Center for American Progress

Developing State Solar Photovoltaic Markets

Riding the Wave to Clean Energy Independence

JP Ross
The Vote Solar Initiative

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Introduction

Solar photovoltaic energy is an established technology that has proven its ability to improve our national security and boost the economy. Photovoltaics produce energy that is both domestic and emission-free, making it key to weaning the United States of our dependence on polluting fossil fuels and helping to curb the effects of global warming. Solar PV also bolsters our economic security by creating more new jobs than any other energy technology.

The federal government has shown support for solar energy in recent years with the passage of the Energy Policy Act of 2005, which provides tax credits for investors in solar power systems. The Securing Energy Independence Act of 2007 (HR.550/S.590) would extend the tax credits through the end of 2016, a necessary step for a rapid transition to solar energy.

Yet federal action is not enough. Energy policy is largely determined at the state level through state and local laws and utility regulation. States must therefore take the lead to ensure that incentives are properly structured to keeps costs declining while regulatory processes become more easily navigable by businesses and consumers. Solar photovoltaics must rival power from the utility grid in both cost and accessibility in order to make solar power appealing to consumers.

Four policies are central to ensuring the wide-scale deployment of solar energy:

- **Financial incentives:** Financial incentives for solar power, sustained over five to 10 years at a declining rate, ensure market stability and cost reductions, and will build a state-based industry by stimulating customer investment.

- **Interconnection standards:** Solar PV customers must be able to connect to the utility grid without undue delay and expense. If the process is lengthy or difficult, it will dissuade many consumers.

- **Net metering:** Net metering ensures that consumers are equipped with PV systems that meet their energy needs while crediting customers for all the energy they generate.

- **Rate design:** Utilities should charge consumers fairly for the electricity they consume and make the same rate choices available to solar customers that are available to other customers.

This report highlights model policies and case studies of four states that have effectively developed thriving solar markets. These models provide guidance to states looking to boost their economies by developing a strong solar industry and show that stronger energy independence through solar power is achievable for every state. These successes will provide essential lessons in shaping a bold national solar policy.

Why Solar

Over 70 percent of our electricity in the United States is generated from fossil fuels, a finite resource that emits greenhouse gases and other pollution. We must transition to domestic, clean, renewable sources of energy in order to avoid a climate crisis and reduce our dependence on fossil fuels and foreign sources of energy.

Solar photovoltaics, which convert light from the sun into electricity, are a mature technology with the potential to play a large part of the solution. The benefits of PV are clear: it provides zero-emission electricity at peak times when energy grids are strained and is a proven, reliable technology with warranties for 20 years. It also improves national security and strengthens the utility grid by delivering energy to American rooftops every day, and it creates economic security by creating more jobs than any other energy technology.

Solar energy can play a central role in improving our energy independence and making the transition to a renewable energy economy. The sooner we begin, the sooner we can reap the benefits.

The Cost of Photovoltaics are Coming Down

The cost of solar PV has declined sharply over recent years as the technology has matured and manufacturing volumes in the solar industry have grown. Every time production has doubled, manufacturing costs have fallen by approximately 20 percent.[1] Solar PV will be competitive with grid power (Figure 1); the only question is when.

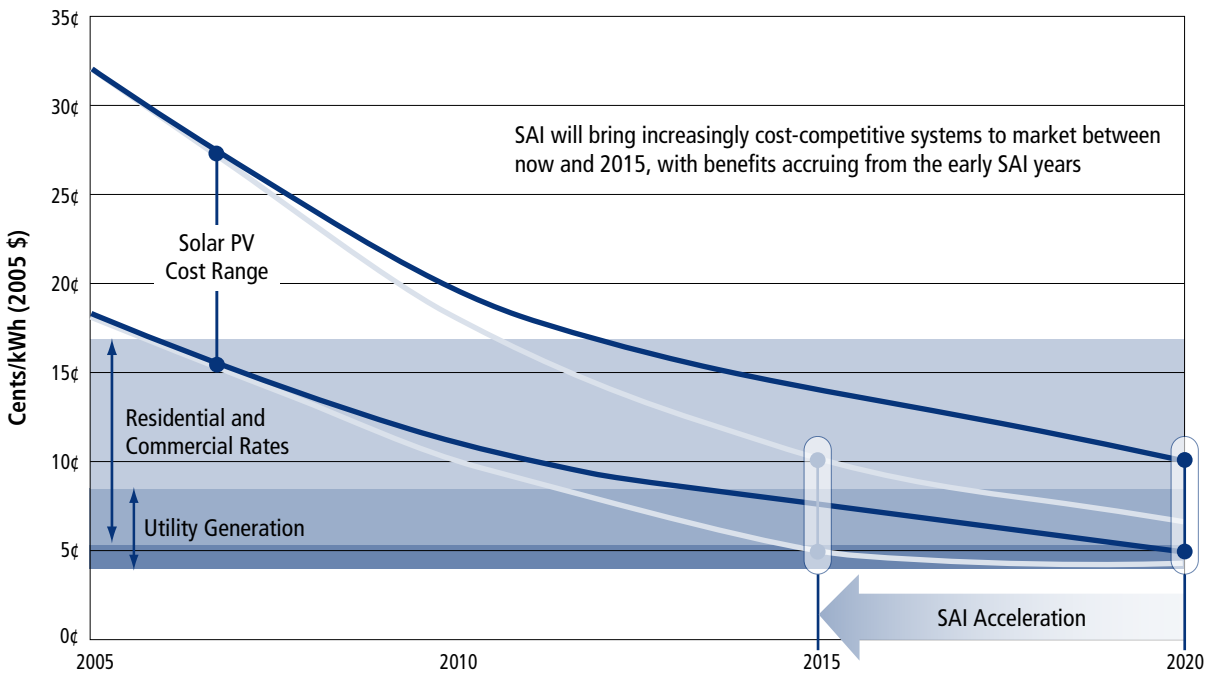
States Can Lead the Way

The federal government has recently initiated programs to increase the use of solar energy across the country. The Energy Policy Act of 2005 created a 30 percent Investment Tax Credit for solar power systems that expires at the end of 2008. The Securing Energy Independence Act of 2007 would extend the credits through the end of 2016, but these measures alone are not sufficient. Most energy policy is set at the state level, so state action is necessary to clear the regulatory hurdles that stand in the way of wide-scale deployment of solar energy and provide incentives to spur development of solar markets.

The Time Is Now

The solar industry had global gross revenues of $19 billion in 2006 and is projected to grow to $70 billion in 2010.[2] This growth means new jobs, a stronger economy, and increased energy independence for states that establish the right market conditions to ride this wave. Many states

FIGURE 1: PROJECTED COST REDUCTIONS FOR SOLAR PV



Note: The Federal "Solar America Initiative" is a research collaboration to bring down the cost of solar, but states must create markets for the technology.[3]

are already taking action to create conditions that will allow solar energy projects to flourish. The following case studies highlight effective state programs that implement the four key policies necessary for solar market development—financial incentives, interconnection, net metering, and rate design—and tell the story of the leader or organization that made it happen. These case studies illustrate how any state across the nation can build on past success to develop a strong solar industry and provide critical lessons for federal policy makers in promoting clean energy.

Financial Incentives

Creating Markets by Stimulating Investment

Eliminating the Cost Barrier
Financial incentives are necessary to stimulate customer investment and market growth while the cost of solar PV approaches grid-based power. Incentive programs allow solar businesses to develop, creating jobs and ensuring economic growth as the market matures.

Five Keys to a Successful Solar Incentive Program

Declining Incentives
Financial incentives should decline in an orderly fashion and eventually phase out to encourage cost reductions and create a self-sufficient market. Declining incentives ensure that the solar industry continues to bring down costs as it matures and competes for ever-lower incentives.

Providing Market Stability
Solar incentive programs need to last for at least five years—and potentially 10, depending on the cost of electricity—in order to enable business development and provide market security. Otherwise, local businesses will not make the investments necessary to take full advantage of the opportunity.

Leveraging Private Investment
Incentives should leverage private investment so that scarce public funds are efficiently allocated. This is best achieved by providing customers with incentives to install solar systems on their own homes and businesses, reducing their electricity consumption and bills. Customers are ensured stable energy prices into the future, while public funding is minimized by leveraging private capital.

Diversifying Solar Applications
Incentives should be available to a wide variety of customers including utility-scale, commercial, industrial, agricultural, and public customers, as well as existing residential and new home construction.

Providing Administrative Transparency
Solar incentive programs should be open and transparent, providing all market participants, including customers, dealers, regulators, and utilities with the information necessary to make the program a success as the solar industry matures.

California Solar Initiative

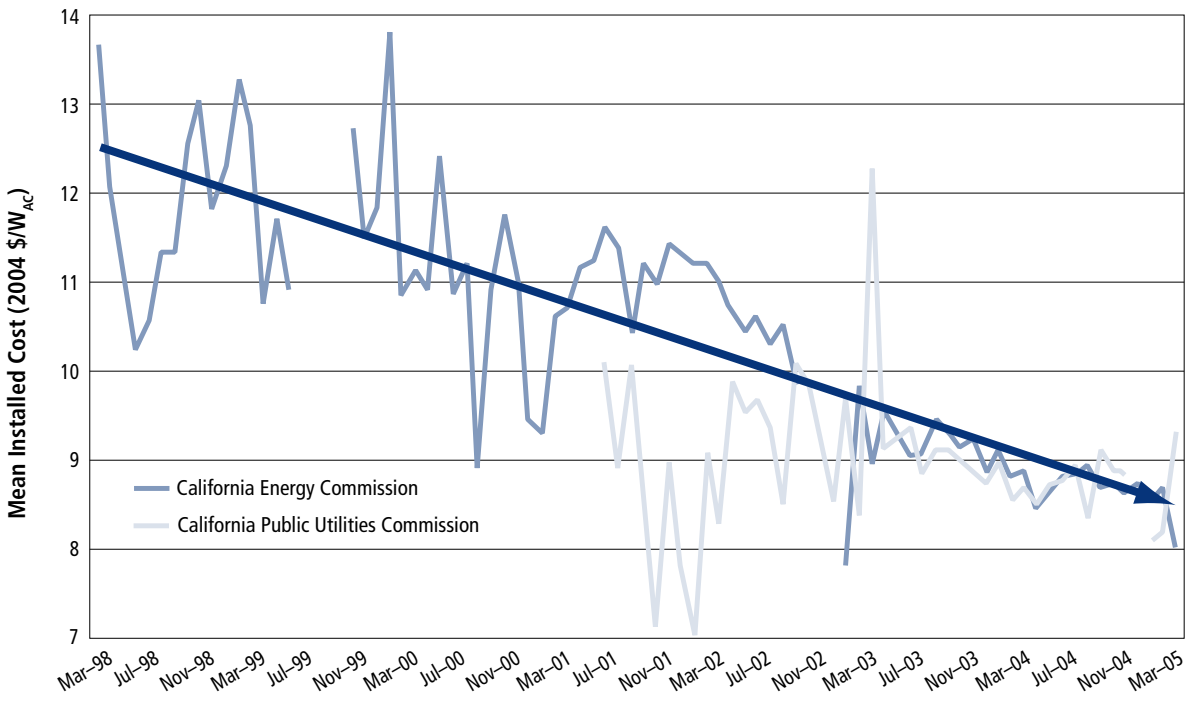
Taking the Lead to Bring Solar into the Mainstream

Gov. Arnold Schwarzenegger of California (R) committed to being a champion for solar energy in his 2003 election campaign. He made good on this promise in 2005, working diligently with California Public Utilities Commission President Michael Peevey to implement the California Solar Initiative. The 10-year, $3.35 billion solar program will result in the installation of 1 million solar systems on residential, commercial, and public buildings across the state.[4] The CSI has the explicit goal of transforming the solar market in order to make solar cost effective without incentives by 2017.

The CSI builds off the success of past California solar programs in place since 1998 that have created a vibrant PV industry with over 400 businesses. The California Energy Commission provided incentives for systems below 30kW and the California Public Utilities Commission provided incentives for solar systems between 30kW to 1,000kW. The industry has matured over time, bringing down the installed cost of solar installations by 4 percent to 7 percent per year[5] (Figure 2). Increasing efficiency and competition have brought down installation costs despite recent increases in the cost of solar modules.

The California Solar Initiative creates the long-term market certainty that previous programs lacked. The CSI will provide a steady stream of declining incentives over the next 10 years, allowing the solar industry—both local installers as well as local, national, and international manufacturers—to ramp up production and bring down costs.

FIGURE 2: THE COST OF SOLAR INSTALLATIONS IN CALIFORNIA HAS FALLEN CONTINUOUSLY WITH STABLE POLICIES TO ENCOURAGE MARKET GROWTH.[6]



Interconnection Standards

Allowing Customers to Plug in to the Grid

Interconnection standards allow customers using solar photovoltaics to connect to the utility grid without undue delay and expense. Without good interconnection standards, utilities can impose significant hurdles that make it extremely difficult for customers to "plug their solar system into the grid."

Barriers to interconnection have been well documented. A 1999 report analyzed 65 distributed generation projects attempting to interconnect to the grid.[7] Of those projects, only seven did not encounter significant barriers to interconnection, while 25 percent of the projects were never completed. A lack of interconnection standards will stop any type of distributed generation market, including solar energy, from developing.

Several key provisions are necessary to facilitate easy interconnection of solar PV systems to the grid:[8]

- **System Safety.** Systems should comply with existing national standards.
- **Standardized Agreements.** Utilities should offer simple, standard interconnection agreements such as the New Jersey two-page interconnection agreement for solar systems below 10kW.
- **Timely Responses.** Utilities must respond to interconnection applications in a timely manner.
- **No Interconnection Fees.** Utilities should not charge interconnection fees, require interconnection studies for standard projects, or charge for inspections.
- **No Added Insurance Requirements.** Self-generators should not be required to obtain additional liability insurance above and beyond their normal homeowner or business insurance policies, which are sufficient to cover most installations.

No solar PV market can develop without simplified interconnection standards. As the Interstate Renewable Energy Council has stated, "Simply put, if a residential customer has to navigate and understand a stack of legal documents before they can install a system, they are less likely to move ahead, even if the major technical issues are settled."[9]

New Jersey Interconnection Standards

Setting the Bar for Reducing Barriers to Solar Energy

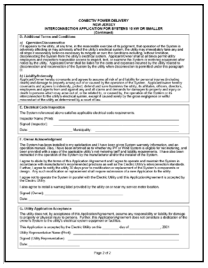
Gov. Jim McGreevey of New Jersey (D) established the Renewable Energy Task Force in 2003 and charged it with advising the governor and Board of Public Utilities on key issues to successfully implement the state's renewable portfolio standard.

The Task Force Report was delivered to the governor on April 23, 2003. It included recommendations to remove barriers to the installation of distributed generation and solar PV systems in New Jersey. Jeanne Fox, President of the Board of Public Utilities and Chair of the Task Force, took the recommendations to heart and worked "with relevant stakeholders to review and implement the recommendations of the Task Force."[10]

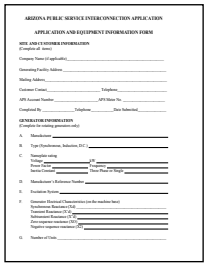
President Fox used a different strategy to develop regulations for renewable energy: she asked the renewable energy industry what they needed to succeed. The response was clear. Renewable energy advocates requested that interconnection standards be simplified and expedited in order to create a thriving distributed generation market and meet the state's renewable energy targets.

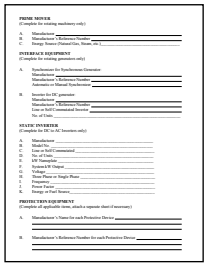
President Fox's strategy differed dramatically from other processes in which utilities that have a vested interest in stopping distributed generation are the main authors of new regulations pertaining to enabling markets. The concerns of the utilities were heard and addressed, but the renewable energy industry had a strong hand in developing the interconnection standards,[11] which are widely recognized as the best in the country.

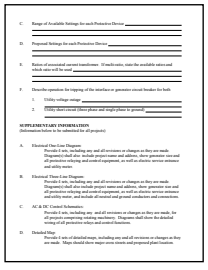
FIGURE 3: SIMPLIFYING THE APPLICATION PROCESS IS A NECESSITY FOR A GOOD INTERCONNECTION STANDARD

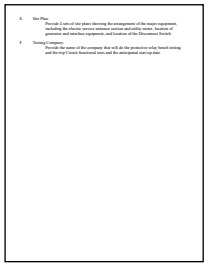


New Jersey's two-page Interconnection Agreement with a simple fill-in-the-blank form.









Arizona Public Service's four-page Interconnection Agreement, which includes requirements for one- and three-line electrical diagrams, full project schematics, maps, and a site plan, adds significant expense and time to an otherwise simple application.

Net Metering

Crediting Customers for Solar Energy Production

Net metering allows customers to appropriately size their solar PV system to meet their electricity needs. Electricity that is not immediately consumed onsite flows back into the electricity grid, "spinning the customer's meter backwards". For example, a customer who uses 700kWh per month and generates 500kWh will only pay for the net consumption of 200kWh. Net metering is essential to allow customers to receive the full value of the solar energy they produce rather than losing credit for excess energy they create.

Figure 4 illustrates why net metering is essential, showing how solar production combines with gross electricity consumption to result in net kWh imports and exports to the utility grid. Negative values indicate electricity exports to the grid. Without net metering, a customer is not credited for the value of all the electricity produced by the solar system and the value of their investment falls accordingly.

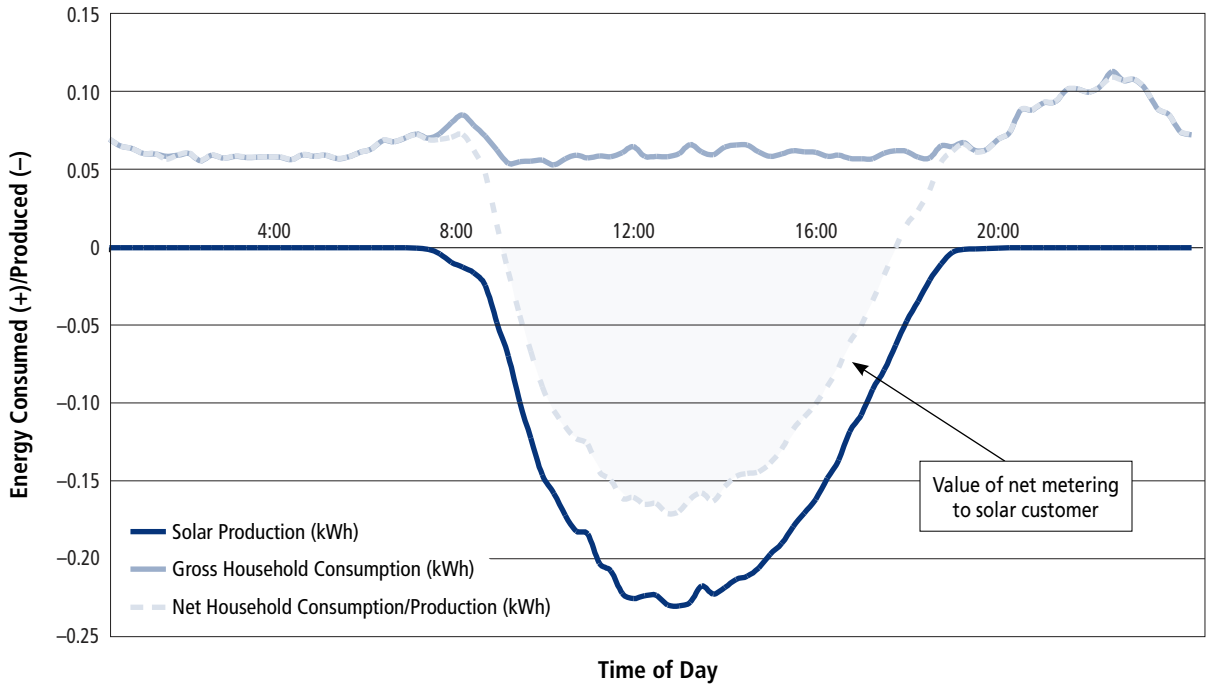
The financial value of net metering is substantial. Customers without net metering do not receive full credit for all their solar production, so the solar system is undervalued. Table 1 compares the internal rate of return[12] for New Jersey solar customers with and without net metering. The IRR is substantially higher for customers with a solar system who have net metering when compared to the same customer with the same solar PV system without net metering.

Net metering is easy to administer and simple to explain. Most customers can use their existing meter, and utility meter readers are not required to perform any additional tasks for net-metered customers.

TABLE 1: INTERNAL RATE OF RETURN FOR SOLAR IMPROVES DRAMATICALLY WITH NET METERING

NEW JERSEY COMMERCIAL CUSTOMER		NEW JERSEY RESIDENTIAL CUSTOMER	
Solar System Size (kW)	*Percent Improvement to IRR with Net Metering*	*Solar System Size (kW)*	*Percent Improvement to IRR with Net Metering*
25	0%	2	5%
50	13%	3	17%
75	28%	4	42%
100	31%	6	87%

FIGURE 4: NET METERING CAPTURES THE FULL VALUE OF SOLAR PRODUCTION



Note: Solar customers need net metering to receive credit for energy produced when production exceeds consumption and the meter "spins backwards."

Net metering is not sufficient in itself to encourage significant installations of solar PV systems. However, due to its simplicity and financial benefit to customers, it is an absolutely critical component of a smoothly functioning solar PV market.

Net Metering in Colorado

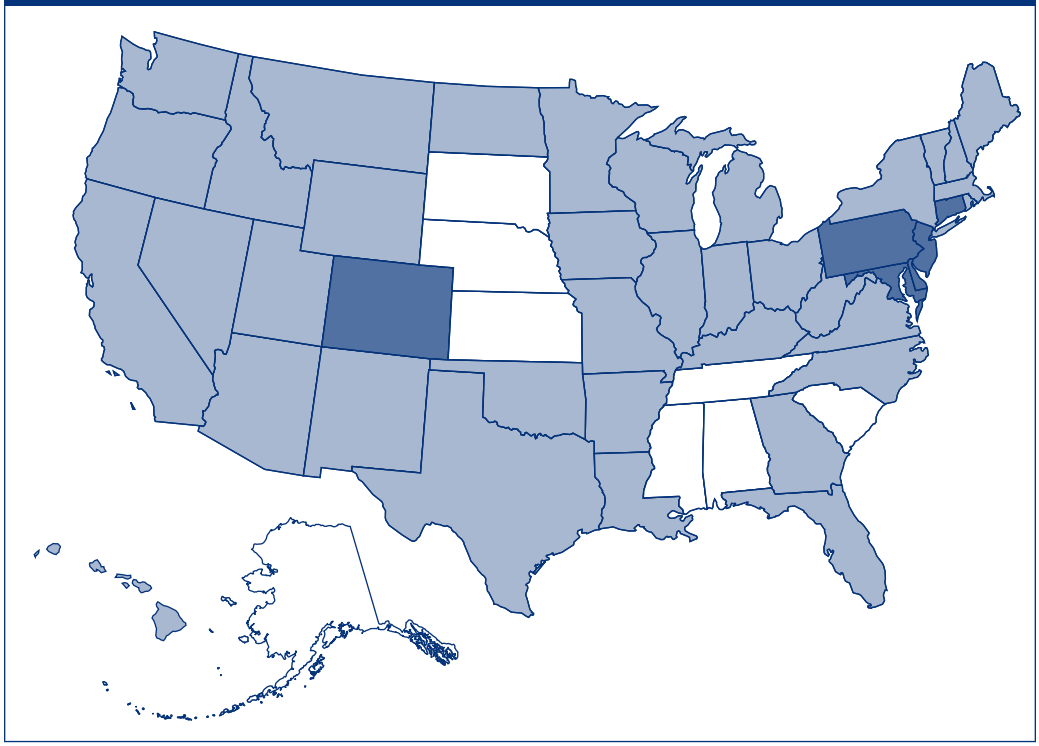
Citizen Leads a Victory for Solar Energy

Residents of Colorado made a strong show of support for renewable energy in 2004 by passing the country's first Renewable Portfolio Standard by ballot initiative with a 54 percent majority. Amendment 37, sponsored by Environment Colorado, required utilities to purchase 10 percent of their power from renewable resources by 2015. When the people lead, the leaders will follow. In March, 2007 Colorado Gov. Bill Ritter (D) signed HB 1281, which doubles the renewable energy requirements established by Amendment 37.

Amendment 37 also required 4 percent of the utilities' renewable energy to come from solar power—a necessary ingredient to develop solar markets through a renewable portfolio standard. Colorado has recently emerged as a strong solar market due to this provision.

Yet Colorado needed to improve its net metering standard in order to develop solar market. Renewable energy advocates drafted net metering rules for Col-

FIGURE 5: SOME FORM OF NET METERING IS AVAILABLE IN 42 STATES AND D.C., WITH QUALITY VARYING WIDELY



Note: Dark blue states have strong net metering rules for systems up to 2,000kW, light blue states have varying net metering standards and white states have no net metering.[13]

orado based on the New Jersey standard and Interstate for Renewable Energy Council standards, which are the best in the country.

Advocates met with the state's largest utility, Xcel energy, on multiple occasions to reach a consensus on net-metering rules. Advocates and utility staff came to agreement on the vast majority of the rules and presented a draft to the Public Utilities Commission for approval. The PUC accepted the consensus position, and Colorado now has one of the best net metering rules in the country.

Net metering has been adopted in many states, as shown on the map above. But the quality varies by state. Colorado and New Jersey originally set the bar with the 2,000kW gold standard. And now more states are following suit; Maryland, Connecticut, and Delaware have all recently adopted strong 2MW net-metering standards.

Retail Electric Rate Design

The Key to a Self-Sufficient Solar Industry

Customers should be charged a fair market rate for electricity, sending the correct price signals for when to use and conserve electricity as well as when to invest in energy efficiency or install a solar energy system. Electricity rates should therefore be based on "time-of-use" energy charges, which vary with the cost of supplying electricity and have low fixed monthly charges.

Rate design is especially important for solar customers, because the economic incentive for a customer to invest in solar energy is entirely dependent on lower utility bills in the future. Utility bills are dependent on the cost of electricity and the design of utility rates.

The solar industry is committed to bringing down the cost of solar PV so that financial incentives are no longer necessary. This will require utility rates to be designed so that customers with solar systems are charged appropriately for the electricity they buy and are therefore appropriately compensated by avoiding buying electricity. The following guidelines will maximize investment in solar, energy efficiency, and other smart energy-management practices:

- **Minimize Fixed Monthly Charges.** Fixed monthly charges that are not dependent on consumption do not relay appropriate price signals to customers and should be minimized.

- **Minimize Demand Charges.** Demand charges are based on a building's highest demand ($/kilowatt) instead of energy consumed ($/kilowatt-hour). Demand charges can account for half of a customer's monthly bill, yet are difficult to control, as they are calculated based on the customer's highest peak demand during a 15-minute period of the month. This lack of control makes customers less able to mitigate high electricity bills and less willing to make investments in energy efficiency and solar, which reduce energy consumption.

- **Develop Time-of-Use Energy Rates.** Time-of-use rates encourage investments in solar, energy efficiency, and demand-side management, which provide power and reduce demand when utility grids need it the most.

- **Give Customers Rate Choice.** Solar customers should be allowed to choose from any rate available to customers in their class, providing flexibility in minimizing their energy bill and maximizing their investment in solar energy.

Vote Solar Victory

Solar-Friendly Utility Rate Improves Solar Investments

Rate structures have played an important role in the distribution of solar installations in California. In 2004, 51 percent of solar capacity installed in the United States was in Pacific Gas & Electric territory, while Southern California Edison, a utility with comparable load size and number of customers, comprised only 18 percent. The reason? PG&E offered a time-of-use rate with no demand charges for commercial customers, which allowed businesses to receive full credit for the value of the solar electricity generated and improving the economics of solar investments.

To rectify this problem, the nonprofit Vote Solar Initiative intervened in the Edison 2005 general-rate case with the goal of creating a pro-solar utility rate. The organization brought in experts from across the energy spectrum, including policy experts, solar customers, installers, and energy efficiency contractors to testify that Edison's rates did not properly value solar energy and energy efficiency's contribution to the grid.

Vote Solar and Edison agreed on a solar-friendly utility rate after months of negotiation, and on June 29, 2005 the California Public Utilities Commission voted 5-0 to approve the settlement. The new rate more accurately values the contribution of solar energy and energy efficiency while increasing the value of solar energy systems for commercial customers by 30 percent to 40 percent.

The new optional rate includes higher $/kWh time-of-use energy charges in exchange for lower $/kW demand charges. The higher energy charges reflect the true cost of purchasing expensive peak power, which is offset by solar energy production. The rate increases the value of solar investments dramatically (Table 2).

California is the nation's largest solar market, and Southern California Edison is the largest utility in the state, making this rate change a significant step in setting the necessary conditions for a self-sufficient solar industry.

TABLE 2: UTILITY RATE STRUCTURES AND SOLAR SYSTEM ECONOMICS

	SCE	
	TOU-GS3 OPTION A	TOU-GS3 OPTION B
ENERGY CHARGES ($/kWh)		
Summer		
Peak	$0.335	$0.118
Part-peak	$0.146	$0.095
Off-peak	$0.064	$0.064
Winter		
Peak		
Part-peak	$0.104	$0.097
Off-peak	$0.067	$0.067
DEMAND CHARGES ($/kW)		
Facility Charges	$7.62	$7.62
Summer Peak		$18.16
Summer Part-Peak		$6.23
Winter		
PV SYSTEM NET PRESENT VALUE SAVINGS		
Solar Savings	$261,151	$185,276

Higher energy charges benefit solar

Penalizing demand charges eliminated

Note: Southern California Edison's new solar-friendly rate increases the savings from a 150kW, $1.13 million solar system by an additional $76,000.

Conclusion

States that provide financial incentives for investing in solar power and eliminate regulatory barriers for doing so are realizing the benefits of increasing consumers' access to clean, renewable distributed generation that provides energy when and where it is needed most. This forward-thinking state leadership in solar energy policy and investment is causing a boom in new solar markets and driving investment and innovation in a technology that will increase our energy independence while strengthening the economy, reducing pollution, and diminishing the threat of global warming.

While no single policy or program is sufficient in isolation, the trailblazing policies of California, New Jersey, and Colorado highlighted in this report together create the conditions for a robust, self-sufficient solar market and can serve as models for other states to follow.

Timely state and federal leadership will be necessary to achieve a full-scale transition to clean energy. Since most energy policy is determined at the state level, state leadership is essential to establish the market conditions for solar energy to thrive. In addition state solar successes will inform federal policy, moving the nation to develop a bold and integrated strategy to transition to a domestic, robust, and secure energy system based on clean, abundant energy like solar power.

Endnotes

1 Handleman, Clayton. "An Experience Curve Based Model for the Projection of PV Module Costs and Its Policy Implications." Heliotronics. Available at http://www.heliotronics.com/

2 Rogol, Solar Annual, Photon International (2006).

3 Solar America Initiative, Denver, CO (August 2006). Available at https://www.eere-pmc.energy.gov/states/Solar_America_Presentation-Denver-Aug_06.ppt

4 Subsequent to the passage of the CSI at the Utilities Commission, the Legislature passed Senate Bill 1, which codified the California Solar Initiative and cleared the remaining hurdles that the commission did not have the authority to change, including an increase to net metering and a requirement that new home developers must offer solar energy as an option.

5 Wiser et al, 2006. Letting the Sun Shine on Solar Costs: An Empirical Investigation of Photovoltaic Cost Trends in California. Lawrence Berkeley National Laboratory (Jan. 2006).

6 Ibid.

7 Starrs, Tom. Making Connections: Case Studies of Interconnection Barriers and their Impact on Distributed Power Projects (1999).

8 Interstate Renewable Energy Council, Connecting to the Grid, A Guide to Distributed Generation Interconnection Issues (2004).

9 Ibid 5.

10 Available at http://www.state.nj.us/bpu/renewEnergy/renEnergy.shtml

11 This process also resulted in the development of the nation's best net-metering standards, which were used as a basis for the Colorado net-metering standard.

12 The Internal Rate of Return is a common economic metric for people making investments in solar energy systems.

13 Please see http://www.dsireusa.org

About the Author

JP Ross is Program Director at the Vote Solar Initiative, where he focuses on creating markets for, and knocking down barriers to, distributed solar photovoltaics. Ross has been active in the development of the California Solar Initiative, which has resulted in the nation's largest solar market as well as other solar markets across the country. Mr. Ross served on the Western Governors Association Solar Task Force and authored the final report to the Western Governors on meeting their 30,000 megawatt clean energy target. Previously Ross was the Policy Analyst for the Greenpeace Clean Energy Now team. Ross holds bachelor's degrees in Chemistry and Environmental Studies from the University of California at Santa Cruz and a master's degree from the University of California at Berkeley Energy and Resources Group.

About the Project Manager

Bracken Hendricks is a Senior Fellow with the Center for American Progress where he works on issues of climate change and energy independence, environmental protection, infrastructure investment, and economic policy. Mr. Hendricks served in the Clinton Administration as a Special Assistant to the Office of Vice President Al Gore and with the Department of Commerce's National Oceanic and Atmospheric Administration, where he worked on the Interagency Climate Change Working Group, the President's Council on Sustainable Development, and the White House Livable Communities Task Force. Mr Hendricks is widely published on economic development, climate and energy policy, national security, and progressive political strategy. He received his Bachelor's Degree in Fine Arts with a Minor in Sociology from Mary Baldwin College, and holds a Master's Degree in Public Policy and Urban Planning from Harvard University's John F. Kennedy School of Government.

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Center for American Progress

ABOUT THE CENTER FOR AMERICAN PROGRESS

The Center for American Progress is a nonpartisan research and educational institute dedicated to promoting a strong, just, and free America that ensures opportunity for all. We believe that Americans are bound together by a common commitment to these values and we aspire to ensure that our national policies reflect these values. We work to find progressive and pragmatic solutions to significant domestic and international problems and develop policy proposals that foster a government that is "of the people, by the people, and for the people."

ABOUT THE VOTE SOLAR INITIATIVE

The Vote Solar Initiative is a non-profit organization with the mission of stopping global warming and increasing energy independence by bringing solar energy into the mainstream. The Vote Solar Initiative works to build robust markets for distributed solar photovoltaics, remove regulatory barriers, and lay the necessary groundwork for a solar future. It mobilizes grass roots support for solar energy, focusing the public demand for clean renewable power on the appropriate targets to ensure a swift and complete transition to a renewable energy economy. For more information, visit www.votesolar.org.

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