

LESS CARBON, HIGHER PRICES

How California's Climate Policies
Affect Lower-Income Residents

Jonathan A. Lesser
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EXECUTIVE SUMMARY

By 2020, California will require that one-third of electricity consumed in the state be generated from renewable sources. California has also pledged to reduce its greenhouse gas emissions by 40 percent below 1990 levels by 2030 and by 80 percent below 1990 levels by 2050. This paper examines the Golden State's history of renewable-energy mandates, as well as its carbon cap-and-trade program; its tiered system of electricity pricing; how prices vary by county; and the impact of energy prices on households. Key findings include:

- 1. Rising Prices.** California households' electricity prices have risen as a result of the state's renewable-energy mandates and carbon cap-and-trade program—and will likely continue to rise at an even faster rate in coming years.
- 2. A Regressive Tax.** The aforementioned policies have created a regressive energy tax, imposing proportionally higher costs in certain counties, such as California's inland and Central Valley regions, where summer electricity consumption is highest but household incomes are lowest.
- 3. Energy Poverty.** In 2012, nearly 1 million California households faced "energy poverty"—defined as energy expenditures exceeding 10 percent of household income. In certain California counties, the rate of energy poverty was as high as 15 percent of all households.

To alleviate current inequities, California legislators should:

- 1. Conduct a Cost-Benefit Review.** Commission a comprehensive, impartial cost-benefit analysis of the state's energy policies. Do the benefits of California's proposed greenhouse gas reductions—which, even if realized, will negligibly affect global emissions and climate—outweigh their considerable and rising cost to local businesses and households, particularly low-income Californians?
- 2. Make the State's Tariff Structure More Fair.** Impose a greater share of the burden of renewable mandates on wealthier households and avoid over-allocating fixed-utility costs to low-income households, which are least likely to participate in California's subsidized rooftop solar photovoltaic programs.

ABOUT THE AUTHOR

JONATHAN A. LESSER, president of Continental Economics, has more than 30 years of experience working for regulated utilities, for government, and as a consultant. He has addressed critical economic and regulatory issues affecting the energy industry in the U.S., Canada, and Latin America, including gas and electric utility structure and operations, generating asset valuation under uncertainty, cost-benefit analysis, mergers and acquisitions, cost allocation and rate design, resource investment decision strategies, cost of capital, depreciation, risk management, incentive regulation, economic impact studies, and general regulatory policy.

Lesser has prepared expert testimony and reports before utility commissions in numerous states; before the Federal Energy Regulatory Commission (FERC); before international regulators in Belize, Guatemala, Mexico, and Puerto Rico; in commercial litigation cases; and before Congress and numerous state legislative committees on energy policy and regulatory issues. He has also served as an arbiter in disputes between regulators and regulated utilities, as well as in disputes regarding the value of electric generating assets. Lesser has designed economic models to value nuclear, fossil fuel, and renewable generating assets, as well as long-term power contracts in the presence of market, regulatory, and environmental uncertainty. He is the author of numerous academic and trade-press articles and has coauthored three energy textbooks.

Lesser earned a B.S in mathematics and economics from the University of New Mexico, and an M.A. and a Ph.D. in economics from the University of Washington.

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HOW CALIFORNIA'S CLIMATE POLICIES AFFECT LOWER-INCOME RESIDENTS

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INTRODUCTION

California has consistently been at the forefront of U.S. energy policy, including aggressive efforts to promote renewable generation, discourage consumption, and create a “low-carbon” economy. By 2020, California will require that one-third of electricity consumed in the Golden State be generated from renewable sources.¹

Not only is electricity purchased from renewable sources by the state’s utilities more expensive than electricity purchased in the wholesale market; California requires utilities to adopt rate structures that raise the price of electricity as consumption increases. The state is also home to a carbon cap-and-trade program aimed at reducing its greenhouse gas (GHG) emissions by 80 percent below 1990 levels—roughly 433 million tons of CO₂ equivalent—by 2050.²

Though transportation is California’s largest source of GHG emissions, electricity generation currently accounts for about one-fourth of total emissions. In April 2015, Governor Brown issued an executive order mandating that the state achieve at least half its GHG reduction goal—a 40 percent cut in GHG emissions below 1990 levels—by 2030.³ California’s GHG emissions-reduction program has already increased wholesale electricity prices and is causing upward pressure on retail prices. As cap-and-trade demands still-greater emissions cuts, it will increasingly affect electricity generators and major industrial firms. Further, California has

implemented policies that have resulted in higher prices for motor fuels, including gasoline and diesel.⁴

As a result of the state's green-energy policies, Californians' electricity bills have risen and appear likely to continue rising significantly.⁵ **Section I** summarizes these green-energy policies. **Section II** discusses the state's electricity-pricing policies. **Section III** evaluates household electricity and natural gas spending by county. The paper concludes with policy recommendations.

I. CALIFORNIA'S RENEWABLE PORTFOLIO STANDARD: A BRIEF HISTORY

California's numerous energy policies—designed to transform the state into a “low-carbon” economy—primarily target electricity supply and demand. The state's 2013 Integrated Energy Policy Report declares: “California continues to lead the nation in designing and implementing innovative policies and strategies to use energy more efficiently, replace fossil fuels with renewable resources, and develop the power infrastructure needed to deliver safe, reliable, and affordable energy to consumers and businesses throughout the state.”⁶

The supply and cost of electricity in California are affected by public programs designed to incentivize development of renewable sources: subsidies to encourage development of solar photovoltaic (PV) power at residential and commercial locations;⁷ “feed-in” tariffs to encourage small (less than 3 megawatts [MW] capacity) PV and bioenergy resources; a carbon cap-and-trade program to reduce GHG emissions;⁸ and, most significantly, a renewable portfolio standard (RPS) mandate.

Before California's RPS

California is not unique in its RPS mandate: 29 states, as well as the District of Columbia, have one.⁹ Such states require utilities to supply increasing percentages of retail electricity from renewable sources.¹⁰ RPS mandates make electricity more expensive. When retail consumers subsidize electricity supplies at above-market costs, retail prices inevita-

bly rise, even if the fuel is “free.” California—which requires that 25 percent of the state's electricity consumption be produced from renewable sources by 2014–16 and 33 percent by 2020—is home to America's most aggressive RPS mandate.

Renewable generation in the Golden State is nothing new. Hydroelectric dams have operated in California for more than a century.¹¹ Since 1960, the state has also generated electricity from geothermal sources. Such resources confer the advantage of supplying electricity around the clock, especially when demand (and the value of electricity) is greatest.¹²

The U.S. Public Utilities Regulatory Policy Act (PURPA) of 1978,¹³ which required electric utilities to purchase power from so-called qualifying facilities (QFs), made California a magnet for renewable-energy development, especially wind power, and later, solar power. Because California did not have competitive wholesale power markets in the late 1970s—these would not arise until after the 1992 Energy Policy Act¹⁴—state regulators established prices based on “utility-avoided” costs (the costs that regulators estimated that utilities would otherwise pay for electricity).¹⁵ Such estimates were based on the cost to construct new fossil-fuel generators, typically coal- or gas-fired, as well as projected fuel costs 10–30 years into the future.

PURPA promoted the construction of thousands of wind turbines in California, with state regulators creating additional incentives to encourage smaller renewable facilities. Regulators developed three types of “standard-offer” contracts, with standard-offer-four (SO4) contracts the most notable. SO4 contracts established remarkably generous fixed electricity prices for small—typically, wind—generators: in September 1983, SO4 contracts hit the market, unleashing a torrent of QF capacity; by April 1985, however, SO4 contracts were withdrawn from the market.

SO4 contracts gave developers fixed energy payments for ten years and, more important, fixed-capacity payments for ten to 30 years. Taking advantage of such contracts, as well as a 10 percent investment-tax credit for wind and solar genera-

Figure 1. Abandoned Wind Turbines, Tehachapi Pass, California



Source: <http://webecoist.momtastic.com/2009/05/04/10-abandoned-renewable-energy-plants>

tion under the 1978 Energy Tax Act,¹⁶ developers erected thousands of wind turbines that blighted California's landscape (**Figure 1**), while producing so little energy as to be derided as "PURPA machines."¹⁷ In 1987, in comments submitted to the Federal Energy Regulatory Commission (FERC), Pacific Gas & Electric (PG&E) projected annual energy overpayments to SO4 QFs at \$467 million in 1990 and \$5 billion for the ten-year, fixed-price period to 1997. By 1990, PG&E projected total QF overpayments at \$857 million—which, PG&E estimated, would raise its retail electricity rates by at least 7 percent.¹⁸

California's RPS

California first enacted an RPS mandate in 2002, with the passage of Senate Bill 1078: investor-owned utilities (IOUs) were required to procure 20 percent of retail customers' electricity consumption from renewable sources by 2010, including from small (less than 30 MW capacity) hydroelectric plants;¹⁹ from bioenergy facilities burning of wood,

agricultural waste, and garbage; from wind turbines; and from PV sources. Utilities that failed to comply faced monetary penalties.

In 2006, IOUs were required to use feed-in tariffs to encourage customer-owned PV and bioenergy resources to generate electricity.²⁰ In 2008, Governor Schwarzenegger expanded the RPS mandate by executive order, raising the renewable energy goal to 33 percent of electricity consumption by 2020²¹—making California's RPS mandate the most stringent among states without significant in-state (or close proximity to) hydroelectric generating capacity.²²

Before 2011, California's publicly owned utilities (POUs), such as the Los Angeles Department of Water and Power (LADWP), were exempt from the state's RPS mandate. In 2011, Governor Brown signed SB 2 (1X), requiring POUs to meet the same RPS goals as California's IOUs. In 2012, Governor Brown signed SB 1332, requiring POUs to estab-

lish feed-in tariffs, too. In January 2015, Governor Brown proposed further increasing the state's RPS mandate to 50 percent of total electricity consumption by 2030.²³

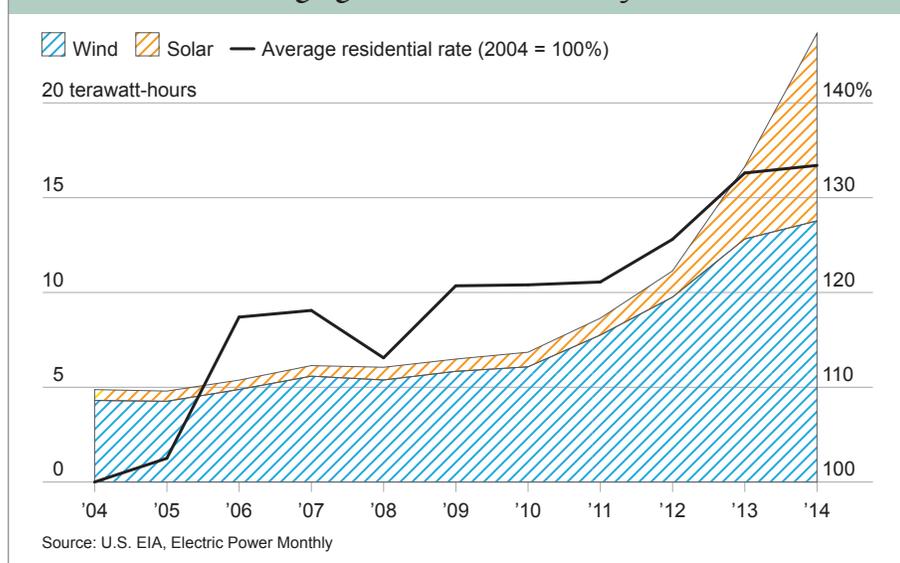
California's RPS mandate contains interim goals as well. In 2013, it mandated that 20 percent of electricity sold by IOUs, POUs, and retail suppliers be generated from renewables; for 2014–16, it mandates 25 percent.²⁴ In 2013, IOUs obtained an average of 23 percent of generating supplies from renewable sources.²⁵ California expects PV power to account for roughly half of total renewable generation by 2020.²⁶

During California's ongoing multiyear drought, hydroelectric generation fell from nearly 43,000 gigawatt-hours (GWh) in 2011 (more than 20 percent of state generation) to 16,000 GWh (about 8 percent) in 2014—with qualifying small hydroelectric facilities generating just over 2,400 GWh.²⁷ The state's geothermal resources typically produce 12,000–13,000 GWh of electricity annually, but such generation is slowing, too, as reservoirs are depleted. Since 2002, generation from biomass facilities, which also produce electricity around the clock, has remained relatively steady, at around 6,000 GWh annually.²⁸

Rising Wind and Solar-Generation Capacity

In contrast with California's declining hydroelectric generation and steady geothermal and biomass generation, its wind and solar generation have expanded rapidly. In 2004, wind and solar facilities accounted for less than 5,000 GWh, or about 2.5 percent, of total electricity. By 2014, wind and solar production had climbed to about 24,000 GWh, or 12 percent of total electricity generation. Wind generation is

Figure 2. California's Rising Wind and Solar Generation and Surging Residential Electricity Prices



now the largest qualifying renewable source under California's RPS mandate. (Solar-power generation, which has soared by more than 1,700 percent since 2004, is likely to surpass wind generation in the next few years.)

Partly to meet such mandates, California's average residential electricity prices have increased significantly (**Figure 2**): the cost of acquiring energy from renewable sources is far higher than the market price of power. Further, because most wind and solar generation is developed in remote locations, California's utilities have constructed hundreds of miles²⁹ of new high-voltage transmission lines, whose costs are passed on to households.³⁰

Despite projections of imminent cost-competitiveness with fossil fuels, renewable generation continues to be considerably more expensive. In 2013, the average cost of new renewable generation acquired by California's three major electric utilities—PG&E, Southern California Edison (SCE), and San Diego Gas & Electric (SDG&E)—was 13.8 cents/kWh, or \$138/MWh, according to the California Public Utility Commission (CPUC).³¹ During 2003–13, overall

average cost of renewable generation acquired by the aforementioned utilities rose by 55 percent, from \$54/MWh to \$84/MWh. In contrast, in 2013, the average wholesale market price of generation was slightly more than \$46/MWh.

The California Independent System Operator (California ISO) estimates that the state's cap-and-trade program accounted for approximately \$6/MWh of the

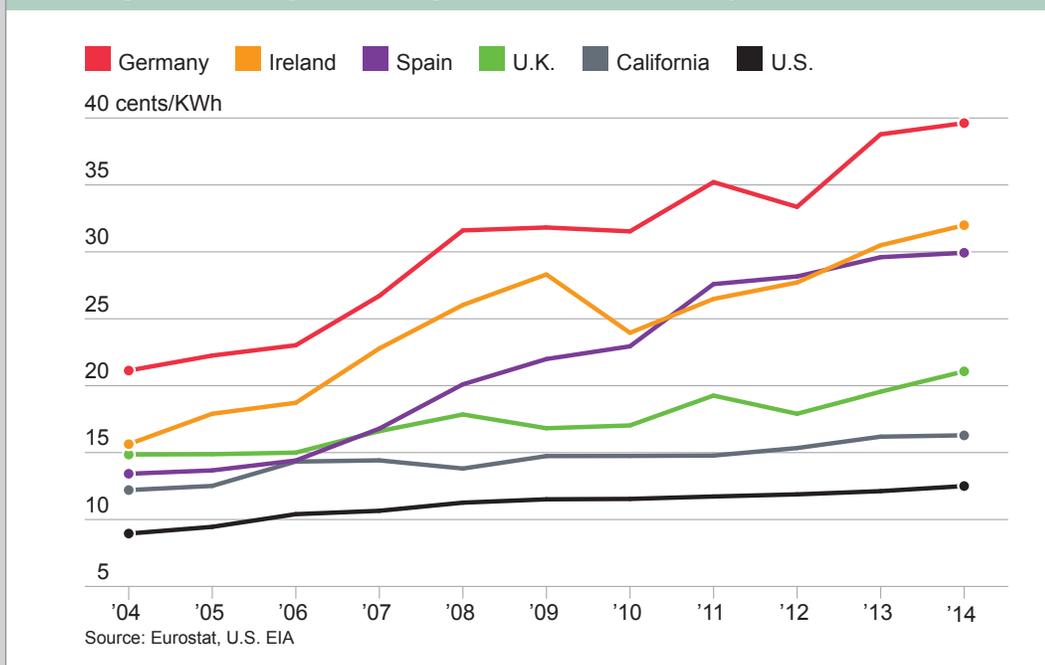
\$46/MWh wholesale market price.³² Given that California's residential electricity consumption (excluding self-generation) equaled roughly 89 million MWh in 2013, cap-and-trade would have raised residential electricity costs by nearly \$540 million.³³ As California's mandated cap-and-trade reductions rise, so, too, will the costs they impose—driven by the purchase of more costly carbon-emitting permits and the switch to carbon-free, higher-cost renewable sources.³⁴

THE EUROPEAN EXPERIENCE

In the three European countries that have most emphasized the development of renewable energy through subsidized production—Spain, Germany, and the U.K.—residential retail electricity prices have soared by 75–120 percent since 2004 (Figure 3). These three countries have responded by scaling back renewable generation and subsidies.³⁵ California, where average residential rates increased by 35 percent during the same period, is instead accelerating its renewable efforts. And while average residential rates for the U.S. as a whole increased by 40 percent during 2004–14, California's rates remain 30 percent higher than the U.S. average.³⁶

Why have U.S. rates risen more slowly than European rates? Competitive wholesale electricity markets and falling natural gas prices—made possible by the rapid increase in supply unleashed by hydraulic fracturing—have played a key role, moderating against the upward pressure on prices created by federal and state renewable subsidies and mandates.

Figure 3. Change in Average Residential Electricity Rates, 2004–14



II. CALIFORNIA'S ELECTRICITY PRICING

California's electricity rates are designed to encourage residents to reduce electricity usage. Rates are disaggregated by season: one for winter (November–April); and the other for summer (May–October). Because electricity demand is higher during warm weather, the state's summer electricity rates are also higher.

California's residential rates separate monthly consumption into tiers. The first tier, "baseline consumption," is disaggregated by region. **Figure 4** illustrates PG&E's baseline consumption service territory. Region S spans the Central Valley, from Chico to Modesto, with the daily summer baseline 13.8 kWh and daily winter baseline 11.2 kWh.³⁷ Coastal regions Q and T, which include San Francisco, have a daily summer baseline of 7.0 kWh.

The state's current rate structure was developed in response to California's 2000–01 energy crisis—produced, in turn, by California's poorly designed electricity market, which encouraged generators to withhold power and raise wholesale prices.³⁸ As a January 2014 CPUC report states: "[California's] current tiered rate structure imposes a heavy burden on those customers who use substantial amounts of electricity in the high-cost upper tier rates while simultaneously subsidizing the cost of electricity to low-consumption customers. These distortions are the unintended consequence of the legislative response to the energy crisis, which subsequent legislative reforms were unable to fully address."³⁹

In 2014, the average, undiscounted⁴⁰ residential retail electricity rate for California's three major IOUs ranged from 18 to 21 cents/kWh (**Figure 5**); the average U.S. rate was 12 cents/kWh. During 2004–14, residential rates for PG&E and SCE increased 50 percent and 80 percent, respectively, while rates for SDG&E increased modestly. (However, SDG&E's average residential rate in 2004 was higher than PG&E's average residential rate in 2014. Historically, too, SDG&E's rates have been the highest of the three major IOUs.) During 2004–14, the gap between average residential rates of California's

Figure 4. PG&E Service Territory and Baseline Consumption



Source: http://www.cpuc.ca.gov/PUC/energy/Electric+Rates/Baseline/pg_e_baseline.htm

major IOUs and average U.S. residential rates also widened. As noted, rate increases in California (and across the U.S.) have been moderated by less costly natural gas, which provides over half the state's electricity generation.⁴¹

While tiered pricing discourages electricity consumption, efforts to alleviate the distortions described by CPUC have produced still more distortions. Under the California Alternative Rates for Energy (CARE) program, low-income consumers⁴² pay heavily subsidized rates (30–35 percent below standard rates, on average). In 2012, nearly 3 million California households qualified for more than \$1.2 billion in CARE subsidies, a sum paid for by other utility customers.⁴³ In 2014, nearly 30 percent of PG&E's, SDG&E's, and SCE's residential customers received CARE subsidies.⁴⁴ Yet CARE,

as discussed in Section III, has not eliminated energy poverty because tiered rates remain high, especially during the summer.

In April 2015, CPUC issued a directive that would collapse the current four-tier structure to two tiers by 2018: under the plan, first-tier rates will increase substantially and second-tier rates will be 20 percent higher than first-tier rates.⁴⁵ Though this revised structure will eliminate the highest electricity rates (which can exceed 40 cents/kWh in the summer), it will also significantly increase low-consumption consumers' total electricity costs.⁴⁶

In a competitive wholesale electricity market, such as that overseen by the California Independent System Operator (CAISO), the marginal hourly cost of electricity is reflected in the wholesale hourly market price. Not only does the latter price incorporate the marginal cost of the least efficient electricity-generating source; it also reflects constraints on the high-voltage transmission system—constraints that can cause prices to rise.⁴⁷ The rise of “smart” electricity meters—which track residential consumption in real time, allowing consumers to be charged based on daily consumption patterns, not total consumption—encourages more efficient pricing.⁴⁸

An efficient retail tariff for full-service customers (those whose local utility also sells electricity) would mimic marginal costs as closely as possible to better reflect the opportunity cost of additional consumption. Current tariffs instead typically reflect a hodgepodge of compromises. For example, while California's three main IOUs collect distribution charges per-kWh consumed, most distribution-related costs, such as maintaining poles, wires, and substations, do not depend on individual house-

holds' electricity consumption.⁴⁹

Because of customer opposition to large minimum bills, the most common rate-design compromise involves reducing the amount of fixed, ready-to-serve charges (minimum bills) and recovering such charges on a volumetric basis in per-kWh rates—despite the fact that a household's consumption does not affect the cost of reading its meter or mailing its bill. PG&E's residential tariff, for instance, specifies a daily minimum bill of about 12 cents, or just \$3.60 per month⁵⁰—a figure well below the true cost of providing, or standing ready to provide, electricity service to households.

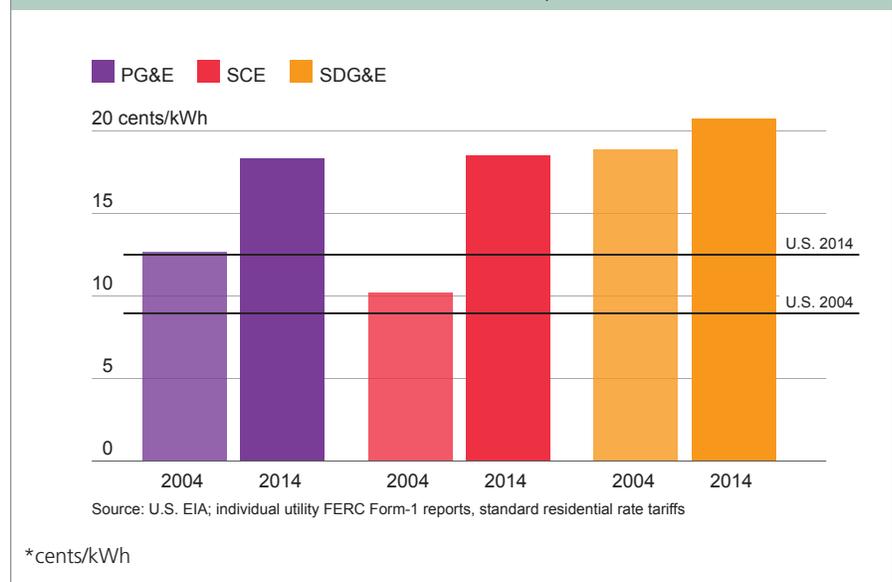
III. CALIFORNIA'S ENERGY POVERTY

California's green-energy policies—which encourage renewables and discourage consumption—raise the marginal cost of electricity. Section III uses U.S. census data on household incomes, utility expenditures, and poverty rates to examine how the state's energy policies affect low-income households.

Access Versus Affordability

Measures of global energy poverty typically focus on access to energy, not the price of energy.

Figure 5. Average Residential Electricity Rates, U.S. and California's Major IOUs*



The International Energy Association's 2012 *World Energy Outlook*, for example, offers an energy-development index for 80 developing nations based on four components: share of population with access to electricity and per-capita residential electricity consumption; share of modern (fossil/renewable) fuels in the residential sector; per-capita electricity consumption for public services; and share of energy used in total consumption.⁵¹

Why exclude the price of electricity? For consumers in developing countries with no access to energy infrastructure (or who cannot afford their own infrastructure, such as PV power), the price of electricity—an indicator of how affordable energy is—means little.⁵² On the other hand, in the U.S. and other wealthy nations, energy supplies are available everywhere and have been so for decades.⁵³ Likewise, America's petroleum refining and distribution infrastructure ensures that all Americans have access to gasoline supplies; though Americans' access to natural gas is not universal (distribution infrastructure is uneconomical in certain rural areas), substitutes for natural gas (propane, butane, etc.) are universally available.

Methodology

Section III's primary data source is the 2012 American Community Survey (ACS) Public Use Microdata file, available from the University of Minnesota's Minnesota Population Center. The ACS is an annual Census Bureau survey of about 3 million addresses. In 2012, its national response rate was 65.7 percent. The ACS is an especially useful data source: its large sample size allows for statistically significant estimates at state and county levels; and it includes detailed questions on electricity spending, gas, and heating costs.

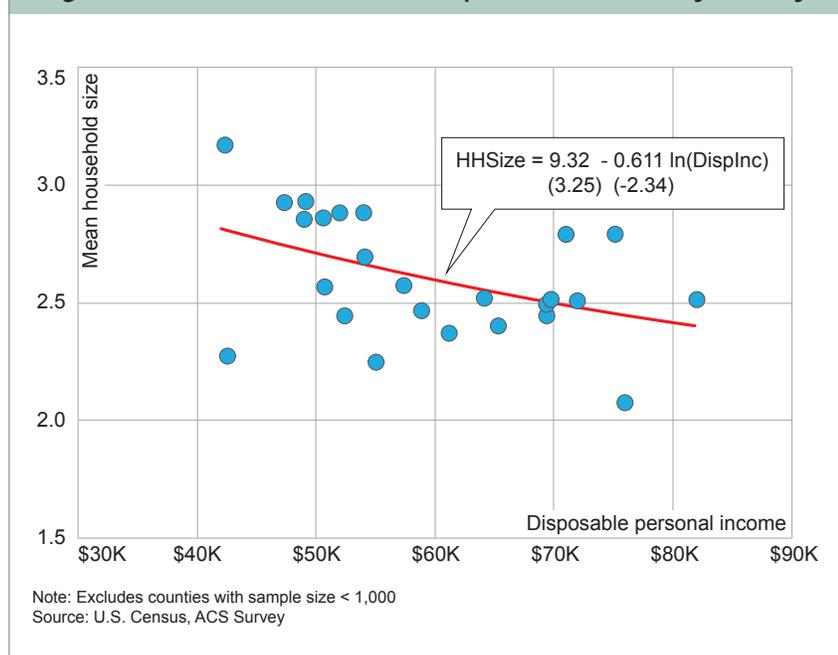
The ACS identifies 33 of California's 58 counties, or about 94 percent of the state's popula-

tion. To develop more useful estimates of household income and utility spending, this paper excludes households reporting negative incomes, households where utility costs were included in monthly rents, and households reporting no spending on basic utilities (electricity, gas, water, etc.).

This paper defines disposable income as total household income minus current taxes. Because the ACS does not provide complete data on taxes paid, this paper uses the Minnesota Population Center's 2012 Current Population Survey (CPS) March Supplement, which covers a smaller number of households (nearly 100,000) and 29 California counties. Because individual-level CPS data allow computation of household taxes paid, the paper considers state and federal taxes, Social Security taxes, property taxes, Earned Income Tax Credit, Child Tax Credit, and food stamps. And because CPS and ACS disposable-income estimates vary, the paper estimates ACS-equivalent household disposable income based on the relationship between CPS total-household income and disposable-household income.

For example, in 2012, mean household income in Napa County was \$93,604, according to ACS

Figure 6. Household Size vs. Disposable Income, by County



estimates, and \$88,408, according to CPS estimates. In 2012, mean disposable household income was \$69,404, according to the CPS, or about 78.5 percent of household income. CPS-equivalent disposable household income would thus be \$73,483 (78.5 percent multiplied by \$93,604). Finally, household poverty rates—drawn from five-year ACS data (2008–12) published on the Census Bureau’s American Factfinder website—were available for all of California’s 58 counties.

Analysis

This paper first examines the relationship between mean household size and mean household disposable income (**Figure 6**): counties with the highest average household incomes, typically in the coastal regions (**Figure 7**), tend to be those with the lowest average household size.

The paper then evaluates the percentage of households in counties where electricity and natural gas expenditures exceed 10 percent of household income; and the percentage of households in counties where electricity spending alone exceeds 10 percent of household income.⁵⁴ The paper uses

total household income, not disposable household income, to calculate energy poverty because the former, a more conservative metric, will, if anything, underestimate energy-poverty rates; because county-level data on disposable household income is less comprehensive than county-level total household income data; and because the disposable-income survey’s small size means higher standard errors of the mean values and, thus, less accurate estimates at the county level.

Merced County, northwest of Fresno in the Central Valley, has California’s highest electricity poverty rate: 11.2 percent of households (about 82,000) spend more than 10 percent of total income on electricity (**Figure 8**). In Tulare County, southeast of Fresno, 15 percent of households (about 140,000) spend more than 10 percent of total income on electricity and natural gas. (Such figures account for the lower rates paid by low-income households under CARE.)

Figure 9 reveals the California counties with the five highest and five lowest rates of electricity poverty. In 2012, nearly 650,000 California households, or 4.9 percent of the state’s households, spent 10 percent or more of total income on electricity; when households’ natural gas expenditures are included in calculations, nearly 1 million households, or 7.4 percent of the state’s households, experienced energy poverty (**Figure 10**). Counties in California’s Central Valley—and those that border it, such as Shasta County—have the highest rates of energy poverty. California’s coastal counties, especially those in the San Francisco–Silicon Valley corridor, have the lowest rates of energy poverty.

Figure 11 compares average residential electricity bills in seven California cities in June–August 2013. In San Francisco, Mill Valley, and San Clemente—located in some of California’s wealthiest counties—electricity bills were lowest. In Hanford, Porterville, and Madera—located in some of California’s poorest counties—electricity bills were highest. In San Francisco, the average household electricity bill totaled \$136; in Hanford (located in the Central Valley, south of Fresno), the average bill was \$534,

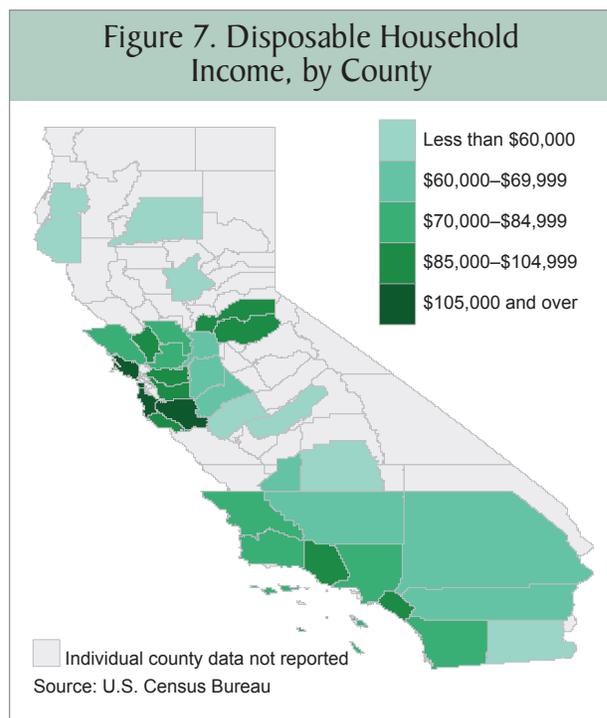
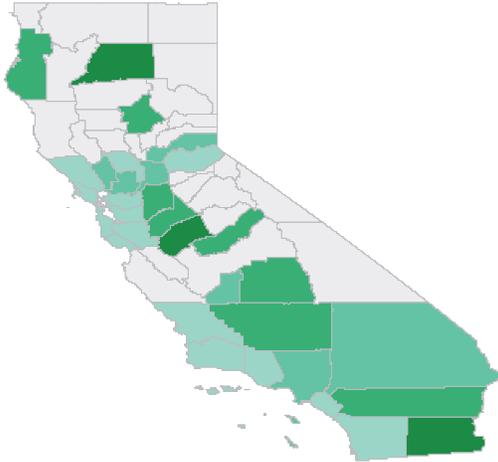


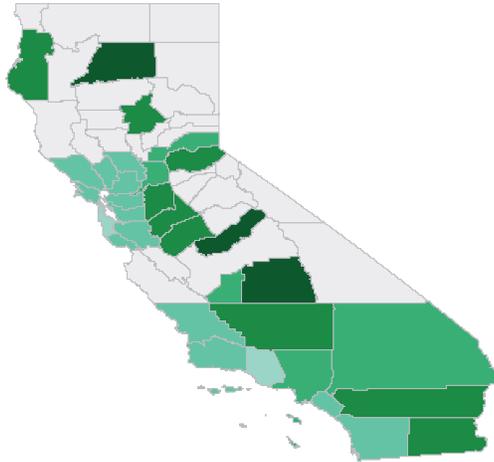
Figure 8. Percentage of Households Spending More than 10 Percent of Income on Electricity and Natural Gas, by County



Electricity only



Electricity and Natural Gas



Individual county data not reported
Source: U.S. Census and author calculations

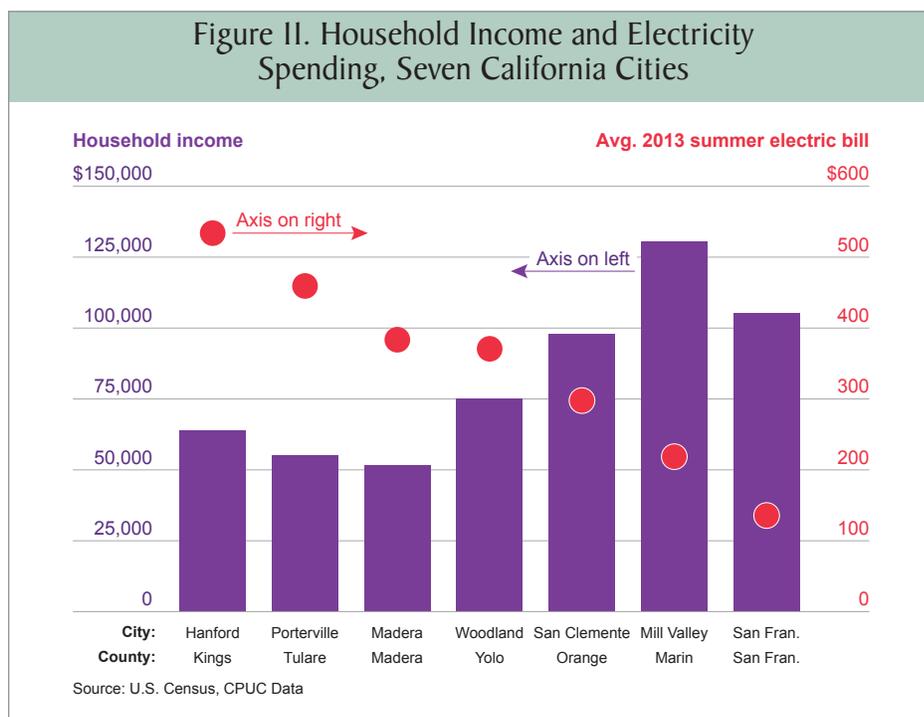
Figure 9. Electricity Poverty in California

Rank	County	Households	Percentage of Households
<u>Counties with Highest Rates of Electricity Poverty</u>			
1	Merced County	9,195	11.2%
2	Imperial County	6,443	10.8%
3	Shasta County	7,252	10.3%
4	Madera County	4,651	9.7%
5	San Joaquin County	21,204	9.1%
<u>Counties with Lowest Rates of Electricity Poverty</u>			
1	Santa Cruz County	2,758	2.1%
2	Ventura County	7,467	2.4%
3	San Mateo County	5,513	2.5%
4	San Francisco County	5,798	2.5%
5	Santa Barbara County	1,817	2.7%
State of California		649,149	4.9%

Figure 10. Energy Poverty in California

Rank	County	Households	Percentage of Households
<u>Counties with Highest Rates of Electricity Poverty</u>			
1	Tulare County	21,052	15.0%
2	Madera County	7,176	14.9%
3	Shasta County	10,397	14.7%
4	Stanislaus County	24,172	14.0%
5	Imperial County	8,095	13.6%
<u>Counties with Lowest Rates of Electricity Poverty</u>			
1	San Francisco County	2,758	3.6%
2	San Mateo County	7,467	3.8%
3	Ventura County	5,513	3.9%
4	Santa Clara County	5,798	4.2%
5	San Diego County	1,817	4.2%
State of California		982,866	7.4%

Figure II. Household Income and Electricity Spending, Seven California Cities



nearly four times larger. Meanwhile, Hanford’s average household income was about \$64,000; and San Francisco’s, more than \$105,000.

California’s rate of energy poverty has likely risen since 2012 for the following reasons. First, standard residential electricity rates for the state’s three major IOUs have continued to increase: during 2012–14, PG&E’s rose by more than 18 percent, SDG&E’s by more than 5 percent, and SCE’s by nearly 2 percent. Second, during 2012–14, average natural gas prices for residential natural gas consumers increased by more than 26 percent.⁵⁵ Third, wholesale electricity prices have increased because of higher delivered natural gas prices and reduced hydroelectric production—the result of California’s ongoing drought. And fourth, the drought has reduced agricultural employment, output, and incomes in inland counties, exacerbating the impact of the state’s high energy prices.

CONCLUSION

As the Golden State continues its pursuit of a low-carbon economy, its green-energy policies are driving rising numbers of Californians into energy poverty.

In 2012, nearly 1 million households spent more than 10 percent of their income on energy bills. In hotter, less affluent inland counties, the rate of energy poverty was as high as 15 percent of households. Absent significant policy reform, the state’s rate of energy poverty seems destined to rise higher.⁵⁶ To alleviate current inequities, California legislators should:

- 1. Conduct a Cost-Benefit Review.** Commission a comprehensive, impartial cost-benefit analysis of the state’s energy policies. Do the benefits of California’s proposed GHG reductions—which, even if realized, will negligibly affect global emissions and climate—outweigh their considerable and rising cost to local businesses and households, particularly low-income Californians?
- 2. Make the State’s Tariff Structure More Fair.** Impose a greater share of the burden of renewable mandates on wealthier households and avoid over-allocating fixed-utility costs to lower-income households, which are least likely to participate in California’s subsidized rooftop solar PV programs.

ENDNOTES

1. California Senate Bill 2 (2011), http://www.leginfo.ca.gov/pub/11-12/bill/sen/sb_0001-0050/sbx1_2_bill_20110412_chaptered.pdf.
2. California Air Resources Board, staff report, "California 1990 Greenhouse Gas Emissions Level and 2020 Emissions Limit," November 16, 2007, http://www.arb.ca.gov/cc/inventory/pubs/reports/staff_report_1990_level.pdf.
3. Executive Order B-30-15, April 29, 2015. Total emissions in 2012, the latest year for which data are available, were 459 MMTCO₂e, http://www.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_scopingplan_00-12_2014-03-24.pdf.
4. This paper does not discuss the state's stringent motor-fuel requirements, even though such rules have made California gasoline among America's most expensive.
5. For example, in November 2014, Southern California Edison, which serves greater Los Angeles, announced an 8 percent rate increase. See S. Roth, "Southern California Edison Hikes Electricity Rates," *Desert Sun*, November 10, 2014, <http://www.desertsun.com/story/tech/science/energy/2014/08/01/southern-california-edison-hikes-rates/13494153>.
6. California Energy Commission, 2013 Integrated Energy Policy Report, p. 1, <http://www.energy.ca.gov/2013publications/CEC-100-2013-001/CEC-100-2013-001-CMF-small.pdf>.
7. See <http://www.gosolarcalifornia.ca.gov/about/csi.php>.
8. Under cap-and-trade, electric utilities are allocated a predetermined number of emissions "allowances" at zero cost. For a discussion of allowance allocations to electric utilities, natural gas companies, and other industrial entities, see <http://www.arb.ca.gov/cc/capandtrade/allowanceallocation/allowanceallocation.htm>.
9. See "States with In-State Resource RPS Requirements," North Carolina Clean Energy Technology Center, November 12, 2014, <http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2015/01/2014-Daniel-In-State-RPS-Requirements.pdf>.
10. *Ibid.* Requirements vary, including the resources that qualify as "renewable."
11. See <http://www.energyalmanac.ca.gov/renewables/hydro>. Detailed data on individual hydroelectric plants are published by the U.S. Energy Information Administration, <http://www.eia.gov/electricity/data/eia860/xls/eia8602013.zip>.
12. Such energy resources are called "firm"; wind and solar energy are termed "intermittent" because they are available only when the wind blows and the sun shines.
13. Pub. L. 95-617, 92 Stat. 3117 (1978).
14. Pub. L. 102-486, 106 Stat. 2866 (1992).
15. See F. Graves, P. Hanser, and G. Basheda, "PURPA: Making the Sequel Better than the Original," Edison Electric Institute, December 2006, <http://www.eei.org/whatwedo/PublicPolicyAdvocacy/StateRegulation/Documents/purpa.pdf>.
16. Pub. L. 95-618, 92 Stat. 3174 (1978).
17. This term is used by the Federal Energy Regulatory Commission. See *Revised Regulations Governing Small Power Production and Cogeneration Facilities*, Order No. 671, FERC Stats. & Regs. ¶ 31,203, *clarified*, 114 FERC ¶ 61,128, *order on reh'g*, Order No. 671-A, FERC Stats. & Regs. ¶ 31,219 (2006).
18. Graves et al., p. 17.
19. Larger plants, such as California's major storage dams, do not qualify as renewable generation under the RPS.
20. A feed-in tariff (similar, in many respects, to contracts signed under PURPA) is a set of annual prices—determined administratively or by auction—at which a utility agrees to pay for renewable generation. See Jonathan Lesser and Xuejuan Xu, "Design of an Economically Efficient Feed-In Tariff Structure for Renewable Energy Development," *Energy Policy* 36 (2008): 981–90.
21. The executive order was codified in 2011 with the signing of SB 2 by Governor Brown.
22. For a map of individual state RPS requirements, see "How Renewable Electricity Standards Deliver Economic Benefits," May 2013, http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean_energy/Renewable-Electricity-Standards-Deliver-Economic-Benefits.pdf. On p. 2, the map shows Maine's 40 percent RPS (2017) and Alaska's 50 percent RPS (2025). Maine mandates only 10 percent of renewables from (mostly wind) resources constructed since 2005, relying instead on hydropower from in-state facilities and imports from Quebec. Alaska's RPS is merely aspirational.
23. A. Nougerny, "Gov. Jerry Brown Begins Last Term with a Bold Energy Plan," *New York Times*, January 5, 2015, <http://www.nytimes.com/2015/01/06/us/california-governor-focuses-on-energy-consumption-as-final-term-begins.html?smid=nytcore-ipad-share&smprod=nytcore-ipad&r=0>.
24. California has a "hybrid" electricity market, in which some retail customers can purchase electricity directly from nonutility-generation providers.

25. See California Public Utilities Commission (CPUC), “Renewables Portfolio Standard Quarterly Report: 2nd Quarter 2014,” October 2014, <http://www.cpuc.ca.gov/NR/rdonlyres/64D1619C-1CA5-4DD9-9D90-5FD76A03E2B8/0/2014Q2RPSReportFINAL.pdf>. LADWP, the largest POU, obtained 23 percent of its generation from qualifying renewables, while 42 percent of its generation came from two coal-fired plants outside California: Arizona’s Navajo Generating Station, of which LADWP owns a 21 percent share; and Utah’s Intermountain Power Project, which LADWP entirely owns and operates. LADWP intends to sell its share in the former by the end of 2015 and convert the latter to natural gas by 2025. LADWP projects that its recommended generating resource strategy will increase average generation-related costs by 50 percent between 2014 and 2023. See LADWP, “2014 Power Integrated Resource Plan,” pp. ES-33–ES-34, 166–67, https://www.ladwp.com/cs/idcplg?IdcService=GET_FILE&dDocName=OPLADWPCCB419127&revisionSelectionMethod=LatestReleased.
26. CPUC, “Renewables Portfolio Standard Quarterly Report: 1st Quarter 2014,” June 2014, <http://www.cpuc.ca.gov/NR/rdonlyres/93E7E363-75A6-40C8-997D-705C53A2713D/0/2014Q1RPSReportFINAL.pdf>. A separate utility ratepayer-funded program, California Solar Initiative (CSI), began in 2007. Projected to cost more than \$3 billion, CSI is designed to produce 1,000 MW of new PV capacity by 2017. As of first-quarter 2014, the program had installed just over 2,100 MW of PV through net metering programs. Projections of CSI’s annual ratepayer impact range from \$370 million to \$1 billion annually. See “California Net Energy Metering Ratepayer Impacts Evaluation,” CPUC Energy Division and Energy and Environmental Consultants, October 28, 2013 (NEM Evaluation), <http://www.cpuc.ca.gov/NR/rdonlyres/75573B69-D5C8-45D3-BE22-3074EAB16D87/0/NEMReport.pdf>.
27. California Energy Almanac, <http://www.energyalmanac.ca.gov/renewables/hydro/index.php>.
28. *Ibid.*
29. For example, in 2012, San Diego Gas and Electric completed the Sunrise Power Link, a 117-mile, \$2 billion high-voltage transmission line, transmitting wind and solar power generated in Imperial Valley to San Diego. In September 2014, the state released the Draft Desert Renewable Energy Conservation Plan, designed to provide a comprehensive plan to construct utility-scale wind- and solar-generating plants—and the high-voltage transmission lines to deliver the electricity—across 22.5 million acres of Southern California desert. See <http://www.drecp.org/draftdrecp>.
30. For example, a 2009 study prepared for the California Public Utilities Commission estimated the infrastructure cost of meeting the 33 percent RPS mandate at \$115 billion. See <http://www.cpuc.ca.gov/NR/rdonlyres/B123F7A9-17BD-461E-AC34-973B906CAE8E/0/ExecutiveSummary33PercentRPSImplementationAnalysis.pdf>.
31. CPUC, 2013 Electric and Gas Utility Cost Report: Public Utilities Code Section 747 Report to the Governor and the Legislature, April 2014, p. 22, <http://www.cpuc.ca.gov/NR/rdonlyres/E1804568-DF65-48A4-A00B-EB6D9AF63E4D/0/AB67CostReport2014.pdf>.
32. Residential electricity consumption data source: U.S. EIA, Electric Power Monthly.
33. This estimate assumes that the average residential customer’s rates are affected on a one-for-one basis by changes in the wholesale market price; this assumption will not be true in a year when residential tariffs are not adjusted, but it will be true in the long run (ignoring small changes in consumption because of price elasticity of demand).
34. This forecast does not include the impact of higher electricity costs on businesses that are passed on to residential consumers, in the form of higher prices for goods and services. Such an analysis—beyond this paper’s scope—would require a dynamic model of California’s economy.
35. S. Lynch, “EU Energy Subsidies to Be Significantly Scaled Back,” *Irish Times*, January 17, 2014, http://www.eia.gov/electricity/sales_revenue_price/pdf/table4.pdf.
36. *Ibid.*
37. For “all-electricity” customers, who use electricity for space and water heating, the summer and winter quantities are 16.4 kWh/day and 27.1 kWh/day, respectively.
38. See, e.g., Peter Navarro and Michael Shames, “Electricity Deregulation: Lessons Learned from California,” *Energy Law Journal* 24, no. 1 (spring 2003): 33–64.
39. See “Energy Division Staff Proposal on Residential Rate Reform: Staff Proposal for Residential Rate Reform in Compliance with R.12-06-013 and Assembly Bill 327,” January 3, 2014. This report addresses potential changes to the current tariff structure, including a recommendation to implement a two-tier structure, http://www.cpuc.ca.gov/NR/rdonlyres/66CCE840-F464-42F5-8B6A-D9F0FC649F67/0/Integrated_ResidentialRateReform.pdf.
40. Utility rates reflect standard residential tariffs for full service, rather than special time-of-use rates, California Alternative Rates for Energy (CARE) discounted rates, or rates for direct-access customers who purchase electricity directly from retail suppliers.
41. In 2008, for example, the average price of natural gas used by electricity generators was over \$8 million Btus (MMBtu). In 2014, the price was just over \$5/MMBtu, a decrease of almost 40 percent.

42. See <http://www.cpuc.ca.gov/PUC/energy/Low+Income/care.htm>.
43. See "Energy Division Staff Proposal on Residential Rate Reform," pp. 83–84, tables 6-1 and 6-2.
44. 2014 individual utility FERC Form-1 reports.
45. See <http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=151305677>.
The CPUC directive, which also discusses imposing an "energy burden" analysis to assess the proposed changes, acknowledges a key issue: "Generally, the average energy burdens for non-CARE customers in cool and moderate climate zones remain under 5%. Customers with the highest usage continue to have the highest energy burdens. However, the energy burden data provided by PG&E may not be reliable given that some of the sample sizes are as small as six customers. There are other affordability metrics in the evidentiary record that demonstrate [that] reducing rates for high tier customers will reduce some energy burdens."
46. In addition to CARE, California's Family Electric Rate Assistance (FERA) is another program targeted at large, low-income households.
47. These prices are called "locational market prices" (LMP) and include the basis marginal generation cost, transmission costs, and transmission losses.
48. Historically, most large commercial and industrial customers have used some form of time-of-use meters—with such customers typically billed based on monthly total consumption and peak electricity demand.
49. Aggregate consumption, of course, affects the cost of distribution, as well as transmission: as electricity demand rises, distribution and transmission capacity must meet demand. This results in "lumpy" capacity additions because capacity cannot be added in 1-kilowatt increments. See Jonathan Lesser and Charles Feinstein, "Defining Distributed Utility Planning," *Energy Journal*, Special Issue, "Distributed Resources: Toward a New Paradigm" (1998): 41–62.
50. See http://www.pge.com/tariffs/tm2/pdf/ELEC_SCHEDS_E-1.pdf.
51. The energy-development index (EDI) for each country ranges between zero and one. OECD/IEA, *World Energy Outlook*, 2012, pp. 541–45, <http://www.worldenergyoutlook.org>. For a discussion of how the individual components of the WEO EDI index is developed, see http://www.worldenergyoutlook.org/media/weowebiste/energymodel/documentation/EnergyAccess_Methodology_2012_FINAL.pdf.
52. Stated differently, if an energy resource is physically unavailable, the marginal price equals the cost to obtain physical access plus the marginal cost of the energy commodity itself.
53. Before the passage of the 1936 Rural Electrification Act—designed to make electricity available at affordable rates to all Americans—many rural U.S. communities lacked access to electricity.
54. This paper conservatively eliminated all households that reported electricity or electricity-plus-natural gas expenditures greater than reported household income. Such households may be experiencing energy poverty or may, instead, reflect retirees living on savings. Further, as with all survey-based data sets, it is likely that there are misreported income and electricity–natural gas expenditures. Excluding such households biases the paper's energy-poverty findings downward. (Though transportation fuel is another important energy expenditure, especially in rural counties, census data do not track it.)
55. It is true that technological progress will likely continue reducing the price of electricity produced by PV power. Yet with the largest wind turbines already towering more than 400 feet, the economies of scale for wind generation appear close to exhaustion; as the best sites for wind and solar development (the windiest, sunniest spots) become occupied; and as local electricity distribution systems are redesigned as (mostly wealthier) houses install more rooftop solar panels, the cost of wind- and solar-generated electricity will climb, with poor households shouldering a disproportionate burden of utilities' fixed transmission and distribution costs. EIA, Natural Gas Monthly, http://www.eia.gov/dnav/ng/ng_pri_sum_dcu_sca_a.htm.
56. In addition to the new infrastructure requirements to connect wind and solar facilities, wind and solar generation are incurably intermittent and require backup generation. The more the state relies on wind and solar power, the more backup generation is required, adding to residents' electricity bills and potentially reducing the overall reliability of California's electricity infrastructure.

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