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Incentives for Distributed Generation in California: The Rise of Third-Party Solar Development

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Glossary

Term/Abbreviation	Definition
AB	(California State) Assembly Bill
CCSE	California Center for Sustainable Energy
CEC	California Energy Commission
CPUC	California Public Utilities Commission
CSI	California Solar Initiative
CSP	Concentrating Solar Power
DE	Distributed Energy
DG	Distributed Generation
FIT	Feed-In Tariff
FITC	Federal Investment Tax Credit
IOU	Investor-Owned Utility
LADWP	Los Angeles Department of Water & Power
NEG	Net Excess Generation
NEG	Net Excess Generation
NEM	Net Energy Metering
PG&E	Pacific Gas & Electric
POU	Publicly-Owned Utility
PV	Photovoltaic
REC	Renewable Energy Credit
SCE	Southern California Edison
SDG&E	San Diego Gas & Electric
SITC	Solar Investment Tax Credit
SMUD	Sacramento Municipal Utility District
SWRCB	State Water Resource Control Board

Introduction

One of the most substantial factors that determines human interactions with the environment is the dominant energy paradigm—everything from choice of energy sources to conservations habits—within which a society functions. This paradigm was static and primitive for a vast majority of our specie's time scale, but has been since the Industrial Revolution irrevocably and even subsequently adjusted. Though the dominant fuels have changed from coal to oil and natural gas, their fossil nature remains unsustainably unchanged. As global climate change—intrinsically linked with patterns of energy production, distribution, and use—obtains the grave and dedicated focus that it merits, world citizens and governments will have to reevaluate contemporary energy production and delivery systems. The continued reliance on fossil fuels to power growing economies worldwide through energy and other byproducts is inherently a losing proposition, as considered from both the input and effluent perspectives.

As of yet, the alternative of widespread renewable implementation has been greatly underexplored. International exemplars of renewable deployment include Germany and Spain, both with significantly different cultures and government structures than the United States. Where these European countries have succeeded in subsidizing and otherwise incentivizing the installation of alternative energy capacity, a less successful California has been the lead state for the US, in a longstanding trickle-up policy tradition. Trickle-up policy refers to the idea that sub-federal governments can "pilot" policies, so to speak, the success of which leads to widespread federal adoption.

I hope to be able to clarify the tangle of laws, cash and tax incentives, and other programs that California has implemented toward its ambitious targets for renewable energy.

Through the examination of US federal and California state energy policy, this thesis seeks to foster greater deployment of distributed-generation (DG) solar photovoltaic (PV) energy production capacity. Today's energy landscape in California does not commonly live up to the myth of a solar and renewable "mecca,"[1] much has been the case in Europe. Along with the significant up-front financing and long payback periods required of such projects, there is less long-term security for US investors that energy fed back into the grid will bring in revenue. Therefore, this research will build off of a theoretical literature-based understanding of energy policy in California to explore the various business models that have emerged to both take advantage of government incentives as well as open up the option for rooftop solar installation to those without the required up-front financing.

In order to approach the complex political issues behind California's renewable energy incentives structure, considerable effort must be focused on the underlying conditions of climate change, energy mix, and social welfare. A successful solution will be one that can mitigate adverse effects on the climate and provide a low-cost, low-risk energy portfolio. The underlying goal of this paper is to illuminate possibilities for residential and commercial customers to take advantage of creative business models in solar installation, financing, and maintenance. But while the policy discussion operates

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[1] Toke, D. *Ecological Modernisation and Renewable Energy*. 2011. 98.

mainly in the context of *current* policy, it will also evaluate the strengths and weaknesses of that policy so that future laws might resonate more beneficially with DG renewable energy.

Concepts from the fields of deep ecology, Jeremy Rifkin's work on the "Third Industrial Revolution," and energy policy frameworks underpin the discussion and evaluation of California's renewable policy programs.

Deep Ecology Perspective

Deep ecology and energy policy do not usually go hand-in-hand. But a deep ecology perspective in fact informs the exploration of energy paradigms in a broader sense, with policy relegated a tool to implement these critical insights. When considering a much larger time scale than the typical discussion of human history entails, energy emerges as a pivotal culprit in the contemporary affliction of global climate change. There is certainly no room in modern discourse, much less in this paper, for a discussion of the merits of "climate change" as a "hypothesis." Therefore, this discussion operates on the assumption that anthropogenic climate change is indeed an immediate threat to not only ecological health, but also social and economic welfare worldwide. With this in mind, altering the energy landscape has dramatic potential to effectively curb carbon emissions and other forms of local pollution, while simultaneously *increasing* the supply of energy to match rising global demand.

The deep ecology movement has inspired an impressive literature, but is a unique theory in that its genesis is easily traced and understood. It stems from the twentieth century's dual development of a strong environmental sentiment—embodied

in the likes of Aldo Leopold, John Muir and Rachel Carson—and a richer scientific understanding of ecological dynamics. Norwegian philosopher Arne Naess in 1973 clearly laid out the core principles of deep ecology in contrast with what he termed "shallow ecology." This duality between deep and shallow specifically refers to time scale, the ethical and moral consideration of non-human entities, and social equality across nations of different development levels.

While Naess' characterization lays out seven principles of deep ecology, two are especially relevant to the topic at hand. Number 5 –"Fight against pollution and resource depletion"[2]—is interesting in that Naess also uses it to describe the central concern of shallow ecology. He in fact embraces the fact that both types of ecology hold this value dear, but emphasizes that deep ecologists do not do so at the expense of "evils of the other kinds," referring to the exacerbation of class struggles and ethical dilemmas brought about by a single ecological focus. Number 7—"Local autonomy and decentralization"—lends legitimacy to the distributed generation energy framework to be discussed throughout this paper. Here, deep ecologists highlight the untangling of complex political hierarchies in favor of local self-control. Importantly, Naess also posits, "Pollution problems, including those of thermal pollution and recirculation of materials, also lead us in this direction, because increased local autonomy, if we are able to keep other factors constant, reduces energy consumption."[3] By reducing imported foodstuffs and energy from concentrated growing operations and

[2] Naess, A. "The Shallow and the Deep, Long-Range Ecology Movement. A Summary." 1973. 97.
[3] Ibid. 98.

electricity producers, communities can deplete natural resources more sustainably and keep in check the environmental effluents related to everyday activities.

These deep ecological principles have in turn inspired much of the work by Jeremy Rifkin, discussed below, in a wide array of environmental policy areas. With an idea of humans' place within a broader ecological community, the need to shift energy supply away from high-polluting, resource-depleting sources to sustainable, renewable modes becomes essential. Such a shift is fundamental not only to the long-term survival of the human species, but also to greater social equity across communities and between countries, and inherently the welfare of all sorts of creatures and environments.

Rifkin's "Third Industrial Revolution" Framework

In his most recent book, Jeremy Rifkin describes a reconceptualization of the industrial landscape as significant as that of the Industrial Revolution. Rifkin is a widely lauded economic and political advisor, and has as an activist who written on a breadth of topics from policy dealing with genetically modified organisms (GMOs) in agriculture to the role of entropy in economic development. Whatever the specific topic, Rifkin's work usually synthesizes economic insight with ecological understanding and knowledge of political structures. In *The Third Industrial Revolution: How Lateral Power Is Transforming Energy, the Economy, and the World*, he accurately depicts humans' impact on the environment through the lens of energy procurement.

Rifkin's book is in constant discourse not only about anthropogenic climate change, but also the economic stagnation currently facing the United States and

European Union. While most political pundits and economists attribute today's sluggish market to sub-prime mortgage lending, rampant government spending, and low consumer confidence, Rifkin turns a completely different direction to understand the drivers of the current situation. He asserts that, in fact, "This wild gyration between regrowth and collapse is the endgame" of the waning oil age.[4] Instead of focusing on lower interest rates and government austerity, then, political elites need to more closely consider the sources from which we derive energy, and inherently linked with that, GDP. But this situation cannot be considered in isolation from either energy history or the energy future.

The first and most famous Industrial Revolution, of course, captured the power of steam and coal to centralize manufacturing and empower concentrated agricultural production. The second Industrial Revolution paralleled the unprecedented extraction of oil reserves from the ground and under the ocean to power the agricultural Green Revolution and today's automobile societies. Rifkin claims, "The First Industrial Revolution gave rise to dense urban cores, tenements, row housing, skyscrapers, and multilevel factories, and the Second Industrial Revolution spawned flat suburban tracts and industrial parks."[5] The Third Industrial Revolution, though it has not yet taken hold, will rely on distributed energy production from largely renewable sources to power economic development in both the Global South and North.

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[4] Rifkin, J. *The Third Industrial Revolution: How Lateral Power is Transforming Energy, the Economy, and the World*. 2011. 9.
[5] Ibid. 37.

As energy sources such as coal- and natural-gas-fired plants, nuclear plants, and incinerators give way to wind, solar, geothermal, and even tidal power, the associated economic and political landscapes will too change. The extraction of coal and oil from the earth and the distribution of these resources naturally require a huge capital investment. As such, First and Second Industrial Revolution social structures entail centralized economic and political power to drive energy production, and inherently the economy, forward. This takes the form of multinational oil companies, powerful political lobbies, and an energy infrastructure based on centralized production and long-distance one-way transmission.

In the envisioned Third Industrial Revolution, though, "dwellings would become energy producers," serving a dual purpose for shelter and renewable production.[6] Though this might take the form of small-scale hydro- or wind-power, by far the most potential lies in capturing the sun's power. Falling nearly everywhere on the earth's surface, solar power accounts for a daily 76 PW (that is, for reference, 76 *billion* MW) in comparison with wind's contribution of .37 PW.[7] As will be explained in greater depth later, efficient and affordable technologies exist in the form of solar thermal collection and photovoltaic panels to harness this abundance of naturally occurring power.

The Third Industrial Revolution will make use of emerging technologies to cut dependence on coal, natural gas, and oil. If Rifkin's prescriptions are followed, the energy sector can be swiftly and effectively decarbonized. He also discusses the trajectories for renewable energy storage and transportation decarbonization that, while

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[6] Ibid. 68.
[7] Kruger, P. *Alternative Energy Resources: The Quest for Sustainable Energy*. 2006. 138.

no doubt integral to the overall remaking of the dominant energy paradigm, are beyond the scope of this examination of solar PV implementation. In order for the electricity sector to be decentralized and remade into a model of sustainable growth, consumers and energy networks will rely on smart metering, innovative pricing methods, and the continued drop in prices for renewable energy production. These are technologies and trends that are already in wide use, especially in Europe and California[8], but an examination of their effectiveness can lead to improvements in future implementation across the United States and in regions just now experiencing their own Industrial Revolutions.

Though Rifkin never explicitly cites the deep ecology movement as an inspiration for the Third Industrial Revolution, there are inherent links between the two concepts. These serve to strengthen the case for distributed generation implementation on a much larger scale than has thus far been the case. In exploring energy procurement as a long-term necessity of human survival, Rifkin embraces the much deeper time scale put forward by Naess. He examines not only the current oil-driven energy paradigm, but also its rudimentary predecessors and considerably advanced successor energy regimes. His focus on the future of energy procurement recommends broad decentralization of contemporary "elite" energy systems. These systems require huge capital investment, economies of scale, and distribution and transmission infrastructure to extract highly concentrated underground mineral reserves. Instead, Rifkin favors more socially and environmentally equitable distributed micro-generation

[8] Rifkin. 43.

in residential and commercial installations. This trajectory represents deep ecology's ultimate goal of "classlessness" in the developed world while also shaping a blueprint for the developing world to leapfrog centralized resource-extractive landscapes directly into the Third Industrial Revolution.

The inspiration for much of the Third Industrial Revolution comes from the European Union, where Rifkin often advises political leaders, not least of whom is Germany's Chancellor Angela Merkel. Rifkin cites the EU as "virtually alone among the governments of the world in asking the big questions about our future viability as a species on Earth."[9] As such, and with Germany as a lead state, Europe has developed an ambitious set of targets with a first checkpoint in 2020 toward sourcing a significant portion of its energy from renewable sources and increasing efficiency of use. These goals are especially important as the EU expands eastward, most immediately with Croatia's 2013 accession, to impact a larger citizenry.[10]

The political parallel between the United States and Europe is imperfect. The federal structures in the United States are similar to the European Union, but ultimately lack the supranational cooperation exhibited in the European Union. There is no higher governing body that can effectively impose regulations on the US federal government. Nonetheless, the US parallel of Germany's lead state status is undoubtedly California. The state has a history of trickle-up environmental policy, in which state-level measures are successfully adapted at the US federal level. Examples of this successful model

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[9] Ibid. Location 147.
[10] Castle, Stephen. "Croatia Given Conditional Approval to Join E.U. in 2013." *The New York Times*, 2011.

include legislation on clean air and water in the 1970s, higher vehicle fuel efficiency standards, and the Renewable Portfolio Standards to be discussed in greater depth in the following chapters. This trickle-up idea is essential to breaking the shackles of the centralized Second Industrial Revolution and its associated fossil-fuel dependence to bring in the Third Industrial Revolution's lateral vision of micro-generation. As much as the policies implemented on the state level in California can successfully shift the sources of energy supply, reduce greenhouse gas emissions, and meet rising demand, the potential for federal adoption of these measures increases.

Importance of DG Solar in California

Sunshine is in prodigious abundance throughout the Golden State, making it an ideal testing ground for technologies, policies, and business models poised to harness this renewable energy resource. Historically, though, renewable energy developers have focused on more cost-competitive wind technology, winning competitive bids to supply utilities with electricity. Even with recent advances in solar deployment, the potential for greater rooftop PV penetration in residential and commercial markets is impressive. Due to utility and policy constraints, most of the renewable supply meeting recent goals has come from wind, utility-scale solar, and geothermal operations modeled largely after the centralized, elite power plants of the twentieth century. Such "wind farms" and concentrating solar plants capture renewable resources in a few remote spots, then rely on massive transmissions lines to convey the energy to urban centers. In this context, Rifkin prudently wonders, "If renewable energies are distributed and found in various proportions and frequencies everywhere in the world,

why would we want to collect them in only a few central points?"[11] In order to truly implement a Third Industrial Revolution energy order, work needs to be focused on existing programs that further the goal of broader DG implementation.

In terms of solar electricity generation, there are two principal technologies that can each be deployed on two broadly defined installation scales. To be more specific, the technologies are either solar-thermal or photovoltaic and the scale of installation is either DG or utility-scale. Trends in installation segmentation have been dynamic over the past decades, dictated mainly by cost reductions through research and development. Where a few years ago, investment in utility-scale installations was trending toward concentrating solar power (CSP)—which uses solar-thermal technology—the comparative costs of technology today make solar PV "an obvious preference."[12]

Solar thermal uses heat from the sun to warm water for household or industrial use, while photovoltaic relies on sunlight to fuel chemical reactions that create a direct current. Solar thermal technology was first developed in 1891, but it is in fact "only 'solar' in terms of what makes the heat – the rest of it is basically nineteenth century technology."[13] In fact, solar thermal was in rather widespread use in Southern California during the late 19th century—more so than today—for the simple purpose of heating water.[14] PV, on the other hand, actually inverts an electrical current into the alternating current that traditionally courses through utility power grids to household

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[11] Rifkin. 36.
[12] Vermeer, Grace. Phone Interview. Southern California Edison. 2012.
[13] Janardhan & Fesmire. *Energy Explained*. 2011. 24.
[14] Asmus, P. *Introduction to Energy in California*. 2009. "Solar Energy."

wall outlets. While these solar panel technologies may look similar in their installed form, solar thermal is a much older and therefore rudimentary technology. While extremely well suited to providing hot water for human use, solar thermal falters in comparison with PV's ability to create electricity identical to that produced by fossil fuel and nuclear power plants.

CSP is concentrated in the sense that it makes use of large-scale installations (usually on the desert floor) to reflect sunlight to a central tube or tower filled with either water or another conductor of heat, such as molten salt, which the benefit of regulating temperatures to spread production past only hours of direct sunlight.. Private investors from abroad (mostly sunny locales like Spain and Israel) and California's own investor-owned utilities (IOUs) have experimented with CSP to meet the Renewable Portfolio Standards to be discussed in later chapters.

In terms of scale of an individual installation, "Distributed, grid-connected PV is not a central concern…to most utilities" because of "low levels of market penetration."[15] While CSP and utility-scale PV plants have the capacity to produce more energy than likely any single DG installation, they perpetuate the centralization of the Second Industrial Revolution's elite energy paradigm. It is unrealistic to expect an energy market fueled by renewable sources to operate in exactly the same way as it does in the fossil-fueled model to which it offers an alternative. The current model entails centralized electricity production passing along the utility transmission grid to end-of-the-line consumers. As the model slowly shifts to a two-way grid, producers,

[15] Schoettl, J. M., and L. Lehmann-Ortega. "Photovoltaic Business Models: Threat Or Opportunity for Utilities." 2011. 145.

consumers, and especially utilities will have to rethink their role in the electricity market.

Further, the development of large panels often controversially infringes on ecologically sensitive desert environs and encourages soil erosion, whereas rooftop PV makes use of areas that have already been impacted by human development. Another drawback of utility-scale systems is that they must be, by their very nature, built far from urban and suburban areas of high energy demand, requiring expensive transmission lines susceptible to line loss. In the case of DG, on the other hand, the transmission grid is already in place, although it does require significant engineering to transform into a "smart grid" capable of efficiently distributing renewable energy and supplementing it with conventional utility-scale sources.

But perhaps the most compelling benefit of DG is its ability to localize, even personalize, the understanding of energy use. A vast majority of electricity ratepayers do not understand the abstract wattage figures that represent their energy use. By quantitatively comparing their grid consumption against their ability to generate electricity on property, those meaningless figures are transformed into a relatable generation capacity against which to compare consumption. Thus not only does distributed generation reduce the need for polluting traditional sources of energy, but it also has the potential to augment increases in energy efficiency and reductions in overall use.

Despite these advantages, energy strategies aiming toward a low carbon future "have largely concentrated on a vision of major changes to the large-scale centralized

supply-side of the system, and by and large assume that demand is an inflexible quantity to be met."[16] And while decentralized energy accounts for 7.2% of global electricity capacity, this metric is likely considerably lower in the United States, where large utilities supply power to grid-dependent customers except in few remote areas.[17] Underlying this fact is a sort of planning inertia, in which governments and utilities model emerging renewable generation on the centralized paradigms of the last century. Cost has also played a significant role in decision-making on the sources of renewable energy. By only looking for the cheapest solution, most solar applications have thus far been beat out by wind and small hydropower, resulting in a poorly diversified supply portfolio. Like solar, wind energy is variable on a short-term basis, depending on wind speeds. Hydropower, while stable in the short term, lends itself to vulnerability imposed by climate change's alterations to the hydrological cycle. The sun, however, will certainly continue to shine daily for the foreseeable future.

In contrast to the multiple technological and theoretical shortcomings of CSP, DG offers a host of advantages in sustainable future energy procurement. While CSP uses direct sunlight to create electricity, PV panels can also derive power from scattered or reflected light, as on a cloudy day or when the sun is relatively low on the horizon.[18] Solar photovoltaic technology also has a higher potential efficiency because there is no middle step in the generation process like CSP's liquid heat medium.[19] In terms of

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[16] Skea, J., P. Ekins, and M. Winskel. *Energy 2050: Making the Transition to a Secure Low Carbon Energy System*. 2011, 245.
[17] Bell, Jeff. "Policies for Distributed Generation," 2007. 2-39.
[18] Asmus, P. "Solar Energy."
[19] Kruger. 149.

transmission, "Locating plants close to where the energy is used also brings down costs by eliminating the need to build long transmission lines," with the ability to place solar panels "just about anywhere."[20] Instead of building disruptive new installations far from sources of energy demand, DG offers consumers the ability to produce their own energy and sell back into the grid for their neighbors' use. The lack of transmission lines required also entails the possibility for faster implementation built on already-established home and business electrical connections. The overall costs of transitioning California's electricity grid to a "smarter" model, though, presents myriad challenges to utilities

It is worth noting, however, that even large-scale DG installations—for example those on warehouse and big-box retail outlet roofs—cannot match the generation capacity of CSP in a single installation. Instead of weakening the argument for DG, though, this fact merely serves to highlight the widespread degree of implementation necessary for PV installations to meet future demand for renewable energy. With the right incentives-based policies and investments in research and development to lower the cost of PV, DG can reach the economies of scale required to make it just as attractive as wind, small hydro, and geothermal energy. Compared to a business-as-usual scenario, there exists an optimal energy portfolio for California that reduces generating costs and CO_2 emissions while lowering market risk. This portfolio includes much more renewable energy than has already been installed.[21]

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[20] Janardhan, V., and B. Fesmire. 28.
[21] Lesser, Jonathan, et al. *Achieving California's 33 Percent Renewable Portfolio Standard Goal*, 2008. E2.

Given the disparity between advantages of CSP and PV, it comes as little surprise that there have been in recent years multiple calls for policies that better support DG in residential and commercial applications. While both types of solar technology contribute to decarbonization, reduce reliance on fuel imports, and provide zero carbon electricity, proponents of DG hope to expose the underlying message implicit in centralized energy production.[22] The political and economic power structures associated with this paradigm are deeply entrenched in elite control of fossil fuels and the production capacity to transform these finite resources into useful energy. In 2004, an event in Bonn, Germany drew 3000 attendants from 154 nations calling for conditions for DG renewable energy "to become an integral part of the energy mix" through "transparent market conditions," the elimination of "market subsidies for conventional centralized energy," and renewable "incentives that are eventually phased out."[23] Again, the parallel federal structures in the United States and the European Union expose Germany and California as sources of trickle-up energy policy. If Germany can lead the European charge for distributed energy production, so too can California in the United States.

Indeed, with anti-government ideology having a strong hold in many pockets of Washington, D.C., state and local governments have emerged as "prime laboratories of energy reforms in the recent past."[24] And while the credibility of California as a true global leader in renewable energy implementation has slipped over the past decades, it

[22] Skea et al. 222.
[23] Bell. 2-39.
[24] Asmus. 305.

is no doubt leading the charge amongst all US states. With specific regard to policies for DG, World Alliance for Decentralized Energy's Jeff Bell asserts, "Steps to harmonize State level policy with policy at the Federal level will be the main factor for successfully advancing [distributed electricity]."[25] If California consumers, businesses, and utilities can harness the power of incentives including investment tax credits, subsidies, and net energy metering to take advantage of DG technology, then this model will likely be adopted by other states and eventually at the national level.

Methodology & Structure

Having built a theoretical base on the tenets of Naess' deep ecology, established Rifkin's Third Industrial Revolution framework, and explored the merits of distributed generation photovoltaic installation, this paper now delves deeper into the specifics of California's energy situation. The second chapter relies on academic literature, historical accounts, and government data to lay a base understanding of the federal and state incentives policies for DG renewable deployment. Chapter three shifts to interviews as a primary source to best explain the emerging business models that seek to bridge the gap between government incentives and often-under informed homeowners lacking the upfront financing for such capital-intensive projects. These include the innovative solar lease and power purchase agreement (PPA) financing instruments used to make rooftop solar attractive to a larger portion of Californians than only the socially and environmentally conscious early adopters.

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[25] Bell. 2-41.

The fourth and final chapter of this paper assesses potential pathways forward for electricity consumers, third-party solar developers, and the state's utilities. As will be discussed, California is headed toward a set of program expiration deadlines that will remove DG solar incentives. Since these incentives have thus far protected solar from competition by lower-cost alternatives, the future of continued installations is at stake. Will third-party financing prove to be a sustainable business model without the federal and state programs that have thus far built it up?

Energy Markets & Incentives Programs

California Energy Market

1973 Oil Crisis & California's Wind Rush

Considering the renewable focus of this project, the most relevant energy history begins with the oil crisis of 1973. The OPEC embargo forced the United States to seek out alternative domestic sources of energy to cut dependence on now-demonized "foreign oil." But as the crisis abated, in a pattern to be repeated after the many price spikes following, so too did interest in alternative energies. As price and supply concerns have been joined by those surrounding global climate change, the urgency of renewable energy capacity has increased. This trend is reflected in state and federal policy, as well as hard data on installation and capacity figures.

In partial response to the 1973 crisis, Congress passed the 1978 National Energy Act, part of which is the Public Utilities Regulatory Policies Act (PURPA).[26] PURPA defines aspects of both the federal and state regulatory environments in which electricity markets operate. Though a federal policy, the implementation of PURPA was left in part to the individual states. In California, this responsibility fell to the already-established California Public Utilities Commission (CPUC). The CPUC has regulatory authority over the state's investor-owned utilities (IOUs), but not publicly owned utilities (POU). POUs are usually wholly owned departments of city governments and are therefore overseen at the municipal level. Data from the California Energy Consumption Database reveals that these two types of utilities (IOUs and POUs) account for 95% of electricity deliveries in the state, which has held constant over the period before deregulation (1990) through to the most recent statistics available (2011). IOUs even gained a percentage point in their share of electricity deliveries over this 21-year period. This data demonstrates the relatively stable segmentation of California's electricity market and legitimizes the CPUC as a relevant institution through which to promote renewable energy for a majority of Californians.

[26] Kollins, K., et al. *Solar PV Project Financing: Regulatory and Legislative Challenges for Third-Party PPA System Owners.* 2010. 1.

Figure 1[27]

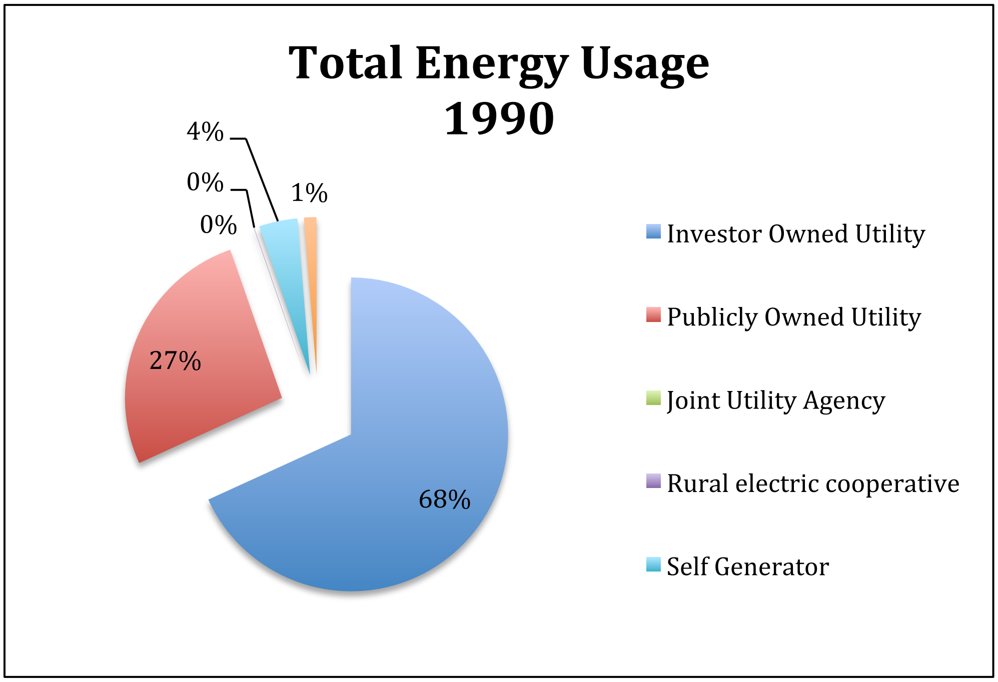
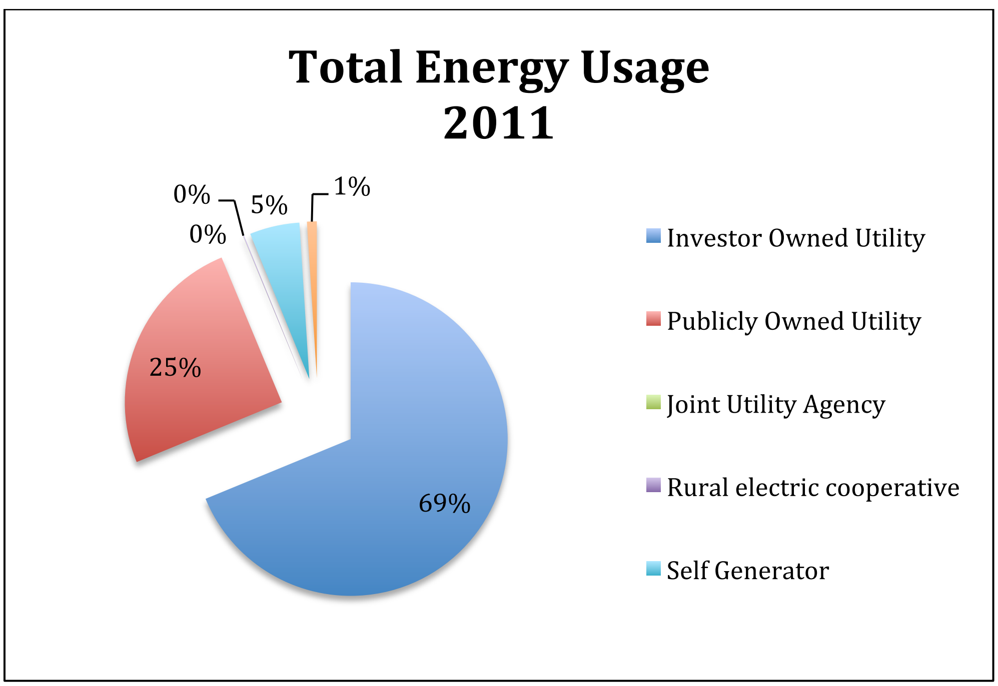


Figure 2[28]



[27] California Energy Consumption Database. <http://www.ecdms.energy.ca.gov/.
[28] Ibid.

The overall aim of PURPA was to increase the use of domestic renewable energy through the requirement that electric utilities allow "qualifying facilities" (QFs) under 80 MW to plug into their grid and be paid by the utility at its "avoided cost."[29] This avoided cost is the amount the utility would otherwise have to either invest in its own generation facilities and fuels or pay to an independent non-QF generator. Technologies qualifying for this provision include renewables PV, wind, biomass, and geothermal, but also cogeneration facilities whose primary production often depends on fossil fuels.

Great uncertainty in international oil and gas markets at the time allowed many California renewable generators to lock in contracts for ten years at rates significantly higher than the actual ensuing market prices. This factor was important in speeding the development of wind energy even though the technology's cost still exceeded that of traditional natural gas-fired plants. The program became very popular, with more than 15,000 MW of qualifying facilities under contract in 1985. Utility planners worried that the grid would not be able to handle such a large distributed capacity if actually built, leading the CPUC to suspend Standard Offer #4, the contract model that most independent renewable generators had used to tie in with the grid. Ultimately, not all of the contracted supply was actually built.

With a booming population, poor air quality, and now an oil crisis, California had certain reason to excel in its ambitions to capitalize on renewable power. At this stage, development centered primarily on wind energy. This is because wind power,

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[29] Kollins et al. 2.

especially on a larger scale, has traditionally held a cost advantage over solar power. This point is also likely when California acquired its mythical status as a renewable energy "mecca."[30] Federal and state investment credits in California did not always align, but for a period from 1980 to 1983 they allowed developers to recoup a full *half* of the installed cost of their systems. This came in the form of two 25% investment tax credits—one at the federal level and one at the state level.[31] California's large utilities made a significant contributions to new capacity by purchasing electricity produced by desert solar installations and wind farms along hillsides and mountain passes.

As the programs and funds advancing renewable energy expired, new installations dropped significantly, leaving California with a stagnant wind and solar sector. Thus "the mid-1990s marked a period of decline as the long-term PURPA contracts began to expire and some wind projects ceased operating."[32] The image of California as the United States' renewable energy leader continues through today, helped somewhat by the substantial incentives to solar photovoltaic generation central to this study. The data is a clear indication, however, that concerns on the part of California's energy producers and consumers over energy supply stoked by the 1973 oil crisis had waned by the twentieth century's closing years.

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[30] Toke. 98.
[31] Bird, L., et al. "Policies and Market Factors Driving Wind Power Development in the United States." 2005. 7.
[32] Bird et al. 8.

Electricity Market Deregulation

Then came California's "infamous deregulation" of the electricity market.[33] Coming on the tail end of an era of widespread industry deregulation across the United States, from airlines to communications, the CPUC favored from the mid-1990s the advantages of increased competition and the dismantling of vertical integration.[34] Under Governor Pete Wilson, the 1996 Assembly Bill (AB) 1890 gave legal mandate to the partial deregulation of California's electricity market, most importantly the decoupling of electricity generation and distribution. This meant that the state's three main investor-owned utilities—Pacific Gas & Electric, Southern California Edison, and San Diego Gas & Electric—had to divest a large part of their electricity generation business from their transmission and distribution business.

"Deregulation," however, was something of a misnomer. Toke asserts, "Deregulation in electricity does not mean a reduction in regulations; arguably it means more regulations, since it creates new markets which need to be defined and governance structures which need to be described."[35] In California's case, the state regulatory bodies, namely the CPUC, still had the regulatory power to set price caps on customer rates, though not on the wholesale prices paid by utilities to the now-separate generation facilities.

The ensuing crisis, which came to a head in 2000 and 2001, is of less importance to this narrative than the reforms that came after it. While the deregulation was

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[33] Asmus. 309.
[34] Blumstein et al. "The History of Electricity Restructuring in California." 2002. 12.
[35] Toke. 101.

intended to increase competition and lower costs, the notorious energy giant Enron was accused of exporting energy to other states and taking production capacity offline at times of peak demand in order to artificially inflate wholesale prices. There remains debate as to what extent out-of-state investors' "gaming the system" is to blame. Regardless of this uncertainty, and in the simplest terms, California's utilities were forced to buy and sell electricity at a loss, leading to the bankruptcy of PG&E and almost the same fate for SCE. By 2000 and 2001, wholesale rates for electricity from independent generators had skyrocketed to far exceed the corresponding retail rates, which were capped by the deregulation law. Because of their highly regulated nature and commitments, the state's utilities were squeezed into insolvency, eventually leading to a market collapse and state intervention by the State Water Resources Control Board.

Californians and Americans in general were shocked that such a highly advanced economy could suffer from the kind of debilitating blackouts that struck the state in 2000 and 2001. This sentiment no doubt resonated with that of 1970s and 1980s spurred by the OPEC oil crisis. In much the same way, lawmakers turned back to budding renewables to diversify the state's energy portfolio and keep generation, transmission, and consumption within California. Over the roughly twenty years between the shocks of the 1973 oil crisis and the 2001 electricity market collapse, the costs of various technologies had changed dramatically. Wind was at this point nearly cost-competitive at wholesale prices with traditional energy sources. And advances in

technology, manufacture, and maintenance had made solar PV—while not as affordable as wind—closer than ever before to greater market penetration.

Many of the same goals motivating electricity regulation and reform in the 1970s—domestic production, security of supply, and protection from resource price shocks—informed the federal and state governments' response to the electricity crisis of 2001. Lawmakers in Sacramento were also able to capitalize on increasing buy-in to scientific evidence of global climate change to craft incentives policies to dramatically increase renewable installation throughout the state. The current incentives structure provides the regulatory canvas upon which private citizens, utilities, and third-party solar developers have installed distributed generation solar capacity.

Federal Regulation

The incentives provided at the federal level apply to all states in addition to their unique programs and portfolio standards. According to SunEdison government affairs expert Curtis Seymour, virtually all solar installations in the United States depend on the Solar Investment Tax Credit (ITC) for financing. This credit is usually referred to as the Federal Investment Tax Credit (FITC) in the context of renewable energy financing and policy. The FITC was adopted in the 2005 Energy Policy Act, the first major federal update to US electricity policy since PURPA in the 1970s. For solar generation specifically, EPAct 2005 moved federal incentives away from a Production Tax Credit (PTC) to a one-time investment-based tax credit. With the now-familiar aim of encouraging domestic renewable energy development, the FITC was offered beginning in 2006 and its various expiration dates have been extended by industry lobbying

efforts to 2016. Though it has been suggested that Congress would extend the measure to 2020[36], the current frenzy of "intense debate over the federal budget" means "government subsidies for wind and solar power are more contentious than ever."[37]

The Energy Policy Act provides two important tax incentives for renewable developers, the first of which is a credit against taxable income. Developers can claim a 30% tax credit on qualified expenses related to the installation of a renewable energy system. [38] For the average residential system costing around $30,000, this amounts to $9,000 in savings. Since 2008, utilities are also able to take advantage of this incentive on their larger-scale projects without any dollar amount cap. This incentive is a fairly straightforward and certainly attractive incentive for both residential customers and developers of all size renewable projects.

In addition to the tax credit, the Energy Policy Act also includes an accelerated depreciation provision. This measure accounts for a "not insignificant benefit to the cash flows of the system in the early years."[39] Accelerated depreciation works by allowing businesses that invest in solar photovoltaic installations as well as solar thermal to write off larger amounts of their taxable income in the first years after a system's installation. This incentive does not allow businesses to pay *less* in taxes; rather it defers tax payments to later years once the investment's accelerated

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[36] Wei, M., and D. Kammen. "Economic Benefits of a Comprehensive Feed-in Tariff: An Analysis of the REESA in California." 2010. 16.
[37] Muro, Mark, and David Kreutzer. "Do We Need Subsidies for Solar and Wind Power?" 2012. R2.
[38] Kollins et al. 38.
[39] Seymour, Curtis. Phone Interview. Director of Government Affairs, SunEdison. 2012.

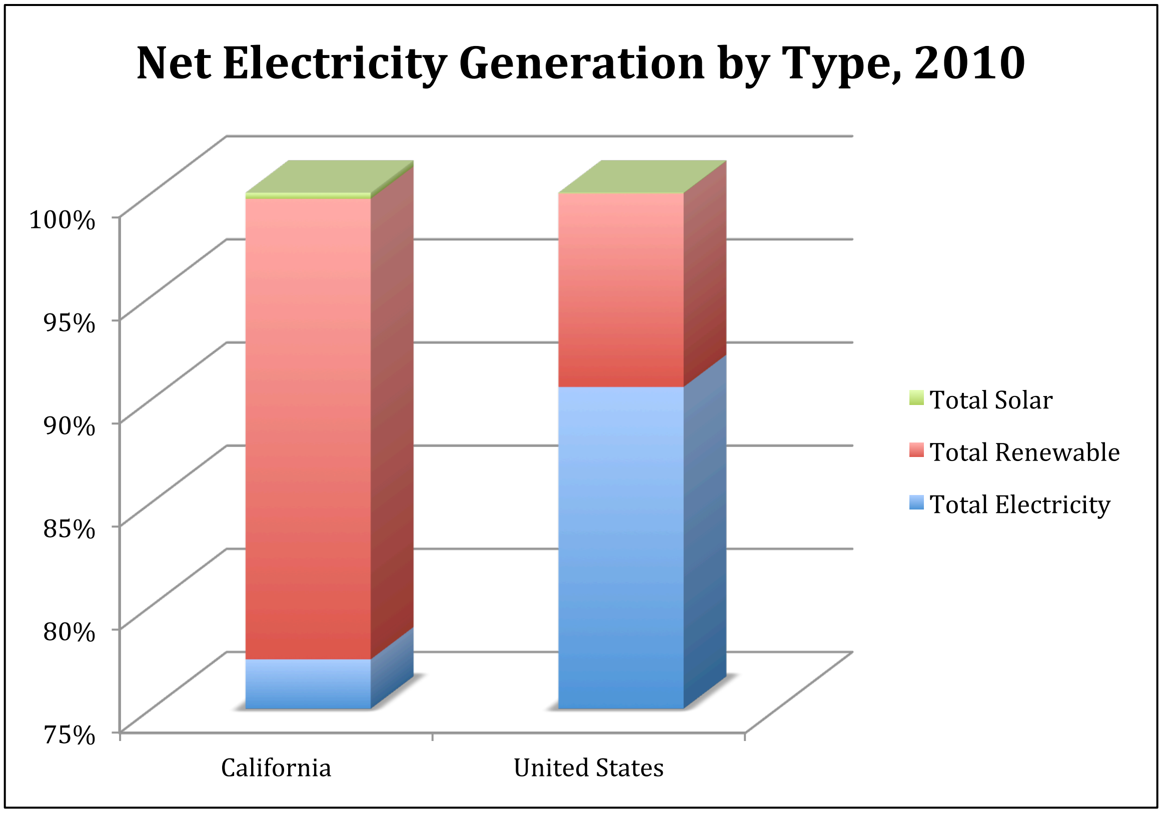
depreciation has been exhausted. The benefit here operates on the time value of money principle, which asserts that money today is worth more than money in the future because of the possibility to invest it now and garner a return on that investment.

While these two federal incentives are a significant push for investment in renewable installation across all fifty states, they do not apply to all installations. In fact, the accelerated depreciation provision is only available to businesses that make an investment in renewable technology, not individual residential producers. Whether intentionally or not, then, the accelerated depreciation part of the federal laws provides an advantage for third-party solar developers as compared with individual homeowners pursuing distributed generation solar on their own accord. This could act to skew DG solar installations toward larger, more traditionally cost-effective ones.

Since the 2005 Energy Policy At, these federal incentives have been renewed multiple times through differently titled congressional actions, though the details have remained relatively constant. However, the current forecast is for the FITC and accelerated depreciation to expire at the end of 2016. This does not, though, mean an end for the program entirely. The current law dictates that the investment credit will drop to a permanent 10% of qualifying costs. Within the solar industry, there is debate as to whether the cost of technology will have fallen sufficiently for it to remain cost-competitive with traditional electricity generation by that time. “What more rational heads are suggesting,” says Curtis Seymour, “is that instead of going from 30% to 10%

on January 1st 2017, that there is some sort of a glide path" decreasing the credit in 5% increments over a longer term.[40]

Figure 3[41]



No doubt the FITC and accelerated depreciation represent a major contribution on the part of the federal government to the advancement of domestic, renewable energy sources across the country. Nonetheless, information on the entire United States' energy mix as compared with that of California supports the claim that state programs are providing an additional push necessary to bring renewable energy into the mainstream. In 2010, renewables accounted for nearly 29% of California's electricity generation as compared with just over 10% for the United States as a whole. Further,

[40] Seymour, Curtis.
[41] *State Renewable Electricity Profiles 2010*. Energy Information Administration. 2012.

solar generation represented 1.3% of California's renewables, while the same figure for the US stood just under .3%.[42] These figures demonstrate that California's approach to renewables in general and solar energy in particular has been more impactful than that of the federal government and many other states'.

State Regulation

Having identified that California's renewable and solar electricity policies have fostered an environment in which those technologies' capacity far exceeds the national average, it is necessary to identify and understand the specific details of those laws. Scholars generally buy in to the principle of states as policy "laboratories," claiming, "The value of using quantitative methods to explore the role of policies in development is that of supporting maximum impact of government intervention for development of renewable energy."[43] Even if California's policy environment for renewable development is not as illustrious as the Promised Land mythology built around it during the wind rush of the 1970s and 1980s, it does continue to exceed other states, if by a reduced margin.[44] Statistics related to solar deployment provided by the Interstate Renewable Energy Council are typically less accurate than those collected by the Energy Information Administration on traditional electricity sources. Nonetheless, California leads the nation with 328.8 MW of installed solar capacity, accounting for six times the

[42] Ibid.
[43] Doris, E., et al. *The Role of State Policy in Renewable Energy Development*. 2009. 5.
[44] Toke. 77.

capacity of New Jersey, the next closest—though considerably smaller—state. Other desert states Arizona and Nevada round out the top four.[45]

Net Energy Metering

Since 1996 in California, producers of renewable energy with systems under 1 MW in size are eligible to enroll in Net Energy Metering (NEM). Non-profit and government producers are allowed to partake in NEM with systems up to 5 MW.[46] Under guidance from federal regulation and more specific regulation from the CPUC, the state's IOUs and POUs—with the exception of the Los Angeles Department of Water and Power—are required to compensate grid-connected electricity generators for energy fed back into the grid. While NEM has been framed by some as a type of Feed-in Tariff like those of Western Europe, it is more of a "billing construct" than an incentive program or premium rate program.[47]

NEM is an important piece of California's electricity market structure that makes DG solar PV an attractive option, especially for residential customers. Unlike wind generation, solar electricity is fairly consistent and predictable in its output. There are occasional clouds and weather events that provide an exception to this rule, but solar energy production generally follows the sun's trajectory with peak production just after midday. For commercial installations, this production schedule aligns well with demand, however residential peak demand is displaced later in the day to early evening "when people come home and it gets dark out, and they turn all the lights on

[45] Doris et al. 4.
[46] "California Net Metering." DSIRE. 2012.
[47] Vermeer, Grace.

and cook dinner and they run the washing machine."[48] There is therefore a mismatch on the individual system level between production and demand, especially for residential installations. With NEM, excess on-site production that is fed back into the utility's grid at midday can offset the cost of utility-generated electricity used when the sun is not shining.

Because NEM producers receive credits against their bill on a monthly basis, compensation effectively occurs at the highest-tier retail rate that each customer pays. The program thus requires utilities to purchase electricity at the retail rate, which is much higher than the alternative of utility-scale PV, which needs to compete at wholesale rates against traditional energy sources. The higher price tag of NEM electricity fed back into the grid cuts out any rate markup over wholesale prices that the utility would otherwise put toward infrastructure maintenance and development.

Since 2009, NEM has been extended with the provision of Net Excess Generation (NEG). This enables independent producers to claim actual financial compensation—not only a billing credit—for generation over a 12-month period that exceeds total consumption from the grid. The compensation is based on day-ahead spot markets for the same 12-month billing period, with projections around 4 cents per kWh, well below retail prices.[49] Essentially, then, DG electricity producers benefit tremendously from NEM billing, but much less when their 12-month grid feed-in exceeds their load over the same period.

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[48] Ibid.
[49] "Assembly Bill 920." Southern California Edison. 2009.

Even though the NEG rate is more sustainable from the utility standpoint, mainly because it trends much closer to wholesale rates than retail rates, resistance from the utilities paints an uncertain picture of NEM's role in future solar development. In May of 2012, the CPUC held a hearing to better define the five percent limit beyond which IOUs are not required to offer NEM. The three IOUs argue that by reducing the rates paid by solar system owners or even eliminating them, non-solar customers are being unfairly left with the bill for grid-related services other than pure electricity generation.[50] The specific argument was over how to define "aggregate customer peak demand", the figure out of which NEM's five percent cap is derived. The Interstate Renewable Energy Council (IREC) in this instance asked the CPUC for clarification in order to ensure security in the industry's future incentive landscape. The CPUC ruled unanimously in favor of solar advocates, providing a higher cap for NEM programming, though it should be noted that five percent—no matter the exact definition of peak demand—is extremely limiting for solar as it seeks to rival wind as a major renewable player.

Renewable Portfolio Standard

California's most pertinent and contemporary policies for driving renewable energy development came directly out of the state's 2001 energy crisis. In 2002, Governor Gray Davis signed SB 1078, laying out the first components of the Renewable Portfolio Standard (RPS). The RPS does not provide financial incentives for renewable production, and as such complements policy goals of the California Solar Initiative

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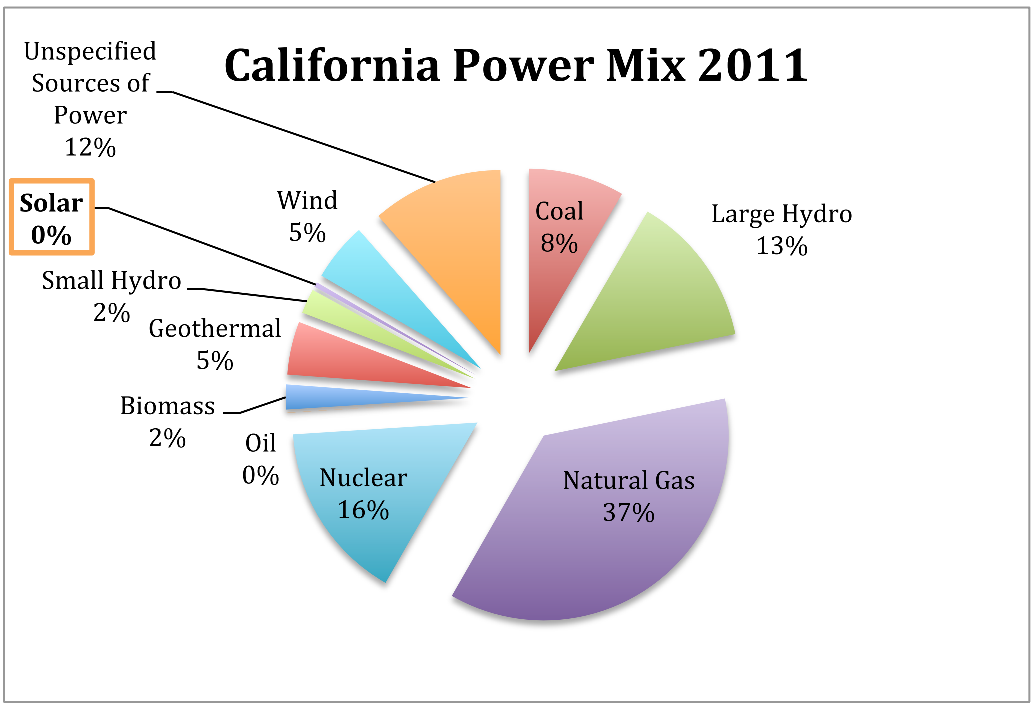
[50] Trabish, Herman K. "The Unintended Consequences of Solar's Net Metering Fight." 2012.

(CSI). The initial incarnation of the RPS called for 20% of retail electricity sales to come from renewable sources by 2017. This quota has been extended through a combination of joint CPUC/CEC Energy Action Plans, executive orders, and legislative codification. The current objective sees the 20% goal moved up to 2013 with an ultimate 33% by 2020, established by Governor Arnold Schwarzenegger in 2008 and approved in 2011 by the State Legislature and Governor Jerry Brown.[51]

Figure 4[52]



The Renewable Portfolio Standard is not a policy tool unique by any means to California. By 2000, 13 states had an RPS and that number had more than doubled to 29

[51] Peterman, Carla. "Renewables Portfolio Standards (RPS) Proceeding Docket # 11-RPS-01 and 03-RPS-1078." 2012.
[52] "Total Electricity System Power." 2012. <http://energyalmanac.ca.gov/electricity/total_system_power.html>.

by 2011.[53] Internationally, there are RPS policies in place in Australia, China, the European Union, and Japan. California's program, like many others, is largely a market-based mechanism that allows for flexibility in implementation. The RPS is less concerned with *how* utilities achieve the retail sales requirements for renewable energy than the mere fact that the goals are in fact reached. Instead of a command-and-control type environmental policy, the RPS sets a reasonable goal for solar electricity procurement in the service territories of the state's utilities that can be met however their planners see fit. Any qualifying renewable energy production facility in the state receives one Renewable Energy Certificate (REC) per MWh of production. These certificates can then be sold to the entities required by law to meet the RPS, including IOUs, POUs, and other retail electricity providers. There is a declining cap on how much of a utility's renewable procurement can come from "unbundled" RECs originating from DG sources.[54]

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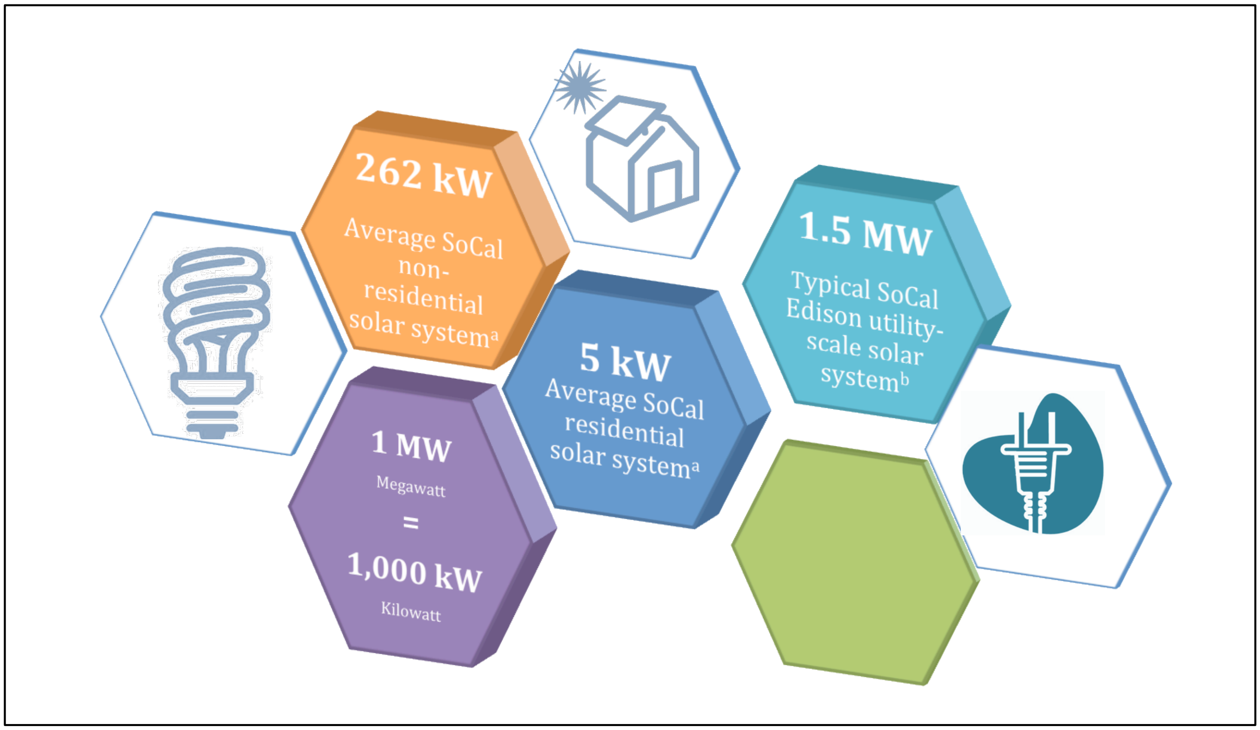
[53] Toke. 105.
[54] "33% RPS Procurement Rules." 2012. <http://www.cpuc.ca.gov/PUC/energy/Renewables/hot/33RPSProcurementRules.htm>.

Figure 5 [55,56]



California Solar Initiative

Aside from the RPS is California's main incentive-based policy, the California Solar Initiative (CSI). In 2006, Environment California, "a statewide, citizen-based environmental advocacy organization," in collaboration with then-Governor Schwarzenegger, launched the Million Solar Roofs initiative. The program operates much like the RPS in that it sets an overarching goal to be addressed with more specific policies. In response to the Million Solar Roofs initiative, the California Energy Commission (CEC) and CPUC joined their programming together under the heading of

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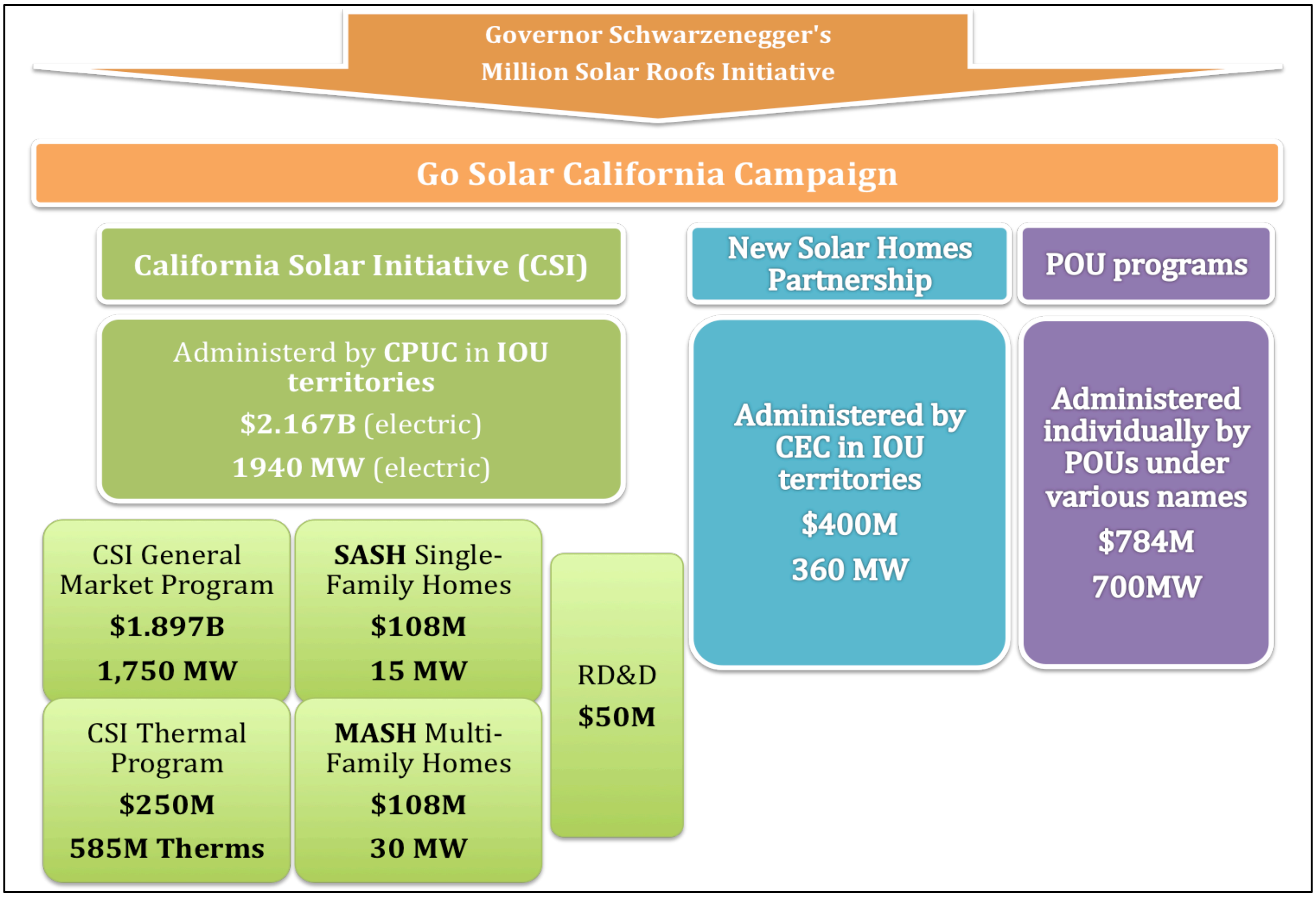
[55] In Southern California Edison's service territory: <http://www.sce.com/solarleadership/gosolar/mash/MASHResources/solar-faq.htm#Q5>.
[56] "Southern California Edison Awards 36 Contracts for Utility-Scale Solar Rooftop Project." <http://www.edison.com/files/072710_news1.pdf>.

the "Go Solar California" campaign. The campaign includes the CPUC's CSI, as well as the various solar programs administered by the state's POUs, and the CEC's New Solar Homes Partnership. However, CSI's funding and, therefore, impact far outweigh these other programs'.

Figure 6 [57,58,59]



The CSI's budget for solar PV is some $2.167 billion, compared with $1.184 billion for all other programs combined. Funding for the program comes entirely from

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[57] Clinton, Jeanne, and Molly Tirpak Sterkel. *CPUC Responsibilities for Renewable and Energy Efficiency Resource Commitments by Investor-Owned Utilities and Ratepayers*. 2011.
[58] http://www.gosolarcalifornia.ca.gov/about/index.php
[59] CSI Thermal Program funded by natural gas ratepayers

ratepayers in the form of a system benefits charge established during deregulation and additional surcharges.[60] The CSI provides strong financial incentives to residential and commercial electricity customers to install solar PV on their property by paying out a rebate based on the system's output. Projects that can take advantage of the CSI are capped at 1MW in installed capacity, a size that is larger than even some utility-scale projects. CSI has five subcomponents, including the General Market Solar Program, the largest with a budget of over $2 billion. Discussion of the other four subcomponents, which focus on low-income and multi-family housing and research and development, follows below. There is also a separate component funded by gas ratepayers to incentivize the installation of solar water heaters.

The CSI's financial incentives come in the form of program rebates, which decline on a pre-established ten-step scale based on installed capacity in each of the three large IOUs' service territories. When the installed capacity for a step is reached, the program proceeds to the next step with incrementally smaller monetary incentives until the tenth and final step of funding is exhausted. While the steps are based on statewide MW capacity, the administration of the program is left to the IOUs, or in the case of SDG&E, the California Center for Sustainable Energy (CCSE). This means that customers in different parts of the state may be at different steps of the rebate program at any one point in time.

Because the range of installation scales varies so drastically within the CSI, there are two accounting methods by which the payment of these rebates takes place. There

[60] Bird et al. 8.

are the Expected Performance Based Buydown (EPBB) and the Performance Based Incentive (PBI).[61] The EPBB is available to all systems less than 30 kW and is the required method for those systems under 10 kW. All systems greater than 30 kW are required to use the PBI.

The EPBB is a one-time lump sum payment based on the expected output of a rooftop solar system. This takes into account the specific system's manufacturer-determined specifications, geographic location, angle of installation, sun exposure, and other relevant factors. In this way, the EPBB aims to proportionately incentivize the most effective solar installations. As of November 2012, EPBB payments for residential systems are on the tenth and final tier in the service territories of PG&E and SDG&E at 20 cents per Watt. In SCE's service territory, residential payments are on the ninth step at 25 cents per Watt.[62] For non-residential systems, the program is on the eighth step for customers of SDG&E and SCE, while it is on the tenth step for PG&E customers. Though the EPBB rates for commercial customers are less relevant because such installations usually exceed 30 kW, there is a substantially higher incentive rate for nonprofit and government agencies, which are likely to take advantage of the lump-sum EPBB for their smaller systems.

[61] Vermeer, Grace.
[62] "California Solar Initiative Statewide Trigger Tracker." 2012.

Figure 7[63]

Step	Statewide MW in Step	EPBB Payments (per Watt)			PBI Payments (per kWh)		
		Residential	Non-Residential		Residential	Non-Residential	
			Commercial	Government/ Non-Profit		Commercial	Government/ Non-Profit
1	50	n/a	n/a	n/a	n/a	n/a	n/a
2	70	$2.50	$2.50	$3.25	$0.39	$0.39	$0.50
3	100	$2.20	$2.20	$2.95	$0.34	$0.34	$0.46
4	130	$1.90	$1.90	$2.65	$0.26	$0.26	$0.37
5	160	$1.55	$1.55	$2.30	$0.22	$0.22	$0.32
6	190	$1.10	$1.10	$1.85	$0.15	$0.15	$0.26
7	215	$0.65	$0.65	$1.40	$0.09	$0.09	$0.19
8	250	$0.35	$0.35	$1.10	$0.044	$0.044	$0.139
9	285	$0.25	$0.25	$0.90	$0.032	$0.032	$0.114
10	350	$0.20	$0.20	$0.70	$0.025	$0.025	$0.088

The other rebate method, PBI, is optional for systems between 10 kW and 30 kW depending on the system area's utility, and mandatory for systems between 30 kW and 1 MW. Installations of this size are typically sited on the tops of warehouses, consumer retailers, and large government buildings. The payment is based on the solar system's actual performance over a five-year period via 60 monthly payments. The 2012 program rates stand between 2.5 cents per kWh and 4.4 cents per kWh for residential and commercial installations. Government and non-profit rates are higher, up to 13.9 cents per kWh. These latter rebate rates are so high because there is high political will in the state for energy- and cost-efficiency in publicly-funded infrastructure and to account for the fact that tax-based incentives like FITC do not benefit entities without tax liability.

The CSI program also benefits tremendously from NEM, especially in view of California's inverted rate structure. Retail electricity rates are determined in five tiers

[63] Ibid.

built on a baseline figure for energy consumption. As energy consumption increases, so too does the price per kWh paid to the utility. In the same way, drawing less electricity from the grid after the installation of a solar PV array allows the ratepayer to avoid the most expensive electricity charges from the utility.[64]

Because the CSI introduced the policy innovation of tying the progression of the ten steps with installed capacity instead of an inflexible time table, there is no way to pinpoint the coming end date of the program. In fact, each of the six segments of the rebates—residential and non-residential for each of the three IOUs—will likely stop approving new applications at different dates throughout 2013 and 2014.[65] PBI payments will continue to be paid out, of course, for projects that have already been approved for the incentive funding. At this point, there does not seem to be any push in the legislature to renew or extend the CSI. It is too early to definitively brand this program a success, but this paper certainly hopes to portray its significant role in furthering solar deployment in California as compared with other US states.

SASH & MASH

Critics point to California's electricity rate structure as contributing to socioeconomic inequity in relation to the CSI. Since solar generators can reduce the most expensive electricity per kWh taken from the grid, this unfairly provides the largest benefits to the owners of "McMansions" who typically do pay the highest tier rates for their grid electricity.[66] However, this dissatisfaction with the CSI might be

[64] Janardhan and Fesmire. 29.
[65] Trabish, Herman K. "Signs of the California Solar Initiative's Coming End." 2012.
[66] Toke. 109.

misdirected, as the reason wealthier ratepayers are benefiting more is because of the NEM program. NEM, because of its essence as a "billing construct," compensates solar generators at the retail rate for electricity sold back to the grid. And while NEM is essential to the success of CSI, more generally "nationwide…residential solar is so dependent on having these progressive or just NEM policies in place."[67]

Because CSI is funded entirely by ratepayers, the State Legislature initiated a pair of programs designed specifically to bring the advantages of DG solar to those living in low-income housing. The 2006 AB 2723 assigned 10% of the CSI budget to low-income housing, as something of an "afterthought" to the General Market Program.[68] Based on this directive, the CPUC decided to evenly split the budget, allocating 5% each towards the Single-family Affordable Solar Homes (SASH) and Multi-family Affordable Solar Homes (MASH) subcomponents. Though similar in aim, these programs vary greatly in terms of their rebate structure, program administration, and target customers.

In the early days of CSI implementation, criticism was mounted because, "as a matter of equity, solar energy programs should be designed in a manner that allows all contributors to participate."[69] Though low-income ratepayers were footing a proportionate share of the bill for CSI rebates, the likelihood that they would benefit from the program was extremely low. Even with the third-party financing possibilities discussed below, low-income homeowners' lack of good consumer credit proves an obstacle to such DG solar projects.

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[67] Monahan, Cathleen. Phone Interview. SASH Program Officer, GRID Alternatives, 2012.
[68] Ibid.
[69] Coughlin, Jason, et al. *A Guide to Community Solar: Utility, Profit, and Non-Profit Development*, 2011. 3.

Within CSI, SASH is unique in that GRID Alternatives is the only program administrator for all three major IOU territories. GRID won the administrative capacity in a bidding process before the CPUC, largely because of its prior work starting in 2004 bringing DG solar to low-income single-family homes. Oftentimes in such communities, bottom-up demand for local solar energy development is low because of a lack of information.[70] In many cases there is the potential, though, to introduce energy efficiency measures alongside distributed generation deployment to significantly reduce electricity costs. While projects before SASH were funded through "piecemeal" combinations of in-house fundraising, corporate support, and Habitat for Humanity grants, among others, GRID's work now focuses almost exclusively on carrying out SASH's goal of providing generous rebates for low-income single-family homeowners, while providing job training, and solar education in these communities.

SASH differs from the General Market Solar Program mainly because of its "higher upfront rebates" and because "GRID [is] the sole provider of SASH services," from energy efficiency audits to volunteer training and grid interconnection procedures.[71] This stems from concerns over predatory lending in low-income communities and the lack of awareness concerning CSI in these communities. These projects also benefit from the cost-savings offered by having supervised volunteers perform panel installation on more than half of SASH installations.

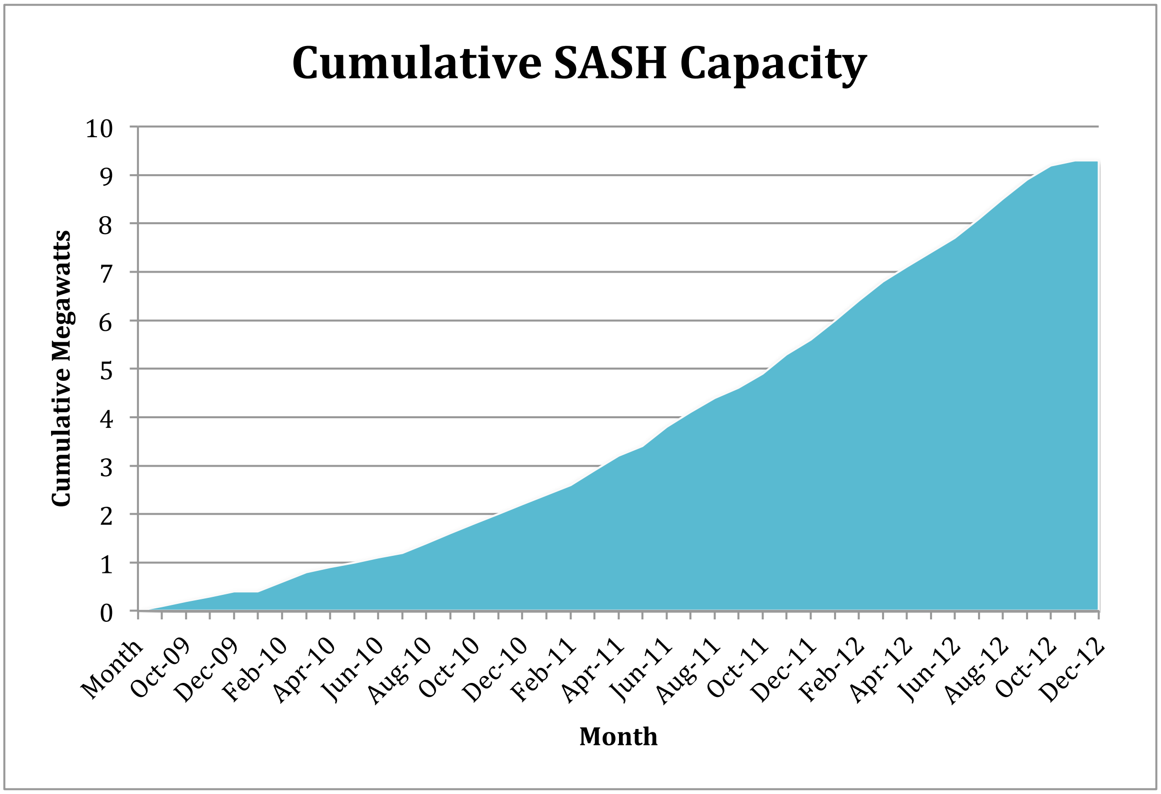
[70] Stupak, Agnes. Phone Interview. Program Manager, California Center for Sustainable Energy. 2012.
[71] Monahan, Cathleen.

In the cases where volunteer labor is not appropriate or sufficient for a SASH installation, GRID has relationships with 24 subcontractors that carry out the work. This list has been refined from an earlier period that was open to any contractor, which resulted in implementation difficulties for the specific customer base of the CSI subcomponent.[72] GRID also requires that subcontractors hire paid job trainees, in line with its job education aims. Because of the community benefits of in-house GRID projects, and as the amount of incentive dollars decreases in the coming years, program officer Cathleen Monahan forecasts a reduction of subcontracted work in the program's final stages.

With SASH's unique volunteer installation provision, GRID boasts the training of 10,000 volunteers and success of 1,000 individuals in finding paid jobs in the solar industry. Also, each project undergoes a sizing process that requires an energy efficiency audit and accounts for about a fifteen percent reduction in load. Especially in low-income homes, energy efficiency gains can be significant. These auxiliary benefits justify further the larger rebates given to low-income homeowners than in the General Market Program.

[72] Ibid.

Figure 8 [73]



CSI's other low-income subcomponent is MASH, which benefits low-income multi-family properties within the three large IOUs' territories. Unlike SASH, the same authorities administer this program as do the General Market Program—that is, SCE and PG&E in their respective territories, and CCSE in SDG&E's territory. With the same budget as SASH, MASH has double the capacity goal. This is in large part because of the economies of scale inherent in DG solar deployment. Though individuals living in multi-family housing have smaller individual load, their collective tie-in to a single system demands a larger capacity than in single-family housing.

[73] California Solar Statistics. Monthly Statistics. <http://www.californiasolarstatistics.ca.gov/reports/monthly_stats/>.

The implementation of MASH is something of a hybrid between the General Market Program and SASH. It shares with its low-income sister program generous rebates and community outreach components. But unlike in SASH, the impetus for DG solar in multi-family housing usually comes from the property owner, "based on the economics" of system installation.[74] In fact, many of the beneficiaries of MASH are non-profit communities eager to offer residents a lower electricity bill in line with their more general missions. Also making MASH more akin to the General Market Program is the fact that the property owner coordinates project management, not the CPUC-designated program administrator. As such, they are free to choose any contractor to complete installation.

In order for MASH to work successfully, it relies on an extension of NEM called Virtual Net Energy Metering (VNEM) for multi-tenant and multi-metered properties.[75] VNEM is vital in allowing multi-family property owners to allocate the benefits of net metering to a large number of tenants sharing a single rooftop PV system. Since 2012, a similar VNEM tariff has been introduced for installations outside of the MASH program.[76] In this way, MASH acted as a pilot program for this important extension of state electricity policy to reach a broader share of energy consumers.

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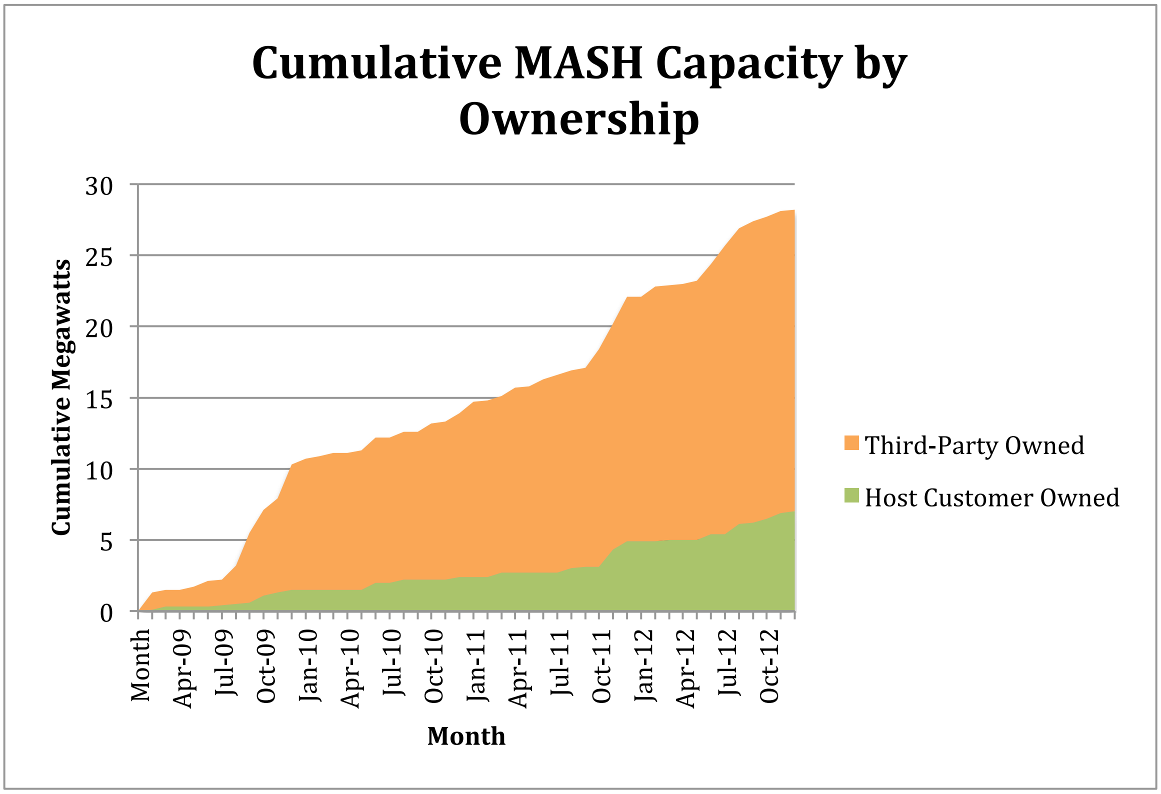
[74] Stupak, Agnes.
[75] Coughlin et al. 23.
[76] Stupak, Agnes.

Figure 9 [77]



Financing Models & Third-Party Development

Business Models

During the course of the CSI's implementation, a new set of business models sprouted up in California and throughout the United States to take advantage of the generous incentive provisions characterized above. For this analysis' purposes, "a businesses model depicts the mechanisms that enable a firm to create value through the value proposition to its potential customers, its value constellation, and how it captures

[77] California Solar Statistics. Monthly Statistics. <http://www.californiasolarstatistics.ca.gov/reports/monthly_stats/>.

this value to transform it into profits."[78] Third-party solar developers Solar City, SunEdison, and Renewable Ventures spearheaded innovations starting in 2004 that broadened the possibilities for residential and commercial solar deployment by introducing flexible financing on an otherwise expensive endeavor. Despite the third-party model having only been in the periphery of policymakers' minds as they crafted the Go Solar California campaign, it rose to greater prominence with each progressive step of the rebate program.

According to Solar City Director of Government Affairs Sanjay Ranchod, "The single thing that has made the biggest difference so far in increasing the access to solar has been…third-party third-party ownership, in the form of solar leases for residential systems and PPAs for commercial systems."[79] Third-party financing acts to transfer up-front capital costs to a party that can capture available tax benefits with lower cost of capital, and allows homeowners with environmental sentiment to forgo the financing, building, and maintenance of their systems.[80] As mentioned in the discussion of federal tax incentives, business developers can also take advantage of a wider range of mechanisms like accelerated depreciation.

Third-party developers have been key in fulfilling the goals crafted by those who put forward the Go Solar California campaign. They represent the most robust promise of a long-term sustainable solar industry, even with the coming expiration of CSI rebates and cuts to federal incentives. Indeed, "The ownership structure of proposed

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[78] Schoettl and Lehmann-Ortega. 148.
[79] Ranchod, Sanjay. Phone Interview. Director of Government Affairs, Solar City. 2012.
[80] Kollins et al. 2-3.

projects can affect whether owners are able to obtain necessary financing and take advantage of incentives. The ownership structure may even affect the acceptability of the project in the public view; locally owned and community-owned projects may be more favorably received."[81] First, this discussion will explore the specific financing and business models in which these developers operate. Then, data from CSI and the National Renewable Energy Laboratory (NREL) will confirm that these models have been successful in broadening accessibility to DG solar electricity in California.

Financing Challenges

Through the federal and state incentives policies and NEM, individual homeowners and those owning commercial properties can reap the benefits of essentially free solar electricity radiating from the sun to their rooftops. This proposition, though, involves a long payback period on a high upfront equipment investment, typically around $40,000 for residential-scale systems and over $1 million for commercial-scale (See Figure 10). Aside from California's tiered electricity rate structure that delivers outsized benefits to heavy electricity consumers through NEM, this cost further disadvantages those without large sums of capital or other methods of financing. Further, payback times on these investments are on the order of a decade, after which point the investment continues to make a profit through continued lower electricity costs.[82]

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[81] Doris et al. 8.
[82] Drury, E., et al. "The Transformation of Southern California's Residential Photovoltaics Market through Third-Party Ownership." 2012. 682.

In many US states, California chief among them, popular sentiment is shifting toward an increased awareness of global climate change and the long-term impact of our energy choices. Yet there persists a disconnect between consumer intentions and actions. Even for those willing to commit to long-term financing to purchase a solar PV system, "Financing fees and administrative procedures may be prohibitive to small developers."[83] The greatest potential for launching distributed generation PV into the energy mainstream lies in the ability of "Third-party companies" to "reduce or eliminate technological risk and complexity, which is frequently found to be a primary concern for potential customers."[84]

Doris et al., in the authors' examination of state energy policy, also proclaim, "Policy measures can address these barriers and make financing available to a broader spectrum of projects representing a variety of ownership structures."[85] California has also been a lead state in this regard.[86] Instead of regulating third-party developers as utilities, California Public Utilities Code 218 "states that if the system generates non-conventional energy and if you serve two or fewer customers on that property, you are not considered" a utility.[87] This allowance paves the way for one of the two main business models used by solar developers to provide affordable solar PV systems for residential and commercial customers, to be described below.

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[83] Doris et al. 8.
[84] Drury et al. 681-2.
[85] Doris et al. 8.
[86] Ibid. 684.
[87] Kollins et al. 42.

Figure 10

Approximate Upfront Investment for DG Solar Systems

	Residential-Scale	Commercial-Scale
Average system size[88]	5 kW	262 kW
Approximate cost per Watt[89]	$8	$4
Approximate system cost	$40,000	$1,048,000

In order to reduce or eliminate the "several common barriers to obtaining financing for renewable energy products," these third-party developers have created innovative leasing and contract mechanisms to offer residential solar with as little initial financial requirement as no down payment.

Solar Lease & Power Purchase Agreement

The two main advances introduced by third-party solar developers in California are the solar lease (stylized as SolarLease® by innovator Solar City) and Purchase Power Agreement (PPA). They are generally quite similar, with some distinctions. Both solar leases and PPAs take advantage of the third-party developer's significant capital to reduce the required up-front investment on the part of consumers. In both scenarios, the third-party developer maintains ownership of the solar PV system and thus claims the federal and state incentives. Whether a customer chooses a solar lease or a PPA depends on factors including their utility service territory (IOU or POU), the scale of the installation, and the desired payment structure. "Third-party companies…reduce or

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[88] In Southern California Edison's service territory: <http://www.sce.com/solarleadership/gosolar/mash/MASHResources/solar-faq.htm#Q5>.

[89] Vermeer, Grace.

eliminate technology risk and complexity, which is frequently found to be a primary concern for potential customers."[90]

In the solar lease model, the third-party developer installs and maintains a solar PV array on the property of the customer. In exchange, the property owner pays a pre-determined monthly lease charge, similar to an automobile lease. The lease is non-traditional in that it is not a direct lease, but rather an operating lease. This accounting arrangement allows for the lessor and lessee to realize the full benefits of accelerated depreciation on business but not consumer expenses. While the investment-related tax incentives accrue to the developer (the lessor), all of the electricity produced by the system belongs to the lessee. Therefore, production in excess of onsite load benefits the consumer through NEM billing. This financing structure is cost-neutral or -positive when the electricity bill savings experienced by the consumer exceeds monthly lease payments to the solar developer.[91]

The solar PPA is more commonly used for commercial-scale DG installations. The third-party developer in this case owns and installs the system on the customer's roof. The developer retains ownership of the system *and* the electricity it produces. By reaping tax incentive benefits, solar rebates, lower financing fees, and NEM compensation, the developer's value proposition lies in its ability offer the customer electricity at a discount to what the utility charges for power from the grid.[92] Even though the cost per watt installed for solar electricity—and renewables in general—still

[90] Drury et al. 681-2.
[91] Kollins et al. 17.
[92] Seymour, Curtis.

exceeds that of traditional fossil fuel-fired generation, third-party solar developers are able to bring together tax and other government incentives into a simple rate per kWh lower than that offered by the utility.

Figure 11

Solar Lease Only	Shared Attributes	PPA Only
✓ Customer owns electricity, can use NEM	✓ Third-party own system ✓ FITC & CSI incentives accrue to third-party ✓ Solid consumer credit required	✓ Third-party owns electricity, can use NEM ✓ Customer pays lower-than-grid rate to third-party

The market of third-party solar developers is diverse, with both small and large players that offer multiple products. These companies take advantage of the incentives landscape that underscores California's need to shift energy sources, which defines their general business model and longevity. Inasmuch as a firm is defined by the role it plays along its industry's value chain, there are numerous approaches filling a gamut of market niches.[93] Solar developers that have long sold and installed solar PV systems have built upon solid financing and credit to widen their reach with solar leases and PPAs. Firms like Solar City, SunEdison, Sungevity, Sun Run, and more have applied their financing model across many states, but most focus on California because of its generous incentives, ambitious RPS, and strong environmental sentiment.

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[93] Schoettl and Lehmann-Ortega. 148.

Success Within CSI

In spite of the fact that the above detailed innovations in third-party solar financing occurred both before and early in the implementation of California's large rebate programs, the full synthesis of the policy and industry did not become apparent until midway through the ten-step process. SunEdison's first solar PPA predated the CSI program upon implantation in 2004, and Solar City pioneered the solar lease in 2008.[94] This particular phenomenon has been easy to discern because of the open records and up-to-date statistics offered by the CPUC's CSI website.[95] Broadly speaking for California, "third-party PV systems grew from 9% of residential PV installations during the first quarter (Q1) of 2009 to 36% of residential PV installations during Q1 2011."[96] This trend toward third-party ownership has only become more pronounced in the later quarters of 2011 and through 2012, as can be ascertained from Figures 12 and 13.

This growth was especially slow to take off in the residential sector as compared to commercial, business, and non-profit projects. Financing innovations, though, have clearly caught on in a big way for new installations nationwide, and especially in California. Third-party ownership has been described as "just the way the solar industry is going."[97]

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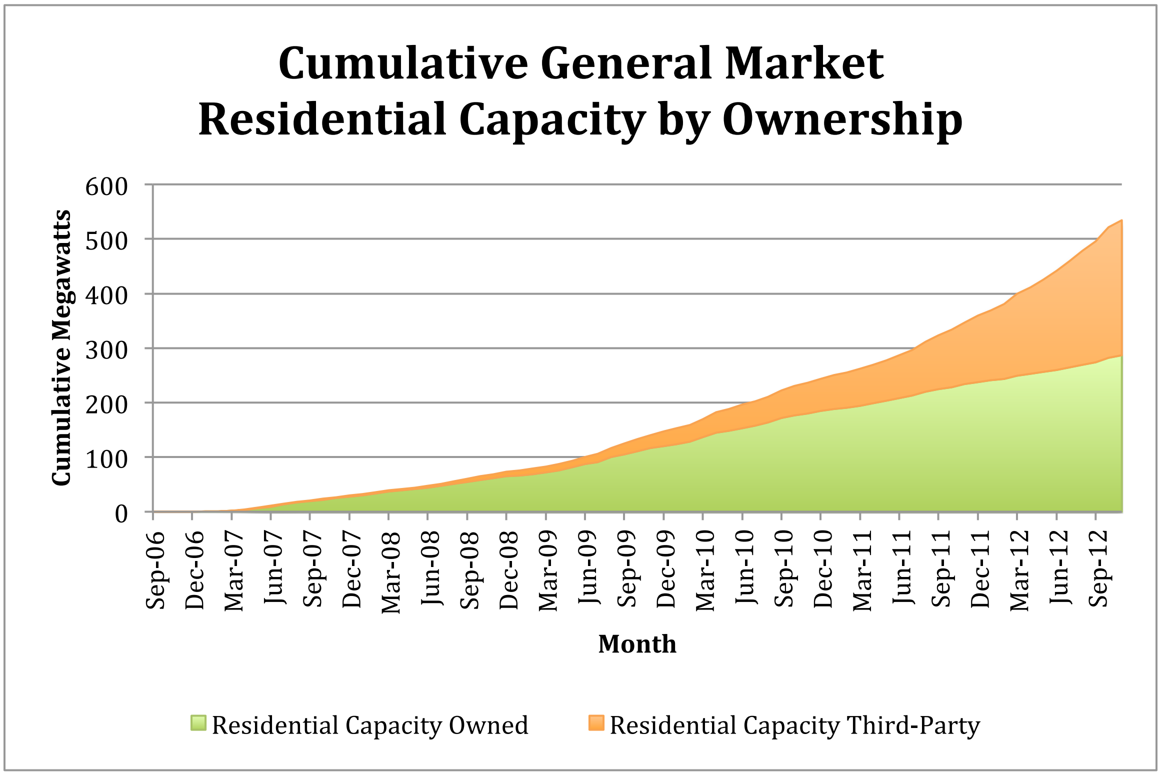
[94] Drury et al. 684.
[95] <http://www.californiasolarstatistics.ca.gov/>.
[96] Drury et al. 682.
[97] Monahan, Cathleen.

Figure 12[98]



What is perhaps most promising about the advent of third-party financing in carrying out the goals of CSI is that, instead of cannibalizing solar deployment on the part of wealthy home- and business-owners with the upfront capital to invest in a solar PV system, it actually *expanded* the market. This is because the third-party finance model appeals to "less affluent, younger and less educated populations. By enticing PV adoption in new regions with different population demographics, third-party PV products appear to be increasing total PV demand, rather than just taking market share from existing, customer owned PV demand."[99]

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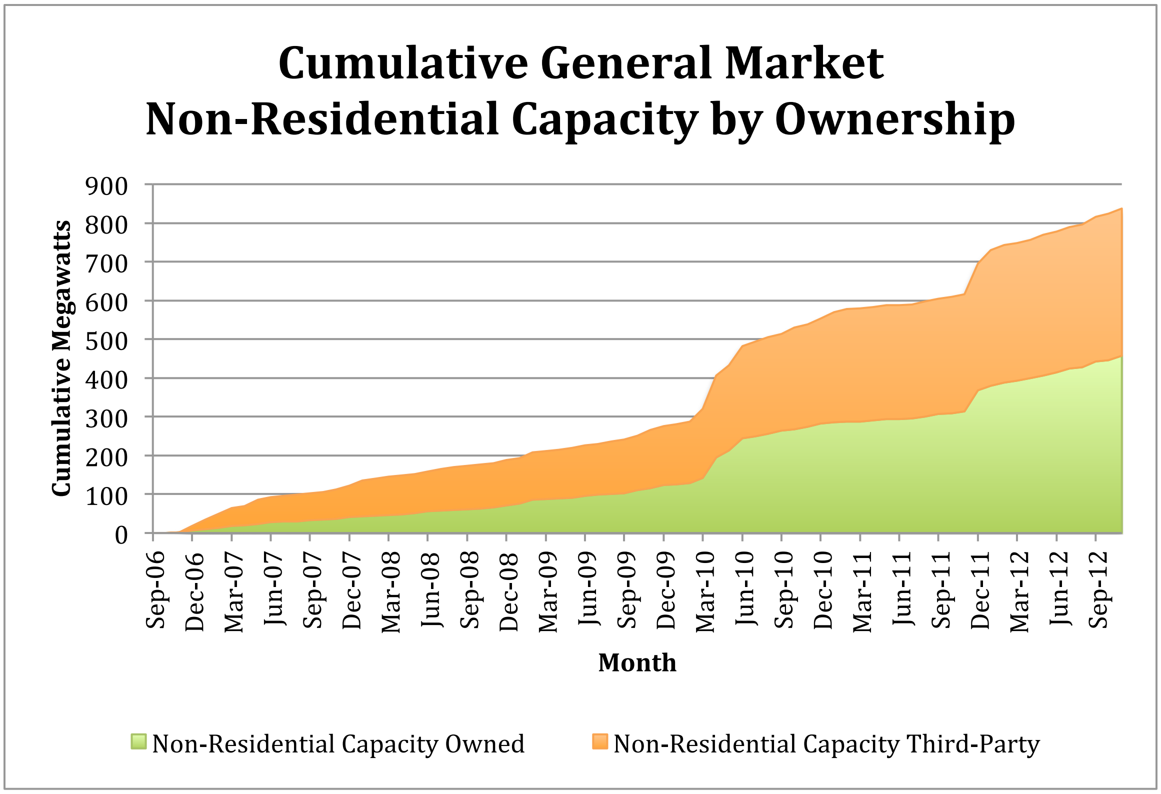
[98] California Solar Statistics. Monthly Statistics. <http://www.californiasolarstatistics.ca.gov/reports/monthly_stats/>.
[99] Drury et al. 689.

Figure 13[100]



Interestingly in the case of California, third-party financing has not played a role in SASH, one of the programs targeting low-income residential rooftops. Seemingly, private developers could pass on the benefits of more generous low-income rebates to this broader customer base, while providing additional financing capabilities for the remaining expenses. But concerns over consumer protection and credit requirements have stood in the way of developing this potential market.

For SASH specifically, third-party developers offering PPAs and leases were explicitly excluded from the program. This has to do largely with GRID's status as a

[100] California Solar Statistics. Monthly Statistics. <http://www.californiasolarstatistics.ca.gov/reports/monthly_stats/>.

one-stop project manager and program administrator. But pressure from these growing businesses has called into question CPUC's position on the issue. As the program is continually evaluated and reviewed, it is likely that third-party developers and their innovative ownership model might be allowed to help low-income customers take advantage of SASH rebates. This represents a key CSI market potential for third-party developers, since less than 10MW of the slated 15 MW capacity goal has been reserved for funding, and even less actually installed.

In terms of multi-family housing, the extension of VNEM from only MASH to essentially any multi-tenant property also broadens the potential market for solar financing. It remains to be seen, though, whether multi-family property owners will recognize the potential benefit of rooftop solar, and by which means of ownership structure they will proceed.

Discussion & Conclusions

The energy regimes that have powered development and westward expansion in America since European colonization are no doubt vital in characterizing the sustainability of cultures over time. Over the past half century, California has experienced two dramatic shocks to its energy and electricity markets, the first tied in with the rest of the United States and the second uniquely Californian. As a result of both of these events—the oil crisis of 1973 and the California energy crisis of 2001—policies were implemented to speed the development of alternative energy resources, mainly wind and solar, but also combined-cycle, biomass, geothermal, and small hydro.

But as the memory of the 1970s oil crisis faded, so too did the public backing for and involvement in renewable energy procurement. This cultural context is just as vital to policy as is the recommendation of climate scientists that we immediately transition our energy systems away from greenhouse gas-producing fossil fuels.

In the twenty-first century, the threat of high energy prices for household and business use, especially in the transportation sector, continues to be much more visible to Californians than it was in the 1980s and 1990s. And even though dominant modes of individual and goods transport remain fossil-fueled, alternatives are appearing which attribute their climate friendliness to grid-tied electricity. Think electric cars, buses, and light rail. This trend in transportation reinforces the importance of transitioning sources of electricity from coal, natural gas, and oil to renewables, including the state's readily abundant and reliable solar influx.

Considering the history of California's "wind rush" following energy regulatory reform in the 1970s, which waned after about fifteen years, solar advocates are eager to prevent such a drop-off in new capacity with DG installations. As the expiration of several innovative incentives programs approaches, third-party solar development presents the best chance of bringing solar electricity into the mainstream and broadening its customer base from the core demographic of wealthy, educated urbanites. These businesses are vital in simplifying the tangle of expenses, interconnection procedures, and income associated with rooftop solar into a simple PV electricity rate or monthly solar lease payment.

The current political moment complicates this goal, though, because of its fiscal severity. Not only does California's deficit continue to present problems to the state, but the federal government also now faces a veritable reckoning when it comes to revenue and expenses. Even if state and federal government programs that support solar development must reduce their contributions considerably in light of this debate, there remain tried-and-true non-incentives policies to capitalize on the solar push's current inertia.

The Future of State & Federal Incentives Programs

The overall effectiveness of CSI in reaching its stated budget and installed capacity goals is relatively simple to assess. This is because, as has been mentioned, the progression of rebates along a declining ten-step scheme is tied to comprehensive live data on approved solar capacity. Were the incentives not attractive enough, the program would have proceeded more slowly than the anticipated timetable ending in 2015. In fact, with the General Market Program subcomponents slated to exhaust their respective budgets in 2013 and 2014, the CSI has been quicker than anticipated in delivering on state legislators' vision for a solar California.

As is readily apparent from the descriptions of the federal and state incentives programs encouraging DG rooftop solar, their program life is far from indefinite. Since CSI's rebate funding is budgeted into different subcomponents and utility territories, programs will close on an independent basis between 2012 and 2015, the predetermined end date. Some subcomponents in certain territories, for example MASH dollars in

SDG&E's region, have been fully reserved already, though program administrators are expecting some of those reservations to not reach installation.

For the General Market Program subcomponent of CSI, the rebates still being offered are relatively small, especially in comparison with those that were offered in 2006 at the program's start. This demonstrates that independent homeowners—and increasingly third-party developers—are able to realize the benefits of smaller-scale DG solar in California without state financial support. Therefore, there is little if any discussion of renewing CSI funding past the initial plan. In terms of California's other non-incentive policies, the RPS could be extended beyond the 33% target to provide continued momentum for renewables, an issue that "*may* come up in the legislature [as soon as] 2014."[101]

Since CSI's low-income programs, SASH and MASH, were introduced after the initial subcomponents, they may provide rebate reservations beyond the closure of the General Market Solar Program. The difference for low-income homeowners and renters, though, is that these rebates have been much more generous. Without CSI to support the costly investment in solar technology and installation, the likelihood of continued expansion in this market segment is unlikely. Third-party developers are hesitant to pick up the slack left by the expiration of rebates for low-income populations because of credit concerns. SolarCity and Sungevity, for instance, both require an "excellent" FICO credit score of 700 or greater.

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101 Seymour, Curtis.

For its part, GRID Alternatives is hoping to continue its campaign to "[change] the face of…who is today's solar adoptee."[102] This means returning to non-CSI sources of financing, including private and corporate donations, alternative energy grants, and, of course, volunteer labor. They have begun to demonstrate this possibility by completing ten pilot projects outside of Denver and opening a Colorado office in 2012.

Projects of all scale and demographic, though, are threatened by the slated expiration of the Federal Investment Tax Credit at the end of 2016. This end of this incentive will impact all types of renewable energy across the fifty states, not only solar in California. But its contribution to DG solar alongside CSI cannot be overlooked. Since the removal of a $2,000 system cap in 2009, the FITC has essentially provided a 30% discount on all upfront renewable investments.[103][104] It is unlikely that technological improvements will further reduce system costs by 30% before the start of 2017. This means that solar developers can expect the capital required for investment to increase by 20% less whatever drop in prices does materialize by then, accounting for the permanent 10% credit starting in 2017.

No doubt, the solar industry will continue to lobby the federal powers-that-be to repeat the pattern of extensions that has thus far defined the FITC. Such lobbying is done largely by the Solar Energy Industries Association (SEIA), which also keeps track of the industry's pulse with quarterly research and reporting done in cooperation with

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[102] Monahan, Cathleen.
[103] Drury et al. 683.
[104] It should be noted that this statement assumes the investor possesses sufficient tax appetite to take advantage of FITC. This precludes non-profit and government entities, as well as those owing less in taxes to the federal government than the FITC would provide, from taking full advantage of the incentive.

Greentech Media. The recommendation of Curtis Seymour with SunEdison that a FITC extension follow a "glide path" is a pertinent one in light of California's success with CSI. A reducing incentive structure tied to installed Megawatts has the dual benefits of extending DG solar deployment nationwide and providing policymakers with predictable budgeting and an eventual incentives phase-out.

The Role of Utilities & Cost Competitiveness

Even before the expiration of California and federal solar incentives, debate has erupted over the future of NEM. With the CPUC siding most recently with those asking for a more expansive definition of the extent to which IOUs must offer NEM, the policy's future will define how utilities evolve with the changing energy landscape and where solar competes on price.

There is certain validity to the argument that NEM is sustainable for neither utilities nor traditional ratepayers. Electricity rates do not merely account for the raw materials required to produce traditionally "elite" energy like coal or natural gas. They must also provide utilities with sufficient capital to maintain their grid networks, upon which DG installations and NEM inherently rely. Therefore, it is unrealistic to expect utilities to be able to meet their customers' needs when increasing market penetration of solar forces them to compensate producers at retail rates, instead of the much lower wholesale rates they pay for utility-scale electricity, regardless of whether it is traditionally or renewably sourced.

However, if net solar electricity fed into the grid from DG installations is compensated at wholesale rates, it will make little economic sense for property owners

and solar developers to continue installing with current component costs. This necessitates some type of hybrid NEM rate that will continue to incentivize rooftop solar installation while allowing utilities and ratepayers to invest in grid improvements. Such a restructuring is especially important in light of a doubling in nationwide electricity demand alongside a halving of spending on grid improvements between 1975 and 2004. [105] More broadly, California's electricity grid needs to be strengthened, not weakened, in order for increasing distributed source electricity to take production share from traditional generation.

Utilities might also seek greater cooperation or integration with the third-party solar developers that have gained considerable traction in California since the implementation of CSI. For example, "Pacific Venture Capital, LLC, a subsidiary of PG&E Corporation" in 2010 entered into a financing deal with SolarCity and Sun Run that enables the two firms to proceed more quickly with DG installations.[106] In light of California's electricity deregulation, though, any such entanglement must proceed with caution. Tighter integration between a financing and electricity-producing entity and a CPUC-regulated utility would likely be highly scrutinized.

Regardless of utility structure, predictions on the falling cost of solar PV component costs are dependent on two factors: at what rate and against what technologies solar must compete. As incentives and subsidies start to fall away from supporting solar, such production will need to push toward grid parity. If small-scale

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[105] Asmus. 279.

[106] Hertzog, Brian, and Jonathan Bass. "PG&E Corporation and SolarCity Announce $60 Million in Financing to Install Solar Power for Businesses and Homeowners." 2010.

solar can continue to compete with retail rates through NEM, the costs are already quite competitive. However, in the wholesale market, solar would have to compete with new shale sources of natural gas, the prices of which hydraulic fracturing has pushed to "extraordinarily low" levels.[107] In competition with shale gas, solar has a competitive edge because its use is confined to its location of generation, extending out to the local grid. Natural gas, on the other hand, can be transported long distances, especially in its liquid form, to booming overseas markets in Asia and South America. If natural gas exports rise, so too will the domestic price, thereby illuminating solar as an advantageous alternative.

Community Solar

Largely because of their transparency and size, this study has focused almost exclusively on programs available to customers of California's investor-owned utilities. As Figure 6 indicates, though, there have also been programs implemented by municipal utilities. Utility innovations on the part of Sacramento Municipal Utility District (SMUD) and Los Angeles' Department of Water and Power (LADWP) have "taken the lead" in attempting for solar development to bridge the gap between residential- and utility-scale installations.[108] This presents the benefits of lower installation cost, broader customer reach, and the same rate reductions that can be offered by third-party developers.

Community-scale projects represent a significant future market for solar development in general and especially for third-party ownership models. Sanjay

[107] Seymour, Curtis.
[108] Coughlin et al. 7.

Ranchod, who advises industry vanguard SolarCity on government affairs notes, “Community solar legislation was considered last year in Sacramento, and I expect in 2013 there will again be an effort to introduce and pass legislation to establish…a community solar program in California.”[109] The push for community solar arises from the fact that, when accounting for structural, shading, and ownership factors, barely more than 20% of residential rooftops in the United States are suitable for solar development.[110] With the economies of scale involved in a larger installation, in tandem with emergent VNEM policies, community solar projects could potentially outpace individual property installations on the residential side of third-party development.

Conclusions

Solar electricity has shown itself to provide substantial benefits for those who decide to install it in a distributed capacity on their property. Though its market penetration represents less than one percent of California’s total in-state electricity generation in 2011, the federal and state incentives for DG rooftop solar have made tremendous progress in bringing this alternative technology into the mainstream.[111] This dramatically low penetration, in fact, demonstrates more clearly the tremendous potential for further growth than it discounts progress to-date. Especially after 2008, third-party developers stepped into the marketplace and greatly expanded the ability for home- and business-owners to reap the benefits of solar.

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109 Ranchod, Sanjay.
110 Coughlin et al. 2-3.
111 "Total Electricity System Power." 2012.

In the same way that the FITC paved the way for "Mom and Pop," a hypothetical pair who "own a farm and want to put up a little windmill or a little hydro turbine in the stream on their property" to invest in renewables, third-party development made the encumbrance of upfront capital even less relevant with their innovative finance tools, namely the solar lease and PPA.[112] Moving forward, third-party development provides great promise for simplifying the process of "going solar" and thereby expanding the target demographics of such campaigns. Challenges to this progress, though, manifest in the form of expiring government incentives, systemic uncertainty in the California electricity market, and competition from cheap and dirty fossil fuels.

Developments to watch for include a possible extension of the FITC and/or California's RPS, legislation regarding community solar in California, and CPUC decisions on the future of NEM. These government initiatives, incentives-based and otherwise, provide a framework within which third-party solar developers will continue to bring savings to customers, while reducing electricity generation's impact on the environment and anthropogenic climate change. Shifting sources of grid-tied electricity to emissions-free solar and other renewable technologies is vital not only for lighting and heating homes and keeping businesses running, but also in decarbonizing the transportation sector, currently the single greatest contributor to greenhouse gas emissions in California.[113] Ultimately, electricity's shift to renewable sources should be

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[112] Toke. 93.

[113] "California Greenhouse Gas Inventory for 2000-2009." 2011. <http://www.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_scopingplan_00-09_2011-10-26.pdf>.

accompanied by a shift in energy regimes, where distributed generation solar plays a major role in personalizing energy use and does away with the elite, centralized production of centuries past.

Within the deep ecology and Third Industrial Revolution frameworks, the third-party solar developer model presents tremendous promise. By redefining the typical demographic of solar adoptees, third-party finance, as well as California's low-income solar programs, has begun to chip away at the ecological damage and social inequity inherent in fossil-fueled energy systems. Each new solar lease or PPA brings California closer to Rifkin's vision of a completely distributed, smart-grid dependent energy regime. Certainly, DG solar is by no means the only focus in reforming energy policy, but its increasing adoption, backed by the momentum created by state and federal incentives, is one of the most readily available and accessible modes of citizen participation in transforming the sources of grid-tied energy.

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