Ask Saint Onofrio:

Finding What Has Been Lost in A Tale of Two Energy Sources

Nancy E. Pfund & Noah W. Walker. August 2013

DBL INVESTORS
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Contents

About the Authors

Nancy E. Pfund is Founder and Managing Partner of DBL Investors, a venture capital firm located in San Francisco whose goal is to combine top-tier financial performance with meaningful social, economic and environmental returns in the regions and sectors in which it invests. She writes frequently on matters relating to clean tech and "impact investing." In 2011, she co-authored the widely-cited study *What Would Jefferson Do?* The report demonstrated that contrary to popular belief, current federal subsidy levels for alternative energy sources are in fact much lower than they ever were in the early days of "traditional" energy sources, such as coal, gas and nuclear. She currently sits on the board of directors of a number of DBL's portfolio companies, including SolarCity (NASDAQ:SCTY).

Noah Walker is a joint degree (MBA/MEM) graduate student at Yale University, studying at both the School of Management and the School of Forestry and Environmental Studies. During the summer of 2013, he was a Summer Associate at DBL Investors and has consulted for Primus Power and GreenWood Resources, Inc. Prior to graduate school, Mr. Walker worked for Senator Barbara Boxer on energy and environmental issues. He can be reached at noah.walker@yale.edu.

Acknowledgements

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Executive Summary

This paper frames the ongoing debate about federal support for the solar sector in California by comparing subsidies that contributed to the recent growth in distributed solar power generation to those that contributed to nuclear technology's early traction as a significant portion of California's energy infrastructure over the last half century.

Using data culled from academic literature, government documents and NGO sources, we conclude that California-based nuclear energy received slightly higher levels of federal subsidies than distributed solar in their respective early days of generation, as seen in Chart 1.

Over its history as a significant California energy source, the nuclear power industry has received four times more subsidies than the California distributed solar industry and has had six times longer to mature with the assistance of such subsidies, as seen in Chart 2.

Significantly, the nuclear industry has benefited from unwavering support in the form of the Price-Anderson Act, which caps the liability of nuclear power producers in the event of an accident. The Price-Anderson Act was originally supposed to be authorized for only ten years, while nuclear developers sought to prove safety and reliability, but has been continuously reauthorized since its passage in 1957.

This study finds that, over the last half century, California's nuclear power suppliers have received over $8.21 billion in federal support. By contrast, the federal solar investment tax credits are slated to revert from 30 percent to 10 percent of initial system costs in 2016. In the context of the recent closure of the San Onofre Nuclear Generating Station at the same time that distributed solar is beginning to comprise a significant portion of the installed generation capacity in California (as seen in Chart 3), it remains to be seen if distributed solar will continue to have the same support that nuclear has enjoyed since its inception more than a half century ago.

Chart 1:
California's Share of Federal Subsidies: Nuclear (1963-1967) and Solar (2007-2011)

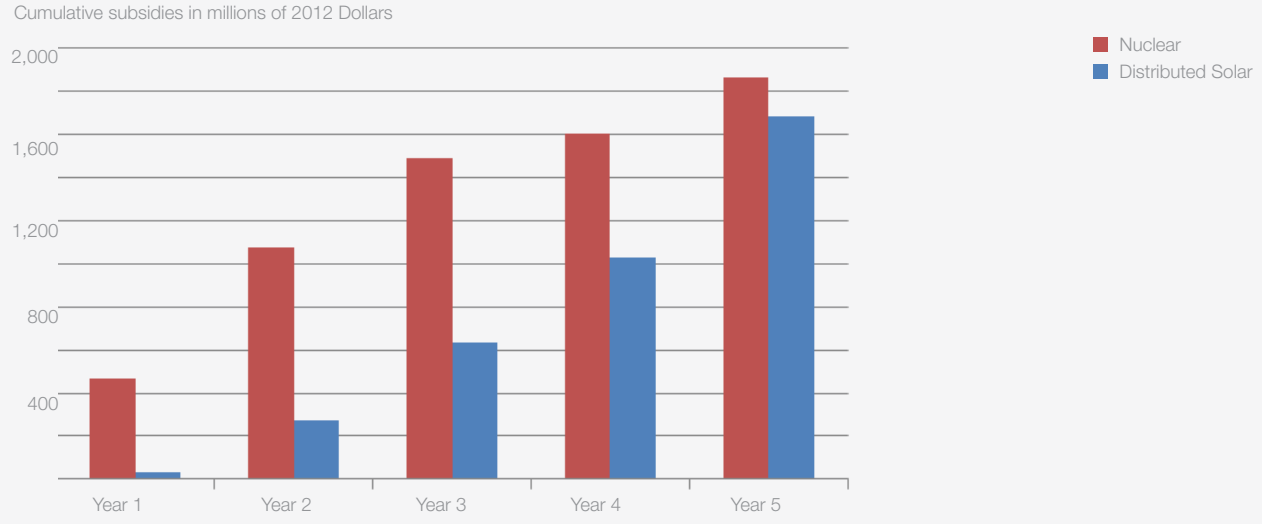


Chart 2:
Cumulative Federal Subsidies to California Energy Sources for In-State Consumption (1963-2012)

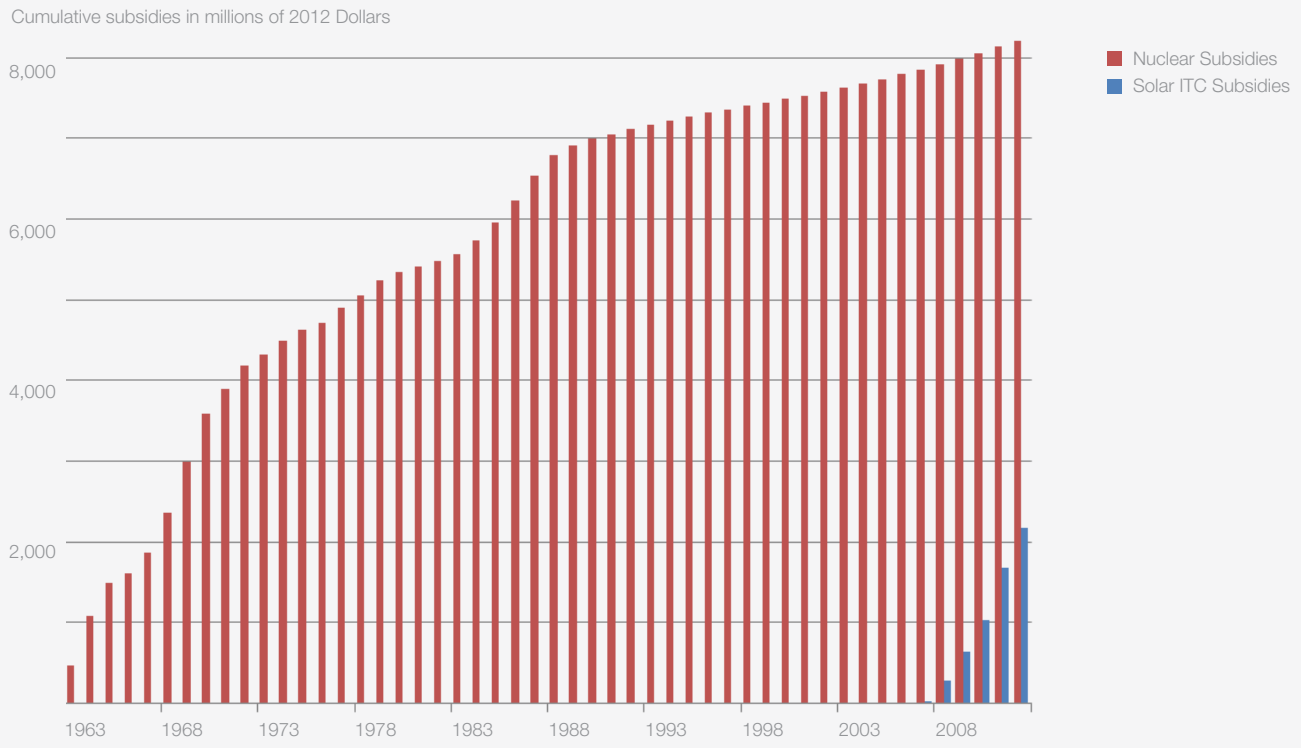
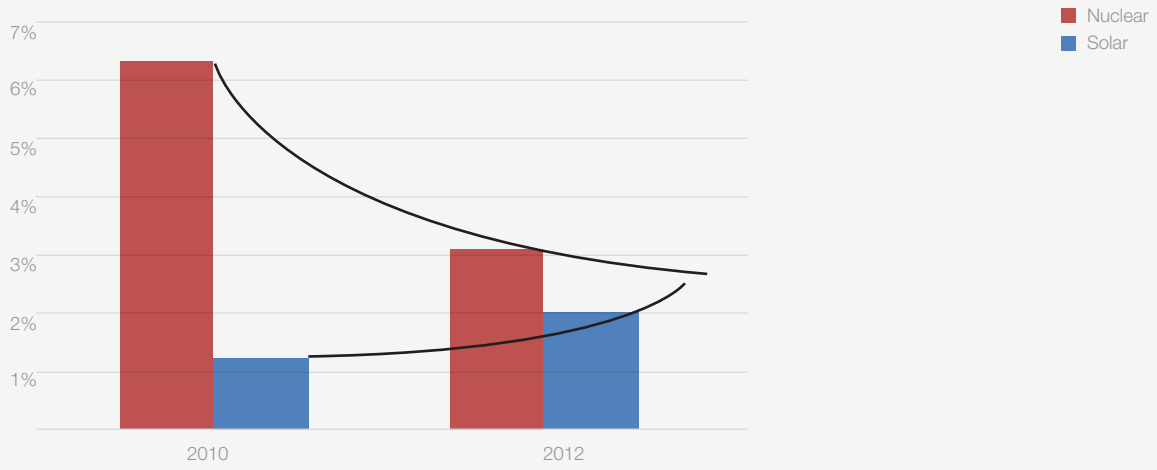


Chart 3:
Percent of California Energy Capacity
Installed capacity (MW)



Introduction

Over the centuries, Sicilian Catholics have prayed to Saint Onofrio[1] (the Italian equivalent of San Onofre), a monk who roamed the Egyptian desert in the fourth century, for help recovering lost items.[2] In the wake of Southern California Edison's recent decision to "permanently retire" the San Onofre Nuclear Generating Station, this Sicilian tradition has taken on new meaning. As Saint Onofrio helps people recover what is lost, so the San Onofre Nuclear Generating Station is a useful symbol for Californians looking to recover the little known history of incentives that continue to shape our energy landscape.

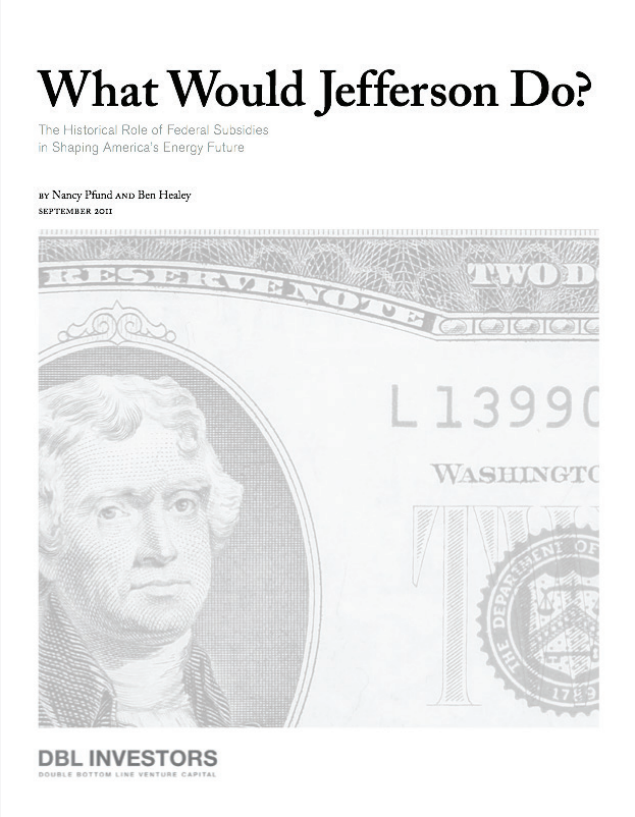
This report looks back at the federal energy subsidies vital to the traction of nuclear technology as a significant portion of California's energy infrastructure since 1963, when the Humboldt Bay Nuclear Power Plant came online and the modern contours of California's statewide generation profile emerged. The report also examines the federal subsidies that have been vital to the recent growth in distributed solar power generation during a period of rapid change in California's energy landscape.

In recent years, innovations and price declines in distributed solar and its financing have contributed to the rapid expansion of solar energy on residential, commercial and government rooftops, lawns and parking lots throughout California and across the country. Meanwhile the closure of San Onofre has reduced California's nuclear generation capacity by almost 50 percent to roughly 10 percent of California's total energy generation (based on the actual energy produced in state) and approximately 3 percent of California's total megawatt capacity (based on the state's total production assets).[3] In the context of these recent market developments, many observers lose sight of how important public support has been, and continues to be, in shaping our energy landscape. In fact, no energy technology in our country's history has gained significant market traction without subsidies from the federal government.[4]

Energy technologies in California are no exception. Federal subsidies were necessary to the early growth of the nuclear industry and have been vital to the more recent growth of the distributed solar industry. The difference is that, just like the monk in the desert who endures as a saint centuries later, the support for nuclear energy in California has stretched far beyond its early days. The implications of this analysis have repercussions for California's future energy policy, from the beaches of San Onofre to the coastal range near Diablo Canyon, from the Golden State's missions to its transmission lines, and everywhere in between.

Taking Jefferson Local: A Note on State-Level Subsidies

In 2011, DBL Investors published a report entitled *What Would Jefferson Do?: The Historical Role of Federal Subsidies in Shaping America's Energy Future*. The paper illustrated the crucial role that federal subsidies have played in supporting emerging energy technologies and driving economic growth for the past 200 years. The goal of this paper is to build off the work done in *What Would Jefferson Do?* with a focus on federal subsidies to the nuclear and solar energy sectors in California. While not part of this analysis, it is important to note the significant role that state policies have played in shaping California's energy profile. For example, state-level subsidies have supported both renewable energy generation, as with the California Solar Initiative and the New Solar Homes Partnership, as well as conventional energy production, as with the state's favorable treatment of oil and gas severance assessments.[5] Beyond subsidies, other state-level policies like the renewable portfolio standard, net metering, and cap and trade have also affected California's energy landscape. And yet, all such policies operate within a context created by federal policy. As such, this addendum to *What Would Jefferson Do?* focuses on federal incentives for California energy and lays the groundwork for a future examination of state-level energy subsidies.



Download *What Would Jefferson Do?* at:

www.dblinvestors.com/resources-reports

Nuclear Power in the 1960s:

A Different Kind of California Steamin'

Our examination of federal subsidies for nuclear power in California begins with the Price-Anderson Nuclear Industries Indemnity Act. Passed in 1957, the Price-Anderson Act catalyzed a new era of power generation in the United States. The new law limited the insurance costs for power plants by shifting a portion of the liability for a nuclear accident from plant operators to taxpayers, "thus removing a substantial (and perhaps insurmountable) barrier to nuclear power plant development."[6]

Despite years of federally-funded research and development, including almost $6 billion (in 2012 dollars) in 1953, which represents over one percent of the entire federal government's expenditure that year,[7] there were zero privately-owned nuclear power generators in the United States prior to 1957. By contrast, in 1965, just eight years after the Price-Anderson Act became law, there were 13 nuclear reactors in operation and today there are 104 nationwide.[8] Congressional testimony at the time of passage confirmed the importance of the Price-Anderson Act. For example, the Edison Electric Institute, a national association of shareholder-owned electric companies, noted, "In our opinion, no utility company or group of companies will build or operate a reactor until the risk of nuclear accidents is minimized."[9]

In California, the Price-Anderson Act and the enormous "on-budget" expenditures for research and development (R&D) that have flowed to nuclear technology since its conception enabled the construction of four utility scale nuclear power plants between 1963 and 1986.[10] California's second generation of nuclear production came online between 1983 and 1986, when Units Two and Three of the San Onofre plant opened and Units One and Two of the Diablo Canyon plant came online. California also sources a portion of its energy from the Palo Verde Nuclear Plant in Arizona.[11] Before the San Onofre plant was closed, nuclear energy made up roughly 20 percent of energy generated in California (see Exhibit A).[12]

On June 7, 2013, Southern California Edison announced that it would "permanently retire" units Two and Three of the San Onofre Nuclear Generating Station. The exact cost that customers and/or shareholders of the plant's owner, Southern California Edison, will pay for San Onofre's decommissioning remains uncertain but it is sure to be large. The parent company, Edison International, has estimated the cleanup will cost close to $4.1 billion, $3.5 billion of which has already been collected from California residents by imposing surcharges on electric bills.[13] The retirement of San Onofre is due to problems related to a $670 million steam generator overhaul, the cost of which is being passed on to ratepayers.[14] Additionally, since the 2012 shutdown, Southern California Edison has spent over $500 million on repairs and purchasing replacement power.[15]

Although quantifying the ultimate cost of San Onofre's decommissioning is important in considering the full price of nuclear power, this paper leaves such quantifying to the California Public Utilities Commission. Instead, this paper builds off the analytical foundation laid by Marshall Goldberg, a preeminent energy analyst and consultant, who quantified the federal subsidies that supported nuclear electricity generators from 1947-1999, including the cost of regulation, civilian R&D and liability risk shifting enabled by the Price-Anderson Act.[16]

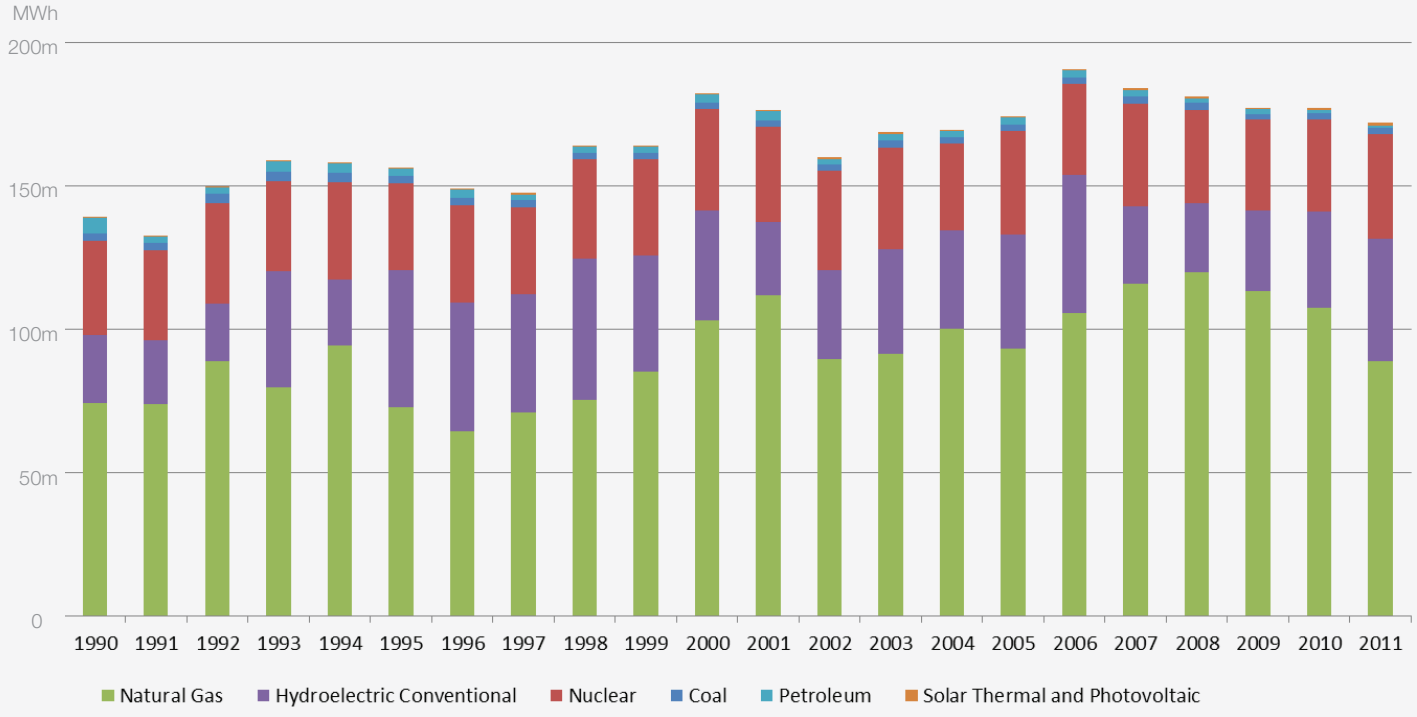
This report also counts the more recent subsidies that nuclear power has received for decommissioning trust funds as outlined in annually published Congressional Joint Committee on Taxation (JCT) reports.[17] Finally, in order to determine California's share of national energy subsidies we sourced Energy Information Administration (EIA) statewide consumption data, by energy source going back to 1963.[18]

Based on California's share of the national electric consumption budget, our analysis reveals that California's nuclear power suppliers have benefited from over $8.21 billion (in 2012 dollars) in subsidization over the last half century.[19] Recent support can primarily be attributed to the liability cap nuclear generators enjoy under federal law and reduced tax rates on nuclear decommissioning trust fund earnings.[20] On an annual basis, these subsidies are conservatively valued at $164.1 million (in 2012 dollars) in taxpayer-funded support to the state's current and former nuclear energy generators.

Exhibit A:

The Many Facets of California's Energy Generation: A Twenty Year Look

CA Net Electricity Generation by Conventional Energy Source, 1990-2011
(EIA Data, Total Electric Power Industry)



Distributed Solar Power Generation:

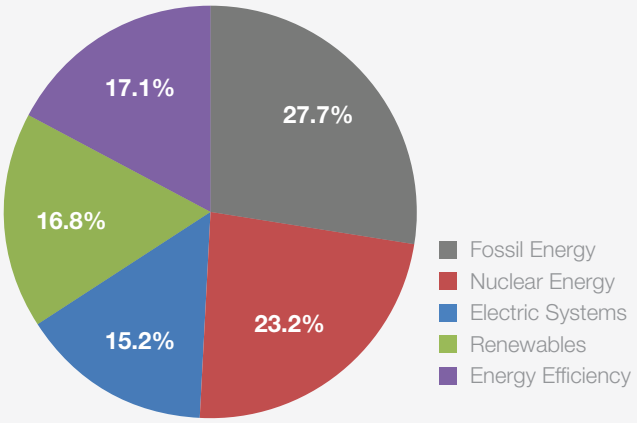
Plenty of Sun at the Hotel California

The solar power industry emerged after significant direct and indirect research and development investment from the public and private sectors. Management Information Services, a Washington D.C.-based economic research and management consulting firm, estimates that from 1950 to 2006, NASA spent nearly $1 billion (in 2010 dollars) on R&D devoted to solar.[21] As *What Would Jefferson Do?* explains, early government support for solar energy was critical to its commercialization, although on the whole it was a much smaller amount than the funding directed to conventional sources. Exhibit B shows the breakdown of Department of Energy (DOE) spending by energy source from FY2001 to FY2010.[22] While DOE only distributes a small portion of the government's overall energy R&D dollars, it is noteworthy that R&D spending for renewables remains significantly smaller than for nuclear and gas, despite the fact that by 2001 nuclear, oil and gas were mature power sources.

Exhibit B:

DOE Energy Funding: Something Old, Something New

DOE Energy Technology Share of Funding, FY2001-2010



Source: Congressional Research Service

We do not attempt to estimate the percentage of R&D investments that can be categorized as a direct subsidy to the distributed solar power sector in California. Instead, as with our analysis of the subsidies nuclear power has received, beginning with its California origins in 1963, we begin our quantitative analysis of subsidies to distributed solar in 2007, when the industry as we know it today began to emerge. Our quantitative analysis focuses on the most important federal subsidies that have supported a rapid increase in the installed base of distributed solar energy: the federal Investment Tax Credit (ITC) and the 1603 Treasury Grant Program (2009-2011).

The ITC was first passed as part of the Energy Policy Act of 2005. Since 2006, owners of solar generation facilities have been eligible for a tax credit of up to 30 percent of their system installation costs, although the credit for residential system owners was capped at $2,000 until 2009.[23] The 1603 Treasury Grant Program became law as part of the American Recovery and Reinvestment Act in 2009. This temporary program authorized the federal government to provide solar and other renewables developers an upfront grant rather than a tax credit in the amount of the portion of their project that would have been eligible for the ITC.

The ITC's impact on residential, commercial and utility scale solar across the country has been substantial. According to the Solar Energy Industry Association (SEIA), a national trade association that compiles solar statistics, the ITC has "helped solar installations grow nearly 3,000 percent since the ITC was implemented in 2006."[24] Similarly, the temporary Treasury Grant Program has been instrumental in accelerating the deployment of solar since 2009, with awards granted to over 23,000 PV projects that catalyzed over $30 billion in investment from private, regional, state, and federal sources as of November 2011 (see Exhibit C).[25]

Exhibit D illustrates the ITC's correlation with the growth of commercial and distributed solar installations in California.[26,27]

Despite the ongoing impact of the ITC, today's solar industry is nascent, starting from a small base, and still accounts for less than one percent of electricity generation in California each year.[28] It is worth noting, however, that the young distributed solar industry already supports 11,000 jobs in California.[29]

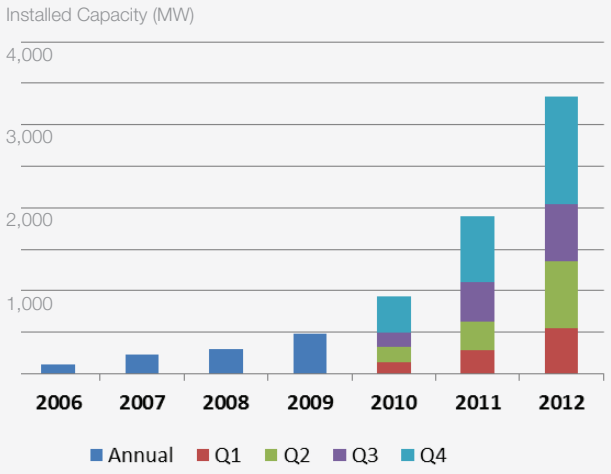
Against this backdrop we determined the size of the ITC subsidy to distributed PV solar in California by examining unit price and installed capacity data compiled by the California Solar Initiative for distributed installations within the customer base of the three investor-owned California utilities—Pacific Gas and Electric (PG&E), Southern California Edison (SCE) and San Diego Gas & Electric (SDG&E)—which together serve the majority of California's energy users. The system cost totals captured by the data set make it possible to estimate each project's ITC or 1603 grant eligibility. We then used data on the annual installed capacity (in MW) of distributed solar projects compiled by the Solar Energy Industry Association to expand our analysis to ratepayers throughout California.[30]

Our analysis reveals that over the life of the ITC and the 1603 Treasury Grant Program, projects in California accrued $2.17 billion in tax credits or direct payments from investment in distributed solar systems between 2007 and 2012.

Exhibit C:

U.S. Solar Energy Growth: The Early Years

U.S. Solar Electric Installations

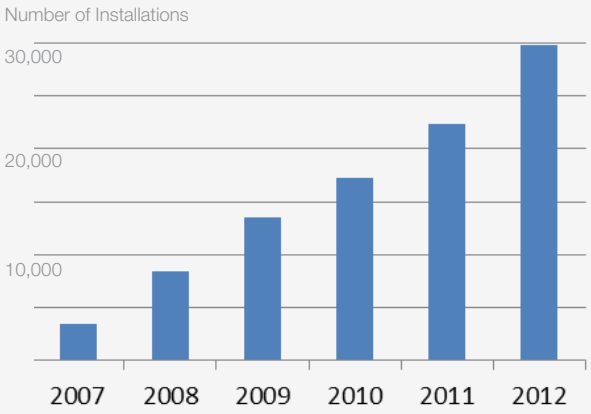


Source: SEIA.

Exhibit D:

Early 21st Century California Energy: Solar on the Rise

Commercial & Residential Solar Installations in Investor-Owned Utility Districts



Source: CSI.

Analysis & Discussion:

A Tale of Two Energy Sources

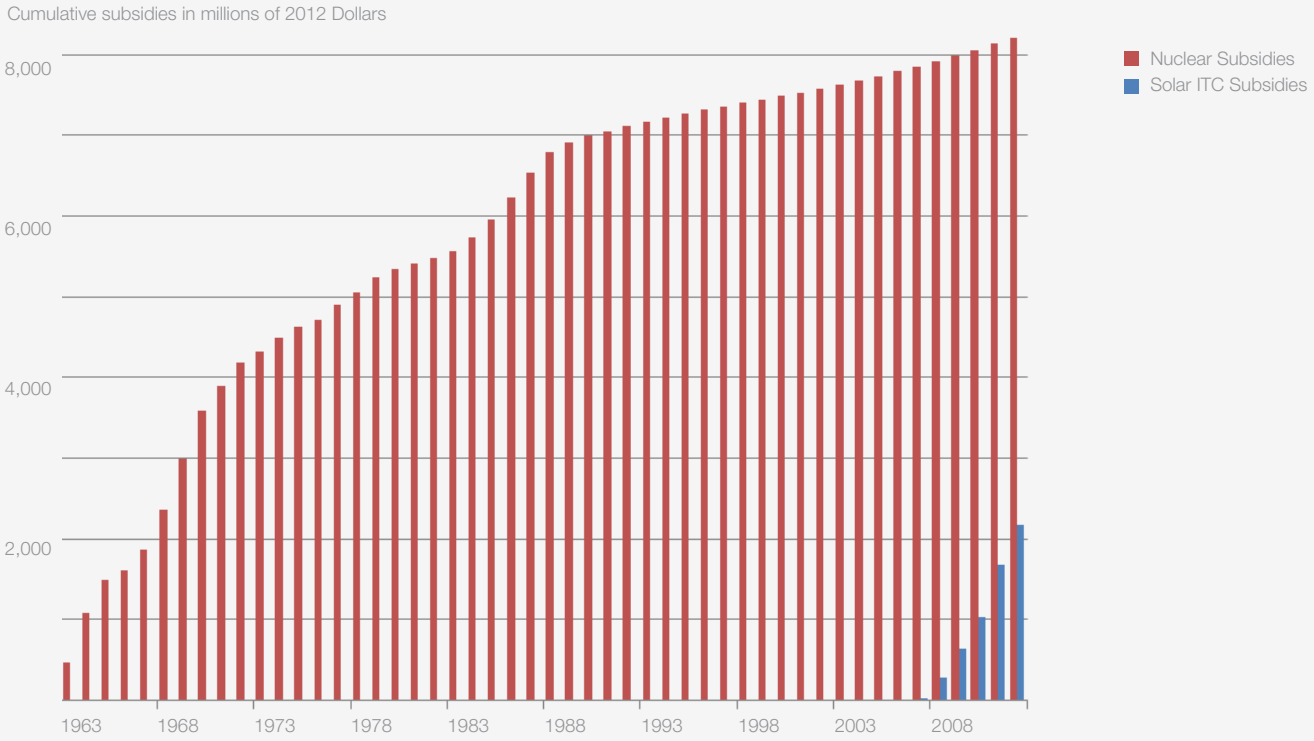
There are a number of ways to compare the subsidies that nuclear and solar energy in California have received over the last half century. The first is in cumulative terms, as depicted in Exhibit E.

As one would expect, the temporal scope of analysis has a significant effect on the cumulative total for each subsidy. Nuclear has had more years over which to accumulate subsidies and therefore solar has a long way to go before reaching nuclear's cumulative total.

Exhibit E:

Nuclear and Solar Federal Subsidies in California: What a Difference a Half-Century Makes

Cumulative Federal Subsidies to California Energy Sources for In-State Consumption (1963-2012)



Source: JCT and Goldberg Op. Cit.

Comparing Subsidies in the Early Days

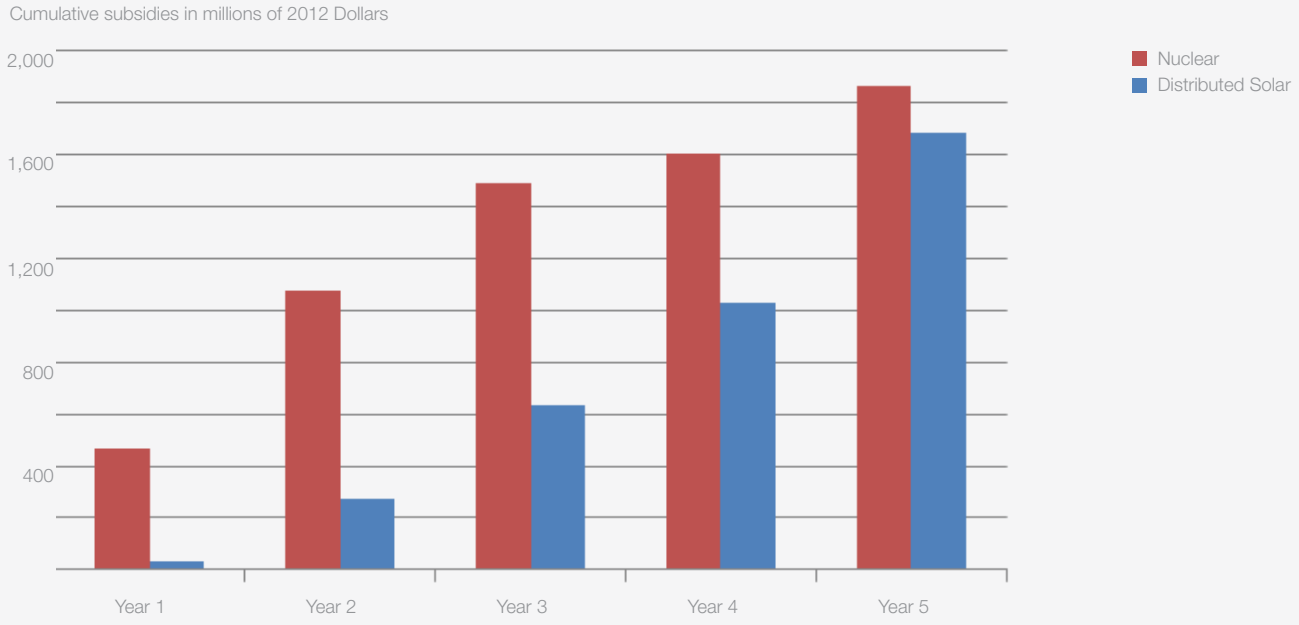
When comparing the size of federal spending on energy technologies it is important to consider the stage of each industry's progression as well as the policy goals driving such federal support. As is reflected in Exhibit E, comparing today's nuclear power subsidies with subsidies for distributed solar is difficult, as the nuclear industry has been producing power in California for a half century while solar energy is just emerging. Thus Exhibit F compares the subsidies that flowed to the nuclear and distributed solar industries during their first five years as energy generators in California. As Exhibit F demonstrates, the nuclear industry enjoyed a level of subsidy (adjusted to 2012 dollars) in its infancy unmatched by distributed solar many decades later.

Exhibit F demonstrates the similar growth trajectory of subsidies for solar and nuclear energy generation in their respective first five years as significant energy technologies in California. The question remains whether the federal government's support for distributed solar energy will continue to resemble its unwavering support for nuclear power.[31] The ITC is currently set to be reduced from 30 percent of cost to 10 percent of cost in 2016 and it is unclear if it will be extended.

Exhibit F:

These Are the Good Old Days: Federal Subsidies to California Nuclear and Solar Energy in Their Early Years

California's Share of Federal Subsidies: Nuclear (1963-1967) and Solar (2007-2011)



Source: JCT and Goldberg Op. Cit.

California on Our Mind:

Looking at Our Past and Finding Our Future

Nuclear energy has played a crucial role in delivering power to Californians over the last 50 years and has become a significant base load power source.[32] While during this time the ratio of federal subsidies per megawatt hour (MWh) of generation for nuclear has declined precipitously, in its early years, nuclear enjoyed very high subsidies per MWh. For example, California's nascent nuclear industry received over $600/MWh in 1963, the first year for which we are including data.[33] Over time, this ratio has declined as nuclear has matured; we anticipate a similar decline for solar as systems whose installation was subsidized continue to produce power for 30 years without further subsidization or decommissioning costs. In addition, financing cost reductions will lead to unsubsidized solar systems being built, further reducing the subsidies per MWh. Tellingly, federal dollars per new MWh of capacity for distributed solar installations are infinitely lower than for nuclear as solar subsidies help create new capacity while nuclear subsidies are perpetuities that support established plants (there has been no new nuclear capacity installed in California since the 1980s). Affordable energy storage for renewable power sources will also increase the usable MWh produced by each solar system and help solar extend into more base load applications.

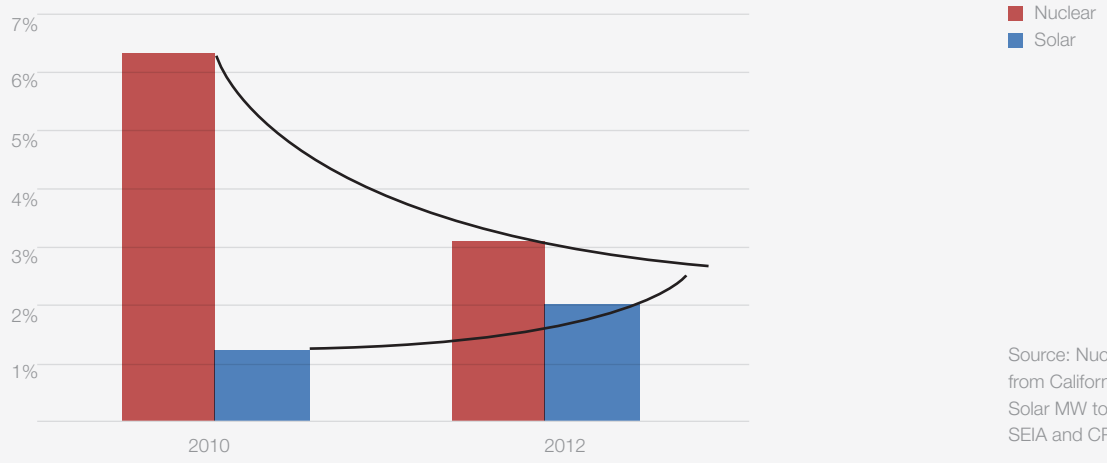
Exhibit G demonstrates the trend in California's installed base of electricity production assets due to massive growth in the solar industry, San Onofre's decommissioning and the absence of any new nuclear capacity in California since the 1980s. A solar energy system's only required fuel source is the sun, which by nature is only available for part of the day. Thus the amount of energy a MW of solar produces is necessarily less than what a MW of a more conventional technology, like nuclear, will produce.[34] While nuclear was about 3 percent of capacity in the state in 2012, it still generated roughly 10 percent of the energy.[35] As California moves toward achieving its renewable energy goals, solar will become an increasingly large portion of the state's generation capacity, while nuclear will decrease in proportion to the generating capability in the state.

Exhibit G:

When Past Meets Future: The Changing Role of Two California Energy Sources

Percent of California Energy Capacity

Installed capacity (MW)



Source: Nuclear cumulative data from California Energy Almanac; Solar MW totals extracted from SEIA and CPUC reports.[36]

Conclusion:

Finding a Way Forward

This analysis puts into perspective the change we are seeing across California's energy landscape and highlights the similarities and differences in how our federal policies treat and affect California's nuclear power and distributed solar industries. The nuclear power industry has received four times more subsidies than the distributed solar industry and has had six times longer to mature. As explained in *What Would Jefferson Do?*, nuclear and solar (and oil and gas, for that matter) have all received significant energy subsidies during their early days. This pattern is reflected in California during the timeframe of this analysis within which nuclear energy and distributed solar received fairly comparable levels of subsidies in their respective early days.

Significantly, despite our continuing federal investments in nuclear power, no new nuclear reactors have been built in California since 1986. In contrast, the federal solar investment tax credit has been crucial to stimulating more than one gigawatt of solar generation (both distributed and utility scale) that was installed in California during 2012 alone[37]—new capacity that comes without multibillion dollar decommissioning costs and with, as stated above, 11,000 new jobs.

Another important difference between nuclear and solar is that the Price-Anderson Act was originally only supposed to be authorized for ten years while nuclear developers sought to prove safety and reliability. The original Price-Anderson Act Senate report justifies the Act's 10-year sunset provision saying that, by then, ". . . the problem of reactor safety will be to a great extent solved and the insurance people will have had an experience on which to base a sound program of their own."[38]

And yet, perhaps due to the potential for massive public costs in the event of a disaster, such as the estimated $250 billion public cost for the cleanup after the accident at the Fukushima nuclear power plant in Japan,[39] the Price-Anderson Act remains in place 56 years later and authorized through 2020.[40] As cities and towns in the coastal regions near California's nuclear installations become more populated, the subsidy associated with shifting liability away from the operator and on to the government has increased (and will continue to increase) over time. By contrast, the solar investment tax credit is slated to revert from 30 percent of initial system costs to 10 percent in 2016, and the policy environment in our nation's capital makes its reauthorization highly uncertain.[41]

As the San Onofre Nuclear Generating Station is retired, the federal government's varying treatment of nuclear subsidies and solar subsidies would lead any Sicilian to ask Saint Onofrio a very pointed question: *Acknowledging Saint Onofrio's knack for finding things, Californians should ask the Saint why the closing of his namesake's nuclear plant hasn't helped us find a new focus on the rationale behind subsidizing mature and declining energy sources and why we have not sought to level the playing field for new, clean energy entrants.*

In light of Governor Jerry Brown's ambitious goal of 12 gigawatts of installed distributed energy generation capacity by 2020,[42] it is important to remember that each dollar of subsidy for a traditional energy source effectively lowers the cost of generation for an entrenched industry. In the context of the federal government's embedded subsidies for nuclear facilities and fossil fuel production, as well as potentially expiring federal renewable energy subsidies and very little consensus on energy policy in Washington, the responsibility rests heavily on California to support the Golden State's transition to clean renewable power. California should take a cue from Saint Onofrio and find what has been lost in over half a century of energy subsidies: an appropriate balance between policies that support our energy sources of the future and past policies that linger and distort the true cost and benefits of current energy generation. Addressing these questions may at times be unpopular and fail to confer immediate sainthood on those who do, but future generations will be better off when our energy perspective which has been lost is found.

Endnotes

1. Saint Onofrio is known in Italian as Sant'Onofrio, in Spanish as San Onofre, and in English as Saint Humphrey or Saint Onuphrius.
2. Father Richard Coles, "The Saints' Lives Will Always Resonate" video, available at theguardian.com/commentisfree/video/2012/nov/05/richard-coles-saints-video. In this video, Father Coles describes Sicilians using Saint Humphrey's hair to locate lost objects.
3. California Government Energy Almanac's Electricity Generation Capacity, available at http://energyalmanac.ca.gov/electricity/electric_generation_capacity.html. This shows that between 2011 and 2012, when San Onofre had a shutdown, nuclear's share of California's generation dropped from over 18% to under 10%. In 2011, nuclear's share of capacity was over 6%; without San Onofre, this would drop to around 3% (the shutdown is not reflected in the Energy Almanac's numbers for 2012, which still includes San Onofre's capacity).
4. Nancy Pfund and Ben Healey, DBL Investors, "What Would Jefferson Do?: The Historical Role of Federal Subsidies in Shaping America's Energy Future" (September 2011). Available at dblinvestors.com/resources-reports/.
5. California is one of the few oil and gas producing states in the country that does not levy a severance tax on oil and gas production. A report by the California State Assembly Committee on Revenue and Taxation estimates that a 10% assessment tax would raise $1.4 billion in revenue. The same report notes that in 2008, California's combined tax burden on oil production was $4.22 per barrel compared to Texas' combined tax burden per barrel of $14.33. The report is available at www.leginfo.ca.gov/pub/09-10/bill/asm/ab_1601-1650/ab_1604_cfa_20100507_112329_asm_comm.html
6. Komanoff Energy Associates, Greenpeace, "Fiscal Fission: The Economic Failure of Nuclear Power" (December 1992).
7. Marshall Goldberg, Renewable Energy Policy Project, "Federal Energy Subsidies: Not All Technologies are Created Equal" (July 2000). In determining the federal subsidies that can be attributed to energy generation in California we did not include subsidies prior to the year the energy source became a substantial source of the state's energy mix. For example, from 1947 to 1963, billions of federal dollars were spent on nuclear power technology research and development; these were not included in our analysis.
8. The high water mark was 112 active nuclear reactors in 1990. See US Energy Information Administration's Annual Energy Review from September 2012, available at http://www.eia.gov
9. Op. cit. Goldberg.
10. Humboldt Bay Nuclear Power Plant, 1963-1976 (PG&E); Rancho Seco Nuclear Power Plant, 1975-1989 (Sacramento Municipal Utility District); San Onofre Nuclear Generating Station, Unit One :1968-1992, Unit Two: 1983-2012, Unit Three: 1984-2012 (Southern California Edison, San Diego Gas and Electric); Diablo Canyon Nuclear Power Plant, Unit One: 1985-Present, Unit Two: 1985-Present (PG&E). Prior to 1963, a small portion of California's power was generated at two experimental pilot facilities: the Santa Susana Sodium Experimental Reactor (1957-1964) and the Vallecitos Boiling Water Reactor (1957-1963). More information on the Vallecitos reactor is available at www.asme.org/getmedia/3663519d-0882-4b7e-ab6c-f036b080cfdd/128-Vallecitos-Boiling-Water-Reactor-1957.aspx
11. As of 2002, the Palo Verde Nuclear Power Plant in Arizona exported 13% of the 30.9 billion kilowatt-hours of electricity it produced to California and Texas. http://www.nei.org/filefolder/economic_benefits_palo_verde.pdf. According to the California Government Energy Almanac, 8.763 gigawatt hours were imported from the Palo Verde nuclear plant in 2012. Available at http://energyalmanac.ca.gov/electricity/total_system_power.html.
12. California Energy Commission Reports, available at http://www.energy.ca.gov/nuclear/index.html
13. Mark Lifsher, Los Angeles Times, "San Onofre Closure Likely to Take 10 Years or Less, Panel is Told" (August 13, 2013).
14. CBS News, "California Utility to Retire Troubled San Onofre Nuclear Power Plant" (June 7, 2013).
15. Michael Blood, Associated Press via USA Today, "California Utility Will Close Troubled Nuclear Plant" (June 7, 2013).
16. We have conservatively projected Marshall Goldberg's data forward to 2012. See the appendix for details on the methodology.
17. The Nuclear Regulatory Commission requires every nuclear plant to set aside funds for decommissioning. In the Energy Policy Act of 1992, Congress reduced the tax rate on earnings in these trust funds from the federal corporate tax rate (35 percent in 2012) to 20 percent. The Joint Committee on Taxation began quantifying this tax expenditure in 2000 and estimated its value at $1 billion in 2012 alone.
18. This analysis included nearly 7,500 data points to determine the total annual electricity generation and consumption by energy source between 1963 and 2012. A portion of California's energy consumption from nuclear power after 1963 came from plants in Arizona.
19. This includes subsidies to both in-state and out-of-state power suppliers based on the volume of electricity supplied to California.
20. See endnote 17
21. Management Information Services, Inc, for the Nuclear Energy Institute, "60 Years of Energy Incentives: Analysis of Federal Expenditures for Energy Development" (October 2012).
22. DOE Energy Technology Share of Funding, FY 2001-FY 2010 chart only shows a small portion of federal R&D funding as DOE is only one of a number of federal agencies investing in energy R&D.
23. The ITC was extended for a year by the Tax Relief and Health Care Act of 2006 (P.L. 109-432) and the $2000 cap was removed when the ITC was extended to 2016 in the Emergency Economic Stabilization Act of 2008.
24. Solar Energy Industries Association, "The Case for the Solar Investment Tax Credit: Fact Sheet," available at seia.org
25. Daniel Steinberg and Gian Porro, National Renewable Energy Laboratory, and Marshall Goldberg, MRG & Associates, "Preliminary Analysis of the Jobs and Economic Impacts of the Renewable Energy Projects Supported by the Section 1603 Treasury Grant Program" (April 2012). Note that these funds are used for wind and other solar projects, such as solar thermal, as well. Since the program was a stimulus policy in response to the financial crisis in 2008, such projects had to commence construction by December 31, 2011 in order to qualify.

26. California Solar Statistics, available at californiasolarstatistics.ca.gov.

27. As mentioned above, distributed solar in California was also assisted by various state policy incentives.

28. Energy Information Administration, "Frequently Asked Questions" available at eia.gov/tools/faqs/faq.cfm?id=427&t=3

29. The Alliance for Solar Choice tracks solar industry jobs figures.

30. The 1603 Treasury Grant Program, accessible secondary markets for tax credits and the rising popularity of solar leasing structures have made it increasingly likely that commercial or residential customers with small tax liabilities are able to benefit from the ITC through a variety of financing approaches. However, there is no available data on what percentage of rooftop solar owners were able to avail themselves of the ITC prior to the 1603 Treasury Grant Program and in the early days of the solar leasing model. In the absence of certainty, we have assumed that commercial and residential owners of solar systems eligible for the ITC took full advantage of the subsidy.

31. The Price-Anderson Act was most recently reauthorized through 2020 as part of the 2005 Energy Policy Act.

32. Energy Information Administration detailed electric power data available at http://www.eia.gov/electricity/data/eia923/

33. This number was derived by finding California's pro rate share (based on consumption) of national subsidies calculated by Marshall Goldberg, divided by California's nuclear capacity at the time. We were unable to perform the comparable analysis for solar because we could not find or estimate appropriate data. California's Energy Almanac, for example, which collects production data for the state, does not include systems under 1 MW, which includes much of the distributed solar that is the focus of this paper. There are many factors, including variations in panel positioning, geography, climate and weather conditions, that make actual generation hard to accurately estimate given capacity.

34. According to the California Independent System Operator, the state hit a new record high for solar energy capacity of 2.07 GW and has grown by a gigawatt in 2013 alone. The Diablo Canyon Power Plant, California's remaining nuclear power plant, by contrast has a 2.24 GW capacity. Currently, 2 GW of base load nuclear power will generate more total kilo-watt hours (KWhs) of power than a comparable capacity of installed solar due to intermittent sunlight and today's lack of viable storage options.

35. California Energy Commission Data and Statistics

36. California Government Energy Almanac, "California Electricity Statistics and Data," available at energyalmanac.ca.gov/electricity/.

37. The Solar Energy Industry Association, available at http://www.seia.org/state-solar-policy/california

38. House Report 107-299 (2001).

39. The President of the Japan Center for Economic Research estimated the cost of the accident at the Fukushima Daiichi cleanup could be up to $250 billion. News on Japan, "Fukushima Cleanup Could Cost up to $250 Billion."

40. The Price-Anderson Act was last reauthorized in the Energy Policy Act of 2005.

41. Jesse Jenkins et al, Breakthrough Institute, "Beyond Boom and Bust: Putting Clean Technology on a Path to Subsidy Independence" (April 2012).

42. Tiffany Hsu, Los Angeles Times, "Gov. Brown pushes 12-gigawatt clean-power goal" (July 26, 2011).

Appendix

Data Sources

Consolidated data behind the charts created for this report are all on file with the authors and available upon request. In addition to the data used in *What Would Jefferson Do?*, the following data sources were used:

- California Public Utilities Commission: California Solar Initiative Annual Program Assessments (2007-2012)
- Energy Almanac of CA.gov: Database of California Power Plants (2012)
- Energy Information Administration: Energy Review (1963-2011)
- Solar Energy Industry Association: US Solar Market Insight (2013)
- The Joint Committee on Taxation: Estimates of Federal Tax Expenditures (2000-2014)

Explanation of Quantification of Nuclear Subsidies

Our quantification of nuclear subsidies in California relies on analysis by Marshall Goldberg. As stated in *What Would Jefferson Do?*, "Goldberg includes principally the cost of regulation, civilian R&D, and liability risk shifting (the Price-Anderson Act), while also taking into account both payments from the government to industry and government receipts from industry- thus coming up with a net annual figure for every year from 1947 to 1999." Like *What Would Jefferson Do?*, we then use a median of $800 million based on the final years of the Goldberg analysis to conservatively project his data forward to 2012. The report also considers the more recent subsidies that nuclear power has received for decommissioning trust funds as outlined in annually published Congressional Joint Committee on Taxation reports.

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