Reverse Robin Hood: Clean Energy Policy Impacts on Energy Equity and Grid Reliability in California

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Good Energy Collective

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Introduction

With over 160 different policies and incentives that seek to hasten the transition to a zero-emissions economy, California has positioned itself as the national frontrunner in its willingness to experiment with new sustainable legislation.[1] As a result, California's policies often serve as models or templates for other states. The recent electric vehicle mandate that requires retailers in California to end the sale of internal combustion engine cars by 2035 is likely to be implemented in Washington, Massachusetts, and Virginia.[2] An additional 13 states and Washington, D.C. have adopted various policies that tie into California's zero-emission vehicle legislation, meaning that new clean energy laws in the state reverberate far beyond California's borders.[3]

Progress on emissions reduction is critical to avoid the worst impacts of climate change, and the global community cannot afford to wait longer to abandon fossil fuels. Aggressive policies are necessary: UN Climate Change has shown that current efforts will fail to limit global temperature rise to 1.5 degrees Celsius this century.[4] We're running out of time, and looking to California can help guide the rest of the country toward a more sustainable economy.

Yet poorly designed policies in electricity markets can have unintended consequences, harming the reliability of energy systems or sacrificing environmental justice. As shared by A. P. Ravikumar et al. in a recent Nature Energy comment on equitable transitions, "the degree to which technological change exacerbates or reduces prevailing inequities and prevents or leads to new injustices will depend on the social and civic structures that govern technology design."[5] In several instances, the design of California's energy policies and their governing structures has led to inequitable impacts, often exacerbating inequality in the state.

A comprehensive analysis of the totality of impacts of all clean energy policies in California is beyond the scope of this study. This report surveys existing clean energy policies in California and evaluates their impacts on equity and reliability.

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[1] "Database of State Incentives for Renewables & Efficiency®."
[2] Weisbrod, "California Just Banned Gas-Powered Cars. Here's Everything You Need to Know"; "California Moves to Accelerate to 100% New Zero-Emission Vehicle Sales by 2035 | California Air Resources Board."
[3] Weisbrod, "California Just Banned Gas-Powered Cars. Here's Everything You Need to Know."
[4] "Climate Plans Remain Insufficient: More Ambitious Action Needed Now | UNFCCC."
[5] Ravikumar et al., "Enabling an Equitable Energy Transition through Inclusive Research."

Context: California's Grid

Pursuing a clean economy, California has met with both success and failure across its energy policy portfolio. Often, a large economy is correlated with immense environmental impact, but this hasn't been the case in California. Two related phenomena have taken place in the state over the past few decades, which suggest that its cocktail of policies has successfully shifted momentum away from fossil fuels. First, California has flattened its per-capita electricity usage since 1975, even as electricity use across the U.S. continued to climb. This effect (often referred to as the Rosenfeld Effect) is often attributed to energy efficiency policies advocated by Berkeley Lab physicist Art Rosenfeld.[6] Furthermore, California has become one of the first Western economies to decouple economic growth from emissions, partly due to policies like cap-and-trade. In the last two decades, emissions declined as GDP increased.[7] This is almost unheard of — per-capita GDP growth is almost always positively correlated with per-capita emissions.

[6] Rosenfeld and Poskanzer, "A Graph Is Worth a Thousand Gigawatt-Hours"; juliechao, "Art Rosenfeld, California's Godfather of Energy Efficiency, Dies at 90 - Berkeley Lab."

[7] California Air Resources Board, "California Greenhouse Gas Emissions for 2000 to 2019 Trends of Emissions and Other Indicators."

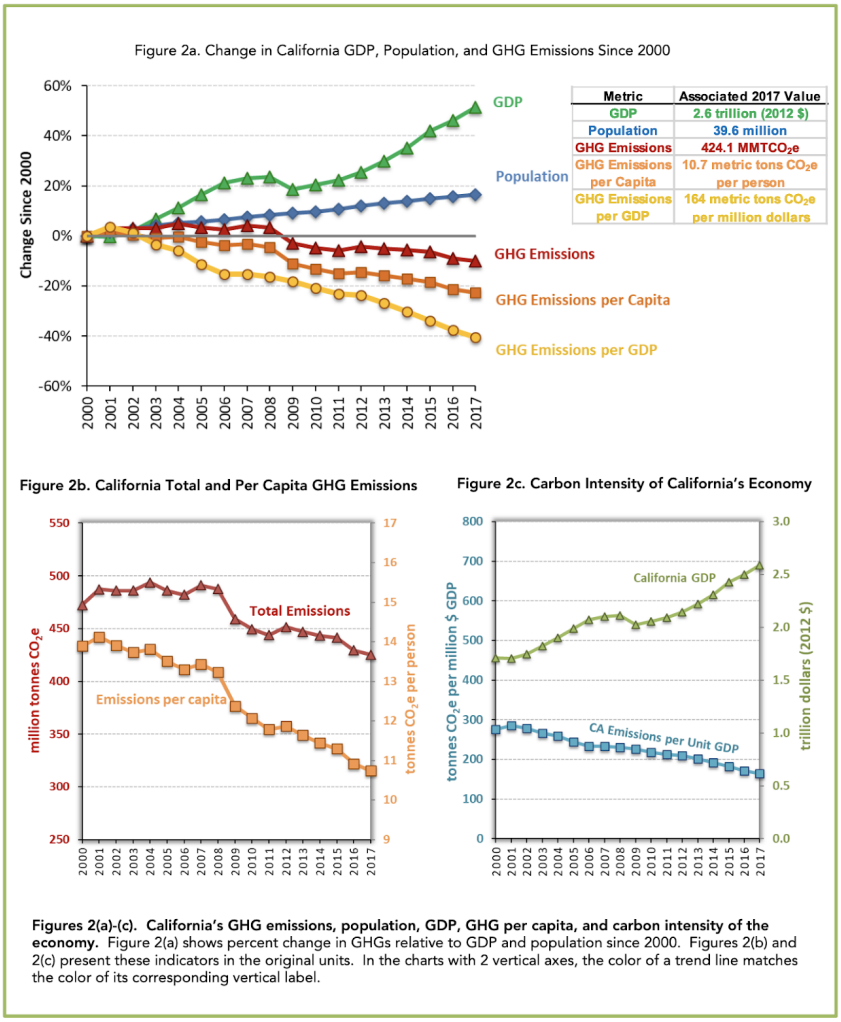

Figure 1: Cap-and-Trade Statistics in California—source: CARB.

However, the last two decades have highlighted systemic issues with how Californian regulators and utilities regulate, price, and provide electricity. Californians pay some of the highest electricity prices in the nation, and at the same time, severe lapses in grid safety have sparked wildfires.[8] This context is critical to understand how state regulators and utilities' clean energy policy decision-making continues to worsen energy insecurity in the state.

Since deregulation in the late 1990s, Californian consumers have consistently faced among the highest rates for electricity.[9] Figure 1 shows this trend — even accounting for low-income rates for residents, the three main utilities (Pacific Gas and Electric (PG&E), Southern California

[8] Blunt, *California Burning*.
[9] Severin Borenstein, Meredith Fowlie, and James Sallee, "Designing Electricity Rates for An Equitable Energy Transition."

Edison (SCE), and San Diego Gas and Electric (SDG&E)) have had rates above the 75th percentile in the country for at least 20 years.

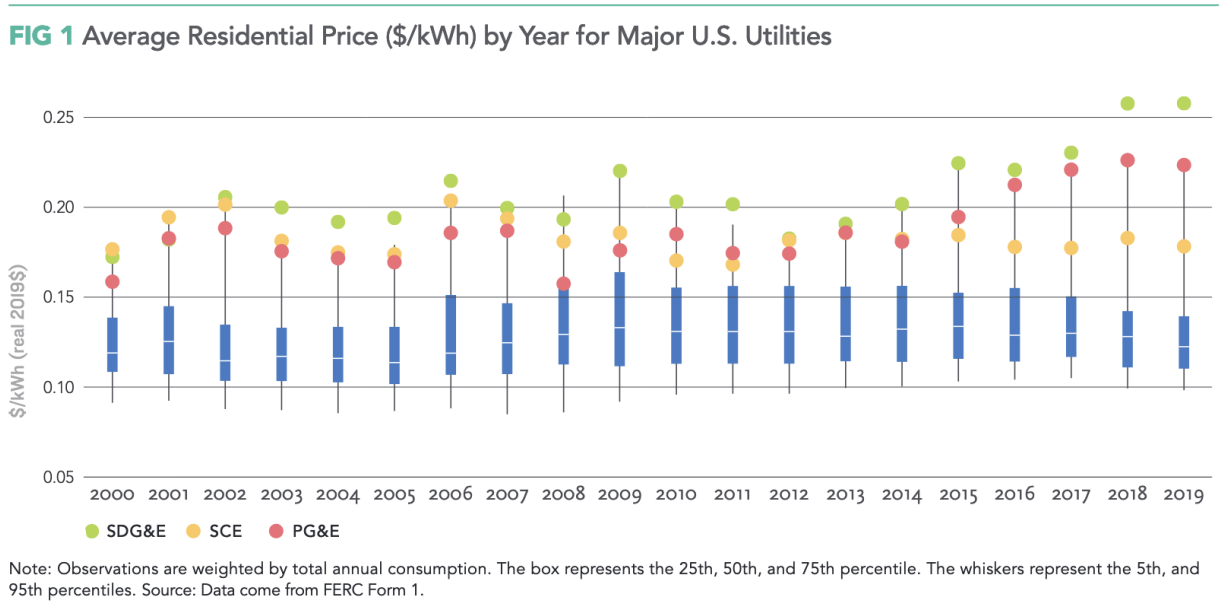

Figure 2: Average Residential Electricity Price Across the U.S., Inclusive of Low-Income Rates. Source: Next10.[10]

Inefficient policy design is a key contributor to California's incredibly high electricity prices. This starts at the root of the market: Deregulation creates a single clearing price for electricity based on which generation source can provide the cheapest electricity at a given time. In theory, this should lead to a more efficient grid, yet a lack of recognition of the benefits and drawbacks of different technologies has eroded reliability and led to increased volatility in prices.[11]

Californians also pay more for electricity than would be expected as a result of a premium on carbon alone. An ideal economic policy will attempt to "internalize" the externalities of producing a product, raising the price a consumer pays to account for the negative impacts that good may create. The price of a good with factored-in externalities is often referred to as the social marginal cost (SMC), implying that society often pays for consequences or benefits that are not reflected in the sale of the good. For instance, a tax may be levied upon a kilowatt-hour of electricity to account for carbon dioxide emissions because CO2 emissions worsen climate change. Such a carbon tax is meant to increase the price of a good to match both the cost to producers and society. The prices paid by households may be efficient if they only raise the costs to account for the externalities created by producing that unit of electricity.

[10] Severin Borenstein, Meredith Fowlie, and James Sallee.
[11] "The California Energy Problem Is Structural, Not Political."

There is evidence that the high prices on the California grid are consistently higher than the SMC of electricity production.[12] This indicates that implemented policies managing California's deregulated grid are likely inefficient and regressive, burdening families with unnecessarily high energy costs compared to the rest of the country. To make matters worse, focusing on the economic externality internalization also clouds the impacts that prices have on equity. Small taxes on electricity may have a negligible impact on high-income families but could make a world of difference for families living paycheck to paycheck.

The critical paradox of equitable clean energy pricing is that high electricity costs are borne by those who can afford them the least. Market mechanisms are meant to make dirty energy more expensive and clean energy cheaper. This is working in California; prices are high. Yet many of these policies fail to account for the reality that high energy prices hurt the most vulnerable citizens hardest. As a result, increasing prices are decreasing the well-being of families who cannot afford to keep up with clean energy-related price hikes. An immense web of conflicting and reinforcing mechanisms has resulted in a costly electric grid that charges customers much more for electricity than what it costs to produce electricity and account for externalities. These price increases occur on a grid that is increasingly unreliable and unsafe. The structural issues plaguing California's grid, exacerbated by suboptimal policy and rate design, are increasing prices, eroding safety, and impacting reliability in the state. These impacts will likely hurt low-income and minority communities the most.

A Survey of Major Clean Energy Policies in California

This study focuses on a few major clean energy policies which operate with different mechanisms in the state of California. This section summarizes the mechanisms by which most clean energy policies work and provides a brief description and analysis of the state's cap-and-trade program, Renewable Portfolio Standards, Net Metering Program, and technology bans on internal combustion vehicles and natural gas.

[12] Severin Borenstein, Meredith Fowlie, and James Sallee, "Designing Electricity Rates for An Equitable Energy Transition."

Summary Table

Category	Policy Examples[13]
More Expensive Fossil Fuels	• Global Warming Solutions Act (Cap & Trade) (2006) • Transportation Infrastructure Funding (2017)
Emission Standards	• Renewable Portfolio Standards (various) • Low Carbon Fuel Standard (2009) • Sustainable Transportation Planning (2008, 2013) • Electric Vehicle Charging (2015)
Cheaper to Adopt Clean Energy	• Net Metering (1995) • Business Energy Investment Tax Credit (ITC) (2002) • Plug-In Electric Drive Vehicle Tax Credit (2010) • Greenhouse Gas Reduction Fund
Ban on Fossil Fuels	• Natural Gas Bans (various) • Advance Clean Cars Program (ICE Car Bans) (2022) • Community Air Protection (2017) • Short-Lived Climate Pollutant Reduction (2016)
Increases in Efficiency	• Weatherization Assistance Program (WAP) (2015) • Low-Income Home Energy Assistance Program (LIHEAP) (1981) • Green Building Standard

[13] "California Climate Policy Dashboard"; "Database of State Incentives for Renewables & Efficiency®."

Cap-and-Trade

California's cap-and-trade program is one of the largest multi-sectoral emissions reduction schemes in the world.[14] The program has already led to significant reductions in carbon emissions, as shown above in Figure 1, and the state is on track to achieve net neutrality by 2045.[15] Cap-and-trade policies exist in several territories across the globe. Each policy sets a strict limit (or cap) on greenhouse gas emissions that can be released in a given year. These programs create an auction for a limited number of permits that allow companies to emit carbon dioxide. Lowering the cap every year and making permits more expensive aligns the long-term interest of these companies with the need to decrease their carbon footprint. In addition, businesses can sell unused permits, another incentive to decrease emissions quickly. While only about 450 businesses in California — typically power plants, industrial facilities, and fuel distributors — are subject to strict caps, those companies account for around 85% of the state's total greenhouse gas emissions.[16]

Permit sales create revenue for the state of California, which is mostly reinvested into carbon emission mitigation programs. The state also invests a quarter of cap-and-trade revenues into programs that benefit disadvantaged communities.[17] As of 2020, the cap-and-trade program had generated over $12.5 billion for the state.[18]

Renewable Portfolio Standards

Renewable Portfolio Standards (RPS) are popular state-level mechanisms that set goals and standards to impact the composition of energy sources in the state. Typically, RPS legislation will set a target that increases the share of energy produced by renewable sources in the state by a specified year. In 2002, California set its first RPS to require that renewables serve 20% of electricity demand in 2017. Later, in 2015, this was increased to 50% renewables by 2030. In 2018, the state increased the RPS to achieve 60% renewable energy by 2030.[19] California has one of the most ambitious RPS in the country. This policy is expected to create more clean energy capacity in California compared to anywhere else in the U.S.[20] SB 100, "The 100 Percent Clean

[14] "California Cap and Trade."
[15] BerkeleyLaw, "CALIFORNIA CLIMATE POLICY FACT SHEET: CAP-AND-TRADE."
[16] "California Cap and Trade."
[17] "California Cap and Trade."
[18] Colter Schroer, "California Cap and Trade and the Principles of Sustainable Energy."
[19] CPUC, "Renewables Portfolio Standard (RPS) Program."
[20] Union of Concerned Scientists, "California's Renewable Portfolio Standard (RPS) Program."

Energy Act of 2018," also counts toward the target of other carbon-free technologies, such as nuclear, that are typically excluded in the definitions of renewables.

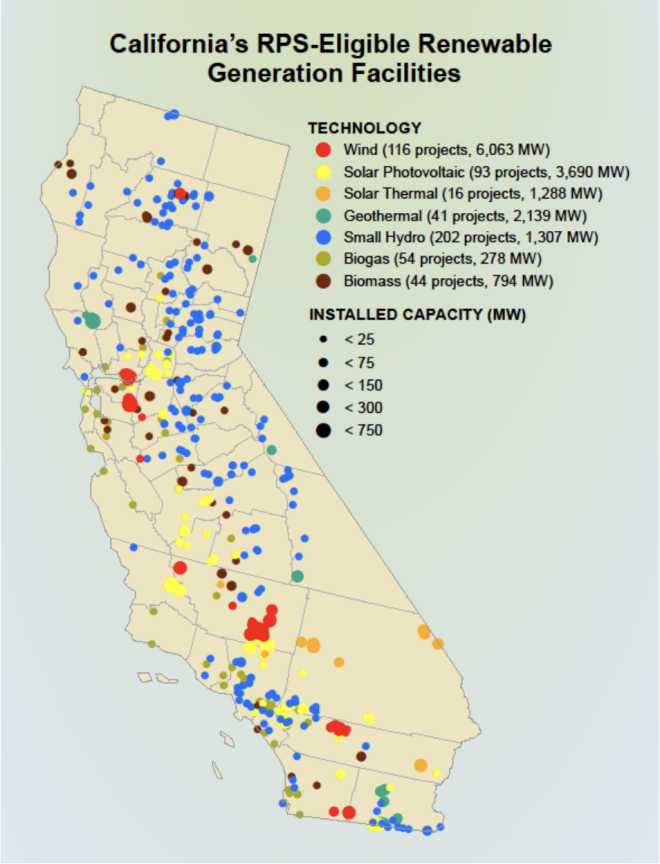

Figure 3: RPS-Eligible Renewable Energy Facilities in California.
Source: UCS.[21]

Net Metering

A common household-focused clean energy policy, net metering seeks to incent the adoption of rooftop solar panels by crediting electricity users for surplus energy that they produce, allowing a household to sell energy back to their utility. A net metering participant gets clean electricity during the day, selling their extra to the grid. Then, at night, they pay less for their energy use as their contributions are credited to their account. Net metering makes the investment in rooftop solar panels much more financially attractive. California, in particular, has been

[21] Union of Concerned Scientists.

innovative in incenting rooftop solar adoption through its net metering program. This is likely why California has captured 50% of the residential solar market in the U.S.[22]

Net metering is incredibly popular among households that have constructed solar panels and among the solar industry as a whole. The existing net metering program, especially in California, has sparked the immense growth of the solar industry.[23] Yet the policy is less popular among utilities, which claim that net metering compensation erodes their revenues and leads to higher prices for non-participating ratepayers. The validity of this claim is explored in later sections.

Natural Gas and Internal Combustion Engine Bans

Of particular interest to equity and climate policy is the continued use of natural gas. To decarbonize everything, a future society must electrify almost every household and business appliance. Achieving this will require a massive shift away from natural gas appliances. Nearly every natural gas stovetop, water heater, and other appliance must be replaced with an electric alternative. To incent a shift from natural gas, cities are beginning to adopt phased natural gas bans and restrictions that pressure residents to adopt sustainable alternatives quicker. At least 40 communities in California, including the major city of San Jose, have passed some type of natural gas restriction already.[24]

Objectively, natural gas bans are a climate win before even mentioning the significant impact that natural gas appliances have on human health. While recent debates have raised significant questions about natural gas use and the role of politics in its regulation, scientists have definitively shown that burning gas in the household releases not only greenhouse gasses like carbon dioxide but also methane, nitrogen dioxide, and other air pollutants that have a significant impact on respiratory health.[25] Natural gas also threatens safety, as shown in the 2010 San Bruno natural gas pipeline explosion, which killed eight people and damaged dozens of homes.[26] Household natural gas is associated with severe health hazards and significant climate impacts.[27]

California has also begun phasing out the sale of new internal combustion engine vehicles. The California Air Resources Board has ruled that, by 2035, all new cars sold in the state must be

[22] "NERC: The Grinch Who Stole Gridmas // California's Rooftop Solar Kibosh // Europe's $1 Trillion Energy Bill."
[23] Groom, "US Home Solar Installers Brace for Slowdown as California Reform Looms."
[24] Bryce, "California's Natural Gas Bans Are Drawing Fire From Black And Latino Leaders."
[25] Pearce, "Gas Stoves Might Pose Risks to Both Our Planet and Health."
[26] Kaur, "Why Californians Are Furious at the Utility Company PG&E."
[27] "Climate and Health Impacts of Natural Gas Stoves."

free of greenhouse gas emissions, with interim targets over the next decade.[28] The impact of the ruling could be immense: The ban could reduce passenger car emissions by as much as 50% from expected levels by 2040. To ensure the successful implementation of this policy, consumers must have access to attractive alternatives — not only to affordable electric vehicles but also to charging infrastructure. Perhaps most importantly, the electricity used to charge the new fleet of electric vehicles must be inexpensive and come from clean energy sources to have the desired impact.

Evaluating Energy Justice Implications of Clean Energy Policies

Studies of environmental injustice and equity explore a variety of issues, from procedural inequities that impact a community's right to self-determination to distributional inequities which attempt to understand how environmental burdens are unevenly dispersed distributed. The concept of energy justice broadly encompasses applying environmental justice concepts to our energy system. More specifically, energy justice seeks to highlight pressing challenges to achieve an equitable and just energy system and energy transition.[29] This section summarizes existing literature focused on the impacts of clean energy policies on energy justice, particularly cost impacts.

Impacts of Cap-and-Trade and RPS

While they differ in design, cap-and-trade and RPS policies have similar outcomes — they spur the adoption of more renewable and low-carbon energy and the early retirement of fossil fuel infrastructure. Cap-and-trade operates with a "stick" and a "carrot" for polluters, rewarding good behavior and making poor behavior more expensive. An RPS only punishes a company's inability to meet the state's ambitious goals. Yet both policies should theoretically result in the same outcome: decreasing fossil fuel use and increasing reliance on renewable energy sources. As a result, their impacts are discussed here in tandem.

A report titled "A Prospective Analysis of the Costs, Benefits, and Impacts of U.S. Renewable Portfolio Standards" from the National Renewable Energy Laboratory and Lawrence Berkeley National Laboratory modeled the future of RPS programs nationwide. It concluded that price impacts of these standards under an existing RPS scheme are minimal, accounting for only 1¢/kWh higher prices than in a scenario without the policies in effect. Expected benefits outside of cost impacts are extensive.[30] The study cites an easing of air pollution burdens associated

[28] Davenport, Friedman, and Plumer, "California to Ban the Sale of New Gasoline Cars."
[29] "Energy Justice and the Energy Transition."
[30] Trieu Mai, "A Prospective Analysis of the Costs, Benefits, and Impacts of U.S. Renewable Portfolio Standards."

with adopting an RPS, which will likely benefit environmental justice communities the most. Additional expected benefits include GHG reductions, water use reductions, and a broad increase in renewable energy workforce opportunities.[31] These results imply that, while RPS frameworks can make energy slightly more expensive, the benefits of energy justice are significant.

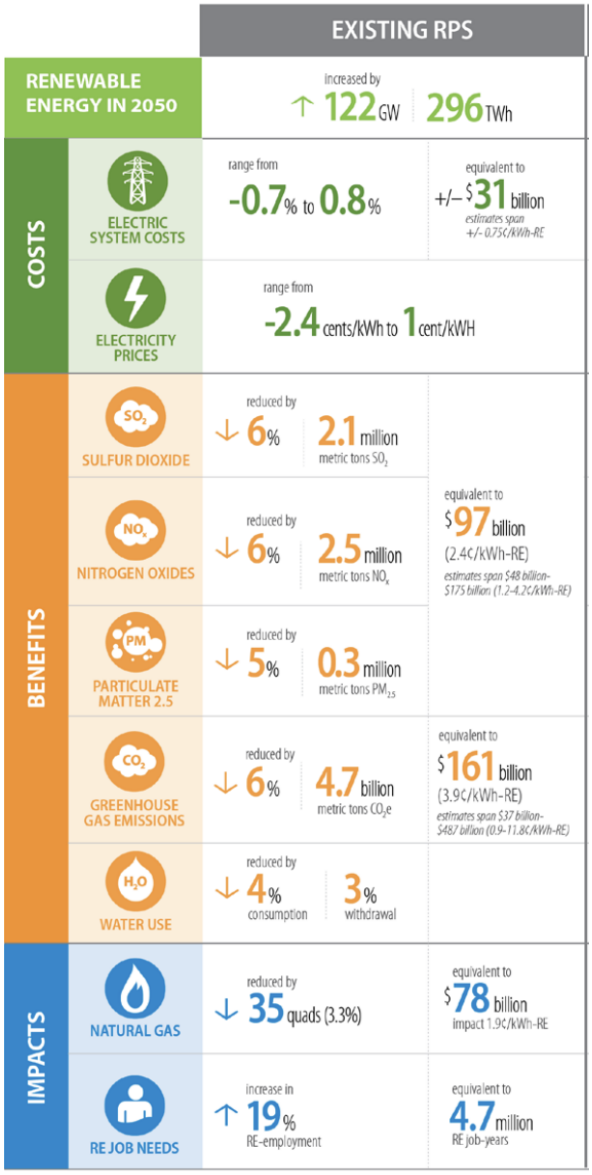

Figure 2: Cost, benefits, and impacts of the Existing RPS scenario. Source: NREL

California's cap-and-trade program is meant to increase fossil-fuel-sourced energy prices. As explored in a UC Berkeley study in 2012, those price increases often have an impact most noticeable for low-income consumers.[32] However, progressive policy design was able to aid some of these financial woes; an accompanying bill, SB 535, directs a quarter of generated revenues from the cap–and–trade program into investments that benefit disadvantaged communities.[33] As a result of the direct attention given to justice and equity in this legislation, most analyses have indicated that the state's cap-and-trade program has not resulted in pervasive price impacts on disadvantaged communities.[34]

Yet outside of pricing concerns, several researchers and advocates have argued that the cap-and-trade program works against distributive justice goals. For instance, some researchers noticed initial increases in pollution hotspots surrounding disadvantaged communities as a result of the program.[35] However, a later analysis at the

[31] Trieu Mai.
[32] Farber, "Pollution Markets and Social Equity."
[33] "California Cap and Trade."
[34] Hernandez-Cortes and Meng, "Do Environmental Markets Cause Environmental Injustice?"
[35] Farber, "Pollution Markets and Social Equity"; Cushing et al., "Carbon Trading, Co-Pollutants, and Environmental Equity."

National Bureau for Economic Research found little evidence to support this claim, instead identifying a 6-10% reduction in environmental justice gaps, such as decreased air pollution in low-income areas.[36]

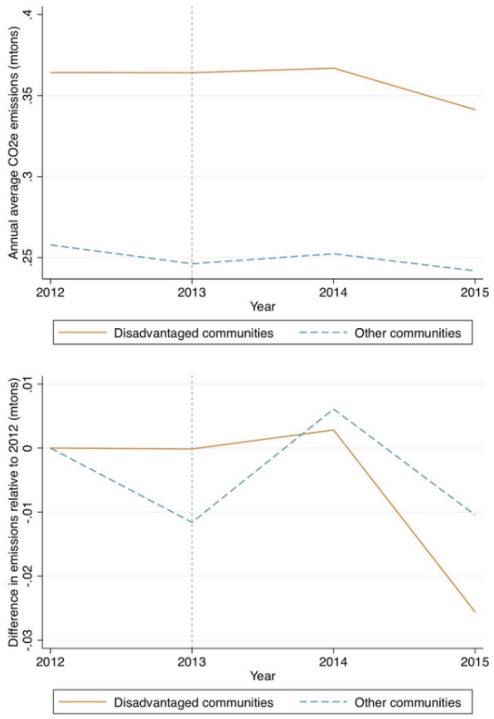

Figure 3: Average CO2e emissions in disadvantaged and other communities since the onset of California's cap-and-trade program. Source: NBER.[37]

As expected, studies of the California RPS have identified similar impacts. The Union of Concerned Scientists has reported that projects resulting from the RPS are often in areas with high levels of unemployment, which has supported local jobs and revitalized economies.[38] The policy has also eased pollution burdens on communities. While the long-term impacts of cap-and-trade and RPS on equity warrant further research, the most recent literature implies that even though implementation may have initially harmed environmental justice, the programs now benefit energy justice goals by investing in energy price-related justice programs and easing pollution in overburdened communities.

[36] Hernandez-Cortes and Meng, "Do Environmental Markets Cause Environmental Injustice?"
[37] Hernandez-Cortes and Meng.
[38] Union of Concerned Scientists, "California's Renewable Portfolio Standard (RPS) Program."

Pricing Impacts of Net Metering

A review of California's net metering policies requires an understanding of electricity compensation schemes. The state's initial approach (NEM 1.0, in effect 1995–2013) offered participating households the prevailing retail electricity rate, i.e., 1 kWh of electricity bought and sold by a household would be the same price.[39] NEM 1.0 compensated households for their generated electricity through the prevailing retail electricity rate. NEM 1.0 raised concerns about overpayments to net metering participants. As a result, the California Public Utilities Commission (CPUC) adopted NEM 2.0, which paid similar charges that non-NEM customers would be responsible for, including a one-time interconnection fee and monthly charges to stay online.[40]

NEM 2.0 failed to address core problems with net metering in California. A 2015 study on the financial impacts of customer-side solar found that the program contributed to a "revenue erosion effect" for utilities, where increasing costs to accommodate net metering participants led to a downward trend in revenue.[41] Prevailing retail prices for electricity do not solely reflect the cost of producing that electricity. They also include several other critical services, such as the cost of maintaining transmission and distribution equipment. California required utilities to pay customers retail electricity prices without accounting for the costs of maintaining grid infrastructure. The utilities paid customers significantly for NEM participation and accounted for these costs by increasing the price of electricity for non-participating ratepayers.[42]

NEM 2.0 raised red flags for equity and inclusion. Across the United States, there is a significant racial and ethnic disparity in rooftop solar deployment.[43] Policies such as redlining continue to significantly impact income, neighborhood diversity, and home ownership in our modern society.[44] Homeownership and household income are some of the most significant barriers to rooftop solar participation.[45] An analysis in *Nature Sustainability* found that even accounting for income, black and Hispanic-majority census tracts have 69% and 30% lower installed rooftop solar capacity, respectively.[46] This is most certainly a result of existing income inequalities that

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[39] Satchwell, Mills, and Barbose, "Quantifying the Financial Impacts of Net-Metered PV on Utilities and Ratepayers."
[40] CPUC, "NET-ENERGY METERING 2.0 LOOKBACK STUDY."
[41] Satchwell, Mills, and Barbose, "Quantifying the Financial Impacts of Net-Metered PV on Utilities and Ratepayers."
[42] CPUC, "NET-ENERGY METERING 2.0 LOOKBACK STUDY."
[43] Sunter, Castellanos, and Kammen, "Disparities in Rooftop Photovoltaics Deployment in the United States by Race and Ethnicity."
[44] Gross, "A 'Forgotten History' Of How The U.S. Government Segregated America."
[45] Sunter, Castellanos, and Kammen, "Disparities in Rooftop Photovoltaics Deployment in the United States by Race and Ethnicity."
[46] Sunter, Castellanos, and Kammen.

have reverberated in the United States' extensive history of racist housing and income policies.[47]

Higher electricity prices combined with lower solar adoption by communities of color and low-income households have placed the burden of net metering on those least able to afford it. This is why researchers have referred to net metering as a "reverse Robin Hood" situation, where low-income minority households who cannot afford rooftop solar are, in practice, subsidizing richer and whiter households who can afford the expense.[48] The program's benefits have flown to households that need them the least, to the detriment of more vulnerable populations.

For these reasons, California is changing its program. In December 2022 — 28 years after net metering began and 10 years after the adoption of NEM 2.0 — CPUC established NEM 3.0, a new way to compensate net metering participants that slashes compensation for household solar production by 75%. This change is based upon the recognition that the previous rate scheme "negatively impacts non-participating ratepayers, disproportionately harms low-income ratepayers, and is not cost-effective."[49] NEM 3.0 could benefit reliability and equity on the California grid, rewarding stabilizing technologies like solar paired with storage and subsidizing new solar projects for low-income households. Yet the ruling has been met with immense pushback from solar industry companies, such as Tesla and SunRun, which claim that CPUC is succumbing to the whims of utilities and hampering a transition to clean energy. The reality of net metering is more nuanced: Rooftop solar is a comparatively expensive and inefficient method of generating electricity for a grid, with severe impacts on equity.[50] Optimizing policies like net metering is critical. Berkeley University researcher Severin Borenstein said amid the latest net metering discussion: "California is among the first movers on renewable energy, and the whole world is watching. If we do it right, we can show the pathway to equitable and cost-effective decarbonization. If we make it into an expensive mess, other states and countries will wonder if they can afford to follow."[51]

[47] Gross, "A 'Forgotten History' Of How The U.S. Government Segregated America."
[48] Josh T. Smith, Grant Patty, and Katie Colton, "Net Metering in the States: A Primer on Reforms to Avoid Regressive Effects and Encourage Competition."
[49] "Order Instituting Rulemaking to Revisit Net Energy Metering Tariffs Pursuant to Decision 16-01-044, and to Address Other Issues Related to Net Energy Metering."
[50] Borenstein, "Rationalizing Compensation for Rooftop Generation."
[51] Borenstein.

Equity Impacts of Fossil Fuel Technology Bans

Net metering is a clear example of how a policy to motivate clean energy adoption can have lasting impacts on energy insecurity. On a broader scale, concerns exist about whether California's clean energy policies for disincenting harmful technologies have the desired impact. If a particular piece of legislation increases the price of electricity, it may also discourage consumers from electrifying other energy-intensive processes in their household, including space heating, water heating, and mode of transport.[52] Low electricity prices will be key to a quick and equitable energy transition.

For a state like California with high electricity costs, natural gas bans carry equity implications. In California (as with most of the U.S.), electricity is significantly more expensive than natural gas. As a result, bans on natural gas can place undue financial burdens on families and businesses that rely on it to provide critical energy services. In the harshest bans, residents must retrofit or replace expensive equipment and pay more for its use. As 86% of California homes use natural gas, researchers have raised equity concerns about how these higher prices will impact lower-income Californians.[53] Environmental justice-focused politicians in California, such as Assemblyman Jim Cooper (Democrat from Elk Grove) and Assemblywoman Blanca Rubio (Democrat from Los Angeles), have voiced concern that cities are implementing natural gas bans without regard for struggling communities, especially areas with a high percentage of low-income and minority residents.[54]

Similar concerns exist with internal combustion engine vehicle bans. While the ruling has yet to achieve meaningful implementation, these bans will only work if they do not erode the state's existing commitment to environmental justice goals. Cars are already an expensive household investment. California's uniquely high electricity rates tend to be much higher than the costs of fossil fuels. As a result, poorer communities may struggle to pay for electric vehicles and the electricity to power them. Meanwhile, a significant increase in electric cars on the road will tax the grid, increasing electricity demand. Depending on the ability of the state to quickly adopt massive amounts of clean energy, that demand could be met through fossil fuels. As a result, bans on gas-powered vehicles could increase pollution hotspots in EJ communities.

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[52] Severin Borenstein, Meredith Fowlie, and James Sallee, "Designing Electricity Rates for An Equitable Energy Transition."
[53] "With California's High Power Rates, Will All-Electric Homes Be Affordable?"
[54] Bryce, "California's Natural Gas Bans Are Drawing Fire From Black And Latino Leaders."

Evaluating Clean Energy Policy Impacts on Grid Maintenance

The web of clean energy regulations in California has visible implications for energy justice, but less studied are these regulations' impacts on safety and reliability. Not only do clean energy policies impact ratepayer incentives through the price of electricity, but they also shift long-term priorities and investments for utilities. This shift in priorities has already affected the maintenance and management of the California grid.

The Impact of Cap-and-Trade and RPS on Reliability

The successes of cap-and-trade and RPS have created a greener, more distributively just, and equitable grid. Yet journalists and industry experts have indicated that the increasing focus on expanding renewable energy capacity has distracted utilities and regulators from ensuring an inexpensive, reliable, and safe grid.[55] While utilities earn a profit on their capital investments, they cannot make money from maintenance and operating expenses. As a result, utilities have incentives to prioritize expensive projects over day-to-day projects that keep pipelines and power lines safe and running.[56] Clean energy policies, therefore, carry significant reliability implications for low-income and other vulnerable Californians, as energy systems are consistently less reliable for EJ communities.[57]

In California, safety lapses have caused or resulted from natural disasters. Price hikes are commonplace. An inability to access energy services is often deadly. Rolling blackouts now occur regularly in California to mitigate wildfire risk, and tens of thousands of people have seen their hospitals, schools, and houses go without power for days at a time.[58] Households that require electricity for medical equipment and to refrigerate medications have been jeopardized.[59] Blackouts are often centered in lower-income and higher-share minority communities.[60]

The lack of focus on safety and reliability due to electricity market action leads to an inequitable, unsafe, expensive, and unreliable grid. Clean energy policies have likely contributed. Many policies within California follow this same trend: Well-intentioned legislation meant to accelerate clean energy development has been implemented without proper attention to risks and equity. For the state, this has meant incredibly high electricity

[55] Blunt, *California Burning*.
[56] Blunt.
[57] Lewis, Hernández, and Geronimus, "Energy Efficiency as Energy Justice."
[58] ABC News, "Why California Has Blackouts"; Blunt, *California Burning*.
[59] Blunt, *California Burning*.
[60] Carvallo et al., "Frozen Out in Texas."

rates, an increasingly dangerous and unreliable grid, and few options for repair. And as the climate crisis worsens, California is on the frontline.

Accelerating Threats from Climate Change

Under the strict need to decrease emissions to fight climate change, increased attention must be given by utilities to ensure the grid can function properly. Unfortunately, fighting climate change has made the California grid more vulnerable to its impacts. California is on the front lines of the climate crisis, already seeing significant drought, coastal flooding, and warmer temperatures.[61] The California grid is increasingly threatened by — and threatening to — climate-related disasters. Wildfires are proving the most dangerous and deadly. Less precipitation and higher temperatures have primed vegetation and forest land to burn. As a result, wildfires are intensifying dramatically — in 2020 and 2021 alone, half of the largest wildfires since 1950 burned in the state.[62] Electric utilities are not immune and often not free from blame. As Blunt describes the problem: "As PG&E secured new wind and solar contracts, its service territory became a tinderbox."[63]

As predicted, electric utilities have been responsible for several wildfires. The 2018 Camp Fire—the deadliest and most destructive wildfire in California's history—ignited due to poorly maintained transmission and distribution equipment built in the early 1900s. Eighty-five people died as a result of the blaze.[64] The utility agreed to plead guilty to 84 counts of involuntary manslaughter due to its role in the tragedy. In the wake of the disaster, regulators understood that utilities must invest in transmission and distribution equipment to protect Californians.[65]

Utilities understand that achieving a safe grid in a climate-constrained California is going to require "unprecedented engineering feats," such as burying tens of thousands of miles of distribution lines and trimming nearly a half million trees to keep Californians at a lower risk of wildfire.[66] These investments are costly, especially for a utility already subject to strict investment requirements in clean energy technologies. Utilities face a balancing act in transitioning to a clean and equitable grid: They must invest incredible amounts of money into reliable and clean energy projects while keeping energy costs affordable to ratepayers.

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[61] Smith, "Climate Change Is Rapidly Accelerating in California, State Report Says."
[62] Smith.
[63] Blunt, *California Burning*.
[64] "New Timeline of Deadliest California Wildfire Could Guide Lifesaving Research and Action."
[65] Blunt, *California Burning*.
[66] Blunt.

Any low-emission contributions from existing clean energy resources ease this transition. The California Energy Commission understands this dilemma. In a recent report on extending life for the Diablo Canyon Nuclear Power Plant, the commission noted, " [California's] shift in conditions is creating challenges for its residents, especially those in disadvantaged communities and low-income communities."[67] The report emphasizes the need to keep firm power plants, specifically DCNPP, open to help manage these issues.[68]

While it will help the grid's resilience, keeping nuclear power plants online won't be enough. Strict attention must be given to achieving a safer, cleaner, more reliable, and more equitable power system in California.

Recommendations

The interwoven web of regulation, external threats, and the complexity of California's electricity system makes it challenging to fix. Restructuring this system has been referred to as "a little bit like remodeling an airplane in mid-flight" by Michael Picker, former president of California's Public Utility Commission."[69]

In 2021, energy modelers crafted separate grid simulations to try and understand how California may be able to continue progress towards its legislative goals — specifically the net-zero emissions commitment by 2045.[70] Their conclusions were clear: As more technologies are electrified, peak demand could double before mid-century. To meet this demand, the state will need an expansive buildout of new infrastructure.[71]

These models indicate that wind and solar cannot do the job alone. The modelers found that if renewables and current storage are used to decarbonize, electricity prices would increase by 65% compared to today.[72] To allow utilities to properly manage the grid without overbuilding, they must consider unconventional firm power sources, such as nuclear and geothermal. Rethinking clean power sources and sharing investment between renewables, nuclear, and geothermal power plants can help ease some of the cost burdens of a renewables-only transition. There's also a clear concern for inequitable pricing of a renewable-only transition:

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[67] California Energy Commission, "Diablo Canyon Power Plant Workshop. Transitioning to a Clean Energy Future: Electric Reliability Outlook."
[68] Commission, "CEC Determines Diablo Canyon Power Plant Needed to Support Grid Reliability."
[69] Blunt, *California Burning*.
[70] Quach, "Clean Firm Power Is the Key to California's Carbon-Free Energy Future."
[71] Quach.
[72] Quach.

The type of energy infrastructure we build will be critical to achieving California's legislative goals, but also critical to ensuring equity in energy pricing in the state.

Regardless of infrastructural composition, we will need new policies to usher in an equitable era of vast buildout to achieve climate goals. The following are recommendations on crafting and adjusting policies to ease energy justice burdens in California:

State regulators must overhaul their definitions for what constitutes a clean energy resource. Different sources, such as grid-scale batteries or nuclear power plants, offer different benefits and risks, and diversifying them often leads to optimal grid conditions. For instance, a grid cannot be run solely on solar and wind due to natural fluctuations. California's Independent System Operator (CAISO) already knows this: Last April, nearly 600,000 MWh of solar energy was wasted — curtailed due to oversupply during the day while the state still relied on natural gas and coal to supply electricity at night.[73] As a result, prioritizing the build-out of diverse low-carbon sources will be critical to achieving greater grid stability and sustainability. The extension of the life of Diablo Canyon Nuclear Power Station and recent legislation that considers the use of small modular reactors is a recognition of the critical need to diversify electricity sources.[74]

Policymakers should also continue to pair policies like net metering with new or existing energy affordability programs and subsidies or further investments in existing programs. To ease the inequities of future policies, care towards the impacts on electricity pricing is critical. From an equity perspective, it matters less if prices are raised and more about who pays those prices, which is clear by how cap-and-trade did not carry significant negative burdens for poor households while net metering did. Existing affordability programs, such as the California Alternate Rates for Energy program, or CARE, require utilities to offer lower rates to low-income households, slashing electricity bills by 30-35%.[75] California also helps low-income customers tap into federal funding for energy efficiency projects from the Department of Energy, such as the Weatherization Assistance Program or the Home Energy Assistance Program, which seek to increase the efficiency of households and bring down costs of electricity and other energy services by a wide margin.[76] Yet such initiatives are limited by their funding and scope: These policies will only work if the households who need them have unobstructed access.

Additionally, California should create new models for the adoption of solar, incenting construction while distributing benefits more equitably. There are successes for equity and safety on the grid. NEM 3.0 has several equitable mechanisms built in for net metering. For

[73] "California ISO - Managing Oversupply."
[74] "As San Onofre Nuclear Plant Comes down, Bill Would Allow Small Reactors to Go Up."
[75] "California Alternate Rates for Energy (CARE)."
[76] "Weatherization Assistance Program."

example, the new rate structure seeks to incent the combination of solar and storage systems to stabilize the grid. It offers households $900 million in incentives to pair solar with storage instead of just building solar alone. $630 million of that funding is slated for low-income households.[77] This policy is just one example of how some suboptimal policies have clear and easily implementable solutions. Of particular interest is community solar, which is a model of solar installation that finds centralized sites for multiple households to have a stake in the same solar operation. Contrary to NEM, which benefits individuals who can afford solar installations, community solar installations often create more clean energy and distribute the benefits across more households. Community solar installations are also more efficient at integrating into a grid. This quality allows for quicker adoption of solar while providing greater access to benefits by previously ineligible groups, such as apartment renters or households that may not have the space or money to build a viable solar installation alone. Yet to truly reach environmental justice goals, marginalized communities will need equitable control and stake in these community solar systems, including the ability to decide how the project is managed, how benefits are distributed, and how projects are designed to reflect what is most important to the community.[78][79]

Conclusion

By no means are the problems of the electric grid in California caused solely by ambitious climate policy, and by no means will they be fixed by further entangling the web of regulations. True structural reform will eventually be necessary to ensure the sustainability of the grid and to ensure that families have access to reliable and clean electricity. Yet, for now, ignoring how clean energy policies are reinforcing regressive structures and mechanisms within the state will lead to undesirable outcomes and slow down a just transition to a clean grid as pushback increases.

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[77] "Order Instituting Rulemaking to Revisit Net Energy Metering Tariffs Pursuant to Decision 16-01-044, and to Address Other Issues Related to Net Energy Metering."
[78] Eric Sippert, "Community-Owned Community Solar: Opportunities and Challenges."
[79] https://elpc.org/wp-content/uploads/2022/09/CommunitySolarReport_ELPC-v7.pdf

Category	Impact on Affordability	Impact on Reliability
More Expensive Fossil Fuels	Makes energy more expensive across the board unless coupled with clean energy subsidies and investments. May impact low-income families hardest unless coupled with energy affordability programs.	Absent scalable storage, utilities may prioritize investments in less reliable technologies to meet demand. May also decrease utility capacity to invest in system upgrades and maintenance.
Emission Standards	Unclear results — may raise prices marginally, in the range of $.01/kWh.[80]	Can distract utilities from investments in reliability and safety. Requires investment in less reliable and more fluctuating energy sources.
Cheaper to Adopt Clean Energy	Decreases energy costs, but inequitably. Some programs make energy cheaper for households that can afford the high upfront investment, and costs are often passed onto lower-income households.	Unclear — some evidence that more renewable heavy grids have more instances of blackouts.[81]
Ban on Fossil Fuels	Forces households to switch to electric capital goods. Electricity is more expensive; these policies may raise household costs in upfront investment and operational costs. May hurt families who require traditional fossil fuels for heat and transportation	Absent scalable storage, utilities may prioritize investments in less reliable technologies to meet demand. May also decrease utility capacity to invest in system upgrades and maintenance.
Increases in Efficiency	Allows for the use of less electricity, thereby decreasing household energy costs.	Lowers peak demand on the grid, increasing reliability during surge periods.

[80] https://emp.lbl.gov/news/new-study-costs-benefits-and-impacts-state
[81] Three Essays On The Efficiency And Equity Of Energy Production And Consumption In The United States

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