Designing Electricity Rates for an Equitable Energy Transition

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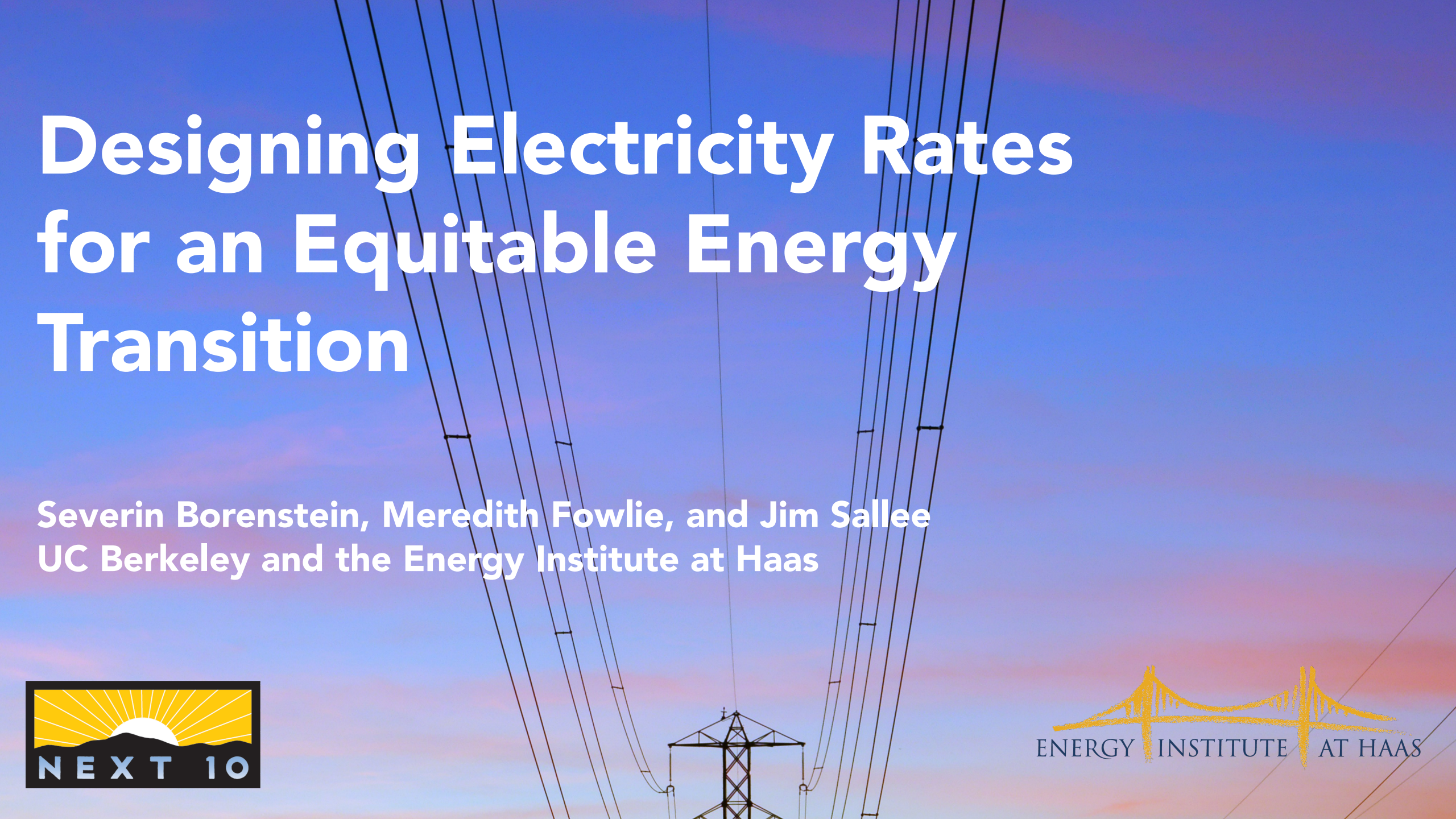


California Has Been a Leader in Fighting Climate Change

1. Energy Efficiency Standards and Policies since 1970s
2. Net Energy Metering for Behind-the-Meter solar 1996
3. Renewables Portfolio Standard in 2002
4. California Solar Initiative in 2006
5. Climate Solutions Act of 2006

   -- Established first broad-based price on GHG emissions through cap-and-trade program that launched in 2012
6. Low Carbon Fuels Standard in 2007
7. Electric Vehicle Subsidies and Standards since 1990s

…and many others

California Has Also Been Hit Hard by Climate Change

1. Wildfires
2. Drought
3. Wildfires
4. Extreme Heat
5. Wildfires
6. Flooding and Rising Sea Levels
7. Wildfires

And has taken actions to adapt to changing climate

1. Improved Forest Management
2. Improved Water and Drainage Management
3. Defensive policies on rising sea levels

Climate Change Mitigation and Adaptation in Expensive

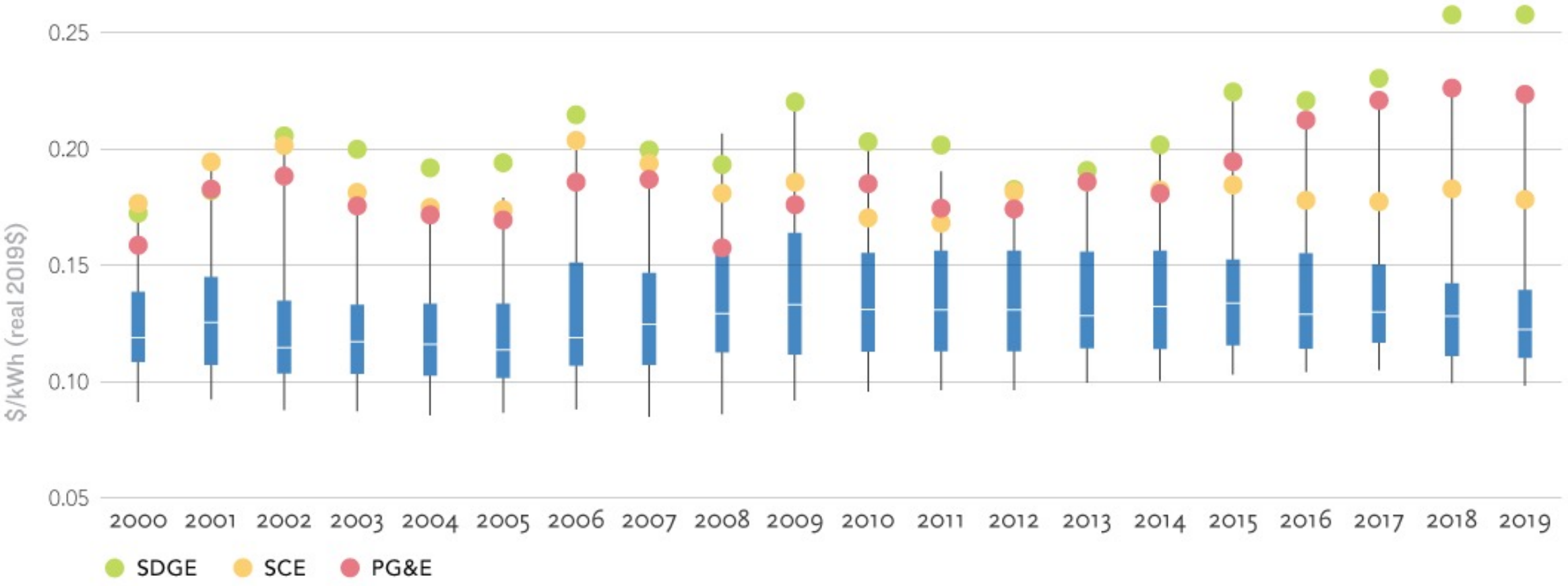
- Some of the costs have been paid through the state budget or from federal budget allocations
- Some of the costs have been paid by individuals complying with standards
- A lot of the costs have been paid through electricity rates
  - Nearly all through higher volumetric rates, almost no fixed charges in California

- California also has one of the most generous low-income energy support programs, also paid for through higher volumetric electricity rates

- California may also be leading in revenue choices to support climate and other social programs. Is that a good thing?

Residential electricity prices are high in California

FIG 1 Average Residential Price ($/kWh) by Year for Major U.S. Utilities



Note: Observations are weighted by total annual consumption. The box represents the 25th, 50th, and 75th percentile. The whiskers represent the 5th, and 95th percentiles. Source: Data come from FERC Form 1.

California's Investor-Owned Utilities

Questions we investigate

1. Why are California's volumetric retail electricity rates so high?
   - In California, costs that are not going-forward incremental expenses of supplying electricity are recovered in volumetric (per kWh) electricity prices.
   - Residential prices are now 2-3 times the incremental social cost.

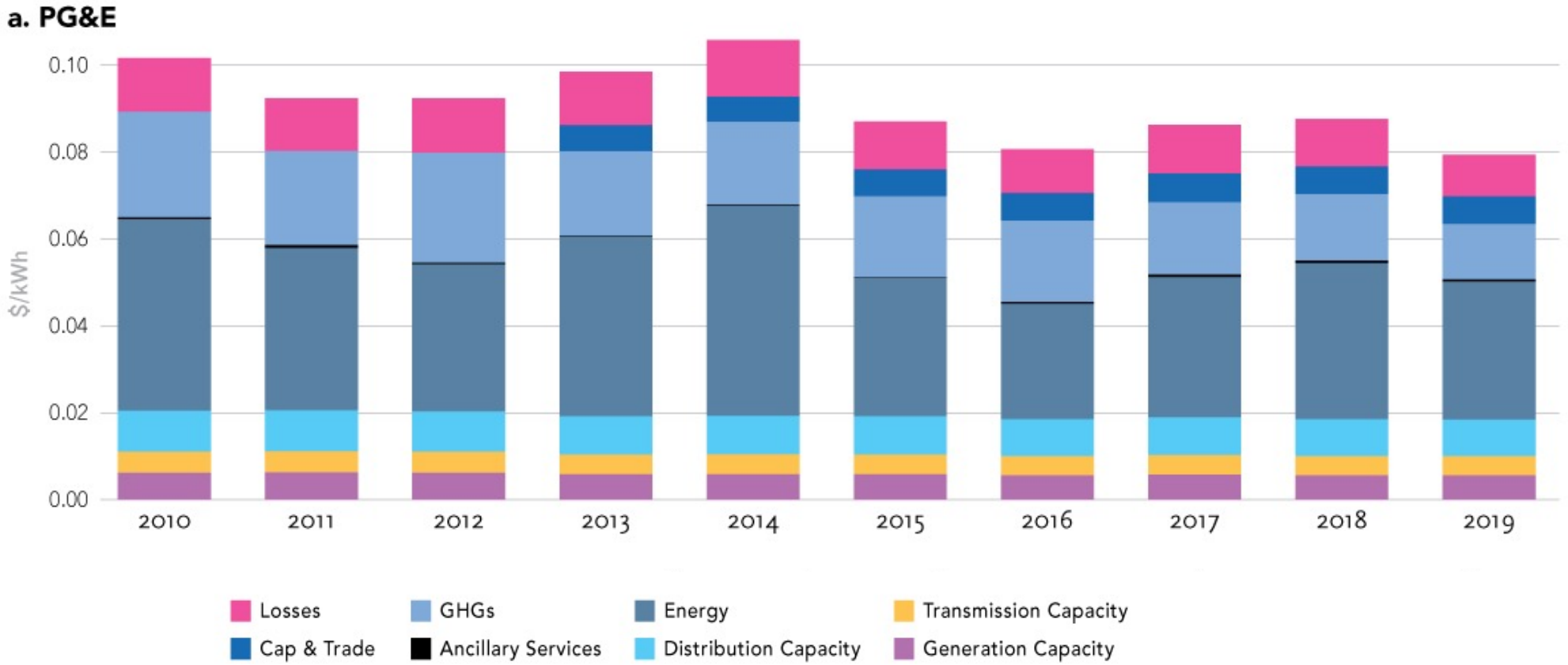
2. Who's paying these escalating costs?
   - Increasingly, it's the households who can least afford it.

3. How might we recover these costs in a more efficient and equitable way?
   - We propose some more efficient and more equitable alternatives to raising needed revenues.

What's the *efficient* electricity price?

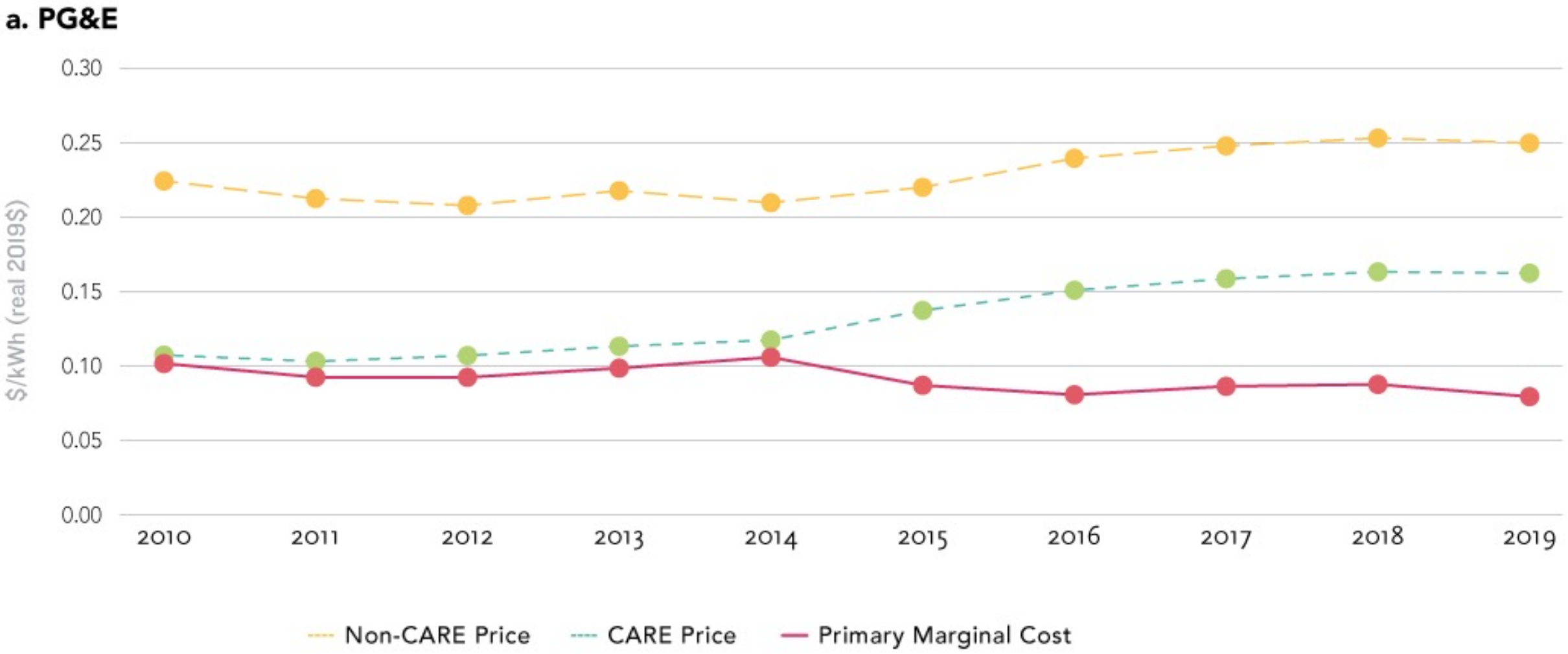
- Ideally, retail electricity prices would reflect the **time-varying social marginal cost (SMC)** of electricity consumption.
- The SMC captures all the incremental costs that electricity consumption imposes, including fuel costs, pollution impacts, etc.
- If price equals SMC, consumer deciding to use more electricity, or not, can trade off their own usage value versus full societal costs
- We estimate this efficiency benchmark for the 3 major IOUs over the last decade.

Annual social marginal cost estimates ($/kWh)

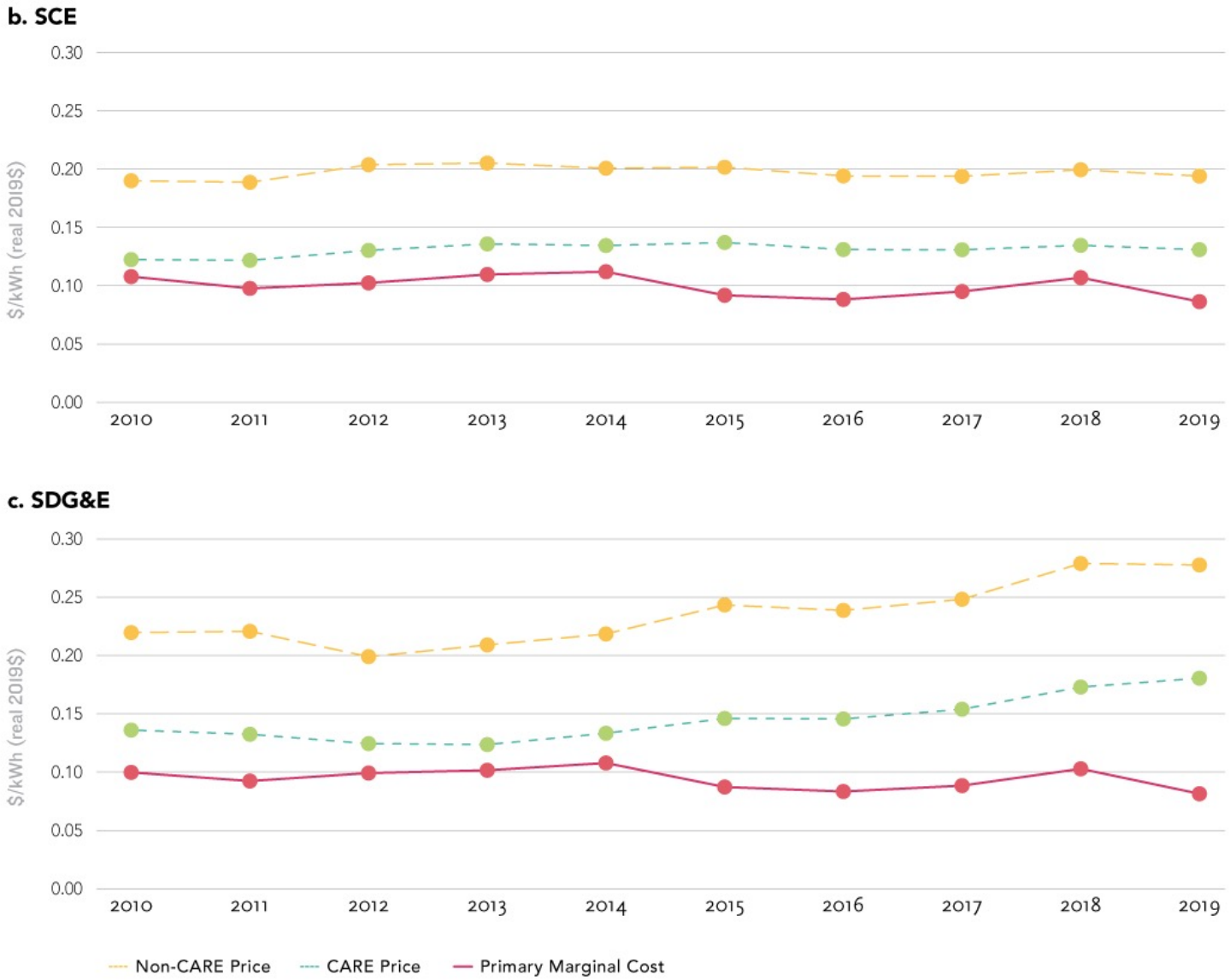


Notes: Marginal cost components are weighted by IOU load. See text for details on the construction of cost components. Additional details on data sources and methodology behind author calculations can be found in the Appendix.

Residential prices versus social marginal cost ($/kWh)



Significant price-marginal cost gaps across all IOUs

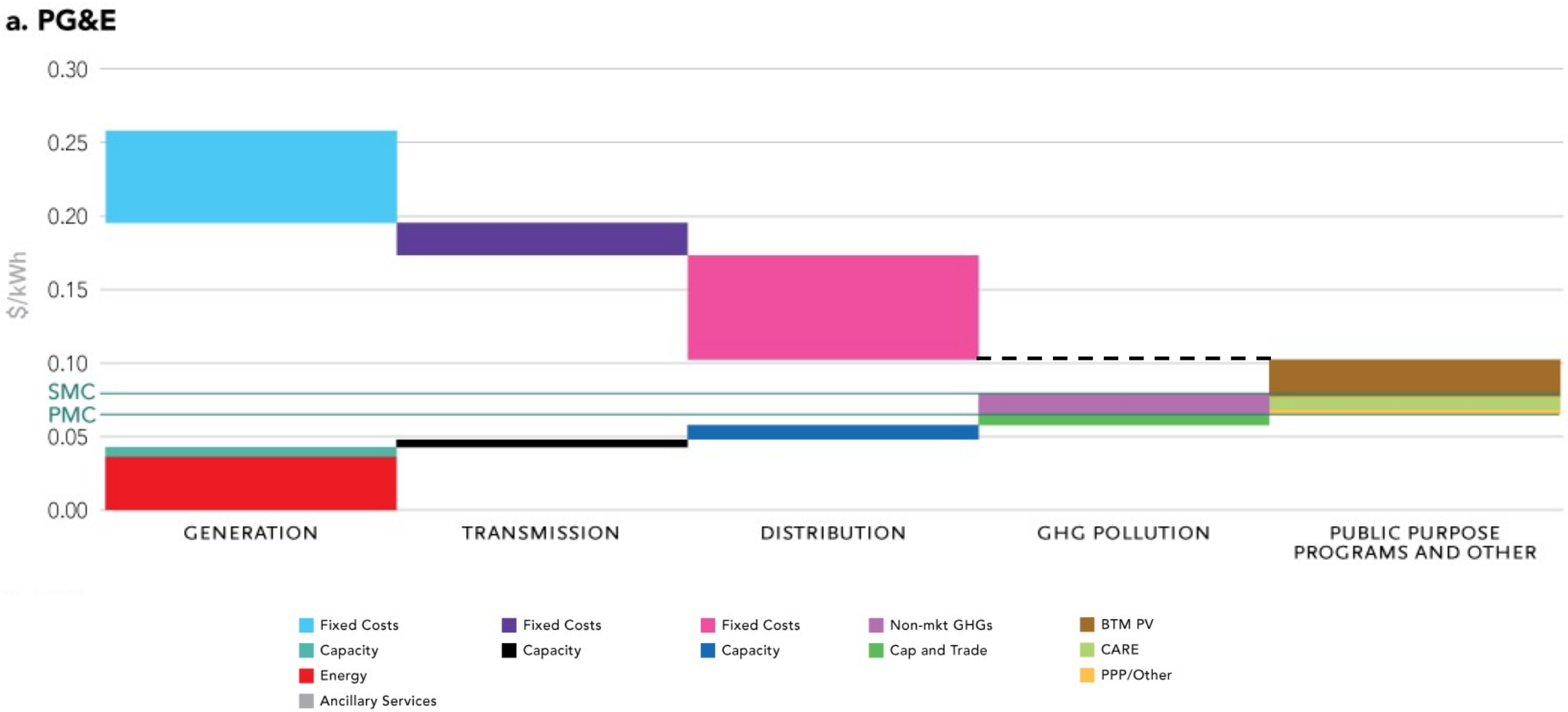


Why worry about high electricity prices?

- **Efficiency**: Burdening electricity prices with costs that are not going-forward incremental expenses of supplying electricity discourages efficient substitution from other energy sources towards electricity.

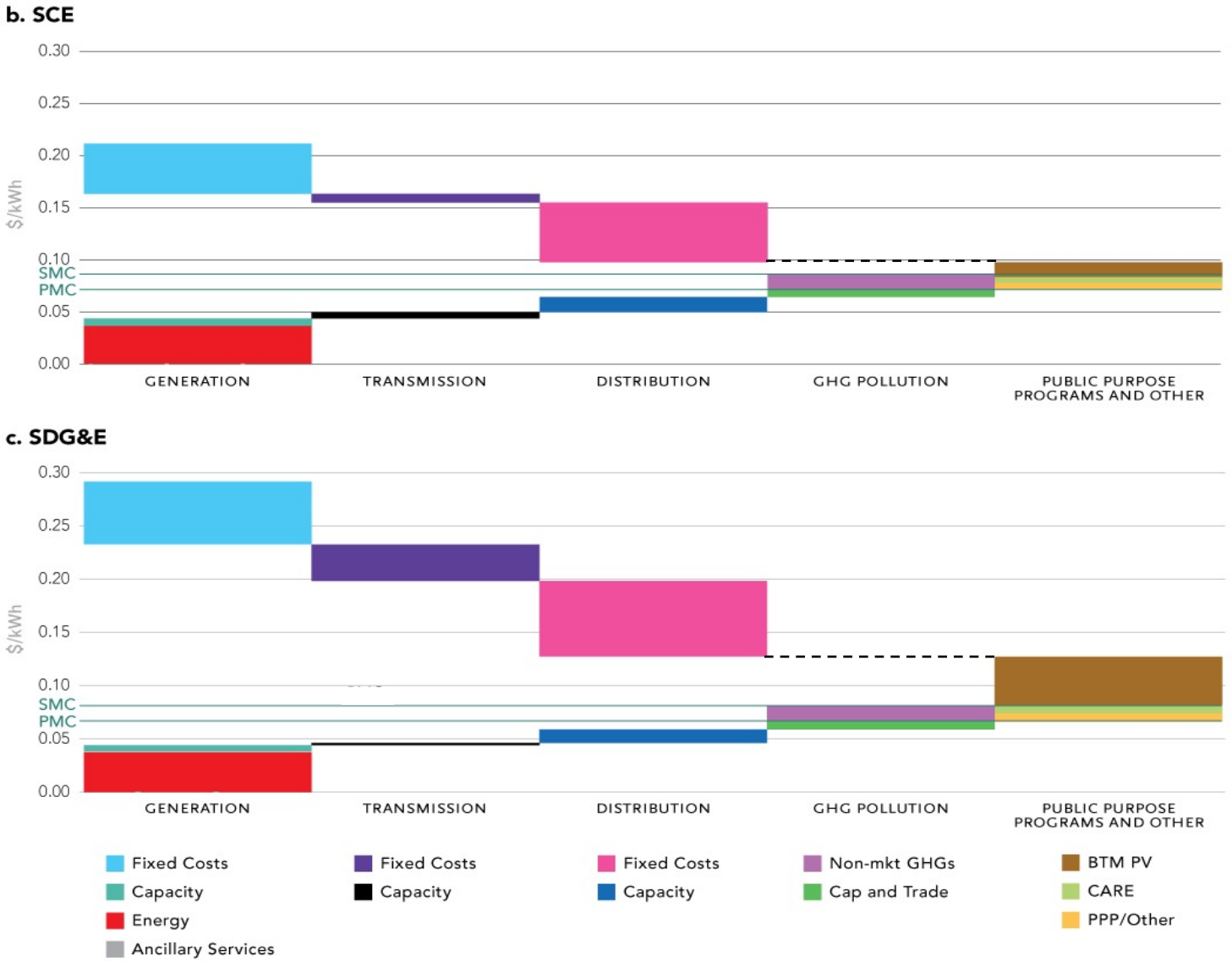
- **Equity**: Higher electricity prices can impose a large economic burden on lower-income households in an increasingly unequal economy.

2019 residential price decomposition ($/kWh)



Notes: Primary marginal cost estimates are weighted by IOU load. Average 2019 residential prices (CARE and non-CARE) are constructed using advice letters and rate schedules PG&E sources: 5366-E-A/B; 5444-E; 5573-E; 5644-E. SCE sources: 67666-E: 67668-E. SDGE: 31811-E; 31501-E. Details on the methodology behind author calculations can be found in the Appendix.

2019 residential price decomposition ($/kWh)



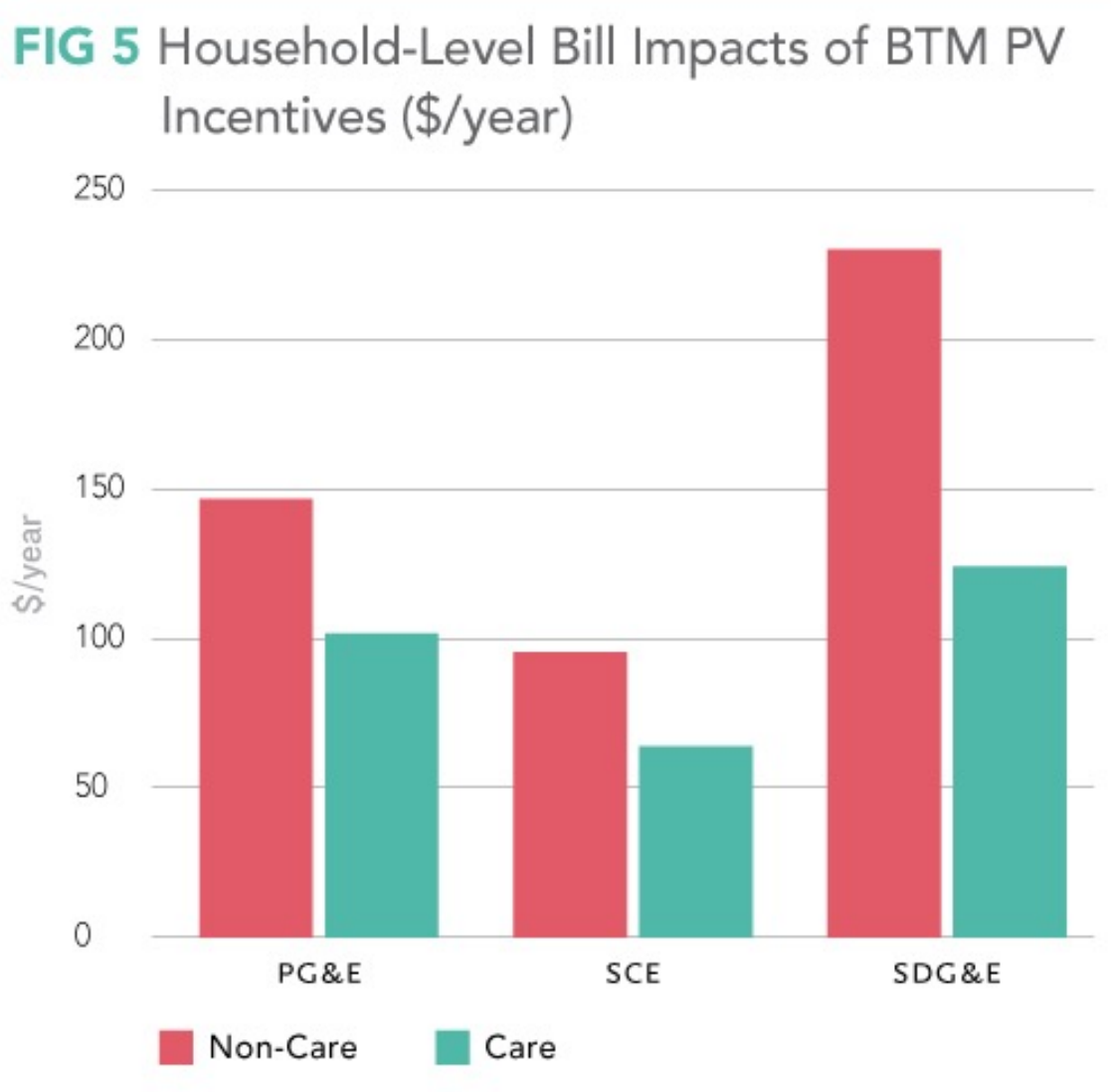
What about dynamic pricing?

- We ❤️❤️❤️ dynamic pricing. An important part of reliability and cost control. We have written numerous papers on dynamic pricing.

- Dynamic pricing is critical to making sure that the hourly variation in the *incremental* costs are reflected in retail price.

- **But dynamic pricing only addresses the lower staircase.** The costs in the upper staircase are not incremental. Putting them in the incremental price distorts the price signal, whether it is dynamic or not.

Net Metering for rooftop solar shifts cost recovery burden

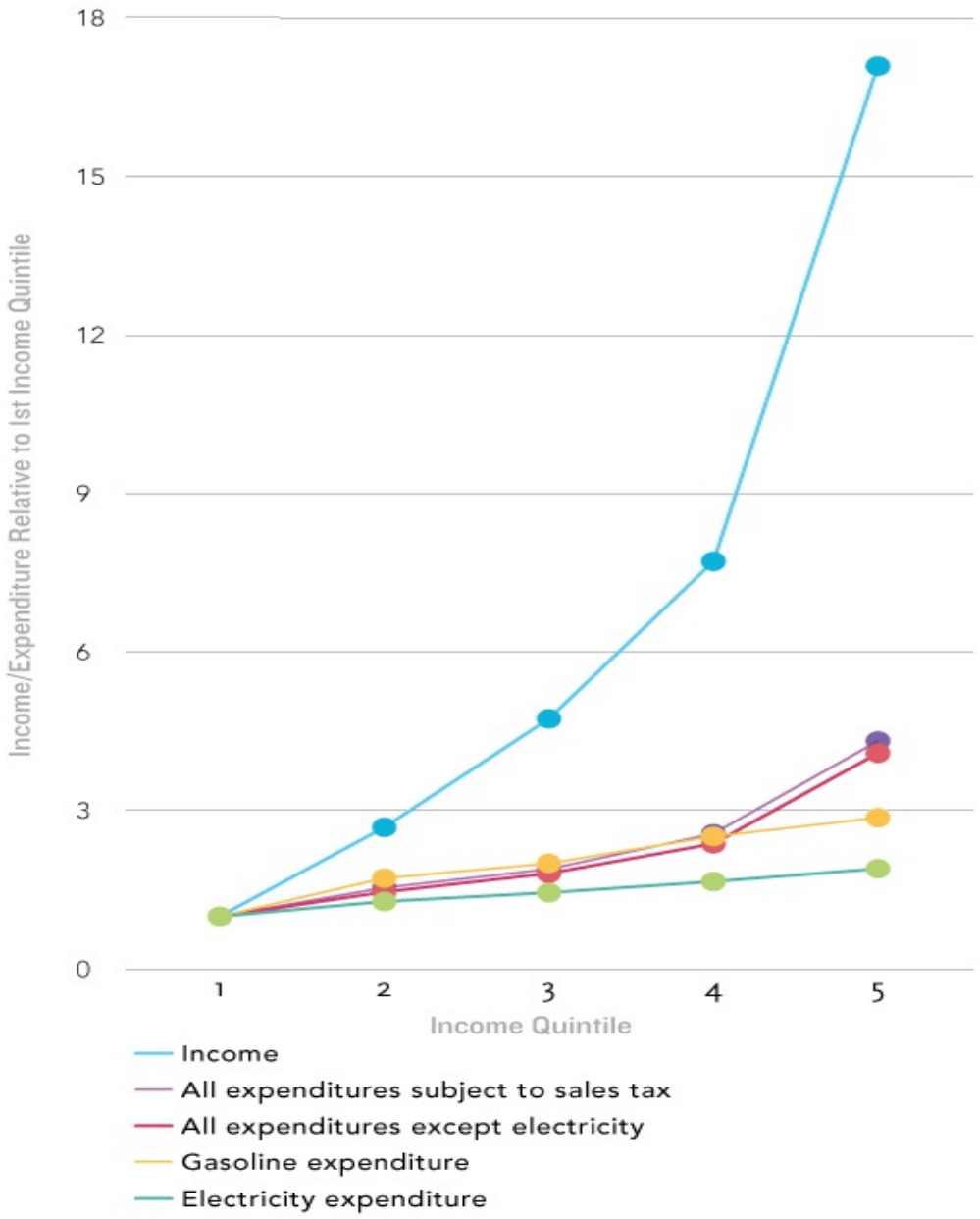


- Estimated bill impacts are based on average annual electricity consumption for CARE and non-CARE households, respectively.
- We further assume PV systems are owned by non-CARE households.

An unequal burden

- This figure charts relative income and relative expenditures across California households by income quintile.

- Lower-income households spend a much larger share of their income on electricity.



Source: Authors' calculations of data from the Consumer Expenditure Survey in 2017-2018. Source data at https://www.bls.gov/cex/2017/research/income-ca.htm

Equity/affordability considerations

- We are taxing electricity consumption to pay for infrastructure, climate change adaptation, and public purpose programs.
- At this point wealthier households consume only slightly more (net) electricity from the grid than poorer households.
- **Implication**: a volumetric tax on electricity is more regressive than sales tax or gasoline tax, and far more regressive than income tax.

Equity/affordability considerations

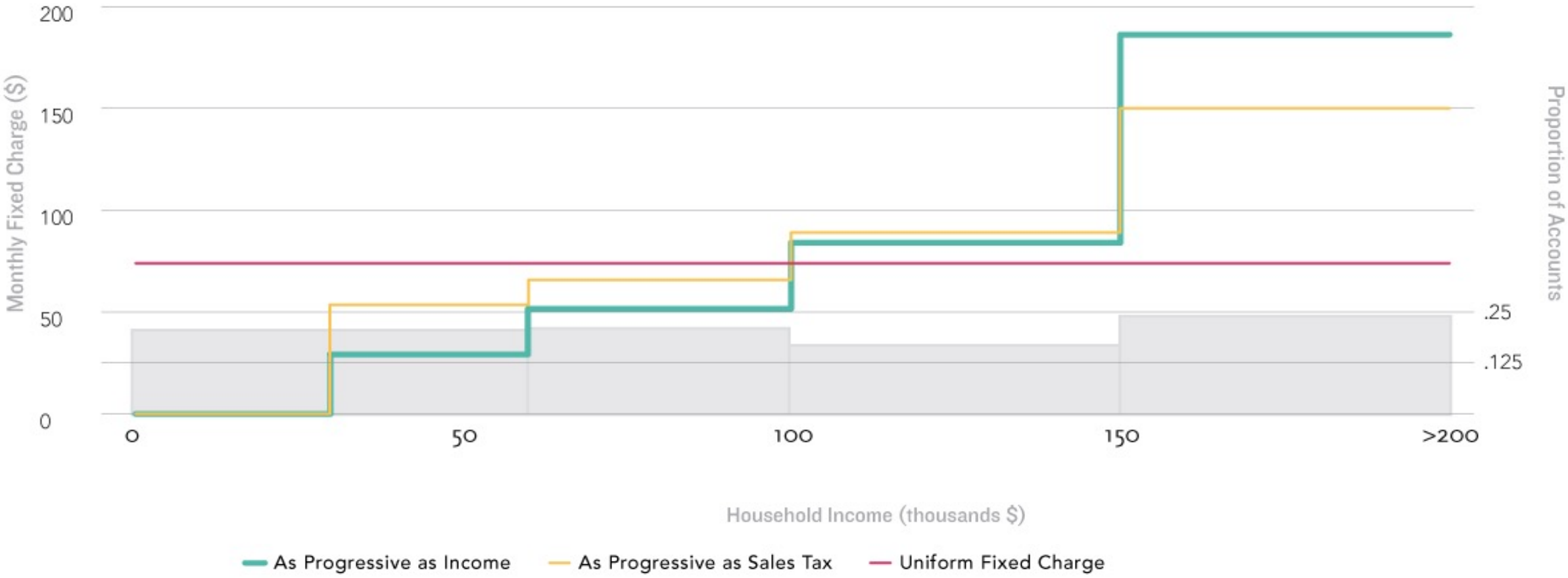
- One solution: pay for state policy priorities through the state budget.

- Alternatively, infrastructure and public purpose investment costs could be recovered *via income-based fixed charges* paired with an efficient volumetric price that reflects the social marginal cost.

- Our report examines alternative ways this could be done
  - Declaration to utility, true up with Franchise Tax Board (FTB)
  - FTB transfers information on income categories to the utilities
  - Presumptive fixed charge by location

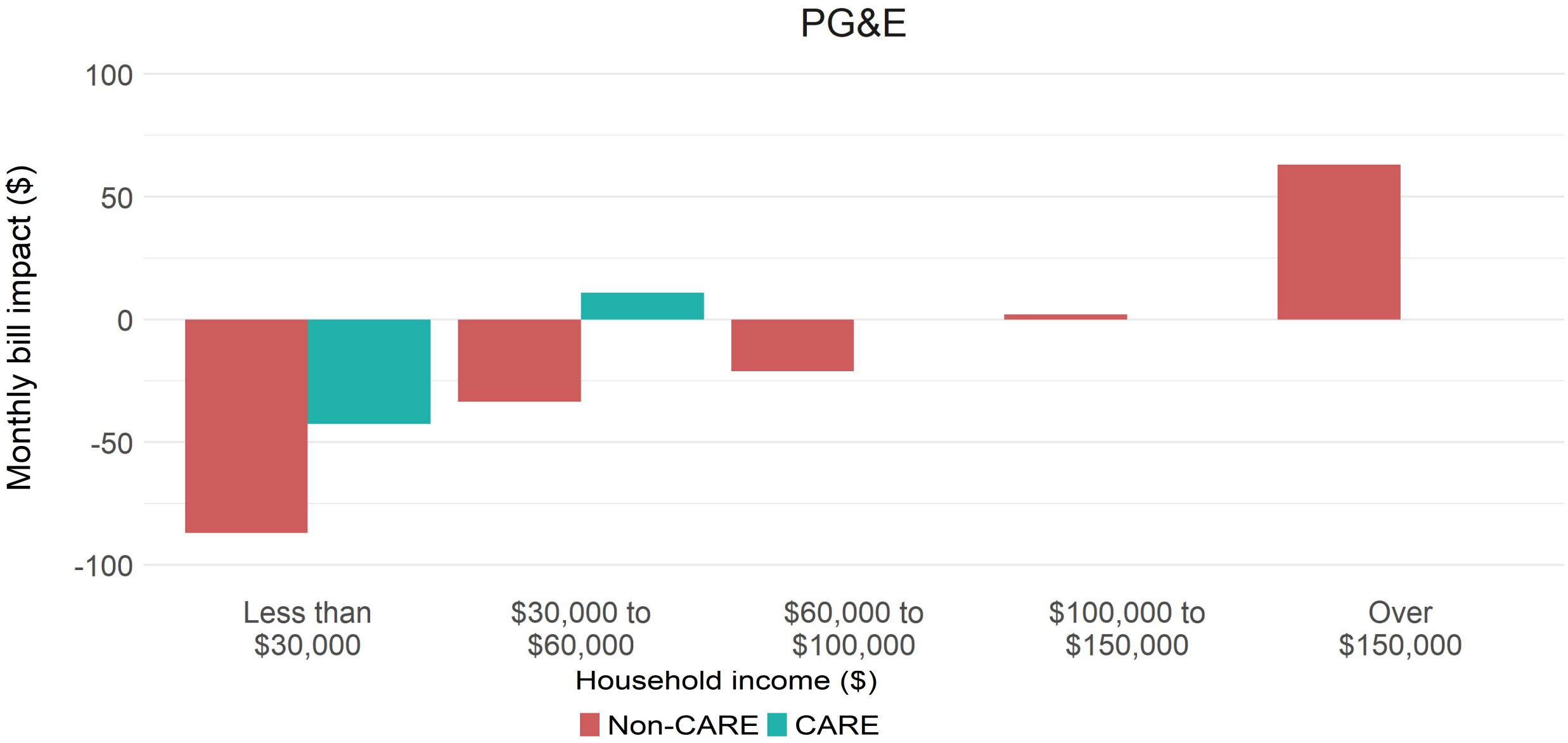
Example income-based fixed charge schedules (2019)

a. PG&E

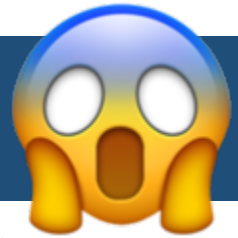


Note: Each scheme depicted recovers the same amount of revenue. The gray histogram shows the proportion of accounts in each of the five pricing tiers in each service territory. Household distribution by income from the American Community Survey. Rates are author's calculations based on cost recovery gap estimated in this study using proportional fees across quintiles as discussed in text. Full calculations available in the Appendix.

Net impacts on monthly bills (Sales tax progressivity)



Will this cause grid defection?



- NO. Remember that the volumetric price would drop by about 2/3 in the case of PG&E (more for SDG&E, less for SCE).
  - Partially offsets fixed charge and creates valuable opportunities for electricity use
- The customers who would pay more at their current consumption levels are relatively wealthy households with relatively low consumption from the grid.
  - Either because they consume little electricity (small dwelling, few people in household)
  - Or because they have already installed rooftop solar and pay only for net consumption
- Bill for a top-quintile customer who consumes 1/3 of average household from the grid would increase by about $100/month (under “progressive as sales tax”)
- Give up grid reliability for $1200/year? ($15k-$20k for batteries with 27kWh)

Conclusion

- In California, volumetric electricity rates are used to raise revenues for climate mitigation, infrastructure investments, wildfire mitigation, etc.
- This amounts to a highly regressive tax with negative implications for both efficiency and equity. Other states and countries are, unfortunately, following California's lead in this policy as well.
- Changing the way costs are recovered to reduce electricity rates can help ensure affordable and attractive electricity consumption as we look to rapidly increase usage on the path to decarbonization.
- Paying for most non-marginal costs through government budget or income-based fixed charges would improve equity by lightening the burden of cost recovery on households that can least afford to pay.