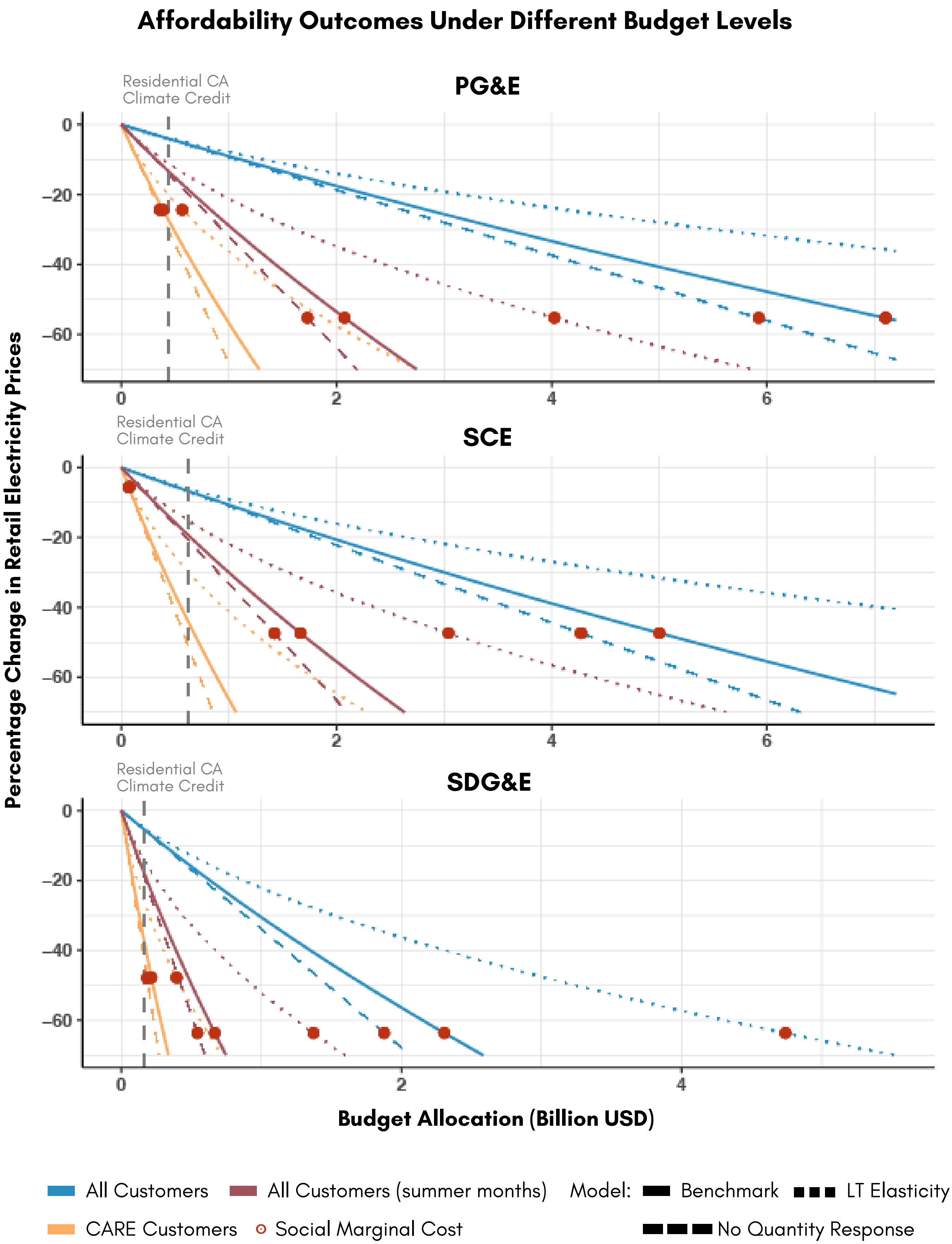
[10] *https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/california-energy-consumption-dashboards-0*
[11] *https://ww2.arb.ca.gov/sites/default/files/2022-12/nc-v2023%20Public%20Allocation%20Summary.pdf*

III. SUPPLEMENTARY FIGURE



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