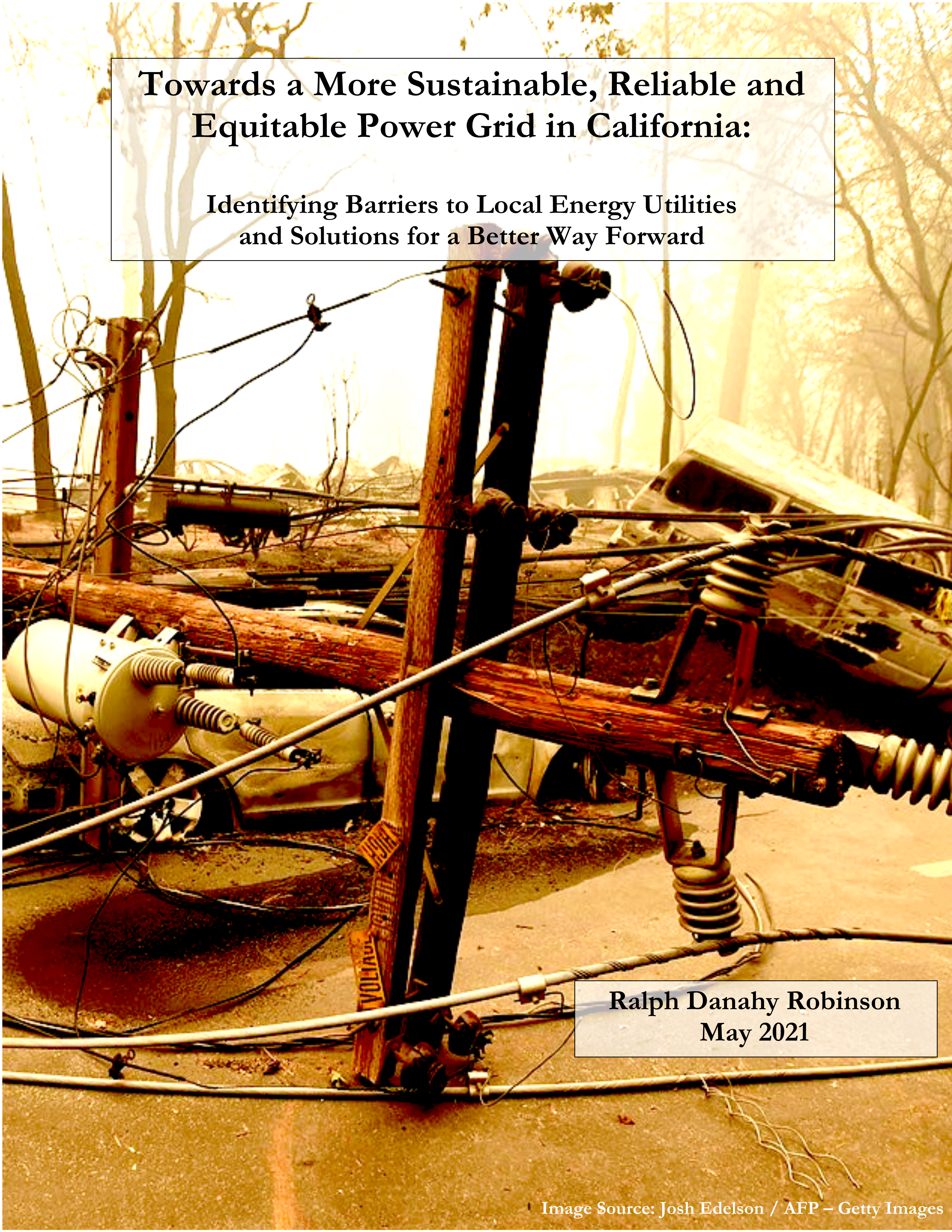
Towards a More Sustainable, Reliable and Equitable Power Grid in California:

Identifying Barriers to Local Energy Utilities and Solutions for a Better Way Forward



Ralph Danahy Robinson

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Towards a More Sustainable, Reliable and Equitable Power Grid in California:

Identifying Barriers to Local Energy Utilities and Solutions for a Better Way Forward

A Planning Report

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By

Ralph Robinson

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Executive summary

How do we make the electrical grid in California more sustainable, reliable and equitable?

The impacts of climate change are at our doorstep. Extremes of drought and precipitation, wildfires, sea-level rise, record heat, and the degradation of beloved plant and animal life are taking the shine off of the Golden State. Aggressive steps are needed to replace fossil fuels with renewable energy.

The state of California has a plan to move to 100% renewables by 2045, but this shift may mean higher costs for customers. With one-third of Californians already receiving financial assistance to pay for their electricity bills, work is needed to reconcile sustainability with affordability. This shift to renewables must also occur without diminishing the reliability of critical electric service.

This research overviews who delivers electrical service in California and how this system is operated and regulated. It assesses present issues with California's electric grid and the future challenges it faces. It evaluates and compares publicly and privately owned electric service providers on progress meeting state targets for renewable energy, reliability of service and ability to keep costs low for consumers. Based on this background work, it recommends reforms for the generation, transmission, distribution and management of electric service in California to improve outcomes for sustainability, reliability and equity.

Methods

Three primary methods of analysis were used: a review of existing regulations for power generation and distribution in California; 7 case studies comparing publicly owned to investor-owned utilities; and 12 interviews with subject experts and professionals in the field.

An extensive literature review was also conducted to identify existing research on the topic and related issues. This review provided extensive background on the history of and present operation of California's electric grid.

Case studies were developed of the state's three largest publicly owned electric utilities (LADWP, SMUD and Silicon Valley Power) and its three largest investor-owned electric utilities (PG&E, SCE and SDG&E). Current rates, existing mix of renewable sources, future plans for expanding renewables, and data on customer outages were used to compare these providers on the three key themes of sustainability, reliability and equity. A proposal from the South San Joaquin Irrigation District (SSJID) to take over electric service in its area from PG&E was also included as a case study for comparison.

Interviews with subject experts were used to fill in gaps of knowledge on the regulatory environment, to highlight differences between the case studies, and to verify the veracity of this report's findings and recommendations. These experts included academic researchers, public power advocates, representatives from public regulatory commissions, and staff of electric service providers.

Findings

The most critical finding of this research is that publicly operated electric utilities in California outperform investor-owned utilities across the three critical areas of sustainability, reliability and equity. The primary reason is that while investor-owned utilities are incentivized to return profits to shareholders, publicly owned utilities can fully invest their revenues back into their systems and the communities they serve. Despite this, there has been no significant state effort to seriously reform electric utilities or enable more communities to operate their own services. On the contrary, recent legislative efforts to address problems with electric utilities have created further barriers for new public operators to overcome.

Recommendations

There is no clear path to allowing more Californians to access publicly owned power. The current system is in stasis. Innovation and bold fixes are necessary to address climate change and provide high quality service to all Californians at affordable rates. This study makes the following recommendations to enable the wide-scale adoption of public power in California as a necessary solution.

- The state of California must define and present a clear path that local jurisdictions can follow to convert from privately owned to publicly owned service.

- The liability to electric utilities from wildfires must be rethought to address rising costs for all Californians.

- The state must take action to increase accountability for investor-owned utilities, remove political disadvantages faced by publicly owned utilities, and plot a path toward the broad adoption of publicly owned power.

- Large scale investment is needed at the state and federal levels to expand transmission and develop utility scale renewables.

- Energy, land use and transportation planning must become more closely aligned to improve outcomes for sustainability, reliability and equity.

Chapter 1: Introduction

This report was inspired by the observation that power outages caused by heat or wildfire risk are a pervasive issue for Californians. These threats to the power grid, as this report will detail, are growing. Dependence on the reliable flow of electricity also continues to rise. To the usual power needs of air conditioners and refrigerators are additional demands from fully electrified buildings and vehicles. Phones, computers, and wireless routers need reliable power, along with the data centers that keep our digital lives operating. Expanding energy needs must be met while transitioning to more carbon neutral sources, a necessary step to lessen the climate maelstrom threatening every facet of human existence. California's power grid must adapt in the face of these challenges.

This research explores how electricity in California can become more sustainable, reliable and equitable. This repeating set of terms will be used to describe optimum future outcomes. Sustainability refers to the use of renewable energy sources (solar, wind, small hydro, landfill gas capture, etc.), with the ultimate goal of carbon neutrality. Reliability refers to system dependability and high level of service, even against additional pressures from climate change, natural disasters, or other man-made or "act of God" calamities. Finally, this report would be deficient without a consideration for equity in the energy space. Equity in this case means sustainable and resilient systems that serve every Californian at affordable rates.

This report will explore the current regulatory framework governing the production and distribution of electrical energy in the State of California. It will examine existing publicly owned energy utilities (POUs), the circumstances that brought them to be, and how they compare to investor-owned utilities (IOUs)—which include Pacific Gas & Electric (PG&E), Southern California Edison (SCE) and San Diego Gas & Electric (SDG&E). This comparison will include a review of the environmental impacts of the energy they produce, the reliability of their service and costs to customers. Having established the advantages of publicly owned power, this report concludes with a set of policy recommendations to enable its broader adoption across California.

This research utilized three primary methods of analysis: a review of existing regulations related to power generation and distribution in California; preparation of case studies comparing POUs to IOUs; and interviews with subject experts. Resulting from this analysis are a set of recommendations for local, state and federal authorities to pursue. These include steps to enable POUs to seamlessly take over electric service in their jurisdictions from IOUs, suggestions for accomplishing a broader public takeover of the grid, better coordination between energy and land use planning, and additional actions to expand the production and transmission of renewable sources.

Throughout this process, the benefits of POUs stood out. POUs in California consistently offer better prices and more reliable service for customers. They compare well with IOUs on measures of sustainability. Yet, there has there been no concerted effort to make public ownership the predominant method of managing electric service. This report uncovers the barriers in the State of California preventing publicly operated utilities from developing and operating their own sustainable, reliable and equitable energy systems.

Previous research in this area provides useful background on the circumstances that shaped today's grid. Extensive work has been done on how to achieve greater sustainability. There is ample research assessing the performance of both public and investor-owned utilities. This report takes these previous efforts further by providing a clear comparison between these two utility types. Most valuable is the set of recommendations it concludes with to motivate local advocates and state leaders to take action on this critical issue. It concludes with a suggested path for others wishing to build on this research to follow. Those who do so will find this research invaluable. The existing literature is comprehensive and far-flung. Nowhere will one find as succinct an overview of the complex issues facing the grid, their causes, potential solutions, and as well-articulated a means of resolving them through a collective effort toward publicly owned utilities.

Chapter two of this paper overviews the history of electric utility regulation in California from its conception up to present day. Chapter three provides greater detail on the current state of California's grid and the relevant agencies and providers operating within it. Chapter four takes a long range look at the state's renewable energy goals and the challenges and opportunities presented by emerging technologies. Chapter five compares IOUs and POUs on measures of sustainability, reliability and equity before detailing the process POUs must undertake to take over from IOUs. Chapter six then provides a set of recommendations for making the statewide energy grid more sustainable, reliable and equitable, primarily through a shift to more publicly owned utilities.

Chapter 2: A Brief History of Energy Production and Regulation in California

This chapter provides background and necessary context on how California's grid got to where it is today. While later chapters will strike a more critical tone, it is worth first noting that the grid is a remarkable accomplishment. "It's important to recognize that these systems are actually really good, if not always perfect," says Barry Moline, the Executive Director of the California Municipal Utilities Association (CMUA). "Now we've gotten so good that we have the luxury of asking how we want our infrastructure to be delivered to us."[1]

California's Early Utility History

The history of utilities in California is closely intertwined with the state's place in the American story. The complete history of California goes back roughly 15,000 years to its first human inhabitants. For the sake of expediency, this study will jump past 99 percent of that history to the mid 1800s and the Gold Rush that kick started California's ascension to become the most populous and prosperous state in the union. Such a rise required a great deal of human and physical energy.

The vestiges of what would become PG&E had its start in 1852 (just two years after California statehood) with the formation of the San Francisco Gas Company to supply the city's first streetlights.[2] In 1879, electricity arrived on the scene through another PG&E predecessor, the California Electric Light Company. The remainder of the 19th century would see these fledgling companies merge and consolidate with other operators to expand service until the eventual formation of PG&E in 1905.[3] That state's two other primary investor-owned utilities, SCE and SDG&E, share similar origin stories. SDG&E began as the San Diego Gas Company in 1881, and rapidly expanded its territory through the early years of the 20th century. SCE incorporated in 1909, consolidating a number of smaller utilities that had operated since the 1880s. Over the following decades, these three companies would come to be the primary providers of electric energy for Californians, with PG&E itself supplying 46 of the state's 58 counties by 1955.[4] Today, over 75 percent of Californians receive their electricity from one of these providers.[5]

At the same time the fledgling IOUs were expanding, cities and towns throughout California were working independently to meet their emerging energy needs. First came the city of Alameda in 1887 with a modest plan to supply power to 13 streetlights. Alameda Municipal Power still provides electricity throughout the city to this day.[6] In 1900, the city of Palo Alto began operation of its own municipal electric system. The Los Angeles Department of Water and Power, serving over 4 million residents as the largest municipal utility in the country, began operation in 1902. These three

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1 Personal communication on March 2, 2021, with Barry Moline, Executive Director of California Municipal Utilities Association.

2 Jim Doyle, "Utility Giant Grew from Gold Rush Roots," *San Francisco Chronicle*, April 7, 2001, https://www.sfgate.com/news/article/HISTORY-Utility-Giant-Grew-from-Gold-Rush-Roots-2934359.php.

3 PG&E, "150 Years of Growth and Change," Accessed November 2020, https://www.pgecorp.com/150_non_flash/index.html.

4 Jim Doyle, 2021.

5 California Public Utilities Commission, "About Us," Accessed March 2020, https://www.cpuc.ca.gov/aboutus/.

6 Alameda Municipal Power, "History," Accessed March 2020, https://www.alamedamp.com/276/History.

agencies are among the 72 members of the California Municipal Utilities Association, of which more than 45 provide electric service today to 22 percent of Californians.[7] (The remaining percentage are serviced by Community Choice Aggregation, which this paper will cover in more detail further on, and energy cooperatives.) They are part of a larger fraternity of some 2000 publicly owned utilities across the United States, many formed in remote communities to meet their needs when major providers were not yet able to.

Today's IOUs and POUs share similar origins, having initially formed to generate and transmit power over a small geographic area. Where IOUs would diverge in the decades ahead is in rapidly expanding their spheres of influence. With capital available from investors, these companies built massive infrastructure to expand the range of their services. To protect these investments, IOUs would enter into long term franchise agreements with local jurisdictions to supply power. These early agreements gave local authorities the power to set rates. As the scale of these utilities grew, so too did the regulatory apparatus overseeing them.[8] Today, that apparatus includes many players at the state, regional and federal level. Notable among them today are the California Public Utilities Commission (CPUC), the California Energy Commission (CEC), the California Independent Operator System (CAISO), as well as the state legislative and executive branches. A detailed overview of this regulatory apparatus and the role played by these agencies today is the focus of chapter 3 of this paper.

The Three Phases of California's Utility History

Before examining the current regulatory conditions around California's electric utilities, this paper explores the historical events that have shaped the industry. A broad understanding of the history of energy utility regulation is needed before bringing the past several decades into more detailed focus. To the benefit of this research, there is ample literature available on the subject.

Clifton, Lanthier and Schroter (2011) conveniently reviewed a number of papers and articles on this topic within a single synthesized paper. Their review organized the history of utility regulation into three key phases: initial creation (occurring primarily in the late 1800s), domestication and increased state involvement (beginning in the first decade of the 1900s), and then deregulation and an emphasis on free markets (dating from the 1970s to today).[9] Though simplistic, this framework is helpful in organizing a historical timeline. This paper borrows the use of these phases when discussing key events in the history of electric utility regulation in California.

In the first phase of this history, private enterprise was typically responsible for covering the high initial costs of developing the first electric generation and distribution systems. Hausman,

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[7] California Municipal Utilities Association, "California Publicly Owned Utilities," July 2020, https://www.cmua.org//Files/About%20CMUA/CMUA_InfoBooklet_energy_July2020.pdf.

[8] Charles C. Read et. al., "100 Years of State Utility Regulation," *Infrastructure*, Volume 57, Number 1, Fall 2017, https://www.lw.com/thoughtLeadership/one-hundred-years-of-state-utility-regulation.

[9] Judith Clifton and Pierre Lanthier, and Harm Schroter, "Regulating and deregulating the public utilities 1830–2010," *Business History* vol. 53 no. 5 (2011): 659-672.

Hertner and Wilkins (2008), who wrote the book on the financing of mass electrification,[10] explain how regulation was initially concentrated in municipalities, who provided rights-of-way through contracts that then gave them the authority to control rates.[11] That early regulation efforts were mostly on a municipal scale is of note to this study, with its intention of creating a roadmap toward greater public control of utilities. Many POUs operating today are a vestige of these early municipal efforts to provide electric service.

In the early 1900s, there was a major change in the conditions impacting electric utilities, leading to the transition from the first to the second phase of this history. As early municipal systems aged, state and national action was believed necessary to ensure improved performance and reliability of the system. Tremendous infrastructure was needed to meet rising demand and bring service to all corners of the state. This was only possible through larger power plants, often built in remote areas, coupled with massive transmission networks to carry the power generated over greater distances. The cost of building these systems required financing at an equally large scale, financing that IOUs could access through shareholders. This led to roughly seven decades of IOUs being primarily responsible for the generation and transmission of electricity with state oversight.[12]

The discordant transition between the second and third phases of electric utilities leads us to the current state of things. It is a subject that has been of particular interest to researchers. The third phase begins roughly in the 1970s, when deregulation pressure arose for IOUs that had long been tightly regulated by states. There is uniformity across the research in when the impulse toward deregulation began, but variance in what is seen as the primary motivation for it. Nowell and Tschirhart (1990) clearly frame the primary motivation as economic, with inflation and rising costs for plant construction leading to unpopular rate hikes for consumers. Gamson (2012) and Puller (2007) both examine this movement through economic terms as well.[13] [14] [15] Gamson (2002), for example, notes that electricity rates in California in the early 1990s were 50 percent higher than the national average.[16] The shared economic perspective is logical considering the three studies provide quantitative measures of consumer costs before and after deregulation efforts.

Other studies put more focus on political factors. Toninelli (2008) cautions that impulses toward greater privatization or greater state control are not driven by purely pragmatic considerations. There exists a natural push and pull between the two forces, with periods of greater

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[10] William J. Hausman and Peter Hertner and Mira Wilkins, Global electrification: Multinational enterprise and international finance in the history of light and power, 1878–2007, *Cambridge University Press* (2008).
[11] William J. Hausman and John L. Neufeld, "How politics, economics, and institutions shaped electric utility regulation in the United States: 1879–2009," *Business History* vol. 53 no, 5 (2011): 723-746.
[12] Ibid.
[13] Clifford Nowell and John Tschirhart. "The Public Utility Regulatory Policy Act and Regulatory Behavior," *Journal of Regulatory Economics* no. 2 (1990): 21-36.
[14] David Gamson, "A California Conundrum: Tradeoffs Among Rates, Reliability and the Environment During California's 2000-2001 Energy Crisis," *Journal of Industry, Competition and Trade* No. 2:1/2 (2002): 91-112.
[15] Steven L. Puller, "Pricing and Firm Conduct in California's Deregulated Electricity Market," *The Review of Economics and Statistics* Vol. 89, No. 1 (February 2007): 75-87.
[16] David Gamson, "A California Conundrum: Tradeoffs Among Rates, Reliability and the Environment During California's 2000-2001 Energy Crisis."

state control creating a reactive call for more privatization, and vice versa.[17] Hess and Lee (2020) frame the evolution of regulatory environments similarly, examining them not through an evaluation of the strengths and weaknesses of particular approaches, but by studying the evolving levels of power and influence held by the primary actors in these debates.[18] This adds to earlier work by Hess (2011) that spoke to a larger trend toward deregulation in all industries that had been gaining momentum since the 1970s.[19] These studies share similar, qualitative approaches that draw heavily from existing literature on the subject. It is worth noting that one of the available quantitative studies, Nowell and Tschirhart (1990), also spoke to the impact of political considerations in addition to economic factors. While researchers and historians argue the reasons for California's ultimate move toward deregulation, the eventual result of these efforts was the crippling failure of the grid in the 2000 and 2001.

The Path to Deregulation

Early momentum for deregulating utilities in the 1970s led to the 1978 passage by the U.S. Congress of the Public Utility Regulatory Policies Act (PURPA). This act aimed to introduce more competition into the electricity market by encouraging non-utilities to create power generation facilities. Regulated utilities were compelled to purchase the power generated by these facilities at rates based on the costs the utilities avoided by not having to generate this power themselves. This early effort to increase competition in the electricity market was furthered on a national level with the Energy Policy Act of 1992. This act created an additional class of independent energy producers, Exempt Wholesale Generators. These producers were exempt from particular requirements of generators imposed by PURPA, along with different rules for how regulated utilities would compensate them for the electricity they produced.

This legislation effectively changed the electric utility business from one where a single utility generates and transmits electricity to one where a utility purchases the power it distributes from a variety of other companies. The legislation aimed to lower costs for consumers by creating more competition in electricity generation. It also transferred the financial liabilities of constructing new plants from consumers to private firms. When regulated utilities controlled generation, costs from plants that were not financially viable were ultimately passed on to consumers. Now, those risks would be borne by the independent firms operating them.[20]

California would take this decoupling of generation and transmission further with the passage of AB 1890 in 1996. While there were a number of important features of AB 1890, its primary effect was the further divestment of energy generation capacity by IOUs, with much of that

[17] Pierangelo Toninelli, "From private to public to private again: a long-term perspective on nationalization," *Análise Social* vol. XLIII (2008): 675-692.
[18] David J. Hess and Dasom Lee, "Energy decentralization in California and New York: Conflicts in the politics of shared solar and community choice," *Renewable and Sustainable Energy Reviews* 121 (2020) 109716.
[19] David J. Hess, "Electricity Transformed: Neoliberalism and Local Energy in the United States," *Antipode* Vol. 43 No. 4 (2011): 1056–1077.
[20] William J. Hausman and John L. Neufeld, "How politics, economics, and institutions shaped electric utility regulation in the United States: 1879–2009," *Business History* vol. 53 no, 5 (2011): 723-746.

capacity being purchased by other private interests.[21] Separating the utilities themselves from the sources of power generation was intended to create a more nimble and competitive energy market. CAISO was established at this time to oversee this market. While the legislation was successful in introducing more firms into California's electricity market, it created the conditions that would lead to the most infamous failure in the system's history.

In late 2000 through early 2001, California's electricity market failed spectacularly. Multiple studies—including Borenstein and Bushnell (2015), Gamson (2002) and Hess (2011)—note that price manipulation and false shortages created by the new private interests in the market led to system failures and rate increases, resulting in a crisis. There were broader issues within the overall structure of California's electricity markets that also played a role. Strict rules for buying and selling—per Hausman and Neufeld (2011)—created a static market ill-equipped to respond to rapidly changing conditions. Tight demand and insufficient power reserves—as noted by Kessides (2004)—were another key condition causing California's deregulation efforts to fail.[22]

This market failure caused prices for electricity to soar exponentially. Regulated utilities, who had to buy power at whatever price the market set, but who were restricted in what they could collect from their own customers, lost billions. PG&E would declare bankruptcy. Blackouts became a regular occurrence for millions of Californians.

The 2000-01 energy crisis would ultimately lead to a flurry of legislative activity in late 2000 to cap price hikes, limit surges and improve capacity.[23] This included the state of California taking over for a time as the sole purchaser of electricity to ensure continued service for customers and prevent further damage for the regulated utilities. Most profoundly, it led to a reversal in the prevailing sentiment towards deregulation. It is an event with profound consequences for the regulatory and political environment around electric utilities in the state today.

[21] Severin Borenstein and James Bushnell, "The US Electricity Industry After 20 Years of Restructuring," *Annual Review of Economics* No. 7 (2015): 437–63.
[22] Ioannis N. Kessides, "Reforming Infrastructure: Privatization, Regulation and Competition," World Bank (2004).
[23] Severin Borenstein and James Bushnell, "The US Electricity Industry After 20 Years of Restructuring."

Chapter 3: The Current State of Energy Regulation in California

Having delved into the history of the grid, this report moves on to a closer examination of electric utilities today. This chapter details where Californians get their power from and the key utilities and regulatory agencies that make it possible.

Utility Regulation in California Today

CPUC and its mission were established in Article XII, Section 3 of the California State Constitution. That document states that any private corporation that transmits power (amongst a number of other services) is considered a public utility and subject to regulation by the state legislature.[24] Initially, this effort at government oversight was focused on railroads, with the Public Utilities Act of 1911 adopting this model of oversight to utilities.[25] The CPUC has broadly defined powers for controlling rates, maintaining oversight and establishing other standards necessary to the operation of such utilities.

Two other agencies play a key role in the state landscape of electric utility regulation, CEC and CAISO. While CPUC's focus is on regulating and overseeing utilities, the CEC takes a broader view to forecast future energy needs, plan for additional power generation, and promote the state's goals related to improved efficiency and sustainability. CAISO is the newest of the three agencies, a residual of 1990s deregulation efforts with AB 1890. Per that legislation, CAISO's role is to balance energy demands with available supply to ensure needs are reliably met and the market operates efficiently. In addition to these three California agencies, the Federal Energy Regulatory Commission (FERC) plays the role of overseeing the transmission of electricity across state lines.

The structure of utility regulation can be challenging to elaborate. Consider that, for IOUs, rates to be collected must be submitted to and approved by the CPUC. The energy to be transmitted is bought within a constantly updating market operated by CAISO. Adding generating capacity is also the responsibility of CPUC, but the CEC is responsible for ensuring new generation capacity aligns with sustainability goals. POUs operate with a greater level of autonomy than IOUs, but nonetheless must follow similar guidelines set by state law. They may generate their own power, but the power they do generate goes into markets operated by CAISO or other system operators. In short, a distributor who generates their own power (both IOUs and POUs) must sell that power into the larger market and then buy it back again. POUs also participate in purchasing electricity from other producers, and often coordinate with other POUs when developing additional generative capacity.

Generating and delivering power to customers also involves multiple organizations. As a consequence of 1990s deregulation efforts, much of the ownership of generation facilities is separate from the work of distribution. Power plant operators in California include major national

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[24] California State Constitution, Article XII, Section 3, November 5, 1974, https://leginfo.legislature.ca.gov/faces/codes_displayText.xhtml?lawCode=CONS&division=&title=&part=&chapter=&article=XII.

[25] Charles C. Read, 2017.

corporations such as NRG Energy, Calpine, AES Corporation and Chevron. Then there is the work of distribution, performed by the familiar names like PG&E, SDG&E and SCE. Municipal utilities also work as distributors and may also own their own generation facilities or engage in contracts with generating facilities to supply their needs. In some cases, POUs also own their own transmission. Other POUs may lease transmission from one of the IOUs.

A customer sees one name on their bill, but their service may be managed by a POU, delivered through transmission lines owned by an IOU, with power generated from multiple generation sources (both renewable and fossil fuel) owned by other independent companies. The landscape is becoming further populated with new entrants, like providers of residential solar power and Community Choice Aggregation (CCA).

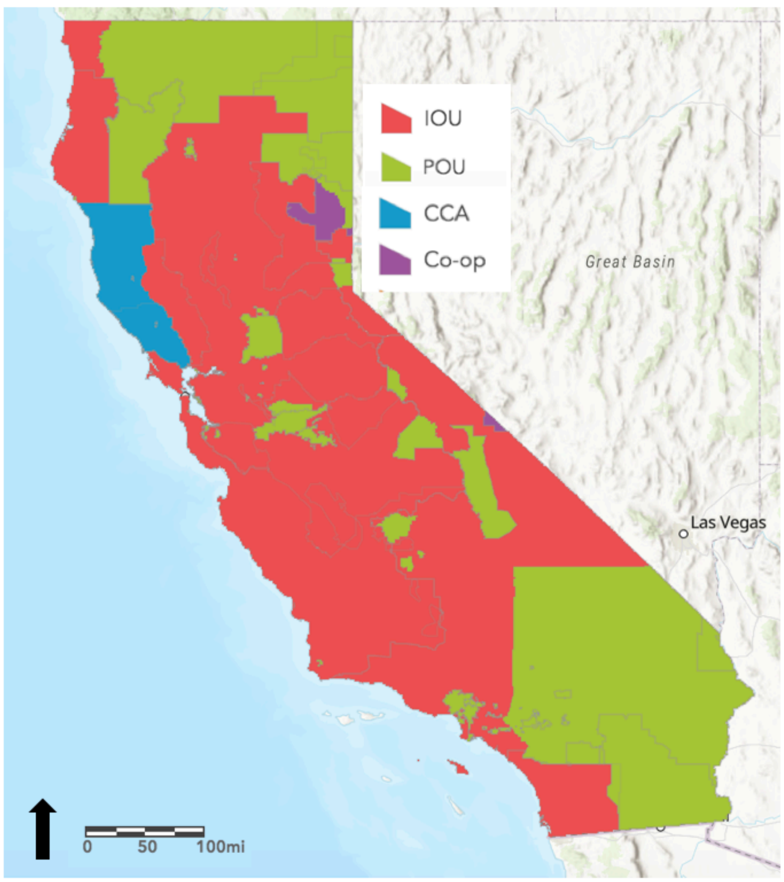

Figure 1: Electric Utility Service Areas by Type (Source: California State Geoportal)[26]

[26] California State Geoportal, "California Electric Utility Service Areas," December 23, 2020, https://gis.data.ca.gov/datasets/b95ca182aa254c3db8ad4d92bd32a73c_0?geometry=-125.267%2C36.652%2C-118.549%2C38.179.

The Emergence of Community Choice Aggregation

In the past two decades, a third alternative has emerged to IOUs and POUs in the form of CCA. The CCA concept was developed with legislation in Massachusetts in 1997, followed shortly thereafter by California in 2002 with the passage of AB 117 and SB 790. That legislation responded to the 2000-01 statewide energy crisis, as voters looked to expand local choice and control in energy services as a means of ensuring greater future accountability from these services. The first of these organizations, of which there are now 23 across the state, included MCE, CleanPowerSF, Lancaster Choice Energy, Peninsula Clean Energy, and Sonoma Clean Power.[27]

The CCA model works within the existing structure of an IOU. A local jurisdiction can form a CCA through voter approval. Households within that area then join the CCA or can opt out and stay with their existing service provider. The CCA buys power from existing sources of generation on behalf of its members and distributes that power using the infrastructure in place, which is still owned by the IOU.[28] The intention is to enable community members to have greater control and management of their electric supply through a manner that requires only organizational, rather than physical, changes.

CCAs may have a number of benefits for communities. Through the collective purchasing power of their members, they may be able to buy power at better rates than what existing IOUs offer. Most effectively, however, the CCA has no profit incentive of its own, so the rates it charges need only be sufficient to cover costs of operation and procurement. Because communities can select where they buy power from, it allows them to prioritize buying power from renewable sources if they choose. In many existing cases, environmental considerations have been a bigger driver of support for CCAs than lower costs, though it is typical that CCAs accomplish both objectives.

One of the strongest arguments in favor of CCAs came from a report by Burke, Finn and Murphy to the CPUC in 2005, with that analysis arguing unequivocally that CCAs could offer substantial cost savings for consumers and efficiency improvements for utilities themselves.[29] Another analysis by McGee and Swaroop that evaluated CCA in California through an environmental justice lens concluded that CCA, by nature of its local focus, is more responsive to a community's needs and priorities. Those priorities may include workforce development, improved energy efficiency, and wildfire resiliency.[30]

While organizing a CCA is not an easy undertaking, the current regulatory environment makes their formation far more expedient and possible than converting from an IOU to a POU. Similar to efforts to organize POUs, the creation of CCA was hampered by lobbying efforts from

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[27] CalCCA, About, Accessed April 2021, https://cal-cca.org/about/.

[28] United States Environmental Protection Agency, "Community Choice Aggregation," Accessed November 2020, https://www.epa.gov/greenpower/community-choice-aggregation.

[29] Garance Burke and Chris Finn and Andrea Murphy, "Community Choice Aggregation: The Viability of AB 117 and its Role in California's Energy Markets," An Analysis for the California Public Utilities Commission, University of California, Berkeley, June 13, 2005.

[30] Alexandra McGee and Shalini Swaroop, "The Power of Power: Democratizing California's Energy Economy to Align with Environmental Justice Principles through Community Choice Aggregation," *Ecology Law Quarterly* 46, no. 4 (2019): 985-1016.

IOUs, as well as the role of CPUC, as detailed by Hess and Lee (2020), in developing policy that made it difficult to form CCAs that could realistically compete with IOUs.

One unique consideration with CCAs is related to the costs associated with developing new sources of generation. Say, for example, the existing utility built a power plant with a 30-year life span and calculated necessary charges on customer bills to pay for the cost of building this plant over that time period. To prevent CCA members from leaving the remaining costs with customers who stay with the existing utility, a charge is negotiated by the CPUC for the remaining obligation owed by the CCA customers. Determining these charges can be a lengthy and highly litigious proceeding, adding an additional financial burden for communities looking to join a CCA.[31] The CCA members pay for these existing assets on their monthly bill, from which they then receive no access or benefit. A proposed state law, SB 612, would change these conditions to give CCA customers access to these energy resources commensurate with the charges they pay.[32]

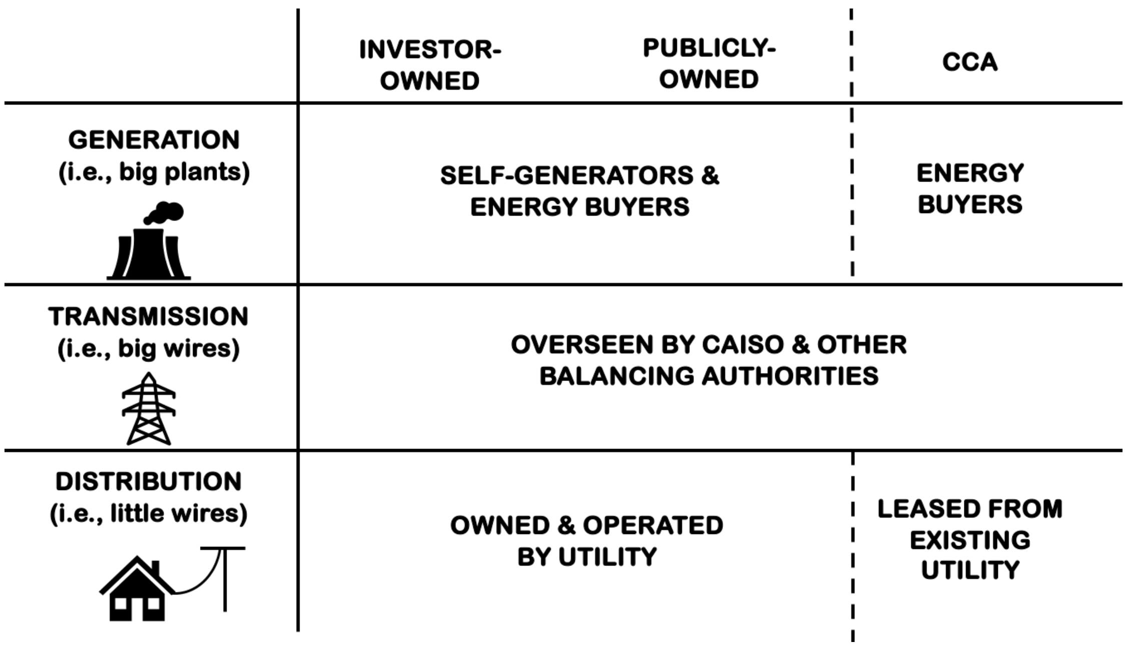

Figure 2: Visualization of key processes for electricity providers[33]

Ultimately, this study is concerned with policy alternatives that amplify the three themes of sustainability, reliability and equity in California's electric utilities. CCAs directly address the issue of local control. They do not, however, contribute a solution to system-wide issues of ensuring adequate generation, expanding renewable sources, and making other physical improvements to the grid. These deficiencies are what has led this study to primarily focus on POUs as a solution to ensure the electric grid in California reaches its goals for sustainability, reliability and equity.

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[31] Personal communication on March 3, 2021, with Simon Baker, Director of Cost, Rates & Planning at California Public Utility Commission.

[32] Ellie Cohen, "RE: SB 612 (Portantino) SUPPORT," The Climate Center, March 24, 2021, https://theclimatecenter.org/wp-content/uploads/2021/03/The-Climate-Center-SB-612-SUPPORT-Mar-24-2021.pdf.

[33] Image created by report author.

Chapter 4: Energy Challenges in California and Future Opportunities

Having provided practical knowledge on how the electric grid works, this report moves on to a more critical examination of the problems facing this system. New technologies jointly offer new pressures and demands on service, but also new possibilities for resolving energy issues. Looming over the entire system is growing threats from climate change, including extreme heat and wildfires. To limit these impacts, the state is making aggressive efforts to reduce its carbon footprint. This chapter overviews these threats and opportunities facing the grid today and in the near future.

Current Use and Sustainability Goals

Energy use in California is unique in a few ways. Per-capita energy consumption for 2019 was the fourth lowest among all 50 U.S. states at 202 million British thermal units (Btu), a measure of heat output.[34] Overall state rankings range from Wyoming at 967 million Btu per capita to Rhode Island at just 187.[35] The U.S. Energy Information Administration attributes California's low ranking to its temperate climate and high efficiency standards. A sizable share of the state's energy usage comes not from heating homes, but powering cars, with transportation (39.1 percent) far outpacing the share of energy usage from residential buildings (18.3 percent).

For the purposes of this study, transportation's share is only relevant in terms of electric vehicles that draw from the grid. That is still a small share. The gasoline gallon equivalent (GGE) of the electric energy used within the transportation sector in 2018 was 21.3 million, while the GGE for gasoline fuel consumption was 14,682.8 million.[36] This total energy need is relevant for forecasting future electricity consumption needs as electric vehicles become more popular, and legally required. While electric vehicles currently make up just 8 percent of new vehicle sales in California, that number has been mandated to reach 100 percent by 2035 per a 2020 executive order from California Governor Gavin Newsom.[37]

For 2019, in-state generation totaled 200,475 gigawatt-hours (GWh), with an additional 77,229 GWh imported from out of state for a total of 277,704.[38] Usage reported from all 58 California counties for 2019 totaled 279,402 GWh.[39] Current sources of electricity generation are provided by data from the CEC in Figure 3, where we see that roughly one third of the energy generated in the state comes from renewable sources, primarily solar and wind.

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[34] U.S. Energy Information Administration, Rankings: Total Energy Consumed per Capita, 2018, Accessed September 2020, https://www.eia.gov/state/rankings/.

[35] Ibid.

[36] U.S. Department of Energy Alternative Fuels Data Center, California Transportation Data for Alternative Fuels and Vehicles, Accessed March 2020, https://afdc.energy.gov/states/ca.

[37] Keith Barry, "California Says New Cars Sold in the State Must Be Zero Emissions by 2035," Consumer Reports, September 23, 2020, https://www.consumerreports.org/hybrids-evs/california-says-new-cars-sold-in-the-state-must-be-zero-emissions-by-2035/.

[38] California Energy Commission, 2019 Total System Electric Generation, Accessed September 2020, https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/2019-total-system-electric-generation.

[39] California Energy Commission, Electricity Consumption by County, Accessed November 2020, http://www.ecdms.energy.ca.gov/elecbycounty.aspx.

The state has aggressive goals for increasing the proportion of energy generated by renewable sources through its Renewables Portfolio Standard (RPS).[40] In 2018, SB 100 accelerated the goals of the existing RPS to demand that the state's electricity grid be comprised of 100 percent carbon-free, renewable energy sources by 2045;[41] an ambitious goal, but one that may be in reach. Just five years ago in 2014, the state's energy portfolio was just over 22 percent renewables, meaning the state has increased that share almost 50 percent in half a decade.[42] An overview of the state's total share of renewable energy for 2019 and sources for both renewable and non-renewable energy is provided in Figure 3.

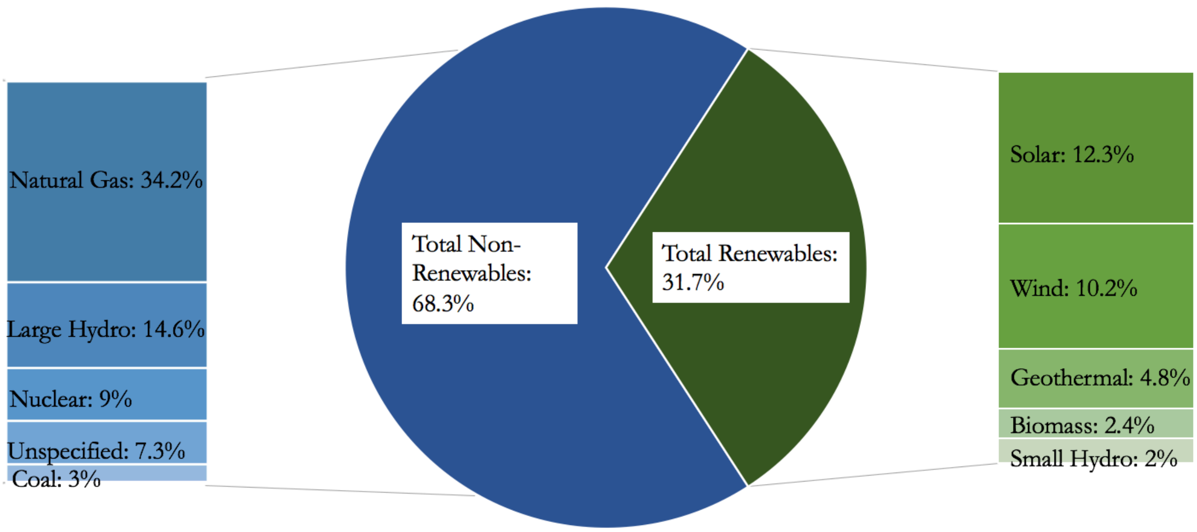

Figure 3: Total California Energy Mix & Sources of Energy (2019)[43]

Increasing demand is a challenge to the state's sustainability goals. Older, fossil fuel powered plants that are slated to be decommissioned are finding their length of service extended to keep up with electricity needs. Along the coast of Southern California, for example, are several natural gas-powered electric plants. In addition to burning fuel, these plants use massive amounts of ocean water to cool down equipment as part of their operation, which warms coastal water and creates adverse effects for marine wildlife. To reduce these impacts, the State Water Resources Control Board (SWRCB) developed standards for the plants to overhaul their cooling systems to dramatically cut their use of seawater, with the end of 2020 as the deadline for compliance.[44] In September of 2020, the SWCRB pushed that deadline back by three years for three of those plants,

[40] California Energy Commission, Renewables Portfolio Standard – RPS, Accessed October 2020, https://www.energy.ca.gov/programs-and-topics/programs/renewables-portfolio-standard.
[41] California State Senate, SB 100 FAQs, Accessed March 2021, https://focus.senate.ca.gov/sb100/faqs.
[42] California Energy Commission, 2019 Total System Electric Generation, Accessed September 2020, https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/2019-total-system-electric-generation.
[43] California Energy Commission, Accessed September 2020.
[44] Dale Kasler, "California is rushing to add solar power. Did recent blackouts just shade our green future?" *Sacramento Bee*, August 23, 2020. https://www.sacbee.com/news/local/environment/article245115560.html.

and by one year for another. That action was in response to pressure from CAISO and CPUC, among other electricity interests, who argued the plants are needed for now to meet power demands.[45]

While progress continues to be made toward adapting renewables, experts caution the need for a gradual transition. "You can't just flip the switch overnight," says Mark Willis, Director of Grid Operations with SMUD. "We're dealing with the largest man-made machine in the world. We will get to zero carbon, but it has to be smooth, and we need to use our thermal resources as a bridge to get there."[46]

High Costs for All Californians

California consumers pay considerably more for electricity than much of the rest of the country. In the U.S., only five states pay more on average than California's Kwh average of 17.92¢, three in New England (Massachusetts, Connecticut and Rhode Island) and the two non-contiguous (Alaska and Hawaii) states.[47] Table A provides a comparison of electricity rates in California, neighboring states and national averages. Electricity costs for Californians are 73 percent more than the national average and compare even worse to rates in neighboring states. Compared to Nevadans, Californians pay 127 percent more.

Table A: California Electricity Rates vs. National Averages and Neighboring States

	Cents per Kilowatt-hour				
	Residential	**Commercial**	**Industrial**	**Transportation**	**All Sectors**
U.S. Averages	12.69	10.31	6.35	9.64	**10.35¢**
California	21.43	16.54	13	9.92	**17.92¢**
% Difference	+69%	+60%	+105%	+3%	**+73%**
Oregon	11.01	8.93	5.76	9.76	**9.06¢**
% Difference	+95%	+85%	+126%	+2%	**+98%**
Nevada	11.53	7.23	4.86	10.39	**7.9¢**
% Difference	+86%	+129%	+167%	-5%	**+127%**
Arizona	11.7	9.34	5.63	8.11	**9.67¢**
% Difference	+83%	+77%	+131%	+22%	**+85%**

Table Source: U.S. Energy Information Administration

45 "California regulators delay natgas plant retirements," Argus Media, September 2, 2020, https://www.argusmedia.com/en/news/2137819-california-regulators-delay-natgas-plant-retirements.

46 Personal communication on March 19, 2021, with Mark Willis, Director of Grid Operations at Sacramento Municipal Utility District.

47 U.S. Energy Information Administration, Table 5.6.A. Average Price of Electricity to Ultimate Customers by End-Use Sector, January 2021, https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_6_a.

There are a number of key reasons for California's higher costs. Much of California's system was developed on the idea of generating power at large scale facilities in remote areas, and transmitting the power generated over great distances.[48] Factor in the sheer size and geographic diversity of the state, and that adds up to significant distances and costs for the system to cover. The root issue leading to past deregulation efforts—lack of competition limiting efforts to increase generation—has also never been fully addressed.

Existing high costs, and efforts to reduce their impacts on lower income Californians, mean a disproportionately high number of Californians qualify for rate assistance. At the same time, households with solar (which tend to by higher income) are also being subsidized. This is putting the squeeze on rate payers in the middle, who must jointly cover the costs of rate assistance for low-income households and subsidies for higher-income solar adopters. Resolving these runaway costs is imperative to the well-being of Californians and long-term health of the state's electricity grid.

Liability from wildfires is a growing contributor to electricity costs. Inverse condemnation laws in California mean that, ultimately, utility companies are responsible for the damage caused by their equipment. This applies to both investor and publicly owned utilities, which have to pay increasingly high costs for liability insurance, when they can get it at all. In the case of IOUs, shareholders are partly on the hook for such damages. With POUs, the rate payers themselves are responsible for covering these costs.

Growing Demand, Increased Disruption

Residential use of electricity tends to follow a seasonal pattern. Usage is at its lowest in cold weather months, as heating systems more often use fuel oil or gas, and then rises in the warmer months as households use more electricity to power air conditioning.[49] A widely understood impact of climate change is lengthier periods of more extreme high temperatures, meaning more days of high electricity usage to cool buildings. This electricity usage is more than a matter of comfort: a 2006 heat wave in California was responsible for the death of 650 people.[50] A 2013 study from researchers at the Lawrence Berkeley National Laboratory estimated that, by the end of this century, rising temperatures will increase California's peak demand for electricity by 10-25 percent.[51]

This additional strain is being added to a system that already regularly features rolling blackouts during peak demand days. In August of 2020, a heat wave that delivered temperatures 10-20 degrees above historical averages led to shutoffs impacting millions of households in California.[52]

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48 Laurence Du Sault, Here's why your electricity prices are high and soaring, CalMatters. March 12, 2021, https://calmatters.org/california-divide/debt/2021/03/california-high-electricity-prices/.

49 Marilyn A. Brown et. al., "Climate Change and Energy Demand in Buildings," Georgia Institute of Technology, 2014, https://www.aceee.org/files/proceedings/2014/data/papers/3-736.pdf.

50 "Preparing California for Extreme Heat: Guidance and Recommendations," California Department of Public Health, October 2013, https://healthyplacesindex.org/wp-content/uploads/2018/02/2013_cph_preparing_california_for_extreme_eat.pdf.

51 Sathaye, J. a., Dale, L. L., Larsen, P. H., Fitts, G. a., Koy, K., Lewis, S. M., & De Lucena, A. F. P. (2013). Estimating impacts of warming temperatures on California's electricity system. Global Environmental Change, 23(2), 499–511. doi:10.1016/j.gloenvcha.2012.12.005

52 Ivan Penn., "Rolling Blackouts in California Have Power Experts Stumped," *The New York Times*, August 16, 2020, https://www.nytimes.com/2020/08/16/business/california-blackouts.html.

Those shutoffs occurred due to a confluence of high demand and an unexpected share of the state's capacity being offline, with Governor Gavin Newsom pointing to poor planning by CAISO as contributing to the shortage.[53]

Climate change is exacerbating an additional source of power shutoffs: wildfires. Hotter, dryer weather, coupled with decades of aggressive fire suppression, has led California to recently experience the largest, deadliest and economically devastating wildfires in its history. 2020 saw the state experience five of the six largest wildfires that have been recorded, including the first fire, the August Complex, to surpass one million acres in size. After PG&E transmission equipment was found responsible for 2018's Camp Fire, which led to the loss of 85 lives, power shutoffs have become a common occurrence for many Californians as a means to curb fire risk on windy days. So, adding to the stress of devastating fires and unhealthy air quality, households in many parts of the state now experience energy volatility throughout the lengthening fire season in late summer and fall.

Population growth in neighboring states is another issue for California's supply of electricity. In past years, the state has been able to buy excess capacity at affordable rates from neighboring states, including Nevada and Arizona. With growing populations of their own, and increased demand caused by a warming climate, there is less excess available for California to purchase. Nevada is also pursuing its own sustainability targets, with voters in the state approving a mandate in November 2020 for 50 percent of the state's electricity to be from renewable sources by 2030.[54] A move toward more renewables may, as California has experienced at times, make Nevada more susceptible to its own shortages in the short-term.

Solving the Transmission Puzzle

Meeting sustainability goals will require a lot more transmission. A research project at Princeton University titled "Net-Zero America" prepared five different scenarios by which the U.S. could achieve rapid decarbonization. To meet carbon reduction goals, a lot more renewable sources of energy must be connected to the grid. This will require expanding transmission networks 60 percent by 2030 and tripling the U.S.'s transmission infrastructure by 2050.[55] That's an enormous challenge to a network already beset by high costs and high levels of bureaucratic complication.

The transmission of electricity, in keeping with all other facets of electricity markets in the U.S., involves many players. In California, most transmission is owned by the major IOUs—SCE, PG&E and SDG&E. The supply of power over these lines is oversaw by balancing authorities, the largest in California being CAISO. Some POUs belong to their own balancing authorities, including the Balancing Authority of Northern California (BANC), LADWP and Imperial Irrigation District

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[53] Ivan Penn, "California Expresses Frustration as Blackouts Enter 4th Day," *The New York Times*, August 17, 2020, https://www.nytimes.com/2020/08/17/business/energy-environment/california-blackout-electric-grid.html.
[54] David Roberts, "Nevada voters seal renewable energy goals in their state constitution," Vox, November 4, 2020, https://www.vox.com/2020/11/4/21536321/nevada-question-6-renewable-energy-results.
[55] Molly Seltzer, "Big but affordable effort needed for America to reach net-zero emissions by 2050," Andlinger Center for Energy + the Environment, December 15, 2020, https://acee.princeton.edu/acee-news/net-zero-america-report-release/.

(IID).[56] California's eight balancing authorities are part of the Western Interconnection (WECC), one of three regional transmission networks in the U.S., the others being the Eastern Interconnection and ERCOT (essentially an independent Texas grid).[57] This interconnection is how California can import energy from neighboring Nevada or Arizona when needed, and vice versa.

These networks include the various independent system operators or regional transmission organizations (RTO) from each state within their territory. Altogether, the three networks form the North American Electric Reliability Corporation (NERC), which also includes all of Canada. For the purposes of transmission in the U.S., these networks take their marching orders from FERC. If that seems like too many acronyms, at least some of them rhyme.

It is here that one might ask, why not one single national grid for the U.S.? Researchers and policy makers are asking this exact question. By one estimate generated by a 2016 study from researchers at the Earth System Research Laboratory at NOAA, "US power consumers could save an estimated US$47.2 billion annually with a national electrical power system versus a regionally divided one."[58] Such a system would benefit from consistency in oversight and investment. Power demand and supply could be better optimized when connected on a national scale. Think of large-scale solar in the southwest powering east coast population centers in the evening when demand is greatest, or west coast population centers tapping into mid-west and east coast power resources as their demand peaks several hours later.

A fractured transmission system also makes building new transmission more difficult. A transmission line crossing multiple states must go through the ISO or RTO for each state, each of which is acting in response to the demands of other state agencies, elected officials, and of course the priorities of their own governors and state legislatures. New lines cross many properties and thus are subject to the objections of many property owners, with objections from a single property owner potentially killing the entire project. Some creative approaches to this right of way issue is to build new transmission in coordination with rail or highway projects, but this then involves buy-in from the rail or transit agencies these projects involve.[59] Additionally, transmission operators are not responsible for the costs of connecting new sources of generation to the existing grid. That responsibility lies with whoever is providing that new generation. That system, to borrow an analogy from report David Roberts, is akin to charging any car that wants to get onto a congested freeway the cost of building a new lane.[60]

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[56] Transmission Agency of Northern California, "A Matter of Balance," Accessed March 2020, https://www.tanc.us/understanding-transmission/a-matter-of-balance/.
[57] David Roberts, "Transmission week: why we need more big power lines," Volts, January 25, 2021, https://www.volts.wtf/p/transmission-week-why-we-need-more.
[58] Alexander E. MacDonald et. al., "Future cost-competitive electricity systems and their impact on US CO2 emissions," Nature Climate Change, January 25, 2016, https://www.vibrantcleanenergy.com/wp-content/uploads/2016/09/Future_cost-competitive_electricity_syst.pdf.
[59] David Roberts, "Transmission week: why we need more big power lines," Volts, January 25, 2021, https://www.volts.wtf/p/transmission-week-why-we-need-more.
[60] Ibid.

Hungry for Data

An economy centered on digital innovation is one that also requires a great degree of energy. Not wanting lag on a Zoom call or a Netflix stream requires building more capacity in the form of data centers. These energy hungry structures present a challenge for energy reduction targets. Researchers at McMaster University estimated that the amount of GHG emissions from data centers will increase 1000 percent by 2040.[61] Such an estimate may prove to be conservative with the growing popularity of digital currencies like Bitcoin and non-fungible tokens even more recently, both of which require huge amounts of data (and thus, energy).

Companies that build these centers are also incentivized to find places where energy is the cheapest. That typically means areas that still depend on fossil fuels. Municipalities that operate their own utilities find themselves caught between the economic incentive of providing an attractive energy environment for these important economic drivers and the need to more rapidly green their energy generation sources.

Planning for Green and Reliable Mass Vehicle Electrification

The State of California is a national leader in encouraging the adoption of electric vehicles (EVs). A 2020 mandate from Governor Gavin Newsom requires new car sales of strictly electric vehicles by 2035. So what exactly will the energy requirements of mass EV adoption look like? And while Californians will no doubt benefit from the removal of tailpipe emissions, might more fuel simply have to be burned in power plants, rather than car engines, to meet this demand?

Reducing car ownership overall is needed to prevent this scenario. That means reversing an overall trend of vehicle ownership that has long pointed upwards. In 2002, there were 20.7 million autos and over 30 million vehicles overall registered with the California Department of Motor Vehicles.[62] As of 2019, those two figures were over 26.1 million and 36.4 million, respectively.[63] Put another way, the state added another 5 million residents in the same time frame it registered an additional 6 million vehicles. If every vehicle on the road today and in the future is replaced by an electric vehicle, it will only be a minor improvement to the myriad environmental impacts of private vehicle ownership.

What the impact of wide-scale EV adoption on the grid will be has not been fully settled. The U.S. Energy Information Administration (EIA) provides very conservative estimates for electricity demand from the transportation sector. Due to slow growth in the adoption of EVs, EIA projects transportation will make up less than 3 percent of all electricity demand by the year 2050.[64]

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[61] Will Knight, "Data Centers Aren't Devouring the Planet's Electricity—Yet," Wired, February 27, 2020, https://www.wired.com/story/data-centers-not-devouring-planet-electricity-yet/.

[62] Brian Alexander, "CALIFORNIA/MOTOR CITY; Almost as Many Vehicles as People, and Every One Says, 'Me!'" *The New York Times*, October 22, 2003, https://www.nytimes.com/2003/10/22/automobiles/california-motor-city-almost-as-many-vehicles-as-people-and-every-one-says-me.html.

[63] State of California Department of Motor Vehicles, Statistics for Publication 2019, March 2019, https://www.dmv.ca.gov/portal/uploads/2020/06/2019-Statistic-for-Publication-1.pdf.

[64] U.S. Energy Information Administration, Annual Energy Outlook 2021, February 3, 2021, https://www.eia.gov/outlooks/aeo/electricity/sub-topic-01.php.

The State of California, in contrast, forecasts that EVs could account for 5.4 percent of electric energy usage by 2030.[65] In 2018, researchers at the University of Texas at Austin's Energy Institute projected how much additional electricity each state will use if every single vehicle is electrified. California checked in with the third highest figure in the country with an estimated 47 percent increase in electricity consumption.[66] The Lawrence Livermore National Laboratory provides some optimistic estimates on overall energy consumption that will result from wider EV adoption. That research projects major energy savings overall from a switch to EVs but illustrates a need for additional generation from natural gas to cover needs that cannot yet be sufficiently met by renewables.[67]

Rapid vehicle electrification is often imagined alongside a similarly rapid adoption of renewables. Using conservative estimates for EV adoption, the assumption that renewables can keep up is reasonable. The realities presented by climate change, however, continue to shift the goal posts for both EV and renewable energy adoption. Timelines for the wide adoption of both continue to accelerate. Corresponding improvements in technology and additional financial commitments are necessary to ensure the further adoption of renewable energy and electric vehicles occurs in lockstep.

A Realistic Vision for Solar

One best-case scenario for mass vehicle electrification includes wider adoption of solar, particularly residential solar. This combination is already seen with many EV owners in California. A 2012 survey by the California Center for Sustainable Energy found almost 40 percent of EV drivers in California had installed home solar.[68] A more recent 2019 survey by CleanTechnica puts the percentage of EV owners in the US with rooftop solar at 38 percent.[69] A high rate of home solar adoption among EV drivers makes logical sense. Both groups draw from a similar pool of higher income individuals with progressive views on energy issues and a tendency to be early technology adopters. The cost of early models of EVs has also limited who can drive them, while installing rooftop solar first requires home ownership. With the demographic overlap between EV and home solar users, the economic incentive of combining these technologies, and recent increases in the

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[65] Alex Brown, "Electric Cars Will Challenge State Power Grids," Pew, January 9, 2020, https://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2020/01/09/electric-cars-will-challenge-state-power-grids.
[66] F. Todd Davidson, "Switching to electric vehicles could save the US billions, but timing is everything," The Conversation, December 4, 2018, https://theconversation.com/switching-to-electric-vehicles-could-save-the-us-billions-but-timing-is-everything-106227.
[67] Liam Denning, "When the Electric Car Is King, Less Energy Is More," Bloomberg, February 1, 2021, https://www.bloomberg.com/graphics/2021-opinion-renewables-will-power-future-of-us-energy/.
[68] California Environmental Protection Agency, "California Plug-in Electric Vehicle Owner Survey," Center for Sustainable Energy, Accessed March 2021, https://cleanvehiclerebate.org/sites/default/files/docs/nav/transportation/cvrp/survey-results/California_PEV_Owner_Survey_Report.pdf.
[69] Zachary Shahan, "EV Ownership + Rooftop Solar Ownership — New Report & Charts," CleanTechnica, December 25, 2019, https://cleantechnica.com/2019/12/25/ev-ownership-rooftop-solar-ownership-new-report-charts/.

adoption of both, it's fair to wonder if the percentage of EV drivers with home solar is higher than surveys indicate.

The connection between EV use and residential solar will lessen as EVs become more widely adopted by middle- and low-income earners. This group is increasingly less likely to own their own homes amidst the statewide affordability crisis. The property owners they rent from have little incentive to install solar, as renters are responsible for paying their own energy bills. While California's 2018 mandate to require solar on all new residential construction will eventually help some renters in this regard, the mandate stops short of covering everyone. Notably, buildings over three stories are excluded from the mandate, which is precisely the type of higher-density buildings that will be needed to house more Californians in the future.[70]

Counting on residential solar to keep more electric vehicles charged presents a dilemma. Drivers returning from work in the early evening and plugging in their vehicles do so during peak energy demand.[71] This is the time of day when utilities often have to buy additional capacity at higher prices, often generated from non-renewable energy sources. Residential solar can fulfill some of this peak need, but not if it is being used to charge EVs. EV users with residential solar need a way to store energy collected during off peak times that they can then plug into overnight. Smart charging systems which only charge at the most optimal time for the grid and to manage costs for the user are another necessary tech fix.

Solving the "when to charge" issue becomes more possible with widespread changes to commute patterns. The COVID-19 epidemic proved the feasibility of more flexible work arrangements for many employers. Employees that recently found themselves in the office five days a week may find themselves working from home part of the week, days on which they are free to recharge their vehicles at off peak hours. This would also reduce the total energy demand from their vehicles. Prior to the pandemic, local governments in the Bay Area were already exploring requiring major employers to offer more work from home days as a means of combatting traffic congestion.[72] Could similar measures be needed to prevent congestion on the grid?

A Better Future Through Technology

The greatest challenge to using more renewable energy is storing that energy for future use. A current advantage of non-renewable sources over renewables is that they can be turned on to meet demand when needed, then just as easily put back offline. Solar panels and wind turbines work great, until the sun is not out, or the wind is not blowing. One proposed solution has been expanding the availability of battery storage. At that same time as those August 2020 outages, the

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70 "Solar Requirements for Commercial and Residential Development in California," Cal Solar Inc, Accessed November 2020, http://www.calsolarinc.com/solar-requirements-for-commercial-and-residential-development-in-California/.
71 Alex Brown, "Electric Cars Will Challenge State Power Grids," Pew, January 9, 2020, https://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2020/01/09/electric-cars-will-challenge-state-power-grids.
72 Roland Li, "Bay Area officials have a plan to combat climate change: force people to work from home," *San Francisco Chronicle*, September 24, 2020, https://www.sfchronicle.com/business/article/Bay-Area-planning-agency-advances-60-work-from-15592276.php.

largest battery-storage system in the world became operational in San Diego.[73] The Gateway Energy Storage Project can store up to 230 megawatts of power, and is one example of what will soon be many similar facilities throughout the state to help develop 3.3 gigawatts of energy storage as part of a strategy to increase the flexibility of the grid (a goal set by CPUC in late 2019).[74] If that target seems ambitious, consider that peak energy usage in the state can reach 50 gigawatts.[75]

Battery farms as currently envisioned are not a perfect solution. They have their own storage limits and are only meant to help fill short gaps in supply (i.e. a few hours). The mineral resources needed to produce them, namely lithium, are also becoming scarcer, and extracting them has its own share of negative environmental impacts.[76] There is also growing competition for lithium for battery storage, from consumer phones and laptops to, increasingly, electric cars. Ultimately, renewable energy's storage challenge will need more feasible solutions than simply building bigger batteries. A 2019 study by researchers at the Massachusetts Institute of Technology estimates that, for renewables to become totally cost competitive with non-renewable sources, energy storage costs will need to decline 90 percent from what they are today.[77]

Combining solar with EVs presents intriguing new possibilities for energy storage. Electric car batteries can store energy collected from rooftop solar panels and provide this power back to the home or into the grid when the sun is down. Companies are also beginning to take the recycled batteries of old electric vehicles and installing them in buildings for energy storage, creating a second life for something extremely resource intensive to produce.[78] While such solutions seem out of reach for most, it is helpful to remember just how fast the costs of a new technology can decline to make it universally accessible. Thirty years ago, cell phones cost thousands of dollars and were a rare sight to most people. In the next 30 years, might we say the same thing about electric vehicles and battery storage for renewable energy in homes?

For now, the most realistic approach to making renewable energy more feasible is flexibility. That means creating adequate capacity for wind generation to cover what solar cannot provide after sundown, and sufficient hydro-electric sources for when the wind dies down. Most critically, it will demand more transmission and an improved national grid for transmitting renewable energy from where it is most available to where it is most needed.

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73 Caroline Delbert, "The World's Biggest Battery Farm Is Alive in California," Popular Mechanics, September 2, 2020, https://www.popularmechanics.com/science/energy/a33783519/worlds-biggest-battery-farm-california/.
74 Eric Wesoff, "Southern California Edison wants its new, huge 770 MW battery storage procurement online fast," PV-Magazine, May 2, 2020, https://pv-magazine-usa.com/2020/05/02/southern-california-edison-wants-huge-770-mw-battery-storage-procurement-online-fast/.
75 CAISO, "California ISO Peak Load History 1998 through 2020," Accessed September 2020, https://www.caiso.com/Documents/CaliforniaISOPeakLoadHistory.pdf.
76 Katwala, Amit, "The spiralling environmental cost of our lithium battery addiction," Wired, August 5, 2018, https://www.wired.co.uk/article/lithium-batteries-environment-impact.
77 Roberts, David. "Getting to 100% renewables requires cheap energy storage. But how cheap?" Vox. September 20, 2019. https://www.vox.com/energy-and-environment/2019/8/9/20767886/renewable-energy-storage-cost-electricity.
78 Hauke Engel "Second-life EV batteries: The newest value pool in energy storage," McKinsey, April 30, 2019, https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/second-life-ev-batteries-the-newest-value-pool-in-energy-storage#.

Additional sources of renewable energy will continue to emerge in the years ahead as well, such as biomass. This is fuel created as a byproduct of the decomposition of organic materials; anything from food scraps, to livestock waste, to potentially even the massive amounts of material that will need to be cleared from California's forests in the coming years to reduce wildfire threats. If that seems insignificant, consider that biomass already accounts for around 5 percent of energy used in the United States.[79]

Also promising is geothermal energy, which taps into the heat provided by the earth's molten core and the movement of tectonic plates beneath the earth's surface. Figure 4 provides an illustration of how it works. One challenge with this energy type is the amount of water required to operate these systems. Silicon Valley Power, which supplies about 6 percent of its non-residential energy needs with geothermal, is creatively meeting this need in a water hungry state by utilizing wastewater in its geothermal plants.[80]

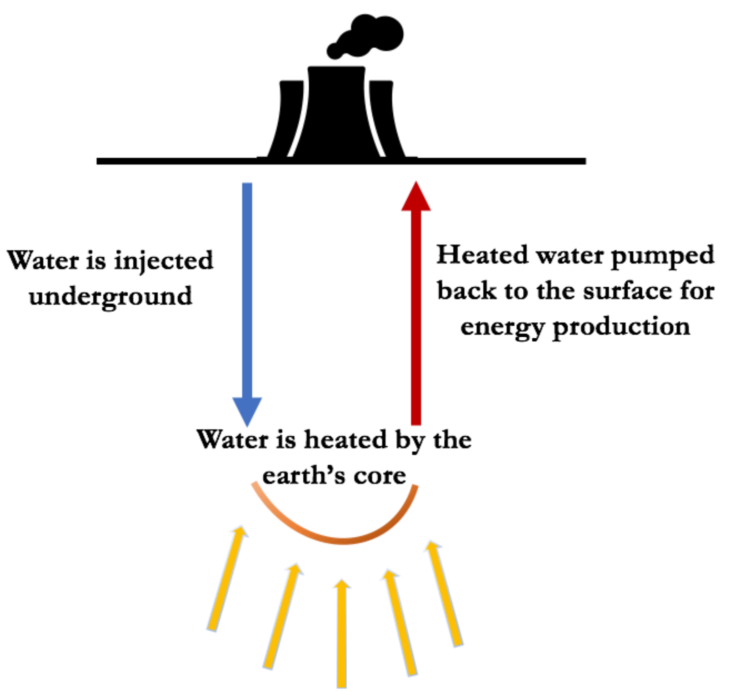

Figure 4: Visualization of Geothermal Energy Process

It seems counterintuitive to describe California as strategically located above a great deal of tectonic activity, but that is exactly the case for tapping into geothermal energy. Of the almost 3.7 gigawatts of geothermal capacity in the United States (which leads all countries), more than 2.7

[79] "Biomass explained," U.S. Energy Information Administration, August 28, 2020, Accessed September 25, 2020, https://www.eia.gov/energyexplained/biomass/.
[80] Personal communication on March 8, 2021, with Kathleen Hughes, Senior Division Manager at Silicon Valley Power.

gigawatts of that capacity is located in California.[81] This is, to excuse the pun, just tapping the surface of the potential of this energy source. Per the Advanced Research Projects Agency of the U.S. Department of Energy, only about 0.1 percent of the total heat content of the earth's core is needed to meet the energy needs of the entire planet for the next two million years.[82] As the technology behind this energy source improves, it could meet a growing share of total energy needs.

[81] David Roberts, "Geothermal energy is poised for a big breakout," Vox, October 21, 2020, https://www.vox.com/energy-and-environment/2020/10/21/21515461/renewable-energy-geothermal-egs-ags-supercritical.
[82] Advanced Research Projects Agency – Energy, "Millimeter-Wave Technology Demonstration for Geothermal Direct Energy Drilling" November 15, 2018, https://www.arpa-e.energy.gov/technologies/projects/millimeter-wave-technology-demonstration-geothermal-direct-energy-drilling.

Chapter 5: The Debate Over Local Choice

How do POUs and IOUs stack up when compared on sustainability, reliability and equity? This chapter overviews the arguments for and against POUs and IOUs and how well those arguments hold up to scrutiny and present reality.

The Argument for Public Power

For proponents of public power, the primary argument comes down to this: publicly owned utilities are only accountable to customers, while IOUs are accountable to shareholders. "There are powerful natural incentives that cause boards and management of POUs to provide the best service they can at the best rates they can," says Bere Lindley, Assistant General Manager at SSJID. "The boards of these POUs are directly accountable to the customer. That makes all the difference."[83]

This underlying system of incentives, public power advocates argue, means public utilities are focused on ensuring excellent service and the best possible rates, while IOUs divert gains to shareholders. "There's no doubt IOUs want to keep the lights on, but financial pressures are focused on profit over costs to consumers," says CMUA's Barry Moline. "With municipal utilities, the conversation is always what is best for the customer. If we operated the entire system with that philosophy, the system would be better."[84]

Cost Comparisons Between IOUs and POUs

Of all the points in favor of POUs, the most compelling is costs for consumers. Consider the excessive rates many Californians pay for electric service. POUs, by nature of their smaller size, can localize their services to address inefficiencies and lower these costs. "Having these large utilities creates inefficiencies when they are working with different loads and demands in all these different regions and geographies," says Peter Rietkerk, General Manager of SSJID. "Having a more localized utility allows for more efficiency."[85] SSJID's proposed takeover of electric service from PG&E, as one example, projects it will immediately provide cost savings of at least 15 percent for customers. POU rates, on average, are 13.5 percent lower than IOU rates.[86] Another contributing reason is that POUs, unlike IOUs, do not have a profit incentive. These providers only need to charge what is required to maintain the service.

Lowering costs overall is critical to address issues of equity. If rates are lower, than fewer households will experience hardship in paying them. POUs, by and large, also have their own ratepayer discount programs. Similar to the state-mandated CARE program offered by IOUs,

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[83] Personal communication on April 15, 2021, with Bere Lindley, Assistant General Manager at South San Joaquin Irrigation District.
[84] Personal communication on March 2, 2021, with Barry Moline, Executive Director of California Municipal Utilities Association.
[85] Personal communication on March 29, 2021, with Peter Rietkerk, General Manager at South San Joaquin Irrigation District.
[86] California Municipal Utilities Association, "California Publicly Owned Utilities," July 2020, https://www.cmua.org//Files/About%20CMUA/CMUA_InfoBooklet_energy_July2020.pdf.

LADWP discounts rates by 30-40 percent for qualified households. SMUD offers rate discounts in tiers from $10-$70 off the monthly bill based on household income (an average monthly bill, for reference, ran about $110 in 2017).[87] A comparison of case study POU and IOU rates is provided in Table B. A full table of rates for all California POUs is provided within the appendix.

Table B: Cost Comparison Between IOUs and POUs (2019)

	Average Electricity Rates, 2019 (cents per kWh)			
	Residential	**Commercial**	**Industrial**	**Total**
Provider Averages				
Publicly Owned	17.2	16.0	12.4	**15.7¢**
Investor-Owned	19.4	17.4	16.8	**18.1¢**
Investor-Owned				
Southern California Edison Co	16.2	14.4	10.8	**14.8¢**
Pacific Gas & Electric Co.	22.3	22.9	19.4	**21.6¢**
San Diego Gas & Electric Co	25.8	23.5	19.2	**23.8¢**
Publicly Owned				
Los Angeles Department of Water & Power	20.0	18.1	17.7	**18.8¢**
Sacramento Municipal Utility District	14.9	13.9	10.6	**13.7¢**
Silicon Valley Power	12.6	16.4	11.5	**11.7¢**
SSJID (Projected)	**15% Below Current PG&E Rates**			

Table Source: California Municipal Utilities Association, SSJID[88] [89]

[87] SMUD, Low-income assistance and nonprofit discount, Accessed March 2021, https://www.smud.org/en/Rate-Information/Low-income-and-nonprofits.
[88] Personal communication on March 2, 2021, with Barry Moline, Executive Director of California Municipal Utilities Association.
[89] SSJID, South San Joaquin Irrigation District Retail Electric Financial Analysis, June 2016, https://www.ssjid.com/wp-content/uploads/2019/02/2016-MRW-Financial-Analysis.pdf.

Reliability Measures for IOUs and POUs

Reliability and level of service is another point that favors POUs. Overall, POUs average half the amount of disruption time per customer as IOUs. Table C provides a comparison of the state's three largest IOUs and three largest POUs on two measures of service, System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI). SAIDI is a calculation of the number of minutes of interrupted service per customer, while SAIFI is the average number of such incidents experience by each customer. For this table, SAIDI's figures in minutes are converted to hours.

Table C: Comparison of Service Quality Between POUs and IOUs

	Annual service outages per customer*	Annual hours of outages per customer**
Investor-Owned		
SCE	0.87	2.28
PG&E	1.05	4.65
SDG&E	0.66	2.02
Publicly Owned		
LADWP	0.9	2.93
SMUD	0.93	0.75
Silicon Valley Power	0.41	0.71
All IOUs		**3.8**
All POUs		**1.5**

* SAIFI

** SAIDI/60

Table Source: Agency Websites, CPUC

Sustainability Measures for IOUs and POUs

Environmental and green energy advocates have argued that IOUs are the best pathway to quickly grow the share of electricity generated by renewables. The state legislator and governor of California can immediately update sustainability standards for IOUs through legislation and mandates. "IOUs are a convenient implementer of state policy, whether dealing with climate or social issues," says Simon Baker, Director for Costs, Rates, and Planning with CPUC. "With POUs, there may be different policy priorities between these organizations and their governing boards are the ultimate deciders."[90]

[90] Personal communication on March 3, 2021, with Simon Baker, Director of Cost, Rates & Planning at California Public Utility Commission.

"It's easier to have three big IOUs to affect through government mandate," says SSJID's Lindley. "When you have a mosaic of local utilities, they won't all agree on how to make the world a better place."[91]

Local governments can also advocate for even more aggressive action using their negotiating power when renewing franchise agreements with IOUs. The City of San Diego's ongoing discussions with SDG&E is a recent example of this.[92] Then there is simply the argument of the advantages of scale that IOUs have. IOUs, with more resources, can build new renewable capacity at larger scale than POUs, and deliver it to more people.

Because of their greater autonomy, municipal utilities may operate under different standards and timelines for meeting green energy goals. Consider a scenario where a POU invested in a natural gas plant meant to operate for 30 years. If five years into operation the state mandates a higher standard for renewables, that would impose a significant financial hardship for the POU. IOUs may face similar quandaries but are better situated to absorb large capital costs and increase their renewable mix elsewhere by virtue of their size.

Preserving low rates may take precedence over immediate environmental concerns for POUs. LADWP's reliance on coal firing plants to meet 21 percent of its energy needs (compared to 3 percent for the state average) is a relevant example.[93] On this standard, the state's largest POU has lagged behind the IOUs on clean energy progress.

For public power advocates, greater autonomy is a benefit rather than a fault. POUs are also not immune to state regulation and still fall under the state's RPS. Action by the state legislature and governor's office to aggressively pursue sustainability goals is still an available avenue with POUs. In a number of cases, POUs have set even stricter targets than what is mandated by the state. The city of Palo Alto achieved carbon neutrality in its energy portfolio back in 2013. SMUD plans to provide 100 percent carbon-neutral electricity by 2030, which would beat the state's mandate by 15 years.[94] Per CMUA, California's POUs will draw 60 percent of their power from renewable sources by 2030, putting them on track to meet state clean energy targets.[95]

Table D provides the power sources for the state's three largest IOUs and POUs. Each has made progress to meet the state renewable standards, with SVP and SDG&E as particular standouts. Here, biomass, geothermal, solar, wind, and small hydroelectric are counted as renewable sources (large hydro, facilities over 30 megawatts, is excluded due to its effects on wildlife and other myriad impacts). Unspecified power includes purchases through the open market that cannot be linked back

[91] Personal communication on April 15, 2021, with Bere Lindley, Assistant General Manager at South San Joaquin Irrigation District.
[92] Rob Nikolewski, "San Diego rolls out timeline for new electric and gas franchise agreement," *San Diego Union-Tribune*, January 28, 2021, https://www.sandiegouniontribune.com/business/story/2021-01-28/san-diego-lays-out-timeline-for-new-franchise-agreement-negotiations.
[93] Carl Smith, "America's Largest Municipal Utility Invests in Move from Coal to Hydrogen Power," Governing, April 15, 2020, https://www.governing.com/next/Americas-Largest-Municipal-Utility-Invests-from-Coal-to-Hydrogen-Power.html.
[94] Personal communication on March 22, 2021, with Maria Veloso Koenig, Director of Grid Planning at Sacramento Municipal Utility District.
[95] California Municipal Utilities Association, "California Publicly Owned Utilities," July 2020, https://www.cmua.org//Files/About%20CMUA/CMUA_InfoBooklet_energy_July2020.pdf.

to a specific source. That could mean wind farms, but more likely natural gas or coal firing plants in other states.

Table D: Power Content by Utility, 2019

	Renewable*	Nuclear	Large Hydro	Natural Gas & Other Fuels	Coal	Unspecified
State Average	32%	9%	15%	34%	3%	7%
IOUs						
PG&E	29%	44%	27%	0%	0%	0%
SDG&E**	43%	0%	0%	29%		27%
SCE	35%	8%	8%	16%	0%	33%
POUs						
LADWP	34%	14%	4%	27%	21%	0%
SMUD	28%	1%	44%	27%	0%	0%
Silicon Valley Power	46%	0%	54%	0%	0%	0%

*Biomass, Geothermal, Small hydroelectric, solar, wind

**2018 Data

Table Source: California Energy Commission

While the most remembered legacy of AB 1890 is a statewide energy crisis, there is a particular vestige of the legislation having positive impacts to this day. AB 1890 established a Public Goods Charge to help POUs fund new energy efficiency programs. Additional legislation, including SB 1037 (2005), AB 2021 (2006), AB 2227 (2012) and SB 350 (2015), created standards for reporting these efficiency increases every three years and identifying sources of additional efficiency in the future.[96] 2017 reporting from California's POUs notes that, since the passage of 1037 in 2005, these utilities have invested $1.37 billion in energy efficiency programs.[97] IOUs have their own requirements for efficiency improvements as set by 2003's California Energy Action Plan and for reporting the costs of all programs as set by AB 67 (2005). The latest report from the state's IOUs in accordance with AB 67 also lists, not surprisingly, greater spending on energy efficiency programs for IOUs overall ($391 million in 2019 alone).[98]

[96] "Energy Efficiency in California's Public Power Sector." California Municipal Utilities Association. 2017.
[97] Ibid.
[98] "California Electric and Gas Utility Cost Report." California Public Utilities Commission. April 2020.

The Path to Public Ownership

Considering the advantages of public ownership displayed by existing POUs, it would seem likely that other local jurisdictions would pursue a similar path. But transferring ownership from an existing IOU to a POU is an arduous, and near impossible task. In interviews for this report, public power advocates were asked the likelihood that California would add additional POUs in the future. The consensus chances these advocates gave were near zero. "It truly feels like there does not exist a significant effort to reform utilities in California and at least pave the way for this to be a viable option," says Peter Rietkerk, General Manager of SSJID.[99]

The difficulty of converting from an IOU to a POU is not surprising. Preventing this from occurring is life and death for the IOUs. More public power customers means fewer customers for the IOUs. A wide-scale movement to create many POUs would threaten the existence of IOUs altogether. Despite the difficulties presented in attempting to create a POU, this study sought to understand what that pathway looks like.

A useful recent example that illustrates this process in greater detail is provided by SSJID. This publicly owned utility that currently provides water service in Escalon, Ripon and Manteca, California has been fighting since 2004 to take over the provision of electric service in its jurisdiction from PG&E.

Efforts to convert to public power are typically rooted in consumer dissatisfaction with the current utility. That may be due to poor service from the existing IOU, high rates or a desire to more rapidly green the system. In SSJID's case, the district has been a producer of power through a hydroelectric dam it operates, with a long running relationship of selling that power to PG&E. Eventually, the district became interested in the feasibility of selling that power directly to customers, finding it could do so at a lower cost and higher standard of service. The utility, with the backing of its publicly elected board, first began pursuing a takeover of PG&E's assets in 2004.

Gathering sufficient local support means establishing that a POU can outperform the IOU, which requires intensive study. This creates upfront costs with no guarantee of success. The proposed POU likely has to outperform the IOU to a sufficient degree to justify the time, money and effort required to take on the process of a public takeover. In SSJID's case, the utility established that it could immediately provide service at rates at least 15 percent lower than those offered by PG&E. The utility based this on the following factors: "SSJID does not pay dividends to shareholders; SSJID has fewer layers of management and its upper management is paid substantially less than PG&E's; Its rates are limited to the cost of services without a profit margin and are set by the District's locally-elected Board in public meetings; As a public entity of the State of California, SSJID does not pay taxes; (and) SSJID is eligible to issue debt that is exempt from federal income tax, making it cheaper to invest in the system's infrastructure."[100]

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[99] Personal communication on March 29, 2021, with Peter Rietkerk, General Manager at South San Joaquin Irrigation District.

[100] SSJID, Staff Report Resolution of Necessity Hearing For SSJIDs Retail Electric Project Property Acquisition, February 2019, https://www.ssjid.com/wp-content/uploads/2019/02/Staff-Report-Resolution-of-Necessity-Hearing-For-SSJIDs-Retail-Electric-Project-Property-Acquisition.pdf.

Detailed plans for the operation of the POU itself must be prepared. From there, approval is necessary from the network of local and state level agencies responsible for the oversight of utilities in the area. In 2006, SSJID's first proposal to take over PG&E's service was denied by the San Joaquin Local Area Formation Commission (LAFCo), a county agency whose responsibilities include annexations, land use disputes between jurisdictions, and oversight of local agreements with services providers. SSJID would resubmit this proposal again in 2009, with approval being granted by LAFCo in 2014. SSJID then began the additional process of taking over PG&E's assets using eminent domain.

If the POU proves feasible and strong enough public support has been established, a detailed plan for taking over assets from the IOU, a process called condemnation, is created. The IOU would need to be paid for existing generation assets and other equipment that the POU would take on, a significant obligation for the POU and ratepayers. At the time SSJID submitted their application to LAFCo in 2009, SSJID's studies determined those assets to be worth in the range of $48-65 million. PG&E's calculation for their value was $420 million. As of 2019, SSJID's offer to PG&E was $116 million.

Raising money to pay for these assets may be done with bonds approved by voters. Creating referendums to support public power, even when there is broad public support for it, is risky. A proposed expansion of SMUD's service into Davis, West Sacramento and Woodland in 2006 lost narrowly in a public referendum.[101] A key reason is that, while PG&E could spend freely to oppose the measure, SMUD was prevented from campaigning for the measure because of its position as a public agency.

In 2019, the city of San Francisco made its own offer to PG&E for its assets in the city for $2.5 billion.[102] The city first pursued forming a POU as a result of the 2000-01 energy crisis. These early efforts failed after two voter initiatives in 2001 and 2002 were effectively contested by PG&E. Reasons for that failure include the success of PG&E in organizing a broad political coalition and spending heavily to oppose the initiative.[103] Both examples reflect a conclusion of several studies on the subject, including Hess and Lee (2020) and Toninelli (2008), that policy decisions concerning utilities may be driven more by politics than pragmatism. Due to these risks, SSJID has been hesitant to rely on public referendums to support its takeover or raise funds to enable it.

Even with necessary agency approvals in hand, a lengthy legal battle is likely between the IOU and the organizing authority for the POU to prevent a takeover. Following the 2014 LAFCo decision, PG&E sued to overturn. After initially siding with SSJID, the judge in the case overruled the LAFCo decision. PG&E successfully argued that a plan for SSJID to pay a fee in lieu of taxes (PILOT) to local governments to cover lost tax revenue from PG&E was not allowed under the state's constitution. SSJID has appealed that decision, which would also end the district's eminent

[101] "SMUD measures defeated despite close votes in Yolo," Sacramento Business Journal, November 6, 2006, https://www.bizjournals.com/sacramento/stories/2006/11/06/daily23.html.
[102] J.D. Morris, "San Francisco makes $2.5 billion offer for PG&E electric system," *San Francisco Chronicle*, September 8, 2019, https://www.sfchronicle.com/business/article/San-Francisco-makes-2-5-billion-offer-for-PG-E-14422051.php.
[103] David J. Hess and Dasom Lee, "Energy decentralization in California and New York: Conflicts in the politics of shared solar and community choice."

domain proceedings, and the case is still pending in appeals.[104] A brief timeline of SSJID's efforts is provided in Figure 5.

2004	SSJID begins process to take over PG&E assets
2006	LAFCo denies first SSJID application
2009	Second application submitted with LAFCo
2014	SSJID application approved by LAFCo. PG&E sues to overturn
2016	Eminent domain lawsuit filed by SSJID
Present	LAFCo decision pending appeals

Figure 5: Timeline of SSJID's Effort to Take Over PG&E Assets

SSJID's efforts show the lengthy and costly commitment that taking over service from an IOU requires. "PG&E is committed to the idea of fighting any municipalization efforts at any cost," says Lindley. "It's not about whether these individual battles make economic sense for them, but the overall message they send to anyone considering taking them on. Even if you win, it will be extremely costly."[105] The IOUs have every financial incentive in the world to fight, so how can the POUs keep up in such a battle?

[104] Powered by SSJID, South San Joaquin Irrigation District, Accessed March 2021, https://poweredbyssjid.com/process/.
[105] Personal communication on April 15, 2021, with Bere Lindley, Assistant General Manager at South San Joaquin Irrigation District.

Chapter 6: Policy Alternatives and Best Practices for Sustainability, Reliability and Equity

Based on a review of the regulatory environment for California's electric utilities, case study comparisons of IOUs and POUs, and interviews with subject matter experts, this report has developed the following set of recommendations. These are intended for stakeholders at local, state and federal levels to advocate for a more sustainable, reliable and equitable energy future.

Clearing the Way for POUs

As evidenced with SSJID, converting from investor-owned to publicly owned service is a lengthy, expensive, highly litigious process. This discourages efforts at public takeover, with threats to do so limited to a negotiating tactic for improving franchise agreements with IOUs. To achieve the outcomes needed in the electric grid, barriers for POUs to take over service from IOUs must be removed.

Sensible reforms are available to accomplish this. It took SSJID more than a decade to gain approval from LAFCo to offer electricity service to customers. SSJID had to undertake this approval process even though state law already provides the authority for irrigation districts to offer these services.[106] In other words, SSJID had to undergo a lengthy and costly effort to get permission to do what should already be allowed by state law. The state legislature should take action to reaffirm these rights of irrigation districts and, where needed, expand these rights to other public utility operators. Recall the timeline of SSJID's efforts from Figure 5. An updated timeline bypassing the LAFCo process is visualized in Figure 6.

2004	SSJID begins process to take over PG&E assets
~~**2006**~~	~~LAFCo denies first SSJID application~~
~~**2009**~~	~~Second application submitted with LAFCo~~
~~**2014**~~	~~SSJID application approved by LAFCo. PG&E sues to overturn~~
2016	Eminent domain lawsuit filed by SSJID
~~**Present**~~	~~LAFCo decision pending appeals~~

Figure 6 Amended SSJID Timeline With Affirmation of Public Utility Rights

New action by the state legislature should, at a minimum, avoid creating new barriers to POUs. SB 550 passed in 2019, as one example, conditions that any takeover of IOU assets by a

[106] Personal communication on April 15, 2021, with Bere Lindley, Assistant General Manager at South San Joaquin Irrigation District.

POU must not negatively impact the employees that work on these assets.[107] By this law, a POU taking over service in an area must retain any IOU employees who work in that area. That creates an additional financial burden for POUs and limits efficiency gains that could otherwise take place.

Addressing Liabilities from Wildfires

Liability from wildfires is a major contributor to the growing costs for electric utilities in California. California's constitution includes the standard of inverse condemnation. This means that public service providers are responsible for any damage they cause to private property (a utility-scale version of "if you break it, you buy it"). That is why PG&E had to pay billions in damages for fires linked to its faulty equipment. For IOUs like PG&E, this obligation goes back to its shareholders. For POUs, the cost of restitution falls on rate payers. With wildfires becoming an even greater issue, is it responsible to burden the public with all of the potential liability associated with them?

To help manage this liability, the state has created special funds for IOUs to pay into that can be drawn from in the case of a catastrophe. Eligibility for these funds requires maintaining specific safety certifications. POUs are not included in these funds. POUs not in fire prone areas do not want to pay into them and there is uncertainty about what to charge POUs at greater wildfire risk. POUs in fire prone areas should consider a separate shared fund, similar to what the state operates for IOUs, to protect themselves against liability and spread this burden among a larger pool of rate payers.

Inverse condemnation must be reconsidered and amended and limits on liability in fire prone areas imposed. It does not make sense, from an economic or equity standpoint, for all Californians to subsidize those who choose to live in fire prone areas. Doing so encourages building in these areas at a time when it should be curtailed. The current system is not unlike someone building a house on the beach at low tide, then asking for financial renumeration when the tide comes in and washes it away.

Accountability for the safety of the electric system can still occur without inverse condemnation. There can still be civil liability for neglect when injury or loss of life occurs. Criminal, in addition to financial, penalties should occur when this neglect is purposeful. If the leadership of a company puts off needed maintenance to help their bottom line, and that leads to loss of life, the answer should not just be cutting a check, it should also include jail time. Doing this will require a rethinking of criminal justice to hold people with means and power as accountable as we hold those without it.

Fire insurance, mitigation planning, vegetation management, increased inspections, accelerated maintenance, and installation of new equipment and monitoring devices are adding to the costs wildfires impose on utilities. This is raising rates for customers of both IOUs and POUs. Whether the state moves toward greater public management of utilities or not, this is an issue that requires attention.

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[107] SB-550 Public utilities: merger, acquisition, or control of electrical or gas corporations, October 2, 2019, https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201920200SB550.

The End of IOUs

Devastating wildfires linked to faulty PG&E equipment motivated calls from figures including California Governor Gavin Newsom and San José Mayor Sam Liccardo for a public takeover of electric utilities. In spite of these calls, there has been no meaningful progress on this issue. One recent piece of legislation, 2020's SB 917, proposed using eminent domain to facilitate a takeover of PG&E's assets and creating a publicly owned Northern California Energy Utility District. Despite incredible public animosity for PG&E, the bill died in committee before the end of the year.[108] Bankruptcy proceedings for PG&E were another avenue by which the state could have advocated for stricter control of the utility, if not an outright public takeover. The company exited those deliberations in June of 2020 while avoiding any significant reform.[109]

The state of California must consider bold steps to either take over IOU assets itself or create a pathway for local agencies to do so. The condemnation of IOU assets by the state of California would be the most expedient path to more publicly owned power. PG&E's latest bankruptcy proceedings were a missed opportunity to undertake this bold step. How long can it be, however, until a similarly calamitous fire lands PG&E back in bankruptcy court? In the interim, Californians are left to hope for increased accountability for IOUs through new legislation. Efforts to achieve this could make the job performed by IOUs harder, and less profitable, over time. Long-term, this may affect a tipping point where these enterprises may be more open to a public takeover.

Legislative action should be taken to level the playing field for POUs and IOUs. Recall the example of SMUD and the City of San Francisco using referendums as a means to expand public power. These efforts failed in part because the IOUs, as private companies, could spend freely to campaign against such initiatives. IOUs are also free to give financial support to the state legislators responsible for passing reforms. POUs, by nature of being public agencies, are limited in their ability to campaign on their own behalf. Broader reform to campaign financing and limits on corporate political spending should be pursued to the greatest extent possible.

Taking over a private industry is messy, and messier considering the varied ties between the industry, the government and private citizens. Among PG&E's shareholders, for example, is the pension program for state employees, CalPERS. This investment makes sense considering the returns these companies make. A public takeover of IOUs cannot occur without the divestment of these public programs from IOUs.

Statewide condemnation of utility assets would require a massive upfront payment to the IOUs. Couple this with the costs of necessary improvements to the system, and the full sticker price for a public takeover may run into the hundreds of billions of dollars. It would be a tough pill to swallow for California taxpayers. But, as with most prescriptions, the long-term cost of doing nothing would be far greater. This initial massive public investment would provide long-term cost

[108] SB-917 California Consumer Energy and Conservation Financing Authority: eminent domain: Northern California Local Energy Utility District: Northern California Energy Utility Services, February 3, 2020, https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201920200SB917.
[109] Sammy Roth, "Meet the new PG&E. It looks a lot like the old PG&E," *The Los Angeles Times*. June 17, 2020, https://www.latimes.com/environment/story/2020-06-17/pge-bankruptcy-new-pge-looks-like-old-pge.

savings for Californians, reduce risks to life and property from outdated equipment, and put the state further on track to meeting its climate goals. With the potential for additional federal spending to improve electric infrastructure, the state may not need to take on this burden all on its own.

A National Effort on Infrastructure and Transmission

More transmission is needed to ensure the reliable flow of sustainably sourced energy at low prices for consumers. At the same time that China is committing massive resources to upgrading its transmission infrastructure, the U.S. has been slow to address its own system.[110] That may be changing. The recently proposed American Jobs Plan, a proposal for more than $2 trillion in infrastructure spending, includes tax credits to incentivize transmission projects. It also would establish a new authority within the Department of Energy to help these projects take better advantage of existing rights-of-way.[111] For example, rail and transit projects could be used as opportunities to create new transmission lines. One ongoing effort is a plan to install 349 miles of underground transmission along an existing rail line to connect wind farms in Iowa to suburban Chicago.[112] Regional transportation projects for rail and roadways throughout the country present limitless possibilities for this sensible combination of transit and transmission.

A sweeping federal infrastructure plan with financial support for new transmission would be a step in the right direction. While the price tag may seem high, the growth these projects will create will more than make up for it. Per a 2018 study from the National Renewable Energy Laboratory, every $1 spent on improving the grid would create $2.50 worth of new benefits.[113] These benefits include new jobs, both in transmission and the renewable energy generation it would support, and cost savings for rate payers.

Fully overcoming the present challenges to this system requires an even more aggressive step: the creation of a single, unified national grid. Consider that much of the energy for wind and solar is in states with low energy demands. Connecting this energy to where it is most needed would mean cost savings for energy hungry states, economic growth for states able to produce ample renewable energy, and lower rates and cleaner energy for consumers across the country. A single, unified grid would enhance the efficiency of the entire transmission network and lead to better coordination in the use of available energy resources.

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110 "China Develops $26bn Ultra High Voltage Electrical Grids to Stimulate Economic Recovery," Power Technology, May 22, 2020, https://www.power-technology.com/comment/china-26bn-uhv-grids/.
111 David Roberts, "The coolest parts of Biden's expansive infrastructure plan," Volts. April 2, 2021, https://www.volts.wtf/p/the-coolest-parts-of-bidens-expansive?.
112 David Roberts, "Transmission fortnight: burying power lines next to rail & roads to make a national transmission grid," Volts, February 1, 2021, https://www.volts.wtf/p/transmission-fortnight-burying-power.
113 David Roberts, "Transmission week: why we need more big power lines," Volts. January 25, 2021, https://www.volts.wtf/p/transmission-week-why-we-need-more.

Building Equity in the Grid

Subsidies have been a common approach to encourage adoption of EVs and home solar. Now, policy makers are getting a better understanding of the impact of these subsides on equity. Early adopters of home solar, by and large, are not low-income persons. A subsidy may have paid for their solar, and then the homeowner gets the benefit of a lower electricity bill. Other rate payers get no such discount and effectively pay the homeowner for the solar power they generate. A study by SMUD of its own subsidies found that solar customers were overcompensated for the value of their solar, costs that added an additional $45 every year to the bills of non-solar customers.[114] This has been a tremendously effective incentive structure for encouraging solar adoption, but with negative consequences for equity.

Some utilities have created targeted subsidies for lower-income households, but this fails to address the system-wide disparities created by solar haves and have nots. Investment in renewables needs to be redirected from residential scale solar to large scale renewable projects that serve the entire grid. This is the only way to deliver adequate renewable energy to meet sustainability goals, lower costs overall and prevent an unequal distribution of benefits among customers.

The best way to address equity concerns throughout the grid is to control the rising costs of service. That requires a wide spate of reforms: more transmission; shifting utilities away from profit-motivated IOUs; controlling for costs imposed by wildfires; and lowering the costs to build and generate renewable energy. The conversation about equity cannot be just about equity. Solve the root problems leading to high costs and there will be fewer issues with affordability. Programs to help low-income households at that point will be even more effective, efficient and available to help more Californians.

The Intersection of Land Use and Energy Planning

The issues in front of California's electric grid can be overwhelming in their scale. Despite the scope of these issues, there is massive potential for meeting big picture challenges through improved planning and coordination of resources on a local scale. Here lies the realization of the intersection of planning and publicly owned utilities.

This intersection will be best achieved by concentrating control of the electric energy supply on the municipal level. Planning, invariably, is highly concerned with sustainability, as is the current regulatory environment around electrical energy production and distribution. It is on this issue where urban planning and the management of energy can achieve greater mutual benefit through improved coordination and alignment. Cities already plan for population growth, new jobs, housing, commercial space and transit to reduce vehicle miles travelled (VMT). Is it not a natural progression of this planning to account for energy use?

Many cities and towns have moved forward with their own climate action plans that exceed state standards and include faster timelines for meeting their goals. Such plans may include new

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114 SMUD, Getting Solar Right, Accessed March 2020, https://www.smud.org/en/Rate-Information/Getting-solar-right.

approaches to land use planning to promote denser, more efficient use of space and encourage the use of active and public transit. Individual cities and their departments often have specific goals for achieving carbon neutrality in their own operations. San Francisco, as just one example, has the goal of becoming a carbon neutral city by 2050.[115] On such targets, planners and energy providers must work in lockstep to the mutual benefit of one another.

It is tremendously valuable for municipal utilities to combine local land use planning with planning for existing and future energy needs. EVs provide an immediate test case. There is a push to expand EV infrastructure, including charging stations, as quickly as possible. At the same time, planners are working to encourage greater use of public and active transit. These efforts must be coordinated to ensure broader EV adoption does not lead to more driving and VMT, and that active and public modes that improve equity and sustainability (not to mention reduce congestion) are more widely adopted. These coordinated efforts can be part of a longer-range reimagining of the built environment as something that does not detract from environmental quality, or further pull resources from it, but that enhances and strengthens it. By reorganizing electric utilities at city scale, more holistic planning toward equity, sustainability and carbon-neutrality is possible.

[115] Dominic Fracassa, "SF mayor sets aggressive goal to shrink city's carbon footprint to net zero by 2050," *San Francisco Chronicle*, September 5, 2018. https://www.sfchronicle.com/bayarea/article/SF-mayor-sets-aggressive-goal-to-shrink-city-s-13204632.php.

Chapter 7: Conclusion

Purpose and Findings

The creation of the electric grid was a remarkable achievement, but reform is necessary to ensure it serves the best interests of Californians in the decades to come. This report has established the escalating threat to this system from extreme heat and wildfires occurring conjointly with escalating demands and reliance on the system. A necessary shift to carbon free energy is occurring, but further technological innovation is needed to make the shift to 100 percent renewables possible. Amidst this, Californians are already faced with disproportionately high electric bills, and many are already in need of payment assistance.

There is no silver bullet to address these issues of sustainability, reliability and equity, but an organizational shift in how power is managed can deliver immediate benefits in all three areas. This research shows that publicly owned utilities deliver more reliable service at lower costs than investor-owned utilities without sacrificing progress toward greater sustainability. The research also finds, however, that adopting more public power in California is almost impossible.

Aggressive action is needed to change this reality. These include a broad effort to adopt public power statewide. Barriers to this private to public shift must be lifted, and the competitive advantages that private companies possess to contest this effort must be curtailed. At the same time, massive investment is needed to expand transmission and develop more utility scale renewable energy. With the broader realization of publicly managed power, planning for the state's energy future can be more closely aligned with land use and transportation planning to improve outcomes for all.

The final alternatives presented by this study give careful consideration to the political environment that may hinder efforts toward a more well-suited regulatory environment for municipal utilities. As Hausman and Neufeld (2011) prudently note, the complexity of current systems, "makes broad reform of the industry politically difficult to accomplish."[116] However, a review of historical events shows that reform is possible.

Additional Research

This report is intended to provide a wide-ranging review of the issues effecting California's grid. It works to capture their root causes and the coming events that may exacerbate them. The existing research it draws from is diverse and comprehensive. By bringing this diversity of information into one place, it intends to elevate the conversation on how best to reform electric utilities in California. It is, intentionally, broad in its scope. An entire report could be composed on just SSJID's specific efforts at taking over electric service from PG&E, or on SMUD's operations and past efforts at expansion. Any researcher interested in pursuing these topics will be well served by the background and context provided by this work.

[116] William J. Hausman and John L. Neufeld, "How politics, economics, and institutions shaped electric utility regulation in the United States: 1879–2009."

The findings relating POUs to the work of urban planners are also cursory. A full report could be prepared on just the relationship between planners and other functions of local government, including utility providers. Those interested in this area would do a great service to the planning field by carrying out further research on this topic. It is broached here to relate this research to the field of planning and the big picture ideas of sustainability, equity and quality public services that planners are immensely concerned with.

Appendices

Appendix A: Total California Energy Mix and its Sources (2019)

Summary of Fuel Types	Total California Power Mix	Total California Energy Mix (GWh)	California In-State Generation (GWh)	Percent of California In-State Generation	Total Imports (GWh)	Percent of Imports
Non-Renewables and Unspecified Totals	68.30%	189,672	136,139	67.91%	53,533	69.32%
Renewables Totals	31.70%	88,032	64,336	32.09%	23,696	30.68%
Fuel Types						
Natural Gas	34.23%	95,057	86,136	42.97%	8,921	11.55%
Large Hydro	14.62%	40,603	33,145	16.53%	7,458	9.66%
Solar	12.28%	34,090	28,513	14.22%	5,577	7.22%
Nuclear	8.98%	24,945	16,163	8.06%	8,782	11.37%
Wind	10.17%	28,249	13,680	6.82%	14,569	18.87%
Geothermal	4.77%	13,260	10,943	5.46%	2,318	3.00%
Biomass	2.44%	6,787	5,851	2.92%	936	1.21%
Small Hydro	2.03%	5,646	5,349	2.67%	296	0.38%
Other (Waste Heat, etc.)	0.15%	422	411	0.20%	11	0.01%
Coal	2.96%	8,233	248	0.12%	7,985	10.34%
Oil	0.01%	36	36	0.02%	0	0.00%
Unspecified	7.34%	20,376	0	0.00%	20,376	26.38%
System Totals	100.00%	277,704	200,475	100.00%	77,229	100.00%

Table Source: California Energy Commission[117]

[117] California Energy Commission, Accessed September 2020.

Appendix B: Full Table of Cost Comparisons Between IOUs and POUs (2019)

Average Revenue per kWh, 2019 (in cents)	**Residential**	**Commercial**	**Industrial**	**Total**	
Provider Averages					
Publicly Owned	17.2	16.0	12.4	15.7	
Investor-Owned	19.4	17.4	16.8	18.1	
Investor-Owned					**Total Electricity Delivered (GWh)**
Southern California Edison Co	16.2	14.4	10.8	14.8	98,307
Pacific Gas & Electric Co.	22.3	22.9	19.4	21.6	91,360
San Diego Gas & Electric Co	25.8	23.5	19.2	23.8	18,306
PacifiCorp	12.9	15.0	13.6	13.7	736
Liberty Utilities	13.4	13.9	-	13.6	558.0
Bear Valley Electric Service	26.4	27.1	18.1	25.5	121.0
Publicly Owned					
Los Angeles Department of Water & Power	20.0	18.1	17.7	18.8	21,754
Sacramento Municipal Utility District	14.9	13.9	10.6	13.7	10,294
Silicon Valley Power	12.6	16.4	11.5	11.7	3,774
IID Energy	12.3	11.9	15.1	12.2	3,453
Modesto Irrigation District	17.4	14.3	10.2	14.2	2,455
Anaheim Public Utilities	17.0	17.8	14.4	16.2	2,312
Riverside Public Utilities, City of	16.3	16.7	11.9	14.4	2,191
Turlock Irrigation District	16.1	13.1	12.4	13.9	2,074
Roseville Electric	15.7	14.0	10.3	13.8	1,144
Burbank Water and Power	15.8	15.1	-	15.3	1,076
Glendale Water & Power	20.1	17.8	16.3	18.6	1,046
Pasadena Water and Power Department	20.1	18.1	-	18.7	1,043
Vernon, City of	11.8	17.1	13.9	15.1	1,028
Palo Alto, City of	16.0	15.8	14.0	15.5	879
Redding, City of	16.7	16.3	18.1	16.5	738
Merced Irrigation District	16.7	13.2	8.0	11.4	502
Lodi Electric Utility	18.7	17.0	13.5	16.8	408

Colton, City of	15.6	19.5	14.5	16.0	357
Alameda Municipal Power	19.8	17.3	-	18.3	342
Azusa Light & Water	13.3	17.7	11.8	14.3	251
Shasta Lake, City of	16.3	16.7	9.4	11.2	195
Moreno Valley, City of	21.2	13.8	14.1	15.4	194
Corona, Department of Water & Power, City of	14.9	14.5	11.3	13.2	154
Truckee-Donner Public Utility District	16.6	15.8	-	16.2	151
Lompoc, City of	15.4	19.1	15.3	16.7	126
Banning, City of	19.0	20.2	15.1	19.0	123
Lassen Municipal Utility District	16.8	15.5	16.4	16.3	123
Ukiah, City of	15.0	14.2	16.4	14.5	107
Victorville Municipal Utility Services	-	-	12.8	12.8	96.65
Rancho Cucamonga Municipal Utility	16.0	14.0	18.5	14.2	76
Healdsburg, City of	18.4	15.2	15.0	16.3	73
Port of Oakland	-	16.2	16.2	16.2	53
Needles Department of Public Utilities	10.9	10.9	-	10.9	45
Industry, City of	9.6	11.5	-	11.4	39
Gridley, City of	21.4	19.7	22.4	20.5	31
Tuolumne County Public Power Agency (TPPA)	-	8.3	-	8.3	24
Pittsburg Power Co.	23.1	22.6	-	22.7	22
Port of Stockton - (CA)	-	-	15.9	15.9	20
Biggs, City of	17.6	12.9	14.8	15.6	15
Lathrop Irrigation District	19.3	14.8	-	17.9	9
Aha Macav Power Service	9.1	13.6	11.6	11.1	
Kings River Conservation District	-	0.8	-	0.8	
San Francisco (Hetch Hetchy Water & Power), City of	18.9	13.9	4.6	13.3	
Trinity Public Utilities District	9.4	9.8	6.1	9.2	

Table Source: California Municipal Utilities Association

Appendix C: Sample Interview Questions

1. I've spent time in my research exploring threats to the power grid from climate change and wildfires. What do you see as the biggest current and future threat to electric energy grids in California, and how well prepared are we to deal with this threat?

2. What, either in your opinion or among the leadership at your organization, is the best case for the management of energy utilities in California? Is it simply responsible management of IOUs? Should local control play a larger role in the form of CCA or Municipal utilities?

3. What immediately accessible regulatory changes should occur to improve the management of utilities in California without sacrificing stated goals for sustainability, reliability and equity?

4. What broader political, regulatory, or economic changes need to take place to make this best-case scenario possible?

5. What do you see as the greatest fallout from past efforts to reform California's electric energy utilities?

6. 20 years from now, what will be the biggest difference in how energy is generated, distributed and managed in California?

7. What is the hardest part of your job at your organization?

8. Are there any other particular resources you would recommend I check out as part of this research?

9. Is there anyone else you could recommend for me to speak to about this topic?

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