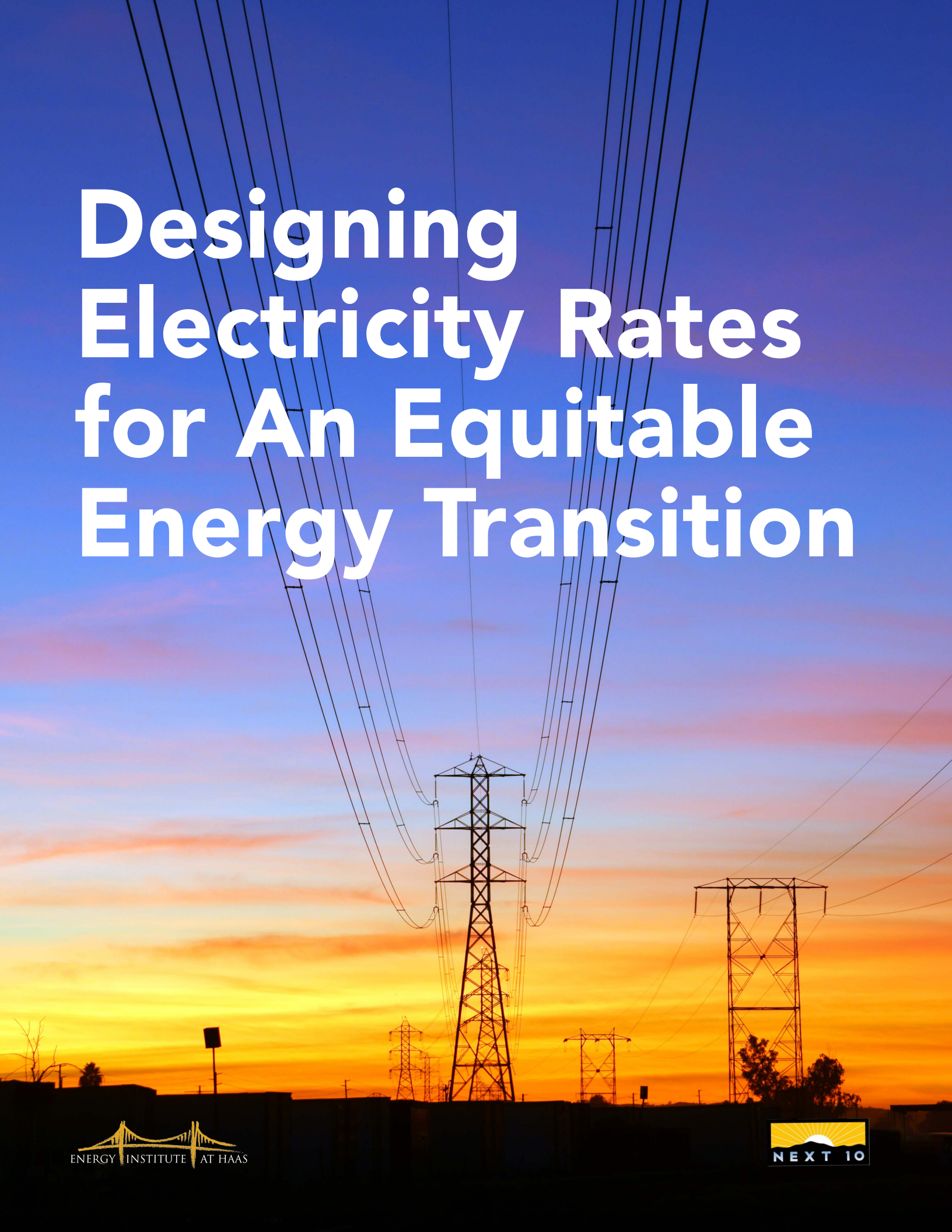

# Designing Electricity Rates for An Equitable Energy Transition

ENERGY INSTITUTE AT HAAS

NEXT 10

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**NEXT 10 is an independent nonpartisan organization that educates, engages and empowers Californians to improve the state's future.**

Next 10 is focused on innovation and the intersection between the economy, the environment, and quality of life issues for all Californians. We provide critical data to help inform the state's efforts to grow the economy and reduce greenhouse gas emissions. Next 10 was founded in 2003 by businessman and philanthropist F. Noel Perry.

**The Energy Institute at UC Berkeley's Haas School of Business** helps create a more economically and environmentally sustainable energy future through research, teaching and policy engagement.

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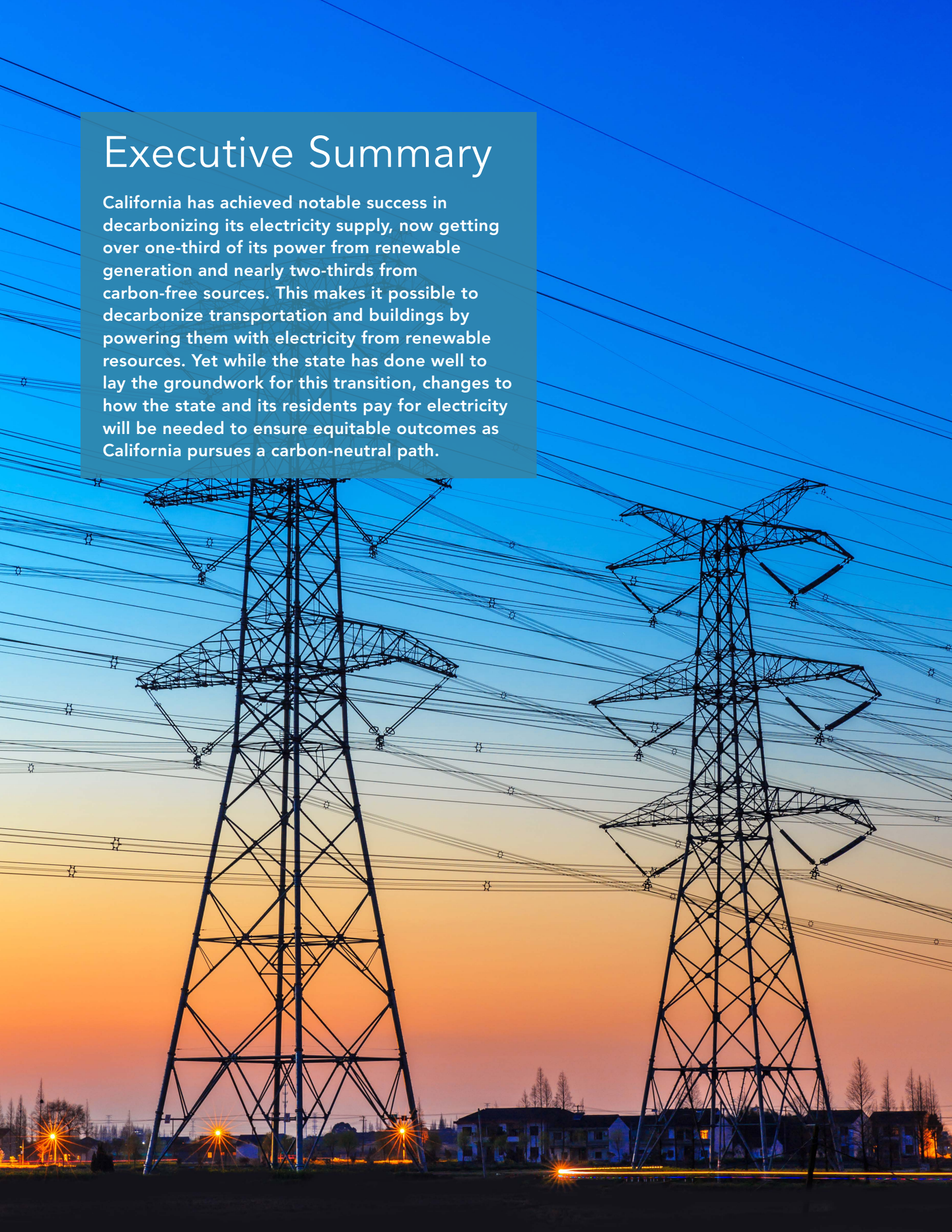
For outstanding research assistance and very helpful comments, we thank Marshall Blundell.
For valuable comments and discussions, we thank Andy Campbell.
The Appendix can be found at https://www.next10.org/electricity-rates

# Executive Summary



California has achieved notable success in decarbonizing its electricity supply, now getting over one-third of its power from renewable generation and nearly two-thirds from carbon-free sources. This makes it possible to decarbonize transportation and buildings by powering them with electricity from renewable resources. Yet while the state has done well to lay the groundwork for this transition, changes to how the state and its residents pay for electricity will be needed to ensure equitable outcomes as California pursues a carbon-neutral path.

Electricity prices in California are high and rising. This poses a heavy burden for many of the state's most economically vulnerable households. It is also a headwind in the state's efforts to combat climate change through electrifying transportation and buildings, which many see as critical steps to a low-carbon future.

The state's three large investor-owned electric utilities (IOUs) recover substantial fixed costs through increased per-kilowatt hour ("volumetric") prices. With nearly all fixed and sunk costs recovered through such volumetric prices, the price customers pay when they turn their lights on for an extra hour is now two to three times what it actually costs to provide that extra electricity—even when including the societal cost of pollution. This massive gap between retail price and marginal cost creates incentives that inefficiently discourage electricity consumption, even though greater electrification will reduce pollution and greenhouse gas emissions. Changing the way that electricity is paid for can address this issue.

This report takes stock of the current situation facing residential customers of California's large electricity IOUs and describes pricing reforms that could improve economic efficiency, facilitate decarbonization, and improve overall equity. The analysis includes several findings that are pertinent to ongoing conversations about affordability, decarbonization, rooftop solar, and wildfire mitigation, including:.

- **California IOUs' prices are high, by both historical and national standards.** A look at national data from the Federal Energy Regulatory Commission (FERC) shows that the average price of residential electricity in California's three large IOUs is out of line with the rest of the country. In the least expensive territory, Southern California Edison (SCE), residential prices per kilowatt hour are about 45 percent higher than the national average. Prices for Pacific Gas & Electric (PG&E) are about 80 percent higher, and prices in San Diego Gas & Electric (SDG&E) are roughly double the national average.
- **These high prices are two to three times the cost of producing additional electricity.** To reach this conclusion, this report analyzed the marginal cost of electricity—that is, the increase in cost incurred in order to deliver additional kilowatt-hours of electricity to an existing customer—and compared that cost to current rates. The authors found that the price of electricity ranged from double to triple the marginal cost in 2019. Even low-income customers who receive a subsidized rate paid prices well above marginal cost. The misalignment between price and cost creates problematic incentives.
- **High prices are driven in part by a shifting burden of fixed cost recovery.** Currently, 66 to 77 percent of the costs that California IOUs recover from ratepayers are associated with fixed costs of operation that do not change when a customer increases consumption. This includes much of the costs of generation, transmission and distribution of electricity, as well as subsidies for low-income household and public purpose programs, such as energy efficiency assistance. In addition, greater adoption of behind-the-meter (BTM) solar photovoltaic (PV) panels—which represented more than 15 percent of the residential electricity consumption across the PG&E, SCE, and SDG&E service territories in 2019—has disproportionately shifted cost recovery onto non-solar customers adopters.
- **Lower- and average-income households bear a greater burden.** These households are increasingly having to cover high fixed costs from a shrinking base as wealthier customers leave for rooftop solar. Higher-income households now consume only modestly more electricity than lower-income households.[1]
- **More equitable alternatives can be found and implemented.** The report authors detail a variety of potential approaches to ensure utility revenues can be kept stable without relying on the current regressive rate model as the state looks to increase electrification.

1 Borenstein (2017) finds that for customers in PG&E territory, households in the top 40% of income were more than twice as likely to install solar PV as households in the bottom 60%. Using a different statistical approach and data through 2016, Barbose et al (2018) find that the median income of California households installing solar PV was more than 40% above the median income of households overall. The next stage of the current research project will update analysis of this income gap. Borenstein available at: https://www.journals.uchicago.edu/doi/abs/10.1086/691978. Barbose et al available at: https://emp.lbl.gov/publications/income-trends-residential-pv-adopters

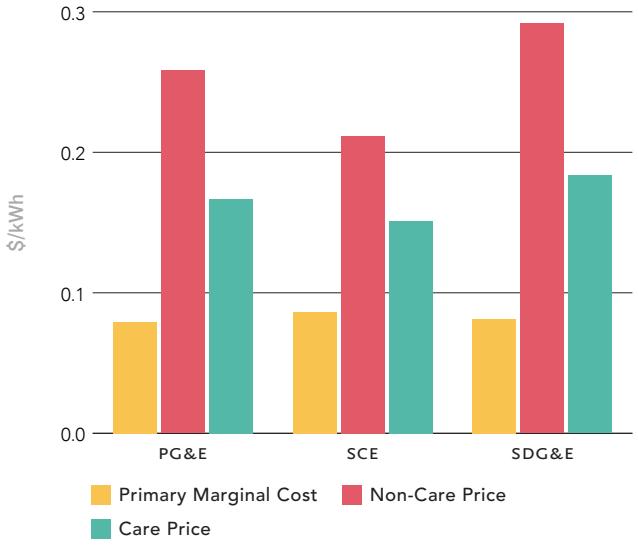
- **The report suggests the following alternatives for paying the cost of electricity in the state:**
  - » Tax revenue: Raising revenue from sales or income taxes would be much more progressive than the current system, ensuring that higher-income households pay a higher share of the costs.
  - » Income-based fixed charge: A more politically feasible option could be rate reform—moving utilities to an income-based fixed charge that would allow recovery of long-term capital costs, while ensuring all those who use the system contribute to it. To make a fixed charge equitable, it would be based on income. In this model, wealthier households would pay a higher monthly fee in line with their income.
    - The report offers several ways to structure an income-based fixed charge, based on three criteria: set prices as close to cost as possible; recover the full system cost; and distribute the burden of cost recovery fairly.
- **Wildfire cost transparency.** Finally, the report identified the need for more transparent accounting of wildfire mitigation costs, as the authors could not obtain clear wildfire-related expenditure data. This is vital as wildfire mitigation costs are likely to be a major driver of price increases in the near future.[2]

More detail on these findings can be found below and in the body of the report.

## Retail Prices Vs. Marginal Cost

The report's estimate of the marginal cost of electricity includes not only the cost of generating additional electricity, but also potential increases in costs for transmission and distribution capacity that scale with usage, as well as the potential need for additional generation capacity. The cost of greenhouse gas (GHG) emissions is also included, which is borne by society rather than the utilities to the extent that existing programs (e.g., cap and trade) only partially price this climate externality. There is no perfect way to calculate all of these costs with the available data, so a variety of alternatives is presented in the Appendix. In all cases, the marginal cost is vastly lower than current rates.

**FIG ES-1** Residential Retail Prices Vs. Social Marginal Cost ($/kWh) for 2019




Note: 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.

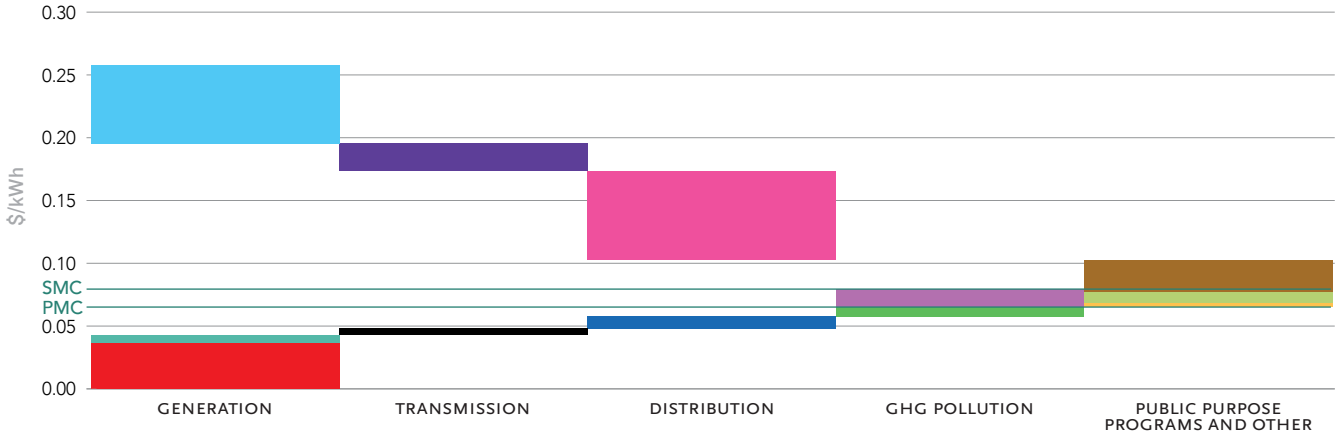
The authors' primary estimate of marginal cost for 2019 is shown in Figure ES-1, along with estimates of the average residential price of electricity for each IOU. The price of electricity is more than double the estimated marginal cost for SCE, and it is more than triple for PG&E and SDG&E. Over 25 percent of residential customers in California pay lower rates through the low-income program, California Alternative Rates for Energy (CARE), but report authors found that even CARE rates are substantially above marginal cost, as shown in the figure.

This finding is not a commentary on the appropriateness of overall costs. High total system costs in California may well be justified by conditions in the state. Rather, the implication of this finding is that by recovering total system costs through high volumetric prices, California's IOUs are now operating a pricing scheme that sends misleading signals about the true cost to society of consuming electricity. Pricing reform that aligns the volumetric price of energy with marginal cost would dramatically reduce prices, which has the potential to spur electrification of other sectors of the economy.

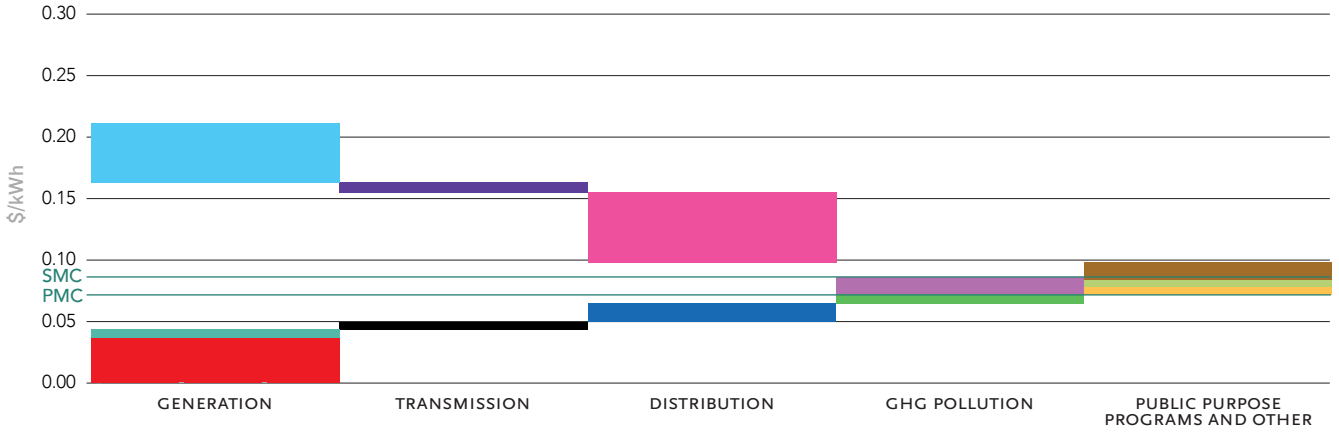
2 Balaraman, Kavya. "California IOUs plan to spend $11B on wildfire prevention in 2021 and 2022 after record-breaking fire season." Utility Dive. February 9, 2021. Available at: https://www.utilitydive.com/news/california-ious-plan-to-spend-11b-on-wildfire-prevention-in-2021-and-2022/594823/

## FIG ES-2a-c Residential Price Decomposition ($/kWh) for 2019

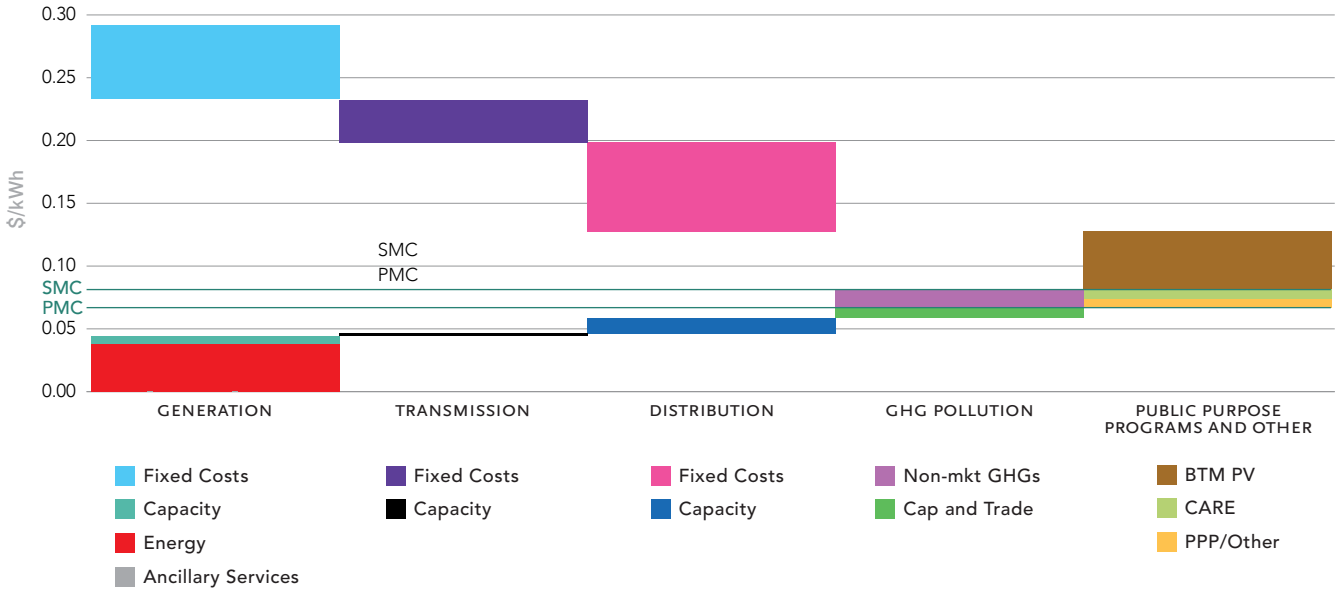
### a. PG&E




### b. SCE




### c. SDG&E




Note: Details on data sources and methodology behind authors' calculations can be found in the Appendix.

## Components of California Electricity Rates

The components of California's high electricity rates are unpacked in detail in this report and are summarized for each utility in Figure ES-2a-c, which breaks down the average volumetric price facing a residential customer on a standard rate. This figure decomposes costs into five main categories: generation, transmission, distribution, pollution and a residual category that combines public purpose programs and other costs. For generation, transmission and distribution, the costs are separated into the component that is part of marginal cost and the remaining costs that do not scale with usage. Details of each item's calculation is included in the report.

The marginal cost components are added up in the bottom staircase. Marginal cost is the combined height of the boxes representing the marginal costs of generation, transmission, distribution and greenhouse gas emissions that are associated with producing an additional unit of electricity. This is labeled here as the private marginal cost (PMC). Adding the unpriced portion of pollution damages resulting from electricity yields the social marginal cost (SMC). The other boxes represent additional system costs that do not scale with usage. These are all costs that are being recovered through high volumetric prices for standard rate customers, but they represent fixed costs that range from regular maintenance to wildfire mitigation to cross-subsidies for CARE customers and rooftop solar.

A few findings are apparent from the figure. First, the additional system costs are spread across several factors that, taken together, drive the high cost. In particular, costs associated with generation and distribution comprise a significant share of the cost recovery gap.

Second, as more and more households adopt behind-the-meter (BTM) solar photovoltaic (PV) panels, cost recovery is disproportionately shifted onto the bills of solar non-adopters. In 2019, the report authors estimate that behind the meter residential solar production supplied more than 15 percent of the residential electricity consumption across the PG&E, SCE, and SDG&E service territories. The fixed costs recovered via high volumetric electricity prices are shifted—not avoided—when a residential customer installs rooftop solar. In other words, as residential solar adoption increases, system costs are being recovered from a shrinking base.

An additional finding of the report's cost component analysis is that there is great need for a more transparent accounting of wildfire mitigation costs that could inform public debate. Despite going to considerable lengths in an attempt to delineate wildfire-related expenditures by separating them from other costs with publicly available data, it was not possible for the report authors to get clear numbers. In Figure ES-2-a-c, these costs are embedded primarily in transmission, distribution and other fixed costs. Wildfire mitigation costs are likely to be a major driver of price increases in the near future. Wildfire mitigation is a statewide priority that delivers benefits to households throughout all utility territories, regardless of the quantity of electricity they consume, suggesting that perhaps some associated costs should be borne by the state at large. Transparent and consistent data about associated costs is essential to inform decision-making about how to pay for wildfire mitigation.

## Improving Equitable Pricing of Electricity

A key finding of the report's analysis is that the current system of recovering system costs through high volumetric prices is not only inefficient; it is also far less equitable than viable alternatives. It imposes a relatively large burden on lower- and average-income households while it recovers a shrinking fraction of system costs from higher-income households because of the diffusion of rooftop solar.

The authors are in the process of constructing a detailed assessment of how the burden of cost recovery is allocated across households in the current rate system, but that analysis involves customer billing data that was not obtained in time for this report. While a forthcoming Next 10-Energy Institute study will incorporate customer billing data, this initial report relied on survey data about household expenditures in California from the US Bureau of Labor Statistics, which are presented in Figure ES-3. Those data show that higher-income households spend only modestly more on electricity than lower-income households, a much smaller differential relative to differences in incomes or expenditures on most other goods, including even gasoline.

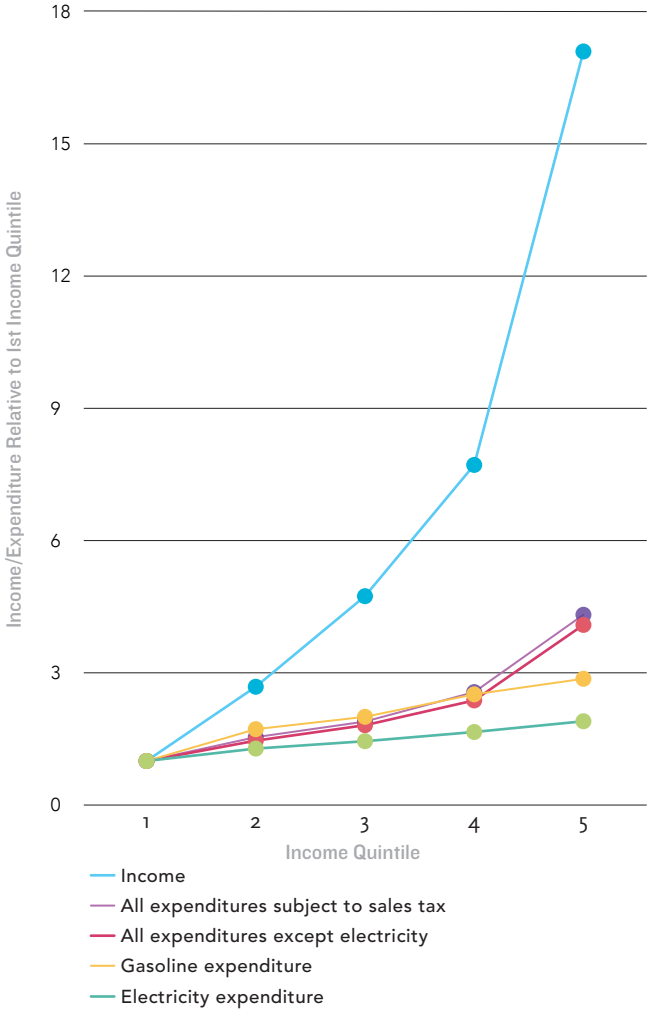
### Alternative Funding Mechanisms to Ensure an Equitable Electrification Transition

To address these inefficiencies and ensure a more equitable path toward greater electrification, the state could potentially support some measures, such as public purpose programs or wildfire mitigation, directly through other tax revenue. Analysis of the survey data from the US Bureau of Labor Statistics (BLS) suggests that

using revenue raised from sales or income taxes would be much more progressive than the current scheme of covering residual costs above marginal cost by increasing volumetric electricity prices. This is apparent in Figure ES-3, which shows that expenditures on goods subject to the sales tax rise much more steeply across the income distribution. Thus, raising electricity system revenue through the sales tax would recover far more of the costs from richer households than does the current scheme. The distribution of income rises even faster than do taxable expenditures—which means that paying for some system costs through additional revenue raised via the income tax in California would be even more progressive.

Recognizing potential political barriers to leveraging state revenue to pay for electricity system costs, the report also considered ways of reforming the electricity system that could align prices with marginal cost without imposing an additional burden on those least able to afford it. To that end, a final key finding is that an income-based fixed monthly connection charge could raise revenue to cover utility costs while maintaining a volumetric price that reflects marginal cost and improving equity outcomes. This fixed monthly charge would require income verification, but would ultimately help reduce volumetric rates while providing stable revenue to utilities. The report concludes by discussing the possible structure of an income-based fixed charge, including some possible rate structures, as well as some of the logistical and equity considerations and trade-offs that would need to be weighed in order to implement such a scheme.

**FIG ES-3** Average Expenditures and Income per California Household by Income Quintile Relative to Lowest Quintile




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