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Analyzing “Sunny” California: A Study of the Role of Solar Energy Subsidies in the Golden State

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**ANALYZING “SUNNY” CALIFORNIA:
A STUDY OF THE ROLE OF SOLAR ENERGY AND SUBSIDIES IN THE
GOLDEN STATE**

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Abstract: With a reputation for mild climate and progressive politicians, it is not surprising that California is at the forefront of the push towards renewable energy, particularly solar energy. But is solar really the energy panacea public opinion makes it out to be? Taking California as an explanatory microcosm, this article delves into the state’s own history with energy legislation and the energy market, as well as the consequences to the public psyche when energy is mismanaged. The article then explores the logistics and statistics of California solar production, while raising questions about the efficacy, extent, and direction of state and federal involvement in the process. This article ultimately concludes that in order to continue progress in the sphere of renewable energy, the focus of the movement should shift away from increasing solar construction and focus instead on increased solar access and the development of high capacity solar storage.

Introduction

In an age dominated by concerns about climate change, it seems like everyone is grasping at ways we can reduce our carbon footprint; people all over the nation are going vegan, ditching plastic grocery bags, and purchasing Prii² in an effort to counteract the effects of global warming. One of the most exciting solutions for western states, particularly California, is the prospect of solar energy. All across the state, miles and miles of black solar panels are being installed at light speed, and, just as quickly, policies incentivizing the use of solar are accelerating rapidly. But is this clean energy source really the cure-all enthusiasts hope it will be?

This paper examines the ambitious goals California has for its future in renewable energy, as well as successes and failures of the steps it has taken in its efforts to achieve them. By first charting the stages and effects of the California Energy Crisis, this paper will

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² “Toyota Announces the Plural of Prius,” *Toyota USA Newsroom*, February 20, 2011 pressroom.toyota.com/toyota-announces-the-plural-of-prius/. “Prii” is the official plural of “Prius”, according to Toyota

lay out the conditions that contributed to California's extensive development of solar technology. In addition, it will outline the current projects the state and federal governments are investing in solar energy projects. Additionally, it will also map out the causes of concern with regard to widespread deployment of solar panels, specifically ways in which the efficacy of solar can be increased in more thoughtful ways than just placing solar panels wherever there is space. It will analyze battery storage, subsidized solar technology development, and the incentives provided to commercial and residential customers for installing solar systems. This paper will ultimately conclude that California's current policy path is inefficient, and, by divesting certain funds toward other projects, how California can more effectively incentivize the use of solar energy.

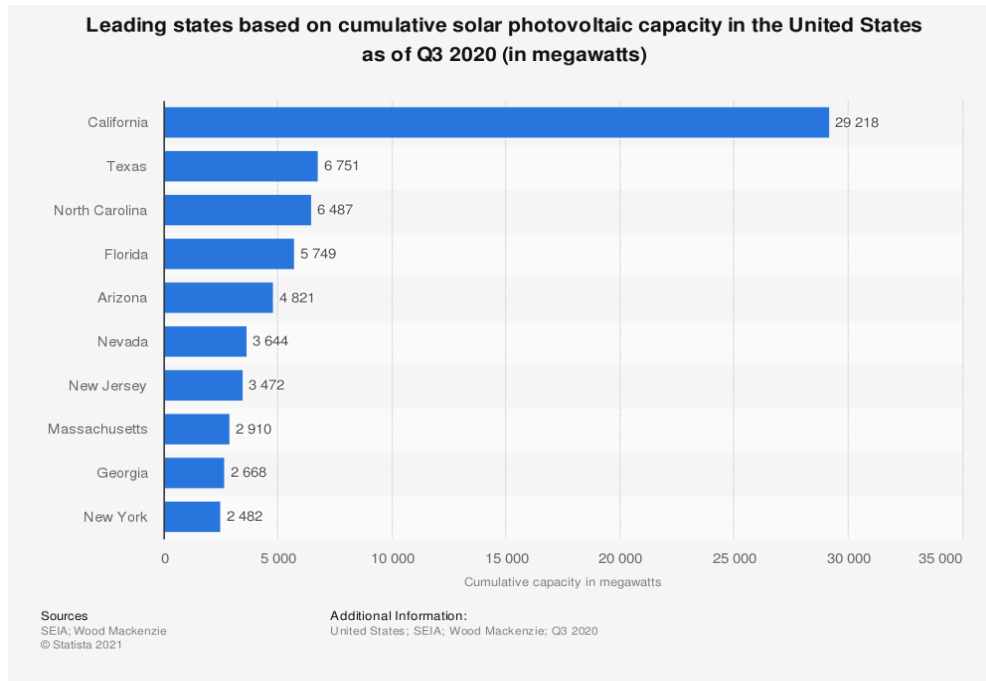
History

California represents a unique microcosm in the rapidly approaching future of renewable energy. Starting in 1974 with Californian politicians Charles Warren and Al Alquist, the two men co-authored the Warren-Alquist Act, which created the California Energy Commission. The commission was born out of a tense energy industry and the increasing demand for electricity, as well as the mounting concern with environmental impacts.³ California has long been a state concerned with the environment, and with the authority of the CEC, California had the power as to set its own standards for sustainability where the federal government was lagging on.⁴ Ever since, the renewable market has exploded, and California is the sustainable energy market par excellence. Seemingly determined to master renewable energy, California's ambition has surpassed the rest of the country by leaps and bounds. As of 2020, California is nearly five times ahead of the rest of the rest of the country in terms of solar capacity⁵; this increase is the result of a decade's worth of the state's efforts to increase its reliance on solar power.

³ "45 Years of Energy Leadership: A Look Back at the CEC," *Youtube*, uploaded by CalEnergyCommission, December 7, 2020, <https://www.youtube.com/watch?v=z8-1eOb5iDo>.

⁴ Four years later, Congress eventually passed two important pieces of legislation: the Public Utility Regulatory Policies Act (PURPA) and the Energy Tax Act. PURPA was created to encourage energy conservation as well as set the groundwork for net metering. It also permitted independent power producers the ability to interconnect with their local utility. The Energy Tax Act on the other hand, was the first statute to offer tax credits to consumers who invested in renewable energy for their homes.

⁵ Madhumitha Jaganmohan, "U.S. Solar PV Capacity by Key State 2020," *Statista*, January 27, 2021, www.statista.com/statistics/183531/renewables-in-the-us-leading-states-in-pv-capacity/.



In 2006, the state passed AB 32, or the California Global Warming Solutions Act.⁶ This was the first nationwide program to attempt a long-term, comprehensive approach to address climate change in a way that would also boost the economy. In creating a law that required a steep reduction in the emission of greenhouse gases, California set a precedent across the country. The act included an executive order from Governor Arnold Schwarzenegger that provided rebates to residents who invested in installing renewable energy technology, particularly in solar. Termed The California Solar Initiative, it aimed to install 1,940 MW of new solar generation capacity by 2016. The initiative worked so well that the state exhausted its incentives two years early, and the program surpassed its production target. Ahead of schedule and riding this success, Governor Jerry Brown signed the 2015 Clean Energy and Pollution Reduction Act, which stated that California must produce half of its power from renewable sources by 2030. The act has since been updated to strengthen these targets; California now aims for 50% renewable energy by 2030 and 100% renewable energy by 2045. By all accounts so far, California seems to be on track.

However, it has not always been a smooth transition for the state. In order to get the ball rolling in 2006, California had to first survive its 2001 energy crisis. In 1995, the

⁶ “AB 32 Global Warming Solutions Act of 2006,” California Air Resources Board, September 28, 2018, www2.arb.ca.gov/resources/fact-sheets/ab-32-global-warming-solutions-act-2006

California Public Utility Commission (CPUC), which sets consumer energy rates, determined the long-established system of energy regulation in the state was “fragmented, outdated, arcane and unjustifiably complex,”⁷ and resultingly voted in December to deregulate the state’s electricity industry, opening it up to competition. On September 23, 1996, Governor Pete Wilson signed the deregulation bill, AB1890. This legislation required utility companies to turn over control of their transmission lines to an independent agency, thus incentivizing them to sell their generating plants to private companies. This move towards deregulation was supported by three major privately held utility companies—Southern California Edison, Pacific Gas & Electric, San Diego Gas & Electric—in the form of \$4.3 million in lobbyists and \$1 million on political campaigns.⁸ Ideally, this reform would give customers lower rates, revitalize the slowing economy, and pave the way forward for other states. Legislators also hoped that the new rules would end the monopoly the three big utility companies had over the energy market.

Unfortunately, these lofty ideals led to devastating consequences. The law required utility companies to freeze their rates until they had completed the sale of their assets. Additionally, it required them to buy power in an open market auction for electricity, where rates were set by the highest bidders. In this auction, certain trading companies such as Enron took their newly purchased plants off the market “for maintenance” on days of peak demand and then sold power at premium prices. On top of these market manipulations, that summer also saw a drought and unusually high temperatures which caused the demand for electricity to spike. Unfortunately, however, there had been no new generation plants built in almost a decade. As a result, wholesale prices jumped, and with their rates frozen as part of the deregulation legislation, utility companies were unable to pass these increasing costs on to their customers. By 2000, California was facing an unprecedented energy emergency. In the summer of 2000, California suffered its largest scheduled blackout since World War II, and such blackouts continued all summer. The crisis continued through the winter, and on January 17, 2001, Governor Gray Davis officially declared a state of emergency. California was forced to buy power from out of state suppliers at an incredibly high price, nearly

⁷ “Frontline: California – Timeline, Blackout,” Public Broadcasting Service, www.pbs.org/wgbh/pages/frontline/shows/blackout/california/timeline.html.

⁸ “Frontline: California – Timeline, Blackout.”

bankrupting the three main utility companies. Pacific Gas & Electric filed for Chapter 11 after failing to pay the \$9 billion they owed to their more than 10,000 creditors – which at the time was the largest ever bankruptcy involving a utility.⁹ Utility companies could no longer purchase power on behalf of their customers, and in order to bail them out, the state had to step in. To do this, the California Department of Water Resources was tasked with buying power. It would not be until 2003 that this temporary measure was lifted.

Eventually, on November 13, 2003, Governor Davis announced the end of the state of emergency that he had declared nearly three years earlier, effectively ending the energy crisis. In those three years, the emergency authority had allowed the state to buy energy from the insolvent utility companies and permitted the CEC to streamline the application process for new plants. By the time the state of emergency was lifted, California had granted licenses for 38 new plants, totaling 14GW of production power. Following the end of the crisis, companies like Enron were investigated by the Federal Energy Regulatory Commission and were forced to pay reparations. While market prices eventually returned to normal and California recovered, the memory of this crisis and its consequences still looms in the minds of many. Nearly two decades later, solar has changed significantly, but as it has gotten less expensive and more accessible, the market has once again started to deregulate. This time, it is not a result of any legislation, but rather because residential and commercial solar installation is now an option. The original crisis can be partly blamed on inefficient government activities, and the failure to act immediately or efficiently. Now the question is, what is the best way for California to reach its ambitious renewable energy goals without slipping into another energy crisis.

Analysis

While the pursuit of a clean, green future is certainly a noble and worthwhile goal, it is one that needs to be approached more judiciously than it is at present. A huge contributor to the California energy crisis was a gap between supply and demand of energy; ever since, California has done everything it can to ramp up energy production through solar power. With the reputation of “sunny California,” people were convinced that laying down a few more black panels to trap sunshine would solve all the energy problems. In reality, it’s not

⁹ “Frontline: California – Timeline, Blackout.”

quite as simple. While solar energy is promising, it has some serious drawbacks that the general public often turns a blind eye. Two of the biggest drawbacks are variability and storage.

Solar energy is not a source of constant supply, rather it is diurnal; there are around 12 hours where there is no sunlight striking the solar panels to produce power. Additionally, there are times when solar is not at its full capacity, such as on cloudy days or during the winter season. As such, solar is not a very reliable source of power on its own. This is where statewide, governmental neglect of other renewable sources can become detrimental. Solar can be easily supplemented by other renewable sources; data from the California Independent Supply Operations (CAISO) shows that on days when solar output is low, wind tends to pick up the slack.¹⁰ Wind is going to be crucial to diversifying California's power sources, but it is being overshadowed by California legislators' captivation with solar power.

The other significant technical problem with solar is that it is incredibly challenging to store. California is certainly capable of generating more power than it uses, an excess known as curtailment. In March 2021, the monthly solar and wind curtailment was 341,959 MWh.¹¹ For perspective, that amount of electricity could power almost 88 million homes if used all at one time. The caveat is as implied: used all at once. The reason the monthly curtailments are so high is because renewable energy storage is inadequate. Having a high curtailment is not only inefficient; it can also be quite dangerous. If too much energy is produced, it stands the chance of flooding the grid. This oversupply could lead to blackouts and delays in energy delivery, and overloaded grids are also dangerous to repair. Unfortunately, as of right now, California has neither the number of batteries needed nor the technology to efficiently store solar power in the long term.¹² That is not to say that the current system is completely inefficient; it actually works quite well on a small scale, such as replacing one natural gas plant. The Moss Landing Power Plant, for instance, was formerly a natural gas plant that was recently converted to a solar facility with an

¹⁰ "California's Renewable Energy Problem," *YouTube*, uploaded by Real Engineering, May 25, 2019, <https://www.youtube.com/watch?v=h5cm7HOAqZY>

¹¹ "Managing Oversupply," *California ISO*, April 11, 2021, www.caiso.com/informed/Pages/ManagingOversupply.aspx.

¹² The most commonly used battery, made of lithium, is simply not designed for long term storage.

unprecedented 567MW capacity of battery storage.¹³ The hope is that, with such a large storage capacity, the converted plant will be able to supply power at peak times when solar generation drops off, there will no longer be a need to supplement renewable energy with natural gas during peak time. However, the days when solar power is reliably capable of this lay ahead in the future.

The CAISO website provides an interactive breakdown of the supply, demand, and prices of the statewide electrical grid being generated in real time.¹⁴ Taking a look at the graph of demand for Saturday, May 8, 2021, demand begins to climb around 4:00pm (16): people may be headed back home from wherever they spent the day and are ready to shower, turn on their appliances, and enjoy their Saturday night. Turning attention to the supply graph, one can see all the different supply sources, but for our purposes, electricity from hydroelectric, imports, coal, and others have been blocked out. Peak demand is approached around 7:00pm (19); at this point, solar generation drops off for the night, and natural gas begins to increase proportionately in order to pick up the slack. Assuming a baseline of about 2,300 MW coming from nuclear power, we can clearly see we are going to need at least 6,000 additional MW of battery storage. Providing this kind of storage is no small task. Once again for perspective, the Moss Landing Power Plant, which is just now being converted into a solar facility, is reported to come with a price tag of \$80 million¹⁵ and can only store 567 MW. Therefore, Moss Landing is, at best, a small step in the right direction; if California is

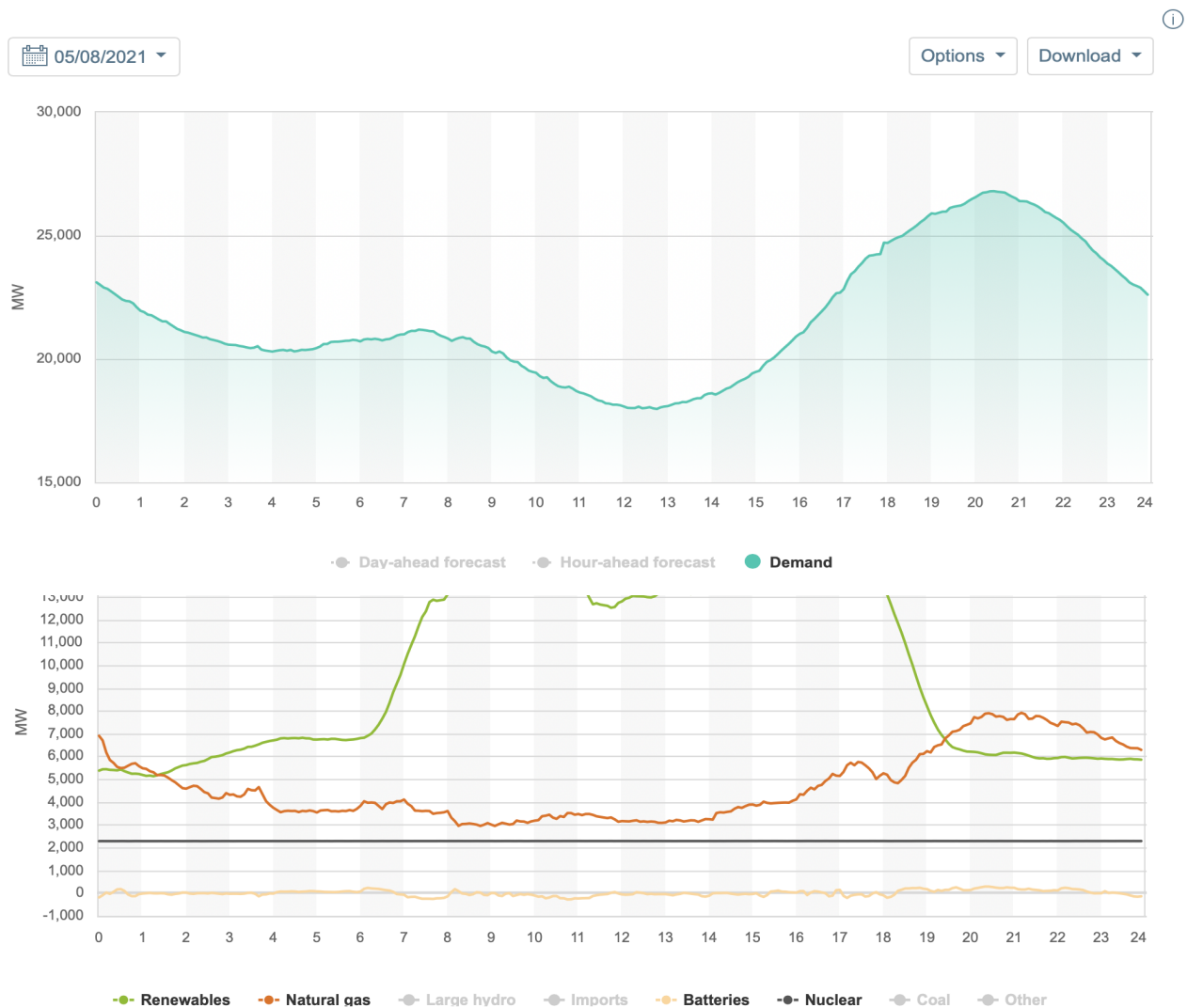
¹³ “California’s Renewable Energy Problem,” *Youtube*, uploaded by Real Engineering, May 25, 2019, <https://www.youtube.com/watch?v=h5cm7HOAqZY>

¹⁴ “Today’s Outlook,” *California ISO*, May 8, 2021, www.caiso.com/TodaysOutlook/Pages/default.aspx.

¹⁵ J.D. Morris, “Monterey Bay Power Plant Now a Record-Breaking Battery Project to Ward off Blackouts,” *San Francisco Chronicle*, January 16, 2021, www.sfchronicle.com/business/article/Monterey-Bay-power-plant-now-a-record-breaking-15872503.php.

to reach its goal of being 100% reliant on renewable energy sources by 2045, this serious storage problem will need to be solved, and soon.

Another misconception about solar is the idea that these new plants and solar installations are going to create “green jobs,” so the government should be funding as many promising start-ups as possible. While this idea is alluring, government subsidies of these green entrepreneurs is not the solution many hoped it would be. In August of 2011, Solyndra, a solar panel manufacturer based in Fremont, California, filed for bankruptcy, and while unfortunate, it should have been unremarkable, except for the fact that it had been the recipient of about \$535 million in federal loans.¹⁶ The company had received its first batch



¹⁶ "Green Jobs: Should the U.S. Government Invest in Green Jobs?" *Issues & Controversies*, Dember 27, 2011, www.icof.infobaselearning.com/recordurl.aspx?ID=2032.

of loans from the Obama administration in March 2009, and, by January 2011, Solyndra needed an additional \$75 million from private investors. Even then, the company had still gone bankrupt by August of that same year. This development sparked huge controversy as emails began to surface from the White House that reflected the administration's lack of confidence in the company from the beginning. The President had planned to visit Solyndra's plant in May of 2010, but many officials voiced their concerns that it might not be a wise idea to be seen publicly endorsing a company on the brink of failure. One advisor said of the visit, "Hope [Solyndra] doesn't default [on its loans] before then."¹⁷ The failure of Solyndra would go on to spark a big question: should the government actually be financing companies developing solar technology?

Proponents of federal investment into solar development assert that the private sector is simply too impatient to wait for start-ups to get on their feet; the development of groundbreaking technology in any industry is not the straight path developers might pitch, and private investors want secure returns. The developers need funding at each stage of the development, including the hiccups, and, traditionally, that funding has come from the government. Additionally, in not developing and supporting American companies, the government sacrifices jobs that could be held domestically instead of importing overseas solar technology. Also, proponents know that anything that can be done to wean the U.S. off the whims of fossil fuels abroad will be a good thing; the sooner the U.S. can reliably produce its own power in ways that are both economically and environmentally sustainable, the better. In order to get there though, solar developers need government subsidies.

Even so, critics argue that the government is actually a very poor judge of the viability of companies. Despite receiving immense funding, Solyndra ultimately proved unsuccessful, and the 1,100 jobs it created disappeared along with it. This suggests that not only is the government not good at determining the strengths and weaknesses of a business, but by subsidizing weak enterprises, it negatively interferes with operations of the free market. If a company can produce a product that is truly viable, they will be able to secure their own venture capital from private investors. By injecting an unnatural element into the natural process of the free market, the government hinders the invisible hand in a way that

¹⁷ "Green Jobs: Should the U.S. Government Invest in Green Jobs?"

results in net harm: with Solyndra, 1,100 people lost their jobs and the parties making loans collectively lost \$610 million.

That said, the government is not currently planning on pulling funding from nationwide investments based on solar technology. President Biden recently released a \$4 trillion plan to address widespread problems across the U.S., and embedded in it is an emphasis on tackling climate change.¹⁸ While most of the emphasis is focused on an increased use of electric cars,¹⁹ President Biden's plan suggests creating a \$100 billion program to update and modernize the electric grid to make it more reliable and less susceptible to blackouts, like those that recently devastated parts of Texas. The plan also intends to build more transmission lines from wind and solar plants to large cities. It also proposes the creation of a "Clean Electricity Standard," which is essentially a federal mandate requiring that a certain percentage of electricity in the United States be generated by zero-carbon energy sources like wind and solar power. However, that mandate would have to be enacted by Congress, where its success is uncertain at best; similar efforts to pass such a mandate have failed multiple times over the past 20 years. While the plan seems optimistic, at this time there are not many details suggesting the logistics of how this energy panacea plan is going to be enacted. President Biden is attempting to cover a lot of ground with this resolution, so it is not surprising that he does not have all the kinks worked out yet. However, it is worth remembering that the last time there was a political attempt to "revamp an antiquated system" without a well-thought out plan all three of California's major utilities were nearly wiped out.

Nonetheless, the DOI recently approved a 350 MW, \$550 million solar facility called the Crimson Solar Project, which will be built on 2,500 acres in southeast California.²⁰ Announced May 3, 2021, the project will be a part of the Desert Renewable Energy Conservation Plan, which the DOI hopes will streamline the transformation of 10.8 million acres of public land in the California desert into renewable energy development facilities.

¹⁸ Jim Tankersley, "Biden Details \$2 Trillion Plan to Rebuild Infrastructure and Reshape the Economy," *The New York Times*, March 31, 2021, www.nytimes.com/2021/03/31/business/economy/biden-infrastructure-plan.html.

¹⁹ The plan proposes spending \$174 billion to encourage the manufacture and purchase of electric vehicles by granting tax credits and other incentives to companies that make electric vehicle batteries in the United States instead of China, with the goal of reducing the price tags on vehicles.

²⁰ Morgan Conley, "Interior Dept. Greenlights \$550M Calif. Solar Project," *Law360*, May 3, 2021, <https://www.law360.com/california/article>.

The project is supposed to create 650 construction jobs and 40 jobs in operations and maintenance over the facility's 30-year lifetime, all of which will be temporary: the DOI notes that the project will most likely only create 10 permanent jobs. The project is supposed to be up and running by the end of May 2021, suggesting a certain degree of urgency. The exciting part of the project is that, in addition to the 350 MW of generation capacity, the facility is also planning to have 200 MW of storage.²¹ This design is encouraging because it suggests that the government is considering storage capacity in addition to generation capacity, and it is taking steps to utilize California's enormous curtailment, not add to it.

While the Crimson Solar Project is a huge endeavor that will provide power to thousands of California residents, it is important to also consider what solar generation will actually look like at the residential level. For as much as California has marketed solar as the energy source of the future, the state of California actually no longer offers residents tax credits for installing solar panels. As such, customers often confuse the federal solar tax credit for the nonexistent state one. The Solar Investment Tax Credit (ITC) was executed in 2006, and, since then, has helped the national solar industry grow by more than 10,000%.²² The ICT currently provides a 26% tax credit for solar systems installed in either commercial or residential properties. Moving forward, it will give 23% in 2023, eventually being phased out for residential properties by 2024. The program was originally set to phase out by 2022, but Congress passed a two year delay in the phasedown in 2020. This program has been crucial in increasing residential and commercial access to solar systems, and, by all accounts, has accomplished the goals it set out to achieve. But, as much success as this program has had, it seems to have one big problem: only those who can afford to install solar can take advantage of the credits. The average cost to install solar panels in California as of May 2021 is about \$2.91 per watt, which when multiplied by the average sized system, 5 kW, translates to an average price of \$14,550.²³ Thereby, the people who have the most to gain by installing

²¹ Scott Dawson, "Re: Battery Storage at Crimson Solar," Message to Grace Mendes, May 8, 2021. Scott Dawson is the Director of Permitting at Sonoran West Solar Holdings, LLC, the sponsor contact for the Crimson Solar Project.

²² "Solar Investment Tax Credit (ITC)," *SEIA*, www.seia.org/initiatives/solar-investment-tax-credit-itc. The program has an average annual growth of 50% over the last decade alone.

²³ "How Much Do Solar Panels Cost in California in 2021?" *EnergySage*, May 8, 2021, www.energysage.com/local-data/solar-panel-cost/ca/. With ICT credits, the number comes down to an average of \$10,767. While solar technology will get increasingly cheaper, it is important to remember that the ICT will give decreasing credits before it is completely phased out in two years.

solar— low-income electric customers— are prevented from doing so because they cannot afford the upfront costs of installation.

However, where there is currently a lack of support from the state and federal governments, certain nonprofit organizations in California have instituted their own programs for low-income families. The Single-Family Affordable Solar Homes Program, or SASH, is one such program. Managed by the Oakland-based nonprofit GRID Alternatives, SASH supplies fixed, up-front, capacity-based incentives to qualified low-income homeowners to try and offset the initial cost of a solar electric system. In order to be eligible for the benefits, applicants must own and live in their home, have a household income that is at or below 80% of the area median income (AMI), live in a home defined as “affordable housing” by California Public Utilities Code 2852, and receive electrical service from PG&E, SCE, or SDGE.²⁴ The incentive itself offers \$3 per watt and strives to not only promote sustainable energy, but also provide job training and employment opportunities in the solar economy as well as reducing costs across the board for qualified participants. The program has been fairly successful; a total of 9,264 PV²⁵ systems have been installed, generating almost 30 MW of solar capacity and conferring about \$132.3 million in incentives. The Program Administrators of the General Market CSI Program manage a similar program for multifamily homes, appropriately named, MASH, with similar success: it is expected to produce 59.8 MW of solar capacity and has supplied \$162.3 million in incentives towards 480 projects across the state.²⁶ Between the two programs, they have incorporated tens of thousands of tenant units into a more sustainable energy system, both economically and environmentally.

The benefits of such programs are better understood when compared to a state like Texas, whose energy market is formally deregulated. Much like California, Texas offers no state subsidies for installing solar, but, as a result of deregulation, there are also no programs incentivizing landlords to make solar PV systems available, especially not to those residing

²⁴ California Public Utilities Commission, “CSI Single-Family Affordable Solar Homes (SASH) Program,” www.cpuc.ca.gov/general.aspx?id=3043.

²⁵ Photovoltaic is one of two solar systems; the other is solar thermal. PV has photovoltaic cells that capture energy straight from sunlight, while thermal uses the sun’s rays to heat water to move a turbine. PV is the more effective system these days, as its capacity and efficiency passed thermal around 2012.

²⁶ California Public Utilities Commission, “CSI Multifamily Affordable Solar Housing (MASH) Program,” www.cpuc.ca.gov/general.aspx?id=3752.

in affordable multifamily housing. Also as a result of deregulation, the Texan electricity industry is run by the free market, which has its advantages. Consumers can choose their own providers and competition amongst retail providers keeps prices low. Cecilia Turchetti charts the fiscal differences between being an electricity consumer in Texas and being an electricity consumer in California:

The average monthly consumption in kilo-watt per hour ("kWh") in Texas is around 1,112, and residential bills for that usage averaged around \$122.47, around 11c per kWh. Quotes for 1000 kWh are as low as 7.5c in areas such as Houston, putting bills as low as seventy-five dollars without including the cost of energy transmission, which was no more than ten dollars per billing cycle. In California, the monthly average was 554 kWh, with an average bill for that usage at \$101.49, or 18c per kWh.²⁷

While this seems like a great reason to live in Texas instead of California, especially as a low-income individual, these numbers actually only offer short term benefits. Texas customers lack opportunities to benefit from PV power over time, so they will continue to depend on their chosen utility company and pay their monthly rates. In California, on the other hand, customers have ever increasing access to solar systems, which decreases reliance on utility companies and places power usage in the hands of the consumers. Furthermore, Californians are increasingly adopting a system of net metering, a process by which consumers sell their excess power back to the grid, which will further lower total costs. So, despite the upfront costs in California seeming considerably less advantageous, the long haul seems to favor individual access to solar systems, especially for low-income customers.

Conclusion and Implications

Like any problem worth solving, what to do about solar energy in California is a problem that does not have one clear-cut solution. But, there are actions that can be taken so that California can meet its goals as efficiently as possible. I argue that while it is not necessary to fund further solar development nor construction, it is necessary for the federal government to subsidize solar access because it can then set the necessary conditions solar systems need to meet, which can prevent an energy crisis and make solar power available to low-income consumers.

²⁷ Cecilia Turchetti, "Here Comes the Sun: Bringing Efficiency and Renewable Energy Solutions to Affordable Housing in the U.S.," *Georgetown Environmental Law Review*, 32, no. 399 (Winter 2020): 414.

As exciting as it is to think that soon California will be totally reliant on renewable power and that much of that power will be solar, the most efficient way to do that is not by installing even more solar generation plants wherever there is space. While part of the reason the early 2000's Energy Crisis occurred was that there was a gap between skyrocketing demand and frozen supply, that is just not a problem we will have to face again. We are not only meeting our demand for electricity, but we are oversupplying by thousands and thousands of MW per day. As California strives to meet its goals, our astronomical curtailment will only continue to climb higher as we recklessly expand commercial sized generation, and it is just not economically or practically effective. Individual residential and commercial PV installation is more than sufficient to meet the demand of the grid; so, the answer is not more generation facilities, it is investing in more storage facilities. The solar storage industry creates just as many, if temporary, jobs as solar installation, and is only marginally more expensive (though no doubt battery prices will continue to fall as development improves) while making the statewide grid more stable than increased generation. With more stability, blackouts are significantly less likely, and California can make use of its enormous curtailment instead of letting it go to waste.

That said, it is inefficient for the state to finance loans to solar technology developers. It is tempting to want to throw money at the technology sector to develop the next big thing as fast as possible; but, as cases like Solyndra show, the government is not necessarily the best judge of the strengths and weaknesses of innovators. As it is, the CEC invests approximately \$130 million annually through the Electric Program Investment Charge (EPIC) for electric system research and development projects.²⁸ While unlikely that the government could, or should, pull all funding, it is worth considering whether this is an overly generous amount. Investing in the solar future is an incredibly lucrative venture, and as solar technology continually becomes better, it will continue become more competitive. In turn, solar energy will push out coal and natural gas for purely economic reasons. With coal and natural gas on their way out, those former sponsors of fossil fuel power will need to invest towards the next big thing, likely renewable energy. As such, the free market is more than capable of selecting the best, most efficient hardware of the future without much governmental intervention.

²⁸ California Public Utilities Commission, *Self-Generation Incentive Program*, www.cpuc.ca.gov/sgip/.

The government should also be subsidizing access to solar and reforming their application process, potentially by making programs like SASH and MASH, stewards of federal funding. The main problem with these programs is that they are out of money and are being phased out as a result of necessity, not because they are obsolete. By furthering these programs, the government can fund specific income-based incentives. These can not only increase access to solar, but also set specific regulations to take advantage of the incentives, thereby managing with a degree of certainty that solar is efficiently installed in a deregulating market. However, to ensure that the incentives are not abused, it might be worth adding that the incentives received are proportional to the energy efficiency of the system in order to discourage excessive energy consumption.²⁹ Federal policy makers might also consider adding to these policies a program like the CPUC's Self-Generation Incentive Program (SGIP). While in its current form it does not support solar systems, SGIP provides rebates for other renewable energy systems while also supporting the installation of storage systems.³⁰ This could be a really useful program to appropriate because, by coupling tax credits for installing solar in low-income areas with rebates for solar storage, California can incentivize a more efficient expansion of the solar industry without full regulation.

After the crisis in the early 2000's, Enron executives were put on trial for a variety of crimes including wire, securities, and mail fraud, as well as money laundering and conspiracy. During the trial, S. David Freeman, the Chairman of the California Power Authority, testified to a conversation he had in 2000 with Kenneth Lay, the CEO of Enron. Lay ridicules the efforts to stop the malicious practices of energy wholesalers, saying: "In the final analysis, it doesn't matter what you crazy people in California do, because I got smart guys who can always figure out how to make money."³¹ While Lay's remark is certainly haunting, it reminds us that, while the problem seems to have been fixed through legislation that ensures something like the energy crisis will never happen again, the private sector has influence and power. Clever, greedy, and without clear regulations, companies

²⁹ Alexande Ritschel and Greg P. Smestad, "Energy Subsidies in California's Electricity Market Deregulation," *Energy Policy*, October 28, 2022, www.sciencedirect.com/science/article/pii/S0301421502001970?via%3Dihub.

³⁰ California Public Utilities Commission, "Self-Generation Incentive Program," www.cpuc.ca.gov/sgip/

³¹ "Testimony of S. David Freeman." *Commerce.senate.gov*, May 3, 2003, web.archive.org/web/20060301072016/commerce.senate.gov/hearings/051502freeman.pdf.

are more than capable of squeezing the market and putting the greater good in danger once again. In that same testimony, Freeman states very poignantly:

There is one fundamental lesson we must learn from this experience: electricity is really different from everything else. It cannot be stored, it cannot be seen, and we cannot do without it, which makes opportunities to take advantage of a deregulated market endless. It is a public good that must be protected from private abuse. If Murphy's Law were written for a market approach to electricity, then the law would state 'any system that can be gamed, will be gamed, and at the worst possible time.' And a market approach for electricity is inherently gameable. Never again can we allow private interests to create artificial or even real shortages and to be in control.³²

Electricity is a public good that must be protected from private abuse. As California charges headfirst into a renewable future, Americans must not forget the lessons of the past. Additionally, while deregulation is not something to be feared, it is not something to be taken lightly either. As the energy industry enters unprecedented times and Americans reach for a fully renewable tomorrow, it is important to remain realistic. Solar is an unparalleled energy alternative because, unlike other renewable options, solar can be influenced by consumer choice; it has been uniquely developed directly for the customer. Unlike hydroelectric, wind, or geothermal energy, solar energy is an energy source that consumers can also be generators of; while customers cannot put an entire wind farm on their property, they can install solar panels. As such, solar has the singular ability to make individuals feel like they have a hand in the energy industry, and this promotes an important mindset going forward. The reason solar is such an essential step is because people are more aware that they are living on borrowed time, and regardless of the things that divide people, the solution will require collective action. Even so, it is just as imperative to not get carried away by this sense of unity; people can save themselves not with more solar, but smarter solar. By focusing on subsidizing low-income solar deployment and increasing quantities of solar storage, Americans give themselves the best chance of not only meeting their sustainability goals but also exceeding them.

³² "Testimony of S. David Freeman." *Commerce.senate.gov*, 3 May 2003, web.archive.org/web/20060301072016/commerce.senate.gov/hearings/051502freeman.pdf.