CleanEnergyGroup
Innovation in Finance, Technology & Policy

Clean Energy State Program Guide

MAINSTREAMING SOLAR ELECTRICITY: STRATEGIES FOR STATES TO BUILD LOCAL MARKETS

Prepared by
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Disclaimer

Executive Summary

This report provides a blueprint of actions that states can pursue to effectively mainstream solar electricity.

Today, in the United States, solar photovoltaic electricity (PV) markets are far from robust. Although increasing numbers of PV systems are being installed in states and installation companies and distribution networks are growing, PV power generation in this country is quite modest, especially when compared to Japan and Germany, which have established programs and policies to aggressively support PV markets. In the U.S., the total cumulative installed PV capacity amounted to 624 MW through the end of 2006. This U.S. total is less than 25% of Germany's installed capacity, despite the U.S. having much more available sunlight and more than 365% of Germany's population.[1] Today, less than a fraction of 1% of U.S. electricity is generated by solar power.[2]

The problem is not on the "seller" side of the equation. Most of the leading states with solar programs have sufficient numbers of installers and distributors with a quality PV product available for purchase and the ability to deliver the product reliably. Existing solar-related companies have the means and motivation to expand in response to increased demand. New suppliers can enter the market with relative ease.

The problem is on the "buyer" side of the equation where potential purchasers have difficulty justifying the expense of a system due to significant first costs and are further hindered by restrictive or non-supportive requirements and regulations. The cost barrier can be further exacerbated by state solar programmatic support mechanisms that impose requirements and special consumer protections that can increase costs and hinder large-scale deployment.

If states hope to see solar photovoltaic technology enter the energy generation mainstream, they must move aggressively to address cost, policy, and programmatic barriers that continue to impede market growth.

This report recommends that states serious about local market-making for solar technologies focus their attention on the following interventions:

- ***Provide Sustained Financial Support for Projects***—Recognize that PV markets cannot function successfully in the near future without predictable, long-term government incentives and policy support
- ***Establish "PV-Friendly" Laws and Regulations***—Pursue a comprehensive public policy agenda that includes expanded net metering, simplified interconnection standards, and renewable portfolio standard "set-asides" for solar technologies

- ***Ensure Sensible Program Design***—Develop solar incentive programs to avoid onerous program requirements that can drive up installer costs in the name of consumer protection
- ***Stimulate Long-Term Financing***—Facilitate creation of long-term, favorable solar financing programs
- ***Promote "PV-Friendly" Building Codes***—Promote standard building codes and permitting requirements that specifically and fairly address the characteristics and requirements of PV systems
- ***Walk the Talk***—Encourage a formal state government commitment to installing PV on public buildings
- ***Support Training***—Advance work force development by supporting installer training and certification programs to meet the demand for trained technicians
- ***Promote Education and Marketing***—Educate consumers and private lending institutions about the benefits of PV technologies and pursue cooperative strategies to grow PV markets

Long-term government leadership and commitment to solar technology deployment are needed if we are to grow the market and bring about the resulting benefits to consumers, businesses, and industry that will come from greater use of PV and other solar technologies.

Mark Sinclair, **Clean Energy Group**
Steve Weisman, **Peregrine Energy Group**
April 2008

Introduction

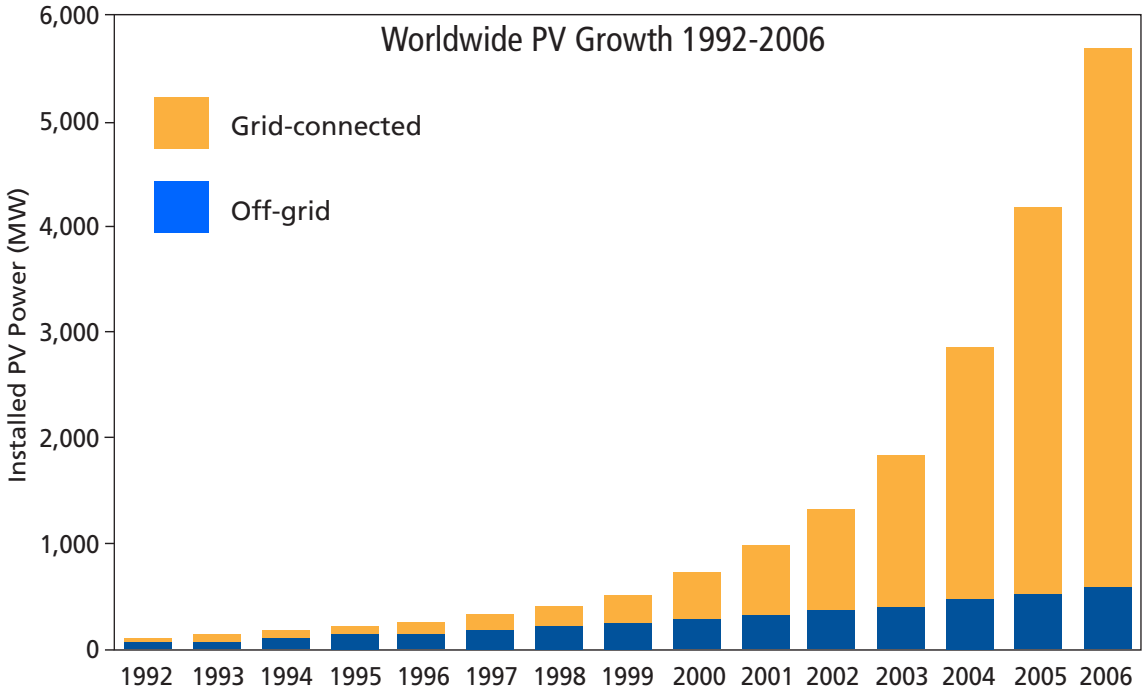
Today, all members of the Clean Energy States Alliance (CESA), an association of 20 states with clean energy funds ("state funds"), have programs in place that support and encourage the growth of solar photovoltaic markets. Why? There are many reasons. PV generation is clean and results in no environmental damage. PV power production is decentralized, with system owners using what they need and selling any surplus generation back onto the grid where it can be used by other consumers. PV systems are easy to site on otherwise unused roofs of buildings. Sunlight is everywhere and free. Local installation of PV systems creates jobs and strengthens local economies.

Recent PV Capacity Growth around the World

There has been tremendous growth in installed PV capacity worldwide. Installed capacity in the International Energy Agency (IEA) Photovoltaic System Programme (PVPS) member countries[3] increased by 1,514 megawatts (MW) in 2006 (the most recent reporting year) of which 1,448 MW was grid-connected. This raised the total installed capacity to more than 5,690 MW in IEA PVPS countries as of the end of 2006.

Of the reported new grid-connected PV installed in 2006, 66% of this growth was in Germany (950 MW), 20% was in Japan (285 MW) and 7% came from the United States (108 MW). Note that the U.S. also added 37 MW of off-grid capacity in 2006, according to IEA.[4 5]

The following IEA chart summarizes worldwide PV growth from 1992 to 2006.



In the United States, while significant goals for market penetration have been established in a few states, most notably in California and New Jersey, and the numbers of installations are increasing, the totals are much lower than in Japan and Germany. IEA reported a total installed PV capacity of 624 MW in the United States through the end of 2006 (of which 57% is grid-connected). This U.S. total is less than 25% of Germany's installed capacity, despite the U.S. having much more available sunlight and more than 365% of Germany's population.

The Path to Mainstreaming PV in the United States

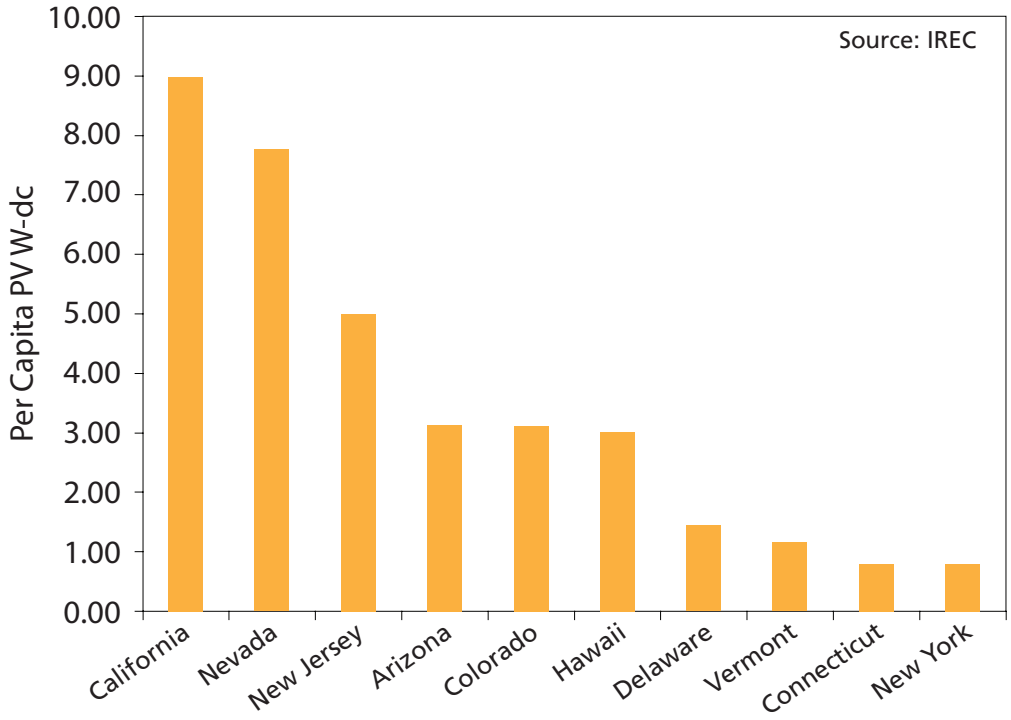
Presumably, if PV system suppliers in U.S. were in a position to present a forceful value proposition and ready financing, the U.S. also would have a robust and fully functional photovoltaic marketplace like Germany and Japan. Systems would be regularly and readily installed in new and existing residences, in schools and government buildings, and in businesses.

Installed Grid-Connected PV (Top States)(1)

	2006 (MW)	2007 (MW)	06–07%	Cumulative Installed PV Capacity(1)
California (2)	69.5	87.1	25%	327.0
New Jersey (3)	17.9	19.2	7%	43.5
Nevada	3.2	14.6	556%	18.7
Arizona	2.1	2.8	33%	18.6
New York	2.9	4.4	52%	15.1
Colorado	1.0	12.5	1150%	14.5
Mass.	1.5	1.4	-7%	4.6
Hawaii	0.7	2.4	243%	3.8
Connecticut	0.7	1.8	157%	2.8
Oregon (4)	0.5	1.1	120%	2.8
All Others	3.0	4.4	47%	19.8
TOTAL	103.0	151.7	47%	471.2

Source: IREC and CESA, February 2008
(1) Through 2007, Grid-connected, MW-dc; (2) CEC, SGIP, CSI & SMUD only; (3) Incentives in addition to Solar-REC; (4) Energy Trust service territory only (Portland General Electric and Pacific Power)

Top 10 States for Cumulative Per Capita PV in 2007



A mainstreamed PV marketplace in the U.S. would have the following characteristics:

Technology maturity and competitive system economics

- Solar electric technology is readily available for purchase, is price-competitive with other power supply options, and produces sufficient value to justify the investment.
- Warranties and reliable service are available to consumers from manufacturers and installers, sufficient to alleviate performance-related anxieties.
- Interconnection with building infrastructure and utility power distribution grids can be successfully accomplished using off-the-shelf equipment and materials and at modest cost.

Effective local distribution networks and an integrated installation infrastructure

- Local product distribution networks are in place, specialized businesses are installing solar systems, and general and electrical contractors are integrating solar installation services into the menu of services they offer.
- Training programs are offered through technical and vocational schools to prepare future installers in proper installation techniques.
- Favorable system financing is available from installers and suppliers and through financial institutions for solar installations in new construction and existing buildings.

Conducive regulatory environment

- Local installation guidelines are codified consistent with the National Electrical Code and other safe building practices; local code enforcement officials are fully familiar with PV systems, and review and approve systems in a streamlined, one-stop approach; permitting fees are reasonable
- Interconnection standards include streamlined procedures and timelines for integration of PV systems into power networks.
- Net metering rules encourage the installation of large and small systems by enabling system owners to realize the value of all electricity produced.

Current U.S. PV Market Barriers

Today, most states have installers and distributors with PV products available for purchase and with the ability to reliably deliver the products. Existing companies have the means and motivation to expand in response to increased demand, and new suppliers can enter the market with relative ease.

However, the market is not robust in most areas of the U.S. and market penetration is low. Sellers are not finding large numbers of prospective purchasers who value the PV product, have the resources to make the purchase, are enabled under relevant codes and regulations to easily install a system, and are confident that the technology will meet their performance expectations. Rather, potential PV system customers often are unable to justify the purchase due to the significant first costs of the technology and are often hindered by difficult interconnection requirements. In addition, because PV technologies remain largely invisible in many markets, potential purchasers fear to go where few have gone before.

In an attempt to explore and address these market failings, in this report, Clean Energy Group, with the assistance of Peregrine Energy Group, identifies and describes a number of strategies and best practices that states can employ to overcome local marketplace barriers. The recommended activities would build local infrastructure capacity and foster long-term cost reductions and market expansion for solar PV.

Solar PV Today in Clean Energy States

CESA SURVEY OF STATE SOLAR MARKETS

To inform our recommendations, in the spring of 2007, Clean Energy Group and Peregrine Energy Group conducted a survey of CESA-member states to explore their perspectives and efforts with regards to expansion of photovoltaic markets. All CESA-member state clean energy funds provide targeted support for solar PV technologies, markets and individual projects, typically through so-called buy-down or incentive programs. The survey sought to identify specific "infrastructure"-related activities that states are implementing to address local barriers to the installation of PV systems. Twelve states responded to the survey: California, Connecticut, Illinois, Massachusetts, Minnesota, New Jersey, New Mexico, New York, Ohio, Oregon, Pennsylvania and Wisconsin (hereinafter referred to as "CESA states" in this report).[6]

Among the solar-support mechanisms addressed in the survey were incentives, project financing, marketing and public education, building codes and installation standards, state laws (such as a renewable portfolio standards and net metering) and regulations (grid interconnection procedures), tax treatment of systems, and training and certification of installers. A summary table describing activities reported by the states is included below.

In addition, respondents were asked to share their visions for the future photovoltaic market in their states and the specific objectives and goals of the state-based solar initiatives. We found the following results:

There are many common objectives and approaches shared by the states to affect the future of photovoltaic generation in their jurisdictions.

- Objectives of all state programs include future economic development and the widespread adoption of solar technology.
- Specific goals cited as most important include creating consumer demand for PV, establishing a workforce of capable and qualified installers, removing regulatory barriers, and encouraging local job growth.
- Many state respondents indicated that their states want to create a stand alone market for PV system sales, installation, and even local manufacturing.

As might be expected, there is considerable variability between states in the specific interventions and activities used to strengthen PV markets.

- Differences largely reflect significant disparities in the funding resources now available in each state to advance solar use.
- When asked "what are the most important things that can be done to strengthen local PV markets," respondents cited the need for system and project financing, better quality standards for installers, improvements to the interconnection process, incorporation of PV technologies

State PV Market Support Elements: 2007

	CA	CT	IL	MA	MN	NJ	NM	NY	0H	OR	PA	WI
BUILDING CODES												
Statewide codes and standards for PV												
Information sharing of best practices				X		X	X	X			X	
STATUTES AND REGULATIONS												
Statewide Interconnection Standards		X		X	X	X	X	X	X	X	X	X
Streamlined standards for small PV	X	X		X		X	X	X	X	X	X	X
Net metering available	X	X	X	X	X	X	X	X	X	X	X	X
Net metering cap per project	1M	2M	40k	60k	40k	2M	80M	10k	80M	25k	1M	20k
Renewable Portfolio Standard (RPS)	X	X		X	X	X	X	X		X	X	X
RPS solar carve out (variably defined)						X	X	X			X	
Time of use rates for peak periods	X	X	X	X					X		X	X
TAX TREATMENT OF PV												
Property tax exemption residential PV	X	X		X	X					X		X
Property tax exemption commercial PV	X			X	X					X		X
Sales tax exemption for residential PV		X		X	X	X	X			X		
Sales tax exemptions commercial PV		X			X	X	X			X		
STATE FUNDING FOR PV												
Capacity-based incentives			X	X	X	X	X	X	X	X		
Performance-based incentives	X	X										X
Adders for in-state mfg. products				X		X	X					
Feed-in tariff established												X
DEBT FINANCING FOR PV												
Long-term commercial financing				X							X	
Special mortgage for new construction												
Reduced interest rate program	X							X	X			
State loans for PV							X			X		
Utility-provided financing for PV												
Solar loan guarantees												
CONSTRUCTION POLICIES												
PV consideration mandated in state-funded construction	X			X								
PV consideration suggested								X				
Financial support for such construction			X	X		X			X			
Technical support for such construction												
Support for PV on schools	X		X	X	X	X	X	X	X	X		
TRAINING / CERTIFICATION												
One-day special installer trainings	X	X		X	X	X	X	X		X		X

State PV Market Support Elements: 2007

	CA	CT	IL	MA	MN	NJ	NM	NY	0H	OR	PA	WI
TRAINING / CERTIFICATION												
Voc tech courses for installers	X		X	X		X	X	X	X	X		X
Training for code officials	X	X		X		X	X	X				X
Training for architects & builders						X		X				X
Qualified installer listings	X	X		X		X		X	X	X	X	X
Installer certification								X	X			X
MARKETING												
Provide "how-to" literature	X	X		X	X	X		X	X	X	X	X
Advertising campaigns	X			X		X	X			X		X
Co-marketing with installers						X				X		X
Solar Day tours of systems	X	X		X	X				X	X	X	X
Support for solar associations	X	X	X	X	X		X		X	X		X
OTHER												
Transferable warranties required	X					X						
Buy back systems at discounted rate												
Encourage pre-configured PV packages								X				
System rating for size and efficiency	X	X						X			X	X

in new construction, particularly in public buildings, and implementing alternative financing mechanisms to the traditional use of rebate-based incentives.

There was agreement that market-rate PV installations are too costly today for the level of consumer benefit created.

- Every state stressed the critical importance of establishing ongoing, significant, long-term PV funding mechanisms, whether grant-type incentives, an RPS solar set aside, or feed-in tariffs, to support and drive consumer demand and industry investment.
- States without such funding mechanisms do not have significant numbers of PV installations.
- Asked whether and when they believed that PV will be viewed as a cost effective investment, not requiring a direct subsidy of the installed cost, the most common response was that it will be cost effective in 10 years, with a number of respondents pushing that date out from 12 to 15 years.

A full summary of survey results is attached to this report.

LOCAL MARKET BARRIERS

Although individual states and the federal government have launched a variety of initiatives to encourage solar markets to grow, there remain substantial market barriers still to be addressed. These include:

- ***Poor system economics:*** The all-inclusive cost of PV systems remains high, the significant cost of system components is largely outside of local control, and would-be purchasers are unable to realize sufficient return to justify their investment. A four-kilowatt system, about the typical size for a residential PV system, requires an initial investment of over $25,000.
- ***Lack of long-term financing mechanisms:*** Potential buyers of PV systems cannot secure favorable loans to amortize costs over a long period, consistent with system cash flows. Most buyers also must spend considerable time to research and apply for loans.
- ***Unfriendly interconnection and net metering requirements***: Many states lack reasonable, simple procedures for connecting a PV system into the grid so that a system owner can produce power when the sun is shining, sell the power that's not being used to the utility, and purchase power from the utility when needed. Each state regulates the process under which a generator can connect to the distribution grid. These policies often pose a barrier as the process is lengthy, arduous and expensive, especially for smaller systems. Many customers encounter unworkable interconnection requirements used by utilities.
- ***Burdensome code enforcement and sometimes expensive permitting requirements***: Formal local rules governing solar electric system standards and installation requirements are lacking and/or the enforcement personnel lack appropriate training, resulting in unnecessary burdens for installers and owners, and increased system costs. Local permitting practices vary widely, and often add significant cost to the consumer. Local permitting fees may be structured more as a luxury tax than as a mechanism to cover the true cost of inspections.
- ***Distribution of trained and experienced installers across states***: As a relatively new trade with still-limited numbers of customers, highly qualified installation contractors are not plentiful and well dispersed, resulting in increased installation expenses associated with long distance travel that is passed along to customers.
- ***Potentially excessive installer licensing requirements***: Licensing requirements may be mandated by states and are often inconsistent with or unjustified for the nature of the work, driving up installation costs and forcing otherwise qualified installers out of the business.
- ***High cost of sales***: Installers often have the additional role of educating and advising prospective buyers and also qualifying their sites as eligible for state solar incentives. Where multiple bids are mandated by state incentive programs, these costs are even higher.
- ***Aesthetic concerns***: The still unfamiliar "look" of solar electric systems on roofs deters some buyers.
- ***Potential impacts on property value***: Some potential buyers have concerns that PV installations may adversely affect property values by increasing tax assessments or reducing market value.

In all cases, the impact of these barriers is to increase the real or perceived cost of photovoltaic technology.

"Best Practice" Recommendations for Addressing Local Market Barriers

CEG's survey found that in the most successful solar markets, states have established specific solar program elements that seek to eliminate local barriers to system installation and to build local markets. Based on the real-time experience of the leading state solar programs, this report explores these barriers in more detail, describes efforts by states to address them, identifies "best in class" solutions where they exist, and recommends practices that states should consider implementing.

THE PROBLEM: ADDRESSING HIGH FIRST COSTS AND LONG PAYBACKS OF PV SYSTEMS

Across the United States and around the world, the first cost of PV systems is the primary barrier to broad adoption. The average installed cost of a PV system nationally is $9.00 per watt with capacity factors of 15% (nameplate capacity). This is quite high compared to the cost of commercial wind energy systems at $2.00 per installed watt of nameplate capacity, with capacity factors of 30%. Conventionally fueled systems such as natural gas CHP, even behind the meter, can be even less expensive with higher capacity factors.

The cost of a typical residential PV system requires an initial investment in the vicinity of $25,000. Compared to the price for home and automobile purchases, this is one of the largest single-item acquisitions that a consumer will make. It is not surprising that consumers want to be clear about the value that PV systems create for them; the opportunity cost of making a poor investment decision is quite high.

The challenge then, put simply, is that PV installed system costs are high, and the financial savings to be expected from avoided electricity purchases are relatively low. Because of the resulting long payback time for PV systems (in excess of 20 years at full cost), many prospective buyers have difficulty justifying the capital cost to generate PV power instead of buying it from the grid.

In response, states have put programs in place to accelerate market making by driving down the total cost and driving up demand for local solar installation services. Over twenty states have established "clean energy funds," most often through a small surcharge on retail electricity rates. The mission of these funds is to support development of renewable energy projects. The widespread popularity of solar, along with its high up-front costs and resulting need for support, has made it a prime target of state clean energy funds. The theory is that a growing local solar market, fostered by supportive incentives and market-building policies, should enable solar firms to capture efficiencies and drive down costs.

In designing state programs, it is important to focus on what solar cost items states can most readily affect. PV system costs include a combination of hardware

costs (primarily the modules and inverters) and non-hardware costs, including marketing, sales, local transportation, hiring and training, insurance, permitting, installation, and inspection. Hardware costs generally are set in the worldwide market, driven by technological innovation, influenced by materials availability, affected by international labor markets, and, therefore, heavily driven by factors *beyond the control* of states and state programs. However, non-hardware costs, equal to 50% or more of the total price of a system, are subject to the influence of state activity, through policies or programs that increase or decrease the installed system cost.

A recent analysis by the CEO of Akeena Solar, Inc., Barry Cinnamon, underscores the importance for states to focus on attacking the causes of non-hardware costs. Mr. Cinnamon notes that the total installation costs for solar are significantly cheaper in Germany than in the United States (approximately $2/Watt less). His analysis indicates that this cost differential is not due to the cost of hardware or the existence of the feed-in tariff approach, but largely due to differences in administrative, technical, sales and marketing approaches in the two countries.

For example, in Germany, installation costs are lower because, unlike the U.S., there is negligible paperwork involved in obtaining government incentives, no interconnection paperwork, no requirement for engineering drawings and local building permits, and no multiple inspections necessary to enable a system. In addition, the technical requirements for solar installations are much less rigorous and precautionary in Germany, with no requirements for AC and DC disconnects, no grounding requirements for each module and rack component, and no conduit requirements for source circuit cabling. However, these reduced technical requirements have not resulted in significant safety or reliability problems.

Finally, in Germany, solar installers have storefronts in most towns, with jobs performed quickly. This faster turnaround results in the need for less working capital.

These differences result in structural costs that are $1–$2/watt higher in the U.S.— costs that state incentive programs must compensate for. According to Mr. Cinnamon, states should take this substantial bureaucratic friction into account when designing and implementing their solar programs.

Below, we first identify some general recommendations, and then some specific strategies for how states can design and implement state solar programs to build local markets, lower installation costs, and mainstream PV technology.

GENERAL RECOMMENDATIONS FOR IMPLEMENTING EFFECTIVE STATE INCENTIVE PROGRAMS THAT ADDRESS HIGH FIRST COSTS

1. Create consistent, stable, long-term state program support.

Sustained, long-term programs should enable more significant PV cost reductions. Building a mature market for PV is the most direct way for states to reduce non-module costs because such markets will attract and encourage suppliers to create an efficient delivery infrastructure. Experience in Japan suggests that deeper cost reductions are possible with a more sustained public policy effort.

Therefore, whatever state funds are made available

for solar incentives, states should commit and release these resources in a way that ensures long-term continuity of the program—for periods of 5 to 10 years or more. This is critical to allow a local supply infrastructure to develop and stabilize, without boom and bust cycles.

California *Example:* Seeking to replicate Japan's success story in the U.S., the California Solar Initiative is designed to create a mature PV market through deployment of a 10-year, $3 billion program, with rebate levels reduced each year by approximately 10%. The California Solar Initiative provides an example of a state program with a good balance between promoting solar installations through meaningful subsidies, providing an incentive for industry cost reductions over time, and budgetary certainty. In California, subsidies start at $2.5/W and decline to $0.2/W after 2,400 MW have been installed by the program, with subsidies zeroing out after 10 years. This approach allows the state to set the maximum cost of the program, and if the initial subsidy is too high, the payment levels are self-correcting. A gradually declining level of incentives is appropriate for an industry with high cost-reduction potential and the potential for rapid growth. It also is preferable to under-funded rebate programs that are subject to arbitrary cessation.

2. Establish specific installed capacity goals for PV.

For similar reasons, state policy makers should consider publicly committing to a solar installed MW capacity goal as the basis for future policy, strategy and program actions. Doing so will create clear market expectations, strengthen investor confidence, and provide predictability for future budgeting and continuity for program deployment. Given the distributed nature of PV technology, achieving long-term PV generation goals will require the collective confidence of multiple investors and customers in the state's commitment to long-term market building.

To that end, through 2007, several CESA states have established specific, ambitious PV goals and resource commitments, including California: 3,000 MW in ten years; New Jersey: 2,300 MW by 2020; Maryland: 1,500 MW by 2022; and Massachusetts: 27 MW in the next four years—to drive the emergence of a local solar industry and market.

3. Ensure incentive design fosters PV cost reductions and mainstream adoption.

The prevalent funding strategies in the U.S. and abroad to mitigate PV costs and grow markets include long- and short-term subsidies and incentives, feed-in tariffs, targeted tax treatments, solar targets in renewable portfolio standards, and other financing mechanisms.

In the U.S., capacity-based incentives offered by states are by far the most common approach to providing financial support for PV installations. These incentives are literally pegged to the number of watts of system design capacity (its nameplate capacity rating) and offer an up-front, set dollars-per-watt grant, subsidy, or incentive (with the terminology for the award varying from state to state).[7]

Recently, a growing number of states have begun to offer installation incentives that are performance-based, in response to concerns that the capacity-based payments may be subsidizing systems with potentially poor performance. Capacity-driven incentives are criticized for not encouraging effective system design, optimal component selection, and regular ongoing system maintenance. However, there is no comprehensive information regarding the extent and specific causes of poor PV system performance. In fact, it is not clear that poor PV

performance is a widespread problem in the U.S., especially in light of the inherent incentive by owners to ensure that their systems perform well. Instead of using performance-based incentive designs, states may want to focus on giving homeowners and building operators the necessary information on performance and maintenance as an effective approach to promote system performance.

However, two primary types[8] of performance-based incentives (PBI) are emerging in the U.S., with a number of variations related to the timing of and basis for incentive payments. The most "pure performance" approach strictly ties incentives paid out over time to demonstrated production by the PV system.[9] In many ways, this approach mimics the feed-in tariffs of Germany.[10]

The other major performance-based approach pays an up-front incentive that is based on an *estimate* of long-term electricity production, taking into account an analysis of specific installed system components in a particular location, and such factors as orientation, declination, seasonal shading potential, and weather. This estimate or modeled output is then used to determine what the up-front payment should be, with adjustments made based on actual measured performance.[11]

Both approaches address the desire to have payments tied to electricity production rather than nameplate capacity. However, while the measured performance approach more effectively accounts for output variability driven by actual weather conditions, system degradation, and poor maintenance, it does not address the significant first-cost barrier of PV systems. It also may be administratively burdensome and costly to have variable ongoing payments tied to production. In particular, performance-based incentives may be a poor match for new residential construction, as the approach does not address builders' concerns with the impact of PV on the up-front cost of new homes.[12]

For these reasons, the estimated performance incentive approach may be more appropriate than a strict PBI approach for PV systems installed on newly constructed buildings or for smaller systems. While it does not take into account the potential for future change in output, it does go a long way toward helping ensure that systems are properly installed and will generate the income the customer has been promised. Most importantly, it provides the same front-end payment and cost certainty that the traditional capacity-based rebate approach offers to a buyer.

4. Ensure program rules do not pose unreasonable barriers and costs on installers & customers.

In choosing an incentive design and program elements, states must take care not to implement program features that are so complex or costly to use (for themselves, installers and their customers) that they make PV systems even harder to afford. Specifically, it is important that states consider and evaluate how the design of their solar support program affects local installation and non-hardware costs. An example from the Small Renewables Initiative (SRI) program in Massachusetts is informative of the unintended cost consequences of rigorous solar program requirements.

A 2006 survey of PV installers working in Massachusetts, completed by the Solar Energy Business Association of New England (SEBANE), asked them to allocate their time and cost by activity to further understand how the total local cost of systems is incurred. Installers reported that, in addition to the time and manpower it takes to physically install a system, their non-hardware costs were being driven up by requirements of the Massachusetts SRI program.

Estimated Allocations of MA SRI Non-equipment Costs by Installation Companies (As Percentages of Total Non-Equipment Costs)

ACTIVITY / COMPANY	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"
Sales	10	20	15	12	10	12	10	4
Program application	20	15	15	13	8	14	5	17
Permitting	10	10	10	10	10	7	5	17
Installation	40	45	50	46	60	60	70	54
Inspection / Interconnect	20	10	10	19	12	7	10	8

According to the installers, the SRI application imposed considerable paperwork requirements. Marketing and sales required a significant amount of time to travel between job sites (given the distances between active customers) to qualify customers both technically (e.g. roof and sun availability) and financially. Other major costs were permitting and the need to participate in several individual inspections by multiple parties (i.e., in some cases, separate trips by the installers to meet an electrical inspector, building inspector, utility representative, and state program representative). As a result, the actual system installation itself averaged only 50% of the non-hardware costs. In response to these concerns, the new Massachusetts Commonwealth Solar Initiative has aimed to reduce program transaction costs.

The lesson here: If the ultimate objective is to mainstream PV technology by making it more affordable, states should weigh both the benefits and the cost implications of program requirements designed to encourage performance and quality. Both the cost of sales and cooperating with local code enforcement already add significant expense to installations.

Solar program requirements should avoid placing additional unnecessary burdens on solar technology installers and contractors that further increase transaction costs, which will likely be passed on to the customer.

Specific Recommendations for States to Build Solar Markets

We now describe areas where states can take specific actions to address major market barriers to PV deployment.

1. STATE LAWS AND REGULATIONS

There is significant effort by states to support customer-sited renewable energy generation through adoption of policies, regulations, and laws to overcome market hurdles and improve system economics. Many of these actions, such as interconnection, net metering standards, and renewable portfolio standards affect regulated electric utility distribution companies.

a) Renewable Portfolio Standards

The majority of states now have established a Renewable Portfolio Standard (RPS) that requires utilities to supply a specified percentage of electricity from renewable resources. An RPS represents an important tool to expand state solar markets if designed with differential support for solar technologies. However, a traditional RPS—where all eligible renewable resources compete—supports least-cost projects such as wind and landfill gas, and is unlikely to provide adequate support for smaller-scale solar distributed energy due to cost and solicitation barriers.

In recent years, states increasingly are providing differential support for solar through an RPS in two ways. First, at least eleven states now have established a solar share or set-aside—a requirement that some portion of the RPS come from solar resources specifically, or distributed generation more broadly. Second, several states use a solar "multiplier," giving more credit to solar electricity than other forms of generation towards meeting RPS targets. These mechanisms attempt to strengthen solar markets by allowing solar technologies to compete against less costly renewable technologies and are becoming more popular and increasingly driving solar electric development.

According to analysis by Berkeley Lab,[13] states are moving towards solar set-asides and away from multipliers due to the greater success with the former approach. RPS policies that only have credit multipliers for solar have not yet seen significant solar additions.

New Jersey has been most aggressive in its use of a solar set-aside, with 2% of its RPS target required to be delivered from solar PV systems, requiring 1,800 MW AC of solar by 2021. New Jersey's solar development targets are the largest in the country on a per capita basis and are now driving the high growth in PV installations in the state.

Berkeley Lab reports that the impact of existing state RPS set-asides on solar PV already has been substantial. Excluding California, 67% of PV additions from 2000 through 2006 came from states with

active RPS solar targets. Further, the future impact of existing state RPS solar set-asides could be sizable: 400 MW in 2010 and 2,000 MW by 2015, assuming full compliance.

CEG Recommendation:

Consider creation of a solar set-aside in the RPS program.

For an RPS to significantly benefit solar technology and markets, a solar set-aside requirement appears to be necessary. States with an RPS should consider requiring a specific solar share percentage in recognition of the special benefits of solar installations (e.g. local job creation, ease of siting, used primarily at the point of generation, no adverse environmental impacts). However, according to Berkeley Lab, contracting and incentive policies are critical to the success of a solar set-aside. Reliance on short-term Renewable Energy Credits (REC)[14] purchases to meet a solar RPS is likely to be costly and ineffective. States therefore should encourage or require long-term REC contracting and/or provide up-front payments for small PV systems. Both **Maryland**'s recent RPS law and **New Jersey**'s new solar REC program provide good examples of state approaches. For Maryland's approach, see http://www.dsireusa.org/library/includes/incentive2.cfm?IncentiveCode=MD05R&state=MD&CurrentPageID=1. For New Jersey's program, go to http://www.njcleanenergy.com/files/file/SOLARTransitionFAQs121707%20fnl2(2).pdf.

b) Interconnection & Net Metering

Interconnection and net metering are two key state-controlled policy issues that can enable states to get serious about promoting solar distributed generation (DG). Well-crafted, simplified interconnection standards and net metering promote the broader deployment of customer-sited solar systems.

Interconnection standards govern how customers can connect distributed renewable generation systems to the grid. A majority of states have established special grid interconnection requirements for photovoltaic systems and other renewables that have been approved by state public utility commissions. These include streamlined standards for interconnection of smaller systems. The effect of these standards is to add more certainty and to reduce budget contingencies in the interconnection process for system installers and purchasers by defining fees that are allowed, processes that must be used, and timelines that must be followed.

Net metering allows customers to send excess on-site solar (and other renewable system) generation back to the grid and receive a payment for that generation from the host utility. Net metering essentially is a billing arrangement by which solar purchasers realize savings from their solar PV systems, and where 1-kWh generated by the customer has the exact same value as 1-kWh consumed by the customer. Net metering requirements are generally set by statute. All the CESA-member states have net metering in place with net metering capacity size caps ranging from as low as 10 kW (NY) to a high of 2 MW (NJ). An increasing number of states are adopting net metering caps as high as 1 or 2 MW.

Caution: All net metering and interconnection rules are not equal—although there is growing consensus on state-level best practices.[15]

New Jersey often is singled out as having best net metering rules and interconnection standards of any state in the country. As a result, New Jersey reports the highest rate of net metering enrollment in the U.S. Among the factors that distinguish New Jersey's efforts are the following:

INTERCONNECTION

- A streamlined and transparent application process with standardized and simple forms
- Elimination of unnecessary and expensive external disconnect switches without compromising safety
- Adoption of plug and play rules for residential-scale systems and expedited procedures for other systems
- Reasonable fees that are proportional to a project's size

NET METERING

- High size limits (2 MW) for net metered renewable energy systems to encourage larger distributed generation, explicit inclusion of large commercial customers as participants, and monthly banking of net excess generation at retail rates for a year
- No caps on system-wide aggregate net metering capacity
- A requirement for utilities to submit annual reports on net metering customers to facilitate evaluation of the effectiveness and impacts of these policies

CEG Recommendation:

Adopt effective interconnection standards.

All states should adopt interconnection requirements for radial grid situations that are appropriate to the real risks and hazards such interconnections create and that are simple and inexpensive to comply with. CEG strongly encourages all states to adopt the interconnection standards that have been vetted nationally through the IEEE 1547 review process.

The model interconnection standards developed by Interstate Renewable Energy Council (IREC) provide an easy way for states to implement effective programs for small generators, available for download at http://www.irecusa.org/fileadmin/user_upload/ConnectDocs/IC_Model.pdf[16]

States also should work with their major utilities to (a) develop a simplified online submittal process and set of forms for interconnection and (b) eliminate solar disconnect requirements for most solar installations (residential).

CEG Recommendation:

Expand net metering.

Net metering is often cited as one of the most significant means to advance solar PV use. The features of an effective and supportive net metering program are a streamlined application process, reduced unnecessary safety requirements, high system size limits, broad customer classes, monthly banking of excess generation, and no limit on total DG capacity.

CEG recommends that all net metering allowances be expanded to 2 MW, appropriate to support larger PV systems.

States should consider adopting IREC's model net-metering rules which were the basis for the programs in **New Jersey** and **Colorado**, considered to have the best net-metering policies in the nation. These rules are available at: http://www.irecusa.org/fileadmin/user_upload/ConnectDocs/NM_Model.pdf.

As PV programs mature, many states are adopting program requirements that are designed to ensure system performance. This trend is evaluated in the CESA/LBNL October 2006 Case Study, *Designing PV Incentive Programs to Promote Performance: A Review of Current Practice*. The case study notes that "[g]iven the relatively high cost of incentives required to stimulate the PV market, ensuring that PV systems perform well is an important issue in PV program design." The case study describes how states are increasingly establishing a variety of performance-based mandates for PV installations in order to achieve high performing systems. These mandates include system specifications, installer certification, installation rating, on-site inspections and metering, and reporting. The intent is to ensure that the public dollars invested in solar result in quality installations that generate the power promised and to protect consumers.

It is important to emphasize here, however, that these state funding program practices, although always well-intended, can have the effect of driving up installer costs. This conflicts directly with the state goal of building a PV market and driving down costs to improve system economics. Because one-half of the cost of PV installations is tied to local labor expenses, a potential drawback is that a program's performance requirements—designed to protect consumers against what are very occasional problems—will increase the time and cost associated with each installation and the business as a whole, keeping prices higher than needed.

In fact, there has not been much empirical evidence cited in research literature that indicates that installer problems are resulting in poor system performance. That is, the increasing concern by state solar programs with ensuring performance may be a solution in search of a problem. The research by Berkeley Lab appears to attribute such performance problems (when they occur) more often to equipment problems than installer errors.[17] And a more recent evaluation, by the California Energy Commission of a pilot performance-based incentive program, raises questions about the added value to the consumer of a PBI approach. Comparing the pilot program's participants to capacity-based incentive program participants, the CEC found that the capacity-based program participants have a high level of satisfaction with their systems' performance.[18] [19]

In light of these observations, CEG suggests that the goal of all state program designs should be to find a reasonable balance between administrative convenience, consumer protection, performance assurance and cost.

CEG Recommendation:

Engage actively with your state's PV industry and include them in discussions and deliberations.

In the survey of CESA members, many states indicated that they maintain relationships with their state solar energy association. However, while these associations are focused on educating consumers about solar technology, they often do not include PV contractors—a key market player who can assist state programs in ensuring effectiveness at driving down costs and building local markets.

Therefore, state programs should consider connecting with their state or regional chapter of the Solar Energy Industries Association (SEIA) as PV installers are often members. If there is not a state SEIA chapter, clean energy funds should consider support-

ing the creation of one. There is likely no group more knowledgeable about the costs and requirements of PV installations than installers, or more important to maintain a dialogue with.

For example, both the **Massachusetts** Renewable Energy Trust and the **Connecticut** Clean Energy Fund have worked closely with the Solar Energy Business Association of New England (SEBANE), providing support for analysis of regulatory and work force issues that influence the growth of PV markets. SEBANE, in turn, has testified in support of legislation that strengthens the state funds and the PV industry, as well as provided both formal and informal industry feedback on proposed policies and programs.

States also should meet regularly with installers to better understand local markets from the supplier's perspective. Program design and modifications should be sensitive to their real-world experience and concerns. They are likely as concerned about maintaining quality standards and cost-competitive, consumer-friendly service as state programs are. Their reputations and livelihoods depend on it.

CEG Recommendation:

Simplify program requirements and paperwork to make them easy to understand and use.

Today, electronic applications for project funding are extremely rare. States should try to move to electronic applications and tracking systems whenever possible.

For example, **California** implemented electronic tracking in August 2007 for the California Solar Initiative. Registered applicants can complete, submit, and track their applications on-line. See https://csi.powerclerk.com/Default.aspx.

State programs should avoid complex structures and formulas for determining the amount of incentives that individual customers are qualified for. This complicates the sales process by creating uncertainty at the very beginning about what a system is going to cost a customer. Income verification and testing also adds time to the application process, disrupting the sales process, and forces customers to overcome privacy issue concerns as part of the sales process.

States also should refrain from requiring the use of special program contracts and instead rely on the consumer protection provisions of general state laws governing contracts. States should recognize that every communication between a seller and prospective buyer is an opportunity to establish trust, confirm the seller understands a buyer's interests and concerns, demonstrate the seller's expertise, differentiate the seller from the competition, and close the sale. If there are set program-related seller obligations that need to be included as a condition for receiving state financial support, summarize them as terms and conditions that are attached to a contract proposal. Required contract terms and conditions should be written using clear language that is easy to understand and that does not require consultation with an attorney.

CEG Recommendation:

Strive for efficient program administration and rapid funding decisions and notifications.

State funds should implement rolling or continuous review of funding applications and provide rapid turnaround of incentive award decisions.

A majority of the states reported taking four weeks or more to notify applicants of incentive funding decisions. While setting fixed, periodic application deadlines (in contrast to rolling application reviews)

may make it easier for program administrators to review and compare multiple proposals, it creates uncertainty for project proponents and system suppliers. The longer a submitted application remains undecided, the more likely that the prospective solar buyer will back out of the deal, wasting the time invested by the installer to close the sale.

To address legitimate state concerns related to equitable and balanced distribution of program benefits among market participants, protections such as these can be employed as an alternative to fixed application deadlines:

- set specific allocations and commitments to targeted market sub-sectors (e.g. residential, non-profits, municipalities)
- place caps on individual project size
- set limits on number or dollar value of open projects that any one developer may have
- impose restrictions on the number or value of projects that a single host may have over a specified period
- establish timed release of funding to help ensure market continuity

CEG Recommendation:

Connect prospective buyers with qualified sellers.

States should create mechanisms for listing PV installers who want to be identified to consumers, either through state program web sites or perhaps through their affiliations with trade associations that have established a code of performance, even if it is voluntary.

For example, the **Massachusetts** Renewable Energy Trust partners with the SEBANE and the Northeast Sustainable Energy Association to identify qualified installers. At the Massachusetts Commonwealth Solar web site (http://masstech.org/solar/), links are offered to SEBANE and NESEA under "find an installer," as part of a set of tabs that explains to participants "How to Go Solar." SEBANE in turn has established performance standards that its members follow.

States can consider also entering into explicit agreements with listed contractors that specify conditions under which installers are able to access incentive funds for their customers. This allows states to use their leverage in project funding to investigate consumer complaints and to restrict participation by installers with recurrent problems. For example, in **Oregon**, there is a Solar Trade Ally Network established by the Energy Trust of Oregon. It includes 60 or more firms that have met the Energy Trust's participation requirements. Go to http://www.energytrust.org/TA/solar/index.html for detailed information on these requirements and application procedures.

And in **New York**, NYSERDA requires applications for incentives to be filed only by those PV installers who are enrolled in and are found eligible for the program pursuant to an RFP announcement. Installer eligibility is determined and maintained based on factors such as, but not limited to, acceptance of all program terms and conditions, responsiveness and adherence to program requirements, training, installation experience, documentation of experience, overall performance, monitoring, customer references, customer satisfaction, and commitment to become certified through a national certification program. Installer eligibility may be revoked at any time if an installer fails to meet all program requirements, terms or conditions. Go to: http://www.nyserda.org/funding/716PON.html.

States, however, should be cautious about requiring specific solar certifications for installers, beyond the necessary licensure requirements that protect public safety (e.g. as a contractor, electrician, or specialized solar contractor), and consider how such a requirement may affect the development of the local solar market. A few states do require certification by the North American Board of Certified Energy Professionals or "NABCEP," with both a written examination and minimum experience and training requirements.[20] This approach, however, can result in a situation where poor test takers who are knowledgeable installers drop out of the business and must be replaced. An alternative strategy is to accommodate new market entrants by providing a high level of initial scrutiny and subsequent spot inspections.

If a state is going to employ a certification standard, do not re-invent the wheel, but take advantage of the existing framework provided by NABCEP. States also should consider first establishing a transitional period of at least several years during which installers are allowed to demonstrate progress toward obtaining certification.

There is also a need to provide or recognize training standards at different skill levels than the one currently defined by the NABCEP certification. A team installing a residential solar project may only need to include one NABCEP certified installer and additional workers with solar installation training.

States should also avoid requiring licensed electricians to complete all phases of an installation when laborers may have the necessary skills for certain tasks. Such "electrician-only" policies will only increase the final system cost. Whenever possible, states should allow competition in the market to drive staffing decisions: an electrical contractor using only licensed employees may or may not have a quality advantage over an installation company that only uses licensed staff when appropriate and necessary.

CEG Recommendation:

Eliminate redundant inspections of completed PV installations.

Routine post-installation inspections are conducted by the majority of CESA state solar programs. However, because on-site inspections and approval generally require an installer's participation, they add costs to a project. When installed systems must also be inspected by a state program representative before grants are released, this adds to the time already needed for other inspections required by the interconnecting utility, the local electrical inspector, and the local building inspector. These multiple inspection requirements drive costs up or margins down, neither one being good for local markets. Given their established role in building code enforcement in most jurisdictions, states should consider arranging for local inspectors to ask the appropriate questions necessary to ascertain, with the support of photos and other installer documentation, that an installation addresses the concerns of both state funding agencies and utilities.

If states need to verify that individual listed installers and their installations are satisfying established program standards, spot or sample checking should be sufficient after an initial confirmation of work practices.

CEG Recommendation:

Require transferable equipment and system warranties.

All states mandate that manufacturers of solar equipment purchased with public funds, and the companies that install the systems, provide warranties to purchasers. However, these warranties

are not necessarily transferable to future owners when properties change hands. This is problematic for system buyers who want to try to recover a portion of their front-end costs by projecting the value the system will create for the new owner over its lifetime.

Given that module life should exceed 20 years and that original warranty terms of 20 years are offered for PV panels, "no cost" transferable warranties should be required by states for products and installers that participate in state incentive programs. Purchasers then would be assured that the value they are creating when a PV system is installed is protected and can be transferred to a future owner of their property.

CEG Recommendation:

Encourage and adopt uniform standards for equipment sizing, rating, and efficiency.

States are beginning to adopt simplified standards for equipment sizing and rating that enable purchasers to more readily compare the differences in electricity production that can be anticipated for different modules. This can result in higher levels of consumer confidence and better system performance. **California** has led the way, providing listings of eligible equipment with specific information about expected performance. **Connecticut** has adopted the California standards for systems that are installed with its incentives. CEG recommends that all states establish like standards, or incorporate California's standards, to move manufacturers to offer products that are readily comparable.

See http://www.consumerenergycenter.org/cgi-bin/eligible_pvmodules.cgi for the California Energy Commission's list of eligible PV for existing buildings.

One of the major questions that customers have when buying a PV system is whether or not it will actually generate the amount of electricity promised by the vendor. Providing the consumer with information on real world conditions is important. To that end, state programs should foster the use of improved capacity rating conventions based on the actual power output of a system under peak sun conditions. State programs should consider using the AC rating convention used by **California**. This AC rating is calculated from modules' rated output at PTC (PV USA Test Conditions) and the inverter ratings published by the California Energy Commission. Module ratings at PTC are generally a better representation of power output under peak sun conditions than nameplate ratings at Standard Testing Conditions (STC), and can be calculated in a relatively straightforward manner from manufacturer's data.

Through their programs, states can influence manufacturers to use PTC data, in conjunction with clearly labeling the square footage and providing a module PTC-watts-per-square-foot specification. This would provide a more useful comparative tool for consumers than a nameplate rating. It also would highlight manufacturers whose products perform better.

Recommended Equipment Ratings

Modules: All flat plate PV modules should be certified by a national recognized testing laboratory as meeting the requirements of and being listed in conformance to the UL Standard 1703 and any subsequent testing standard. All flat plate module ratings should be determined according to IEC 61215/ 61646. The factory measured maximum power of each module, and the lower bound of the manufacturer's stated tolerance range, as specified in UL 1703, should be no less than 95% of the Maximum Power reported to the state program.

Inverters: All inverters should be certified as meeting the requirements of UL 1741. Each model should be tested by a qualified National Recognized Test Laboratory to be eligible for the program. Performance ratings for each model should be determined according to the test protocol prepared by Sandia National Laboratories.

Capacity Rating: To be eligible for the state solar incentive, system components should be listed by the California Energy Commission as eligible equipment, and have module performance ratings labeled in watts/square foot on the equipment and on the specification sheets. All manufacturers should label their products with numbers that correspond to their performance under PTC conditions. All product data sheets should display the PTC ratings prominently so the end-buyer can make an informed purchase decision. PTC watts per square foot (total module size, frame included) should be the most prominent specification listed among the specifications and listed on the front page.

3. FOSTERING LONG-TERM PROJECT FINANCING

Until costs fall or market economics improve for PV, a lack of long-term project financing options impedes the sale of PV systems to consumers that can not pay for the high first costs. Although financing does not reduce the up-front cost, by spreading that cost over some portion of the system's life, financing certainly can make PV systems more affordable. While consumer loans, home equity loans, regular home improvement loans, and even credit card debt can be used to finance PV installations over time, the paybacks on PV systems generally fall well outside of the practical loan term for such instruments. This has led states to explore establishing or stimulating the creation of special solar loan programs that target homeowners, featuring low interest rates and/or no hassle application requirements.

CEG's survey of the states found that today very few states have PV-targeted long-term commercial financing available, either for retrofit installations or for new construction; equally rare are state-originated loans and manufacturer or installer financing. While a few state funds report having reduced interest rate programs for financing PV system installations that target specific audiences (e.g. government or non-profits), the great majority of state funds do not promote or support loan programs for PV outside of their own organizations, nor do they offer loan guarantees on solar loans by commercial banks.

The new home construction market, where owners and developers already are making significant debt commitments, poses additional opportunities and challenges for solar financing. On the one hand, the incremental cost of a PV system may be small, relative to the total cost of new construction. On the other hand, the owner or developer may not view this investment as the most attractive use of those incremental funds (either as an added inducement to buy for a spec house or as a perceived amenity compared to a fancier kitchen) or may even see the pre-installed system as an aesthetic detriment.

Various financing strategies, targeting either homebuyers or home builders, can be employed to encourage PV on new homes. One strategy is to work with banks to offer increased loan eligibility limits for buyers of homes with PV, assuming that the PV will decrease monthly utility costs. This approach has been attempted through the creation of energy efficient mortgages that include PV, but has generated limited interest to date. Other consumer financing strategies focus on reducing financing costs. One option is to use state public funding to offer low-interest loans for PV. However, this is not particularly well-suited to new construction, since it requires that the homebuyer take out a separate loan in addition to their mortgage. Another approach is interest rate buy-downs on the mortgage itself, although this may be a less-efficient use of public dollars than an equivalent buy-down incentive.

CEG Recommendation:

Consider emulating New York's interest rate reduction program for PV loans.

States should consider developing loan programs targeted to renewable energy. An effective loan program from the perspective of stimulating residential customer interest in solar installations has the following attributes:

- Long term: The loan should have a term of at least 10 years to reduce monthly payments to affordable levels.

- Low interest rate: For residential loans, the interest rate should fall below that on a 30-year mortgage.
- Low hassle and administrative fees: Applications, paperwork, and fees should be kept to a minimum, with quick loan approval.
- Unsecured: No debt service coverage requirements or lien on property should be required (other than the solar system being financed).[21]

New York State provides an example of an effective renewable energy loan program. NYSERDA created the New York Energy $mart[SM] Loan Program to provide interest rate reductions on loans for qualifying renewable energy projects below participating lenders' normal loan rates for terms up to 10 years. The reduction in most of the state is 400 basis points (4.0%). Residential borrowers can qualify for reduced rates on loans up to $20,000. The borrower must be approved for financing through a lending institution or leasing company that participates in the program. Go to http://www.nyserda.org/loanfund/ for more information.[22]

CEG Recommendation:

Enable PV generators to secure long-term power purchase agreements with utilities.

Although not yet used in the U.S., an effective mechanism to ensure long-term solar financing is a feed-in law. A feed-in law is a price-based policy that specifies the price to be paid for renewable energy. Feed-in laws guarantee a solar generator a guaranteed power sales price (i.e., a feed-in tariff), coupled with a purchase obligation by the electric utility. Feed-in laws are popular in many European countries as an effective way to stimulate expansion of the renewable energy sector, with impressive results in project deployment. A feed-in law can both stimulate the development of a local renewable industry as well as generate a large number of project installations.

A successful feed-in policy includes design features that eliminate risk to potential renewable investors, including long-term contracts, guaranteed buyers, and a price that offers a reasonable rate of return for the system owner. Feed-in laws reduce transaction costs and minimize any perceived risk, making investments and financing in solar projects very attractive to the investment community. A solar project that receives a long-term feed-in tariff agreement from a utility company can readily obtain loans that are secured by these agreements. CEG recommends that states consider the pros and cons of feed-in laws as a mechanism for ensuring long-term solar financing.

Criteria for a successful feed-in tariff program:

- Ensure the tariffs are high enough to cover costs and encourage development.
- Ensure regular adjustments of tariffs to track changes in technology costs.
- Guarantee tariffs for a sufficient time period to ensure a high enough rate of return.
- Eliminate barriers to grid connection.
- Establish tariffs according to each particular technology type with input from the renewables industry.

The **Ontario** Power Authority recently established a standard offer program for small electricity generators (capacity of less than 10 MW; 20 year contracts) in the Province, including solar PV, which may serve as a useful model for states for establishing an effective feed-in regime, simplified eligibility, and contracting rules. See http://www.powerauthority.on.ca/Page.asp?PageID=1224&SiteNodeID=245.

CEG Recommendation:

Establish a Renewable Energy Tax Credit Program.

Tax incentives have proven to be effective in encouraging private sector deployment of renewable energy resources, as is evidenced by the effect of the federal investment tax credit on the purchase of solar PV systems. Residential and commercial decisions to invest in PV can be directly influenced by investment tax incentives that reduce the effective up-front cost of the systems and increase demand for the technology. Several states have established investment tax incentives for customer-sited renewable energy applications, including **Arizona, California, Massachusetts, New York, Ohio, Oregon** and **Vermont**. Oregon's program is particularly comprehensive and effective and includes both a residential and business energy tax credit.

Under **Oregon**'s Residential Energy Tax Credit, homeowners and renters are eligible for a tax credit for purchase of premium efficiency appliances, heating and cooling systems, solar water and space heating systems, PV, wind, fuel cells, and alternative fuel vehicles. PV systems are eligible for $3 per peak watt with a maximum limit of $6,000, up to 50% of the installed cost. The amount claimed in any one tax year may not exceed $1500 or the taxpayer's state income tax liability, whichever is less. Unused credits may be carried forward for five years. See: www.governor.oregon.gov/ENERGY/CONS/RES/RETC.shtml.

Oregon's Business Energy Tax Credit is for investments in energy conservation, recycling, renewable energy, and less-polluting transportation fuels. Any Oregon business may qualify. The credit covers costs related directly to the project, including equipment, engineering, materials, and installation costs. The tax credit is 50% of the total cost, with a maximum credit of $10 million, taken over five years, 10% each year. Any unused credit can be carried forward up to eight years. The credit also is now extended to home builders who install renewable energy systems on the homes they construct, with a maximum credit of $9000 per single family home or $12,000 on a certified high-performance home. There also is a pass-through option by which a project owner may transfer the tax credit to a pass-through partner in return for a lump-sum cash payment (the net present value of the credit). See: www.governor.oregon.gov/ENERGY/CONS/BUS/BETC.shtml.

CEG Recommendation:

Support the use and expansion of 3rd party ownership models for PV project development.

Third party ownership is a PV business model in which another party—not the system user—owns the system and sells the power or use of the system back to the owner or user of the building where the PV system is installed. This is emerging as a powerful approach, since the 3rd party has access to low cost financing, greater ability to take on, understand, and mitigate technical risks, and can make use of all government incentives and tax advantages. It also reduces hassle and complexity for the end-user and provides better access to financing.

This business model is often primarily a "financial play," in which the host enters into a long-term power purchase agreement with the developer, and investors take advantage of investment tax credits and depreciation, while providing the long-term needed financing.[23]

The attraction of this "no money down" approach is that it moves the purchasing decision for the prospective customer out of the capital budgeting process and into the annual operational and utility

budgeting process. Further, both ownership and maintenance become the responsibility of a third party. However, to succeed, these projects often still require state incentives to offset high up-front costs. **California** and **New Jersey**, among other states, allow this ownership structure and business model to participate in their solar incentive programs. Other states may want to explore how they can support the expansion of this business model and other innovative business models, such as utility ownership of PV systems.

4. BUILDING CODES AND INSTALLATION STANDARDS

Local jurisdictions usually control what gets built and how. Solar installers report that inconsistent and inefficient local building codes and code enforcement create unnecessary expense, driving up costs.

Excessive regulatory requirements can be a problem. Solar installers also often face varying requirements in each jurisdiction which add costs to installations that could be avoided by a standardized approach and guidelines. These variations often are caused by lack of understanding of PV system issues or perceived risk by local officials.

Some of these problems can be attributed to the early workings of a market that is not yet familiar with the physical requirements and operating characteristics of a new solar product. However, states also are not providing the leadership needed to ensure that there are appropriate statewide standards and compliance codes for solar.

Most states lack uniform codes, standards, and enforcement mechanisms specific and suited to photovoltaic system installation. The treatment of PV systems by local code officials can be extremely inconsistent within a state, according to the CEG survey of state funds. For example, electrical permits are required in most states for system installations, and a building permit is also needed although most building codes have only general provisions that are not specifically written with the objective of evaluating PV systems.

Local concerns most often involve roof loading (weight and wind effects) and fire safety in the context of the National Electrical Code. Enforcement personnel often lack experience with—and appropriate training about—PV and must make independent determinations of what is a "proper" installation or be educated by installers.

Furthermore, permit fees are set locally and can vary widely for the same system within a state. Where PV system permit fees are seen as a potentially significant local source of revenue (and an indirect "luxury tax"), they can further increase the cost of systems. A 2007 study by the Sierra Club analyzed permit fees for PV systems in northern California.[24] It found that, for 3-kW residential systems costing $18,600 (after rebate), permit fees in California counties ranged from $0 to $1,298, or from 0% to 7% of the post-rebate system cost. Fees were computed using a variety of approaches—a flat fee method, a valuation-based method, or a combination. The valuation-based method was particularly problematic when it was based on total installed cost before rebates and when it increased as system size increases.

CEG Recommendation:

Establish state-level building and fire code provisions that specifically set electrical and structural safety performance requirements for PV system permitting.

None of the states indicate that they have a statewide model code that specifically governs PV installations and provides specific direction and guidance to local officials. Establishing and adopting such standards would improve the quality of installations, reduce installer uncertainty about expectations of local code officials, and save consumers money as best installation practices incorporate proven cost-saving approaches. These standards should include reasonable, standardized permit requirements for submitted construction plans and drawing submittals, and define those exceptional situations where a Professional Engineer (PE) stamp is necessary.

A good source of recommendations for reasonable and effective permitting and inspection of PV systems is the *Inspector Guidelines for PV Systems*, prepared for the Renewable Energy Technology Analysis Project of Pace Law School (March 2006). These guidelines address both the "plan check" stage where information is reviewed for accuracy and completeness and the "field inspection" stage where the installation is reviewed for compliance with approved plans. See www.irecusa.org/fileadmin/user_upload/NationalOutreachPubs/InspectorGuidelines-Version2.1.pdf.

CEG Recommendation:

Building codes should include a reasonable and uniform statewide fee structure for PV system building permits.

Local jurisdictions often impose different cost structures and approaches for permits for PV systems. However, the purpose of permit fees should be only to reimburse local government for the reasonable costs associated with permitting PV system installation and ensuring that systems conform to safe building practices. For example, **California** has established a requirement,[25] upheld by the California State Supreme Court, that fees for development projects must be based on the estimated reasonable costs of providing the services for which the fees are charged.

There is no reason why permit fees should vary with the cost of the system, as is the case in some jurisdictions. A reasonable flat fee should be established that adds more certainty and does not unnecessarily raise the cost of systems. CEG recommends that all jurisdictions use the cost-based flat fee method to assess permit fees that reflects the similar time required to permit both small and large residential PV systems. The Sierra Club suggests fees of $300 or less for flush mounted residential PV systems.

The Pace Law School provides useful recommendations for developing a local permit cost structure for PV systems in its *Inspector Guidelines for PV Systems*: Costs for permits are often based on overall project cost. This works well for many conventional projects because this accurately represents the scale of the project. However, with a PV installation, the equipment costs are much higher than with other projects of similar scope. It is recommended that an alternative permit fee scale be used for PV system installations. The scope of a PV installation is similar to that of installing a retrofitted residential HVAC system. The permitting costs for a PV system should be similar to those for an HVAC system. A subdivision of more than 10 units should be considered for an additional fee reduction based on the repetitive nature of the reviews.

A suggested fee schedule is:

- Small PV systems (up to 4 kW): $75–$200
- Large PV systems (up to 10 kW): $150–$400

CEG Recommendation:

Provide training for local code officials on PV system requirements and the National Electrical Code.

Many states have sponsored PV installation training using resources provided by the U.S. Department of Energy and IREC. While the target audience for training often has been installers, local code officials also have been welcome. As states adopt more comprehensive PV installation standards, the training of local enforcement officials will become more important.

IREC is now offering code official training that specifically targets code officials to states that want to sponsor such training.

CEG Recommendation:

Collaborate with statewide organizations, associations, trade groups, and municipalities to improve local PV permitting practices.

Only half of the states surveyed said they promote and share PV permitting best practices among municipalities, and then only informally and in the context of voluntary training.

Installers are probably the best source of information about permitting issues. States may want to identify local jurisdictions where inspections and permitting are problematic to target training activity. They also may be able to identify and highlight locales where permitting is most effective.

States should work with municipalities to implement the following consistent and streamlined processes for permits and inspections:

- Solar residential permits should be issued "over the counter," especially for installations that meet standard weight and roofing criteria.
- Municipalities should adopt sections of the most recent National Electric Code (NEC) that affects PV systems, such as article 690.
- Municipalities should accept manufacturers' specification cut-sheets for major system components as sufficient for purposes of evaluating system components for permit issuance and require no more than two drawings for residential solar permits: (1) a schematic of the electrical system with wire and conduit types and sizes shown, and (2) a roof drawing showing the location of the solar modules relative to the entire roof surface with attachment points, rafter size, and spacing specified.
- Municipalities should not require PE stamps to address typical structural issues for flush-mounted rooftop systems, except for excessive wind zones or unique structural issues.

A city with an exemplary solar permit program is Mill Valley, CA. Residents enjoy an "over-the-counter" permit that costs only $3.29 to file. Mill Valley's permit application form is a simple, two-page document that details the size of a customer's home and expected solar production. The form can be filed by a contractor, architect or "builder-owner" who completed a 30-minute site inspection. See http://www.cityofmillvalley.org.

CEG Recommendation:

Work with utilities and code officials to establish procedures that minimize the need for multiple inspections of completed PV projects.

Another significant project cost for installers is the number of individual inspections required to get an installed system on line. In some states, a PV project receiving public funding support may require as many as four independent inspections prior to being cleared to operate—from a building inspector, electrical

inspector, utility inspector, and a clean energy fund inspector. Each inspection can require the installer to revisit the project site, further driving up the total cost of an installation.

State solar programs should take the lead in consolidating and simplifying the inspection requirements in their states, identifying information that is really necessary to satisfy different jurisdictions and promoting procedures that minimize redundant inspections and unnecessary expense for installers.

Local code officials are likely the best vehicle for integrating inspection requirements. States also should promote the goal of eliminating inspections by allowing experienced, high quality installers to self-inspect and commission their systems through a Permit by Rule process similar to what is used for water heater and pool equipment installations.

5. TAX TREATMENT OF PV

A state's sales tax and property tax policies are both powerful and highly flexible tools that can be used to encourage or discourage solar technologies—either limiting a PV system's first and lifecycle costs or further escalating those costs. Sales taxes on equipment and property taxes can be significant for solar energy technologies because these systems are capital intensive. There are a number of tax policy design issues that deserve attention by states to encourage solar PV growth.

Sales tax reductions or exemptions allow consumers to avoid paying up to 100% of the sales tax for the purchase of solar energy-related equipment. Less common than tax reductions, tax rebates are refunds of a specific share of a sales tax. About one-half of the CESA states have sales tax exemptions for residential solar PV systems, and a few states offer exemptions for commercial systems.

Property tax reductions can eliminate up to 100% of the property taxes on fixed assets (and land) used by the solar PV facility. The majority of CESA states allow exemptions of residential and commercial PV systems from local property tax. However, only a portion of the states mandate it, with the remainder leaving it to the discretion of local tax assessors. Some of these property tax exemptions have conditions that limit their value such as only applying to the homeowner that originally installed the equipment (**California**) or only if the system is owned by the host property's owner, but not by a third party (**Oregon**). The other CESA states are silent on the question of property tax and allow them to be assessed and taxed like any other property improvement.

Where a property tax is imposed on a PV system, this further complicates the purchase decisions as the seller must determine the local tax policy prior to performing his cost/benefit analysis, find out what the applicable tax rate is in the particular locality, and estimate the assessed value of the system. This is particularly significant with larger commercial scale installations.

CEG Recommendation:

Exempt all PV systems from state and local sales taxes.

If sales tax exemptions are not possible under state law, restrict the tax basis for PV systems to the cost of equipment only.

CEG Recommendation:

Exempt all PV systems from property taxes.

In states where property taxes waivers are allowed for PV systems under law, advocate for statutory revisions that require such waivers without any local discretion. **Minnesota** provides an example of effective tax policy that supports solar PV deployment. The state offers both property and sales tax exemptions for all PV systems.

For more information go to http://www.state.mn.us/mn/externalDocs/Commerce/Solar_Electric_Rebate_Program_110802025911_RebateInstructions.pdf.

6. STATE CONSTRUCTION POLICIES AND PRACTICES

States should seek to encourage high-value applications for which PV technology is particularly well-suited and more cost effective: public buildings, schools, new home construction, etc.

Fostering the use of solar technology on public buildings has great merit for states for several reasons. Such solar applications help to educate officials and the public about the benefits of the technology, provide the technology with high visibility, and offer economies of scale, reducing solar costs due to the larger size of most public buildings.

State funds already are used in almost all local and state building projects, including public housing, schools, municipal buildings, fire and police stations, public colleges and universities, correctional facilities, and the broad range of office buildings and special purpose structures that are required by state government operations. Incorporating PV installations in the projects will reduce life-cycle energy costs for these public buildings, saving tax payer dollars over the long term. States also administer federal resources targeted at public housing, including housing tax credits, and are positioned to impose renewable energy-driven construction standards in making awards for the allocation and use of these limited resources.

While two-thirds of CESA states reported having funded state building projects to incorporate PV systems, this is not pursuant to formal state policies to deploy PV on state-funded buildings. In fact, consideration of PV installation generally is not mandated for state-funded projects in most CESA states, the exceptions being **California** and recently **Massachusetts** and **Oregon**. Nor is PV installation even recommended in most states for public buildings.

While a number of states report having special financial resources that are available to assist incorporation of PV systems in public buildings, no states reported that they had technical support available for siting and design of these systems.

Most CESA states do indicate that public schools have been a target for PV installations. Several states, including **Massachusetts** and **New York**, have provided elevated incentives to public schools for installation of PV systems. Often, recipient schools are required to use the PV system as an education tool by incorporating it in the curriculum.

CEG Recommendation:

Require that PV system installation be considered and evaluated for all major public building construction.

States should lead by example in employing solar technology on state buildings. States can demonstrate their confidence in solar technology and strengthen the PV market by adopting policies that mandate the inclusion of PV systems as appropriate given site conditions for all publicly-funding building projects that involve major renovations or new construction using state funds. The additional expense for a PV system installation often will be very small in the context of a project's total design and construction cost. Further, because these buildings will likely be occupied and used for a public purpose for the life of the system, a life cycle analysis of costs and savings should justify the additional expense.

Several states provide good approaches to fostering solar on public buildings.

Oregon's recent legislation enacted in June 2007, introduced a unique requirement for installing solar energy systems on public buildings. It requires that all public building projects include solar technologies in an amount determined by the total building cost. The solar technology investment must amount to at least 1.5% of the total contract price. The solar energy system can either be a solar electric or thermal system, and can also include passive solar if it will achieve an energy consumption reduction of at least 20%.

The policy also applies to major renovation projects if the cost of the renovation exceeds 50% of the total value of the building. Before entering into a public improvement contract, a contracting agency must prepare a written determination of whether a solar energy system is appropriate for the building. If the agency determines that solar technology is not appropriate for a particular project, they must reserve the 1.5% of the project cost to install solar technology on a future building project. These reserved funds then will be coupled with the 1.5% of the future project's cost that must be set aside for solar technologies. See: http://www.leg.state.or.us/07reg/measpdf/hb2600.dir/hb2620.intro.pdf.

In **California**, Assembly Bill 532, signed into law in October 2007, extends a state requirement that solar energy equipment be installed by January 1, 2009 on any public building or facility, new or existing, where such an installation is determined to be cost-effective over the life of the system, and funding is available.

CEG Recommendation:

Require and provide support for the installation of renewable energy systems and PV as part of major public school construction projects.

Installation of renewable energy systems in schools provides high demonstration value and an important teaching tool that offers students the opportunity to see first hand how renewable energy can supply our every day electricity needs.

New York State has been a leader in targeting the installation of PV systems on public schools. NYSERDA's *School Power Naturally* program installed 2 kW systems in 2003 on 50 local schools selected through a competitive process. Under the $2.1 million program, each of the 50 schools received a solar energy and data collection system, worth about $24,000, for a school contribution of $1,500, or over 90% of the cost to the school. Curriculum materials for different grade levels were developed and are available to schools across the state. Go to: http://www.powernaturally.org/programs/SchoolPowerNaturally/default.asp?i=9.

Connecticut kicked off its own schools initiative in October 2006, called the *High Performance Schools Program* (HPSP), with a budget of $1,375,000.

Its goal is to change how Connecticut's schools are designed and built and to move towns to include energy efficiency features and clean distributed energy generation as standard components in newly constructed schools and major renovation projects. The program includes outreach and early intervention with key decision-makers including architects, school boards, and facility managers; education of a range of stakeholders concerning the benefits of high performance design, construction and operation; technical assistance for a number of targeted communities; and preparation of case studies on selected high performance schools.

The program dovetails with existing **Connecticut** Clean Energy Fund (CCEF) initiatives. CCEF will seek to leverage its funding with grants offered by the Connecticut Department of Education, the Connecticut Energy Efficiency Fund and other available incentives. More information can be found at http://www.ctcleanenergy.com/about/about.php.

CEG Recommendation:

Avoid using Societal Benefits Charge funds earmarked for renewable projects to support public PV projects when other funding sources (e.g. bonds) can be tapped.

To conserve state solar incentive funding, where capital project funding is available and being used for new construction and major renovations, states should consider using that same funding source for the PV system, integrating it into the building design and capital budget in the same way that heating systems, air conditioning, and building management systems are included.

CEG Recommendation:

Lobby for inclusion of PV requirements in the state Qualified Allocation Plan that governs awards of federal low income tax credits.

Working with state housing agencies, clean energy funds and PV advocates can promote the use of PV in affordable multifamily housing projects. Tax credit allocations to investors drive the construction of multi-family housing projects. State housing agencies have the responsibility and authority under state and federal laws to establish criteria in their Qualified Allocation Plans (governing the award of housing tax credits) for new construction projects that further other state policies such as advancing efficiency and renewable energy. States can revise these criteria to evaluate housing development proposals and award tax credits to competing projects to reward use of solar technology.

State funds also can commit a portion of their solar incentives to multi-family housing to make PV investment in affordable rental housing feasible. For example, in **New Jersey**, the SUNLIT Program (for 'Solar Underwriting for Low Income Tax Credits'), operated by the New Jersey Housing and Mortgage Finance Agency, provides technical assistance and financial support to projects that seek to include PV systems in low income housing projects. This PV program is supported by funds from New Jersey's Clean Energy Fund. See http://www.newjersey.gov/dca/hmfa/biz/devel/gho/pdf/FINAL%20Sunlit%20Guidelines.pdf.

See also a 2006 Clean Energy State Program Guide, *Strategies to Support Solar Energy and Advanced Energy Efficiency in Affordable Multi-Family Housing*, at http://www.cleanenergystates.org/CaseStudies/CEG_Peregrine_PV_Multifamily_2006.pdf.

7. TRAINING

A specialized, qualified workforce is necessary to meet growing demand for PV systems. An ample supply of installers and an increasing number of installation companies will create competition for customers that can help drive prices downward and quality installation and services upward.

Today, consistent with the common goal of building installer networks, most CESA states offer training to installers. Training efforts consist of both one-day trainings on special issues and formal technical courses through trade schools or community colleges. Training targets in most states also include local code officials and inspectors. Some states also target builders and architects. In a few states, training is provided to utility personnel on proper PV installation and inspection, although more often this training is provided by the utility company.

While it is likely that on-the-job training will address some of the need for new labor, there is a need also for more formal technical classes and programs that focus on preparing additional tradespeople to work in the PV industry with an understanding of the electrical, structural, and siting requirements and operating characteristics of PV systems. Ongoing one-day refresher classes and special trainings may encourage practitioners in related industries (e.g. electricians, building contractors) to expand their offerings to include PV installation.

CEG Recommendation:

Establish training programs at local technical colleges for would-be PV practitioners.

States should actively support the creation of formal training programs to bring new qualified workers into solar markets, integrating PV-related training into other related trade and technical education. States also should work with local educators (community colleges, adult education centers, trade schools) to define curriculum and certification programs for occupations unique to the solar industry.

New York has been a leader in the integration of PV courses and certifications into school programs at the secondary school level and in its state colleges. NYSERDA provides funding to New York technical schools, colleges, and continuing education programs to develop and implement nationally accredited training programs to train PV installers. Funding is being provided for accreditation at three levels: instructors, training organizations or institutions, and continuing education providers. To date, NYSERDA has invested nearly $1,000,000 in developing ten nationally accredited training centers and continuing education programs across the state. Find more information on this initiative at http://www.powernaturally.org/Programs/Solar/educationtraining.asp?i=1.

CEG Recommendation:

Offer, sponsor, and support PV training for PV installers, the related building trades, and code enforcement officials

States should make every effort to take advantage of periodic course offerings by IREC and the U.S. Department of Energy that bring nationally-known PV specialists before local audiences. IREC has been instrumental in helping to bring these trainings to the states. Go to http://www.irecusa.org/ for more information about specific training programs and resources for states.

CEG Recommendation:

Encourage creation of internship and apprenticeship opportunities with PV installation companies.

Installation companies are always looking for new enthusiastic helper; would-be installers are always seeking on-the-job experience.

In **Massachusetts**, when SEBANE put out a call to members for internship opportunities, 25 places were identified within 12 companies in just two days. Positions ranged from seasonal to year round opportunities for interns and apprentices. SEBANE connects these companies to students and graduates of training programs at local technical colleges.

8. MARKETING AND EDUCATION

For most consumers, PV technology is still relatively new, unproven and expensive. Therefore, there is a need for states to stimulate PV marketing activities by reaching out to understand the interests and needs of potential purchasers, by listening to sellers' experiences, and by using public resources to impartially respond to consumer questions and concerns and validate the technology.

State efforts to help educate and stimulate prospective purchasers can help drive down sales costs. The most common outreach mechanism employed by states is web-based and printed "how-to" information and installer listings. The majority of states also support state or local solar energy associations, which have their own consumer education goals and activities. All the CESA states indicate that they have relationships with these solar energy associations. States also work with and provide training materials to associations of builders, state and local architectural societies, electrical contractor unions and associations, and financial institutions.

A few CESA states even sponsor advertising campaigns, and there is some co-marketing with PV installers. Many states sponsor or participate in "Solar Days" when local systems can be visited and solar system purchasers can speak about their motivations, expectations, and satisfaction.

CEG Recommendation:

Establish explicit marketing objectives.

To be successful, it is important to develop state marketing strategies that are based on specific research to identify the messages that will be most effective in making consumers interested in purchasing solar energy. Solar "messages" often will be different depending on the state and media market so it is important to perform messaging and marketing research at the outset.

States also should lay out clear marketing objectives for what they hope to accomplish and over what period of time. Is the objective to maximize the number of PV megawatts installed as quickly as possible? Is it to establish a broad and diverse demonstration of the applicability of the technology in different market sectors (public buildings, new home subdivisions, non-residential sector, multi-family housing)? Is it to set the stage for steady growth of system implementation by developing and solidifying necessary infrastructure elements? Is it to gain awareness for the state clean energy program? Is it some combination of these objectives? Marketing efforts should be designed to meet the program's specific solar deployment goals.

Further, state marketing efforts should be integrated with existing programmatic efforts. This will ensure that necessary incentive resources and technical services are available to motivate action by the targeted audiences. And it will provide consumers with a specific and achievable "clean energy action" that consumers can take.

CEG Recommendation:

Understand what motivates specific markets and develop outreach targeted to the specific sectors.

In considering outreach strategies, states should recognize that there are many different PV market segments, each driven by different motivations, governed by different economic and other constraints, and best reached through different approaches. A useful first step is to differentiate between the diverse non-residential markets where systems as large as 500 kW can be installed and residential markets where system size will usually be 5 kW or smaller.

The non-residential market for PV is actually many different markets:

- larger commercial and industrial customers that can make use of federal tax incentives, but which have strict hurdles for rates of return
- other similar large customers who may be willing to set aside these hurdles for a project that contributes to its "green" branding efforts
- institutions, like colleges, universities, and even hospitals, that may be driven by concerns about climate change and sustainability and a need to demonstrate to stakeholders that they understand the importance of clean energy and can afford to take a long, life cycle perspective on investment
- state government agencies that want to demonstrate leadership and are building for the long term, using bond funding
- local government and public schools which both reflect and form the values of residents, through demonstration and education

Reaching each of these sectors involves networking through existing market channels, partnering with other organizations, arranging for group and individual meetings, and other targeted outreach efforts.

The residential PV market is quite distinct from commercial PV markets. While the theoretical market size is quite large, individual residential projects are small so the cost of sales is a higher percentage of total cost. In addition to finding interested consumers and qualifying every residential prospect's ability to pay, installers must qualify each and every site as suitable for a PV installation. States can assist installer efforts by supporting cooperative marketing events that attract and assist potential buyers to address their concerns and increase their understanding of solar's merits.

CEG Recommendation:

Support and collaborate with solar and other related building trade and professional associations.

These organizations will provide insights into market trends and issues as well as avenues to piggyback PV onto other activities and initiatives. It is important to realize that PV today is sold "on the ground." While web-based information and printed "how to" brochures are useful, the real sale of solar takes place as the result of person-to-person activities and persuasion. This is best accomplished through effective collaboration with a broad group of solar stakeholders.

CEG Recommendation:

Engage marketing professionals to design and implement PV marketing strategies.

Marketing is an unfamiliar concept for many state agencies. For example, it is not simply "public relations" although it may include some PR work. Because marketing is not a core competency of state clean energy programs, states may want to commit funds to a formal, organized marketing campaign supported by qualified marketing professionals.

For example, efforts in **Arizona** to promote solar technology demonstrate how a professionally supported effort could work. Arizona Public Service Company (APS) established incentive programs in 2006 to stimulate sales of solar energy systems. The company contracted with SmartPower (www.smartpower.org) to help develop a customer base for these programs, focusing on education, awareness, messaging, promotion, and collaboration. The goal is to create a more robust market for the programs in the APS service territory, position APS as an environmentally concerned company investing in sound energy choices for the future, and stimulate program participation by APS customers.

CEG Recommendation:

Never lose sight of the value of ongoing public education and market building: make visibility of systems and data sharing a criterion for state support.

Many states require recipients of incentives to make their projects accessible for education and promotional purposes. CEG recommends that states take this philosophy a few steps further with the following efforts:

- For larger installations at public institutions, including schools, hospitals, and public buildings, suggest that they set aside space and install publicly accessible kiosks or displays that provide real-time and cumulative information on PV generation, as well as educational material.
- For business installations, recommend that lobby space be dedicated to providing employees with information about system production and renewable energy technology. A data acquisition system, often already included in the system design, can be enhanced to support this educational objective.
- Map all installations supported and provide listings and tools that can be used to support informal or formal solar tours.
- Provide web-based access to project descriptions, as well as production information generated by supported systems.

Conclusion

If states are to build mature solar markets and achieve widespread adoption of PV technology, states must act to address the real barriers: high up-front costs, lack of easy financing, unfriendly interconnection and permitting requirements, lack of local installer and supplier channels, and lack of strong public demand for the technology. The recommendations offered in this report are intended to provide approaches and program strategies that states can employ to help the solar industry reach its potential. Our recommendations, while not exhaustive, are based on best practices being used by states today. Our major goal is to stimulate additional innovation and discussion by states and solar stake-holders to ensure more effective efforts to grow solar markets in the U.S. and to make PV more economical for consumers.

PV Market Infrastructure Survey of Clean Energy States

STATE-BY-STATE: CURRENT ACTIVITIES AND ADDITIONAL NEEDS

The following tables provide a state-by-state summary of activities that individual CESA states have taken to promote and support the growth of PV markets and installations, as reported in a Clean Energy Group/Peregrine Energy Group survey that they completed in mid-2007. In addition, it includes the responses to a free form question where CEG asked states to identify the most important things that could be done locally to strengthen their PV markets today.

California	What They are Doing Today	What They Say They Need
Formal Goal: 3000 MW of PV within next 10 years **Vision for PV:** **2 years** Increased public awareness **5 years** More financial options and lower govt. subsidies **10 year** Sustained growth without subsidies	**State funding:** Performance-based incentives only **Program guidelines:** PV system warranties must be transferable to future owners **Financing:** Gov't & non-profits only, cost effectiveness may be applicable **Building codes / standards:** • Requires building permit, electrical permit, building code compliance inspection, and utility inspection • No statewide PV standards • Local inspections focus on safety issues and electrical requirements • No state-sponsored best practices promotion or information sharing **Statutes / regulations:** • CA PUC has established simplified interconnection standards for small systems, though they vary utility to utility; munis will soon be required to comply as well • Net metering is available for PV systems up to 1 MW • There is an RPS; no solar carve out • Time of use rates are in place to monetize special value of PV during peak periods • Feed in tariffs available on a limited basis **Tax treatment for PV:** • Property tax exemption for "new constructed" systems only applies to original owner • No sales tax exemption **Construction policies:** • PV consideration mandated for state funded projects • PV is installed where economical in state funded projects • PV has been earmarked for schools but higher incentive funding has been used up **Training and certification:** • One-day focused installer trainings and technical courses on PV offered • Qualified installers are listed • Training for code officials offered • CEC will provide training for builders • Utilities train their own inspectors **Marketing activities:** • Include how-to literature, advertising campaigns, Solar Days, web-listings of installers, support to solar associations • Add'l relationships with financial institutions, builders associations ("New Solar Homes Partnership")	• Improve financing structures; • Increase public awareness; • Encourage comparison shopping to reduce prices.

Connecticut	What They are Doing Today	What They Say They Need
Formal Goal: No installed capacity goals **Vision for PV:** **2 years** 3 MW small (<10kW) customer sited PV installed **5 years** Quadruple install rates; reduce dependency on incentives **10 years** A viable industry capable of sustainable operation without subsidies	**State funding:** Performance-based incentives only **Program guidelines:** • Electronic application process results in quicker funding decisions • Some targeting of low-income installs **Financing:** Attempting to create a loan program outside of CCEF for PV **Building codes / standards:** • Requires building permit, electrical permit, building code compliance inspection, and utility inspection • Streamlined standards by 1/1/08 • Separate state inspection for state-financed installation • No statewide PV standards; local inspectors use NEC • No state-sponsored best practices promotion or info sharing **Statutes / regulations:** • Each of the major utilities has established its own interconnection rules • Net metering is available for PV systems up to 2 MW • The is an RPS; no solar carve out • Time of use rates are in place to monetize special value of PV during peak periods **Tax treatment for PV:** • Residential PV exempted from local property tax; commercial systems exempt at discretion of local authorities • PV is exempt from sales tax **Construction policies:** • A few schools have incorporated PV, but no mandate for consideration or special funding • No PV consideration mandated in state-funded construction **Training and certification:** • One-day focused installer trainings • Qualified installers are listed • Training for code officials offered **Marketing activities:** • Web-based how-to literature and installer listings, Solar Days, support to solar associations, support to trade associations • Also, relationships with realtors	• Require consideration of PV on all new and renovated state-owned or state-subsidized buildings; • Reduce utility barriers to interconnection; • Reduce financial barriers to first costs • Add more installers

Illinois	What They are Doing Today	What They Say They Need
Formal Goal: "No formalized state PV initiative exists"	**State funding:** Capacity-based incentives only **Program guidelines:** Long waiting period for award decisions **Financing:** No PV financing programs **Building codes / standards:** • Requires electrical permit, electrical code compliance inspection • Some jurisdictions also require building permit • No statewide PV standards • No state-sponsored best practices promotion or info sharing **Statutes / regulations:** • No state PV interconnection standards • ComEd has attempted to streamline small system interconnection • Net metering for systems up to 40 kW • No RPS • Time of use rates in place monetize special value of PV during peak period **Tax treatment for PV:** • No PV property tax exemption • No PV sales tax exemption **Construction policies:** • There are special financial resources to assist with PV in state funded buildings, but no PV consideration is mandated in state-funded construction • PV system installation is encouraged and supported in public schools **Training and certification:** • Formal technical courses in PV available • No one-day installer trainings • No training offered for code officials, builders **Marketing activities:** Annual Renewable Energy Fair, support to solar associations	• Statewide interconnection standards • Long term state support to prevent raids on renewable energy funds • Net metering • RPS with solar set-aside Note: SB680 passed the IL House and Senate and is awaiting Governor Blagojevich's signature. This bill, if signed, will require net metering for DG up to 2MW and the Illinois Commerce Commission will have to establish interconnection standards based on industry best practices within 120 days of the Governor signing the legislation.

Massachusetts	What They are Doing Today	What They Say They Need
Formal Goal: 250 MW by 2017 **Vision for PV:** **2 years** Sustained moderate growth; improved installer base and training; reduced regulatory barriers **5 years** Begin consideration of phasing out PV subsidy **10 years** Phase out of subsidy gains momentum; prepared for rapid PV market growth	**State funding:** • Capacity-based incentives only • Incentive adders for in-state manufactured equipment **Program guidelines:** • Warranties required but not transferable • Special incentives for PV in green affordable housing **Financing:** Market rate loans for PV available **Building codes / standards:** • Typically requires building permit, electrical permit, electrical code compliance inspection, building code compliance inspection • Also separate utility inspection • State inspection often required for state financed installations • State encourages SNL suggested practices for permitting statewide • State promotes best practices **Statutes / regulations:** • Statewide PV interconnection standards • Streamlined small PV interconnection • Net metering for systems up to 60 kW • RPS, but no solar carve out • Time of use rates in place monetize special value of PV during peak periods **Tax treatment for PV:** • All PV exempt from property tax • Residential PV sales tax exemption • Commercial PV excise tax exemption **Construction policies:** • Consideration of on-site renewable energy mandated in state buildings • Special financial resources available to assist with PV in state funded buildings • PV system installation is encouraged and supported in public schools **Training and certification:** • One-day special trainings offered; formal technical courses in PV available • "Qualified" installers listed for consumer information and exploring NABCEP certification • Training offered for code officials and utilities through solar trade association **Marketing activities:** • Distributes how-to literature in print and via web, web-based installer listing, advertising campaigns, Solar Days, support to solar associations and trade associations • Add'l relationships with architectural societies, financial institutions, builders associations, electrical contractor associations	• More focus on leveraging out of state funding • More funding • More training • Better understanding of solar finance by all

Minnesota	What They are Doing Today	What They Say They Need
Formal Goal: None at this time **Vision for PV:** **2 years** 1200kW of installed PV capacity by 2009 **5 years** PV feed-in tariff; stable PV market that rewards high quality installs; growing base of installers; broad distribution of installed systems **10 years** More affordable PV for a larger segment of population; standardized PV interconnection processes; new buildings PV ready	**State funding:** Capacity-based incentives only **Program guidelines:** Warranties required but not transferable **Financing:** None available at this time **Building codes / standards:** • Requires electrical permit, electrical code compliance inspection, and also separate utility inspection • No statewide PV standards or codes • Counties each have own processes to ensure compliance with general codes **Statutes / regulations:** • Statewide PV interconnection standards • Net metering for systems up to 40 kW • RPS, but no solar carve out • No time of use rates are in place **Tax treatment for PV:** • All PV exempt from property tax • All PV exempt from sales tax **Construction policies:** • PV system installation is encouraged and supported in public schools. Schools are eligible for PV rebate program **Training and certification:** • One-day special trainings offered • NAPCEP training program is under development **Marketing activities:** Web-based how-to literature and web-based installer listing, Solar Days, support to solar associations	• PV-specific feed-in tariff • Incentives for systems installed by NABCEP-certified installers • Coordination with counties, municipalities, utilities on permitting and inspection processes and fees, as well as on net metering and interconnection

New Jersey	What They are Doing Today	What They Say They Need
Formal Goal: ~2300 MW by 2020 (2.12% of retail sales) **Vision for PV:** **2 years** 90 MW installed **5 years** 450 MW installed; market no longer needs rebates **10 years** 1000 MW installed; phase out of RECs being discussed	**State funding:** • Capacity-based incentives only • In-state manufactured equipment adder **Program guidelines:** Warranties required to be transferable to future system owners **Financing:** Long term commercial financing for PV retrofits **Building codes / standards:** • Requires building and electrical permits, building code compliance and electrical code compliance inspections • Also separate utility inspection • Also state inspection for state-financed installations • No uniform statewide PV codes; home rule state • Promoting best practices and training is planned **Statutes / regulations:** • Statewide PV interconnection standards • Streamlined small PV interconnection • Net metering up to 2 MW aggregate, not to exceed annual electric meter reading • RPS has a solar carve out ("market is booming with 100%+ annual growth") • No time of use rates are in place **Tax treatment for PV:** • All PV exempt from property tax at local option • All PV exempt from sales tax **Construction policies:** • Special financing available for PV in state-funded buildings • PV system installation is encouraged and supported in public schools and rebates higher for public sector **Training and certification:** • One-day special trainings offered; also formal technical courses • Installer certification and listing • Code official training be offered with IREC; also builder and architect training **Marketing activities:** • Print and web-based how-to literature , advertising campaigns, co-marketing with installers, web-based installer listing • Additional relationships with architectural societies, electrical contractor assns., environmental organizations, ratepayer advocates	• Reduce rebates • Delist poor installers • Limit residential applications to 5 kW unless proven energy efficient

New Mexico	What They are Doing Today	What They Say They Need
Formal Goal: No installed capacity goals **Vision for PV:** **2 years** Largest PV system installed increases from 25 kW to 1 MW **5 years** State solar tax credit program fully subscribed at $3 million per year **10 years** Incentives for CO_2 reduction, not system capacity, because cost parity with utility power achieved	**State funding:** • Capacity-based incentives • Renewable Energy Tax Credit offers 2.7 cents/kWh for large-scale solar **Utility funding:** • Performance-based incentives offered by largest utility **Financing:** • Clean Energy Revenue Bond for state agencies and public schools • Public Facility Energy Efficiency Act for energy performance contracting in state agencies, municipalities, and public schools. **Building codes / standards:** • "Solar-ready" construction required for new homes • Requires electrical permit and electrical code compliance inspection • Also separate utility inspection • No uniform statewide PV codes • Promote best practices of inspectors through state-coordinated training **Statutes / regulations:** • Renewable Energy Transmission Authority created • Statewide PV interconnection standards currently being developed • Streamlined small PV interconnection • Net metering unlimited except by FERC 80 MW interconnection limit • RPS has a solar carve out **Tax treatment for PV:** • 30% personal income tax credit for PV • PV not exempt from property tax • All PV exempt from sales tax for residential and business installations **Construction policies:** • PV system installation is supported in new state agency facilities where USGBC LEED silver with 50% energy reduction is required • Development of *Zero Energy Homes* which supports PV installation and energy efficiency **Training and certification:** • One-day special trainings offered; also formal technical courses • Targeted training for code officials and installers **Marketing activities:** • Advertising campaigns • Relationships with architectural societies, realtors, builders assns., local code official associations, solar industry associations, state agencies, public schools	• State corporate income tax credit • Transmission facilities to deliver renewable energy to other power markets • Regional trading mechanism for greenhouse gas emissions • Expansion of solar industry • Uptake of solar in new homes marketed by developers and builders • Expansion of solar incentives offered by utilities • Utilities using solar to meet portion of RPS requirements

New York	What They are Doing Today	What They Say They Need
Formal Goal: No installed capacity goals for PV **Vision for PV:** **2 years** Continue to build a strong installer base **5 years** Installer businesses become viable integrated companies; local & institutional decision making becomes routine **10 years** Common installations priced so that customers do not require rebates or cash incentives (tax incentives may still be of value)	**State funding:** • Capacity-based incentives only **Program guidelines:** • Very quick decisions on applications • Heavy program focus on establishment of installer base **Financing:** Reduced interest rate programs are available to finance PV **Building codes / standards:** • No information available on specific permitting requirements, which are locally driven • No statewide codes for PV • Best practices promoted among localities **Statutes / regulations:** • Statewide PV interconnection standards • Streamlined small PV interconnection • Net metering cap is 10 kW • RPS has a PV kWh target **Tax treatment for PV:** • All PV exempt from property tax • Residential PV exempt from sales tax **Construction policies:** • PV system installation recommend in state funded building projects • PV supported in public schools ("PV on Schools" program) with higher incentives **Training and certification:** • One-day special trainings offered; also formal technical courses • Installer certification through NABCEP • Qualified installers are listed • Additional training for local officials, utility personnel, builders and architects **Marketing activities:** • Distribute how-to literature, web-based installer listings • Relationships with architectural societies, financial institutions, builders assns., electrical contractor assns., local code official associations, solar industry associations	• Easier installation and interconnection • More funding for incentive programs • Increased net metering caps

Ohio	What They are Doing Today	What They Say They Need
Formal Goal: No installed capacity goals **Vision for PV:** **2 years** Production based PV program **5 years** RPS with solar carve out **10 years** Ohio is leader in PV manufacturing	**State funding:** Capacity-based incentives only **Financing:** Reduced interest rate programs are available to finance PV **Building codes / standards:** • Require building permit, electrical permit, and electrical code compliance inspection • Separate state inspection required for state financed installations • No statewide codes for PV; NEC used as local standard for electrical safety **Statutes / regulations:** • Statewide PV interconnection standards • Streamlined small PV interconnection • Net metering has no project limit, with total limited to 1% of a utility's load • No RPS • Time of use rates are available to monetize value of PV at peak periods **Tax treatment for PV:** • Property tax exemptions only through Air Quality Development Authority • No sales tax exemptions except through Air Quality Development Authority **Construction policies:** • Special financing is available to assist with PV in state-funded buildings, though no such projects have been built • PV supported in public schools through rebates and financing programs **Training and certification:** • Formal technical courses are offered on PV • Installer certification programs • Qualified installers are listed • Additional training for local officials, utility personnel, builders and architects **Marketing activities:** • Distribute how-to literature in print and web-based installer listings, Solar Days, support to solar associations • Relationships with financial institutions, builders assns., solar industry associations	• Effective PV in new construction program • An RPS with a solar carve out • Improved interconnection and net metering standards

Oregon	What They are Doing Today	What They Say They Need
Formal Goal: No installed capacity goals **Vision for PV:** **2 years** 2MW net metering cap; increases in incentives funds double installed capacity; customers make decisions in less than 6 mo.; new sophisticated contractors in market increase capacity on commercial bdgs by 50%; installer base grows **5 years** Major manufacturers in OR; system costs declining; PV on 20% new homes; permits streamlined; PV value promoted by realtors; low interest loans for PV by banks **10 years** PV on majority of new homes; electrical contractors design / sell PV; utilities use PV to defer new infrastructure	**State funding:** Capacity-based incentives only **Program guidelines:** • Different offerings for different markets: new/existing residential, nonprofit/government, new commercial and retrofits • Commercial projects capped at 50 kW to spread funds across projects, installers, locations, sectors **Financing:** State-provided loans for PV system installation **Building codes / standards:** • Require electrical permit and electrical code compliance inspection (building permits and inspections are also require in some jurisdictions or circumstances) • Also separate utility inspection • Also separate state inspection for state financed installations • No statewide codes for PV • Best practices not generally promoted among localities **Statutes / regulations:** • Statewide PV interconnection standards in process of development • Streamlined small PV interconnection (for systems less than 25 kW) • Net metering cap is 2 MW • RPS passed in 2007; no solar set-aside **Tax treatment for PV:** • All PV exempt from property tax if owned by host property owner • No sales tax is charged in OR **Training and certification:** • One-day special trainings offered; also formal technical courses • Qualified installers are listed • Occasional training for local officials **Marketing activities:** • Distribute how-to literature and provide web-based how to information, web-based installer listings, advertising campaigns, co-marketing with installers, Solar Days, support for solar associations, support to trade assns., free workshops for consumers • Relationships with builders assns., electrical contractor assns., local code official associations, solar industry associations	• Develop the solar industry to ensure capacity keeps up with demand • Encourage and reward solar in new construction • Coordinate and promote a statewide "solar brand" campaign to raise consumer awareness of and confidence in the technology

Pennsylvania	What They are Doing Today	What They Say They Need
Formal Goal: Alternative Energy Portfolio Standard (AEPS) will require 560 MW by 2019 **Vision for PV:** **2 years** PA's subsidy program operating with installers in all urban areas; solar REC market growing with utilities offering 15 yr. contracts **5 years** Qualified installers serve all PA; financial products now available to reflect value of environmental attributes, etc.; virtual net metering to allow exchange of power offsets **10 years** PV on roofs will be the norm; additional PV financing products emerge	**State funding:** No incentives are offered to reduce PV capital costs **Program guidelines:** No statewide funding program has yet been implemented in PA **Financing:** Long term commercial financing for PV retrofits **Building codes / standards:** • Requires electrical permit and inspection • Also state inspection for state-financed installations • No uniform statewide PV codes; local reliance on electrical code • Promoting best practices among townships **Statutes / regulations:** • Statewide PV interconnection standards • Streamlined small PV interconnection • Net metering up to 1 MW (2 MW if system is part of a public safety microgrid); no cap on utility system capacity • RPS has a "solar share" in it, but too early to determine effectiveness yet • Time of use rates are in place to take advantage of peak pricing **Tax treatment for PV:** No exemptions for property or sales tax Construction policies: • While some state projects have PV, policy is unclear • No special school programs supporting PV **Training and certification:** • No installer training at this time, though SDF had organized prior training event • Qualified installer listing **Marketing activities:** • Web-based how-to literature and installer listing, Solar Days • Relationships with architectural societies, financial institutions, builders assns., electrical contractor assns., solar industry associations	• Replace current SDF PV program which has used up its budget with a new statewide program (as has been proposed by Governor in his Energy Independence Strategy) • Implement the AEPS (proposed PA RPS) rules to encourage utilities to enter into long term solar REC purchases • Strengthen installer training and certification and assist installers with marketing plans and business growth

Wisconsin	What They are Doing Today	What They Say They Need
Formal Goal: 600 kW (dc) to be installed in 2008; no long-term installed capacity goals **Vision for PV:** **2 years** Continued growth of kW installed by 80% per year; large statewide network of NABCEP certified installers **5 years** Cost parity with other power sources **10 years** Cost parity	**State funding:** • Performance-based incentives • Two utilities buy PV generation @ $0.23 to $0.25 per kWh for 10 years • Utility programs also offer grants for PV to schools and non-profits **Program guidelines:** • Quick turn around on application funding decisions (1-2 weeks for systems <10 kW); longer (4-6 weeks) for larger systems **Financing:** • None at present • Low interest loans had been offered for a few years, but very few takers **Building codes / standards:** • Requires electrical permit and utility inspection • No statewide PV standards; local inspectors use NEC • Limited state-sponsored best practices promotion or info sharing **Statutes / regulations:** • Statewide interconnection standards • Net metering is available for PV systems up to 20 kW • There is an RPS; no solar carve out • Time of use rates are in place to monetize special value of PV during peak periods **Tax treatment for PV:** • Both residential PV and commercial PV exempted from local property tax • PV not exempt from sales tax **Construction policies:** • No policies in place that support or mandate PV on public schools • While state buildings have installed PV, consideration of PV is not mandated in state-funded construction **Training and certification:** • One-day focused installer trainings • Formal technical courses available • Installer certification through NABCEP • Qualified installers are listed • Training for code officials offered **Marketing activities:** • Printed and web-based how-to literature, installer listings, co-marketing with installers, Solar Days, support to solar associations, conferences, news releases	• Solar carve out in RPS • Better education of "green innovators" • Increased use of solar buy-back rates with higher buy-back rates

ENDNOTES

1 TRENDS IN PHOTOVOLTAIC APPLICATIONS Survey report of select IEA countries between 1992 and 2006, Report IEA-PVPS T1-16:2007.

2 Klein & Erlichman, *What the Solar Power Industry Can Learn from Google and Salesforce.com* (2006).

3 IEA PVPS member countries are: The G7 member countries and Mexico, Austria, Denmark, Finland, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Israel, Korea and Australia.

4 TRENDS IN PHOTOVOLTAIC APPLICATIONS Survey report of selected IEA countries between 1992 and 2006, Report IEA-PVPS T1-16:2007

5 Japan, Germany, and the U.S. accounted for 91% of installed capacity (grid connected and off-grid) in PVPS member countries at the end of 2006, and the share of these three countries has been increasing steadily over the past decade. The growth in German installed capacity has been especially dramatic, rising by an average of more than 55% annually over the past decade. Total installed PV capacity reached 2,863 MW in Germany at the end of 2006, 99% of which is grid-connected .Germany surpassed Japan in solar power generating capacity in 2005, and today, Germany continues to be the world's leading market for PV energy. A main reason for Germany's leading position in PV is the Renewable Energies Act, (EEG). The law, often described as a "feed in tariff", requires power companies to buy electricity from the owners of PV installations at a set price over twenty years. Press release: Intersolar 2007: Germany leading the international PV market, 6/20/2007.

6 Participants included: California Energy Commission; Connecticut Clean Energy Fund; Illinois Clean Energy Community Foundation; Massachusetts Renewable Energy Trust; Xcel Energy Renewable Development Fund (Minnesota); New Jersey BPU Clean Energy Program; New Mexico Energy, Minerals, and Natural Resources Dept.: Energy Conservation and Management Division; New York State Energy Research and Development Authority; Ohio Department of Development: Ohio Energy Office; Energy Trust of Oregon; Sustainable Development Fund of the Reinvestment Fund (Pennsylvania) and Wisconsin Energy Conservation Corp.

7 Two CESA states reported offering an incentive adder for installations that use in-state manufactured equipment, although others express concern that such policies could fragment the national markets that are needed to drive cost downward. Some state subsidy adders are tied to household income levels or even a home's relative fair market value compared to others in a community (e.g., Massachusetts).

8 See *Photovoltaic Incentive Design Handbook*, T. E. Hoff, December 2006, completed by Clean Power Research of Napa, CA, under the sponsorship of National Renewable Energy Laboratory, for a detailed examination of performance based incentives.

9 For example, the California Energy Commission's pilot program pays a constant $0.50 per kWh over a period of 3 years. Wisconsin' s utility-sponsored solar program (We Energies) pays a constant $0.225 per kWh for 10 years.

10 T. E. Hoff notes in his *Photovoltaic Incentive Design Handbook* (NREL, 2006) that there is a lack of consistency among measured performance programs to date that implies little industry consensus over what constitutes best practice in the design a performance-based incentives.

11 For a description of the leading expected performance-based incentive program, see the California Energy Commission's approach, described in Guidelines for California's Solar Electric Incentive Programs Pursuant to Senate Bill 1, CEC-300-2007-012-CFM (December, 2007), at Chapter 4.

12 CESA &LBNL, *Supporting PV in Market-Rate Residential New Construction* (February, 2006), at 22.

13 Analysis by Ryan Wiser, Berkeley National Laboratory, Presentation to NARUC, November 14, 2007, "Renewables Portfolio Standards: An Opportunity for Expanding State Solar Markets."

14 To comply with an RPS, suppliers often are allowed to obtain and use a renewable energy certificate, which represents the environmental benefits or attributes of one megawatt-hour of renewable electric generation.

15 In the 2007 edition of *Freeing the Grid*, the Network for New Energy Choices applies a scoring methodology developed by the Interstate Renewable Energy Council ("IREC") to grade the renewable energy friendliness of states' net metering and interconnection rules. With respect to net metering rules, five states (NJ, CO, PA, MD, and CA) receive "A" grades and seven states receive "B" grades (OR, DE, IA, NV, CT, OH, and NM). For interconnection, no state earned an "A" grade and only two states (NJ and AZ) received "B" grades. Grades of "D", "E", and "F" are given to numbers of states for both net metering and interconnection policies in place.

16 Note on radial versus network grid issues: Interconnection requirements may be different for radial grid situations (where there is a single power feed) and network grid situations (often in highly urbanized areas where there are multiple, redundant feeds). Most state-approved standards focus on the simpler radial grid interconnections.

Thus far, interconnection standards that have been adopted for network grids vary significantly from state to state. Two CESA states that have adopted effective standards allowing for interconnection of large DG systems in networked areas are New York (2 MW) and New Jersey (500 kW). By contrast, Massachusetts only allows network interconnection of systems under 10 kW.

The IEEE regulations adopted to date cover interconnection in "radial" grids primarily, and efforts are underway to expand coverage to "network" grids as well.

CEG also recommends that states consider emulating New Jersey in adopting interconnection standards allowing large-scale DG in network grid areas. This will further PV market penetration, as well as help address the need for congestion relief in network grid areas. See http://www.njcleanenergy.com/ for more information.

17 *Designing PV Incentive Programs to Promote Performance*, LBL and CESA, October 2006, p29.

18 *Preliminary Evaluation of Pilot Performance-Based Incentive Program*, California Energy Commission, September 2007, Pp26-27.

19 The potential tension between a state fund's consumer protection interest and the interests of PV businesses was illustrated by a recent proposal by the Massachusetts solar program to implement a Standard PV Contract for small system installations. While the goal of the proposed Standard Contract was to institute additional consumer protections for purchasers, the specific provisions proposed were seen by installers as,

- impeding competition among PV contractors by reducing their ability to differentiate their offerings
- placing significant additional liability burdens on them,
- hurting small business cash flows by extending waiting periods for payment,
- requiring sellers to prepare detailed project designs for buyers without compensation, that could then be used to secure competing bids, and
- disrupting operations by permitting purchasers to cancel contracts with little cause after as long as 60 days and get complete refunds.

Further, the Standard Contract language was seen to be unfriendly and complex with too many sophisticated legal terms, potentially intimidating customers and forcing installers into the position of needing to explain and sell a contract they didn't support.

Fortunately, Massachusetts program managers had strong communications lines established with the state's PV industry through the regional Solar Energy Business Association of New England. When they started to get negative feedback, they were able to meet with industry representatives, consider their concerns, and adjust the planned contract roll out to address installer issues.

20 The NABCEP certification for PV installers has been developed by a broad base of experts in the field and incorporates many, if not all, of the essential skills needed for PV installers.

21 See Berkeley Lab and Clean Energy Group Case Study: *Renewable Energy Loan Programs* (Sept. 2002).

22 One barrier to note about low-interest PV loan programs is that the residential solar investment tax credit (ITC) is subject to "anti-double-dipping" rules. Specifically, the residential solar ITC is reduced if the system also benefits from "subsidized energy financing", which is likely to include most government-sponsored low-interest loan programs.

23 These projects are often described as using the "Sun Edison Model" after the company that first popularized it, although there are an increasing number of large and small companies that use it. See http://www.sunedison.com/resources-overview.php.

24 *Solar Electric Permit Fees in Northern California: A Comparative Study*, Sierra Club: Mills and Newick, 2007.

25 See California General Code section 66005(a).

States Advancing Solar

States Advancing Solar is an initiative of Clean Energy Group and the Clean Energy States Alliance, with funding support from the Department of Energy Solar America Initiative's State Solar Technical Outreach Project. This report and many others can be found on the States Advancing Solar web site. This web site serves as a resource for state policy makers and decision makers interested in developing or updating a solar program.

The site offers introductory information on solar energy technologies, the policies being used by states to support solar energy technologies, and highlights successful state solar programs that can be used as models by states looking to develop solar programs and incentives. The site also provides links to state solar programs across the country and to other organizations and resources concerning solar energy technologies.

We invite you to visit this web site at
www.statesadvancingsolar.org

NOTES

Peregrine Energy Group, Inc. is an energy consulting firm based in Boston, Massachusetts. Founded in 1992, Peregrine provides strategic and technical services to private and public organizations on a broad range of energy supply and demand issues.

Services include strategic planning and policy development; market research; regulatory analysis and advocacy; program design and administration; project development and management; group facilitation and mediation; and energy information management.

Peregrine clients include utilities, energy service companies, competitive power suppliers, trade associations, and federal, state, and local government, as well as educational institutions, property managers, non-profit organizations, and other energy end users. Principle areas of energy practice focus on renewable energy and distributed generation on the supply side and advanced efficiency on the demand side.

Peregrine manages the Solar Energy Business Association of New England and the Northeast Energy Efficiency Council, trade associations representing the full range of businesses employed in these markets.

Staff apply their specific expertise in renewable technologies and distributed generation systems to help craft policies that encourage and support the deployment and interconnection of such technologies and systems. They consult to state clean energy funds on program and project design and development. They also are engaged in development of individual projects, both at the merchant scale and behind the meter.

Peregrine has proven capabilities in the areas of performance contracting, green design, and high performance building construction. They have assisted individual projects with concept development, financial impact analysis, and technology selection, as well as project management and building performance measurement and verification. They have had particular success in the affordable housing sector.

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Clean Energy Group (CEG) is a nonprofit organization established in 1998 to increase the use of clean energy technologies in the U.S. and internationally through innovative financing, business partnerships, public policy and advocacy.

CEG works with state and nonprofit officials from across the U.S. that are responsible for over $4 billion in clean energy funds. CEG manages the Clean Energy States Alliance (CESA), a nonprofit assisting its member clean energy funds and programs in research, information sharing and multi-state strategies to deploy clean energy technologies. CEG also works with public officials in Europe interested in trans-Atlantic efforts to build clean energy markets.

CEG, including its work through CESA, is supported by state clean energy funds, and by foundations including the Rockefeller Brothers Fund, The John Merck Fund, New York Community Trust, Jane's Trust, The Energy Foundation and others.

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