Berkeley Lab and the Clean Energy Group

CASE STUDIES OF STATE SUPPORT FOR RENEWABLE ENERGY

Quality Assurance for Photovoltaic Systems

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CASE SUMMARY

Case Description

Ensuring that customer-sited photovoltaic (PV) systems perform adequately should be an important goal for clean energy fund managers. Performance issues are especially pertinent for state funds whose PV incentives are tied to installed capacity and not performance. This case summarizes the approaches that certain states have used to help ensure product quality and reliability.

Innovative Features

As discussed in this case, states have used a variety of approaches to attempt to ensure quality installation and reliability. These approaches can be segmented into:

- system requirements (e.g., UL listing of modules and inverters),
- installer requirements (e.g., installer certification and training),
- installation requirements (e.g., to ensure proper orientation),
- warranty requirements (e.g., on parts, labor, and installation),
- performance incentives (e.g., apply incentives based on kWh rather than kW), and
- voluntary training and certification programs.

Results

- Performance and reliability issues with PV, especially for residential systems, clearly exist and are of concern to potential PV buyers.
- This case study shows that states are taking very different approaches to provide quality assurance; some have taken minimal steps in this regard while others have aggressive warranty and installation requirements and/or use per-kWh payments rather than standard per-kW buy-downs. Installer training and certification requirements are also being considered in some states.
- Unfortunately, no single "best practice" has emerged as offering the ideal balance between adequate levels of assurance and reasonable cost.

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CASE STUDY DETAILS

The photovoltaics (PV) industry has long struggled to provide assurance of product quality and performance to its customers. Before 1998, for example, PV modules sold in the U.S. routinely carried 10- to 20-year warranties, but balance of system components and installation had either short warranty coverage or none at all (Starrs and Schwent 2000). Today, standard practice (absent additional state requirements) includes 5-year warranties on inverters, 20-year warranties for modules, and perhaps a 1-year warranty on installation workmanship. A recent survey in California confirms that performance concerns are salient: the two most important concerns noted by residential and commercial electricity customers in California about PV systems were (a) cost and (b) performance and product reliability (Phelps Group and ICF Consulting. 2001).

Moreover, even under California's PV buy-down program, which requires comprehensive 5-year system warranties, monitoring of select residential PV systems revealed that AC output was frequently one-quarter to one-third below that expected based on certified module and inverter efficiencies at standard PVUSA Test Conditions; performance issues were relatively more serious for those systems with battery back-up and those that were owner-installed (RER 2000). Factors that contributed to this underperformance relative to PVUSA Test Conditions included component mismatch, wiring sizes, shading, battery storage, panel orientation, and inverter loading. It was also found that many program participants had no way of monitoring their systems' instantaneous or cumulative performance, and/or had little understanding of what quantity of output to expect. Possible solutions to these issues considered by the CEC include:

- requiring customer-friendly metering of PV system output,
- providing better performance estimates to PV buyers, and
- applying buy-down incentives to a de-rated version of PVUSA Test Condition data.

Performance issues are especially pertinent for state funds whose PV incentives are often tied to installed capacity, not performance, potentially exacerbating the performance problem absent additional requirements. States that have established incentives for PV have therefore also generally established technical and performance requirements. Although a "best practice" among these programs remains elusive, it is clear that a number of approaches are possible.

Efforts taken by states to provide quality assurance can be segmented into 6 categories:

- system requirements,
- installer requirements,
- installation requirements,
- warranty requirements,
- performance incentives, and
- voluntary training and certification programs.

Rather than providing a comprehensive survey of the approaches taken in each state, the discussion below summarizes the standards and requirements of the majority of state clean energy funds to illustrate the issues.

System Requirements

California, New Jersey, Montana, Massachusetts, Delaware and others require that PV components carry UL listings, while Illinois allows 1-year of field-testing to replace UL requirements. Pennsylvania's SDF requires that systems be FSEC-approved or that components be CEC approved, or else components must meet a series of IEEE, UL, and other standards.

Installer Requirements

While California, Massachusetts, and others only require PV installers to carry the appropriate contractor licenses (though in California system owners may be allowed to

install their own systems without being licensed), Pennsylvania (and SunWize in New York) goes one step further. Pennsylvania requires the use of a participating contractor from a pre-certified list of contractors that have met financial requirements and that have passed an approved solar proficiency exam. New York and other states are also considering formal installer training and certification requirements, though these have generally not yet been implemented and some states are waiting on the development of a national training and certification program for PV, discussed below.

Installation Requirements

In addition to offering a "carrot" to encourage peak performance, Pennsylvania also employs a "stick": to be eligible for the program, the placement and orientation of PV modules must enable the system to produce not less than 70% of the annual output achieved by an optimally placed and oriented system. New Jersey employs a similar mechanism, with different minimum efficiency levels depending on PV module orientation and whether BIPV systems are used. New Jersey will also inspect 100% of all systems in the first year prior to issuing their rebate incentive. LIPA has the option of such inspections, while Massachusetts and Montana require that sites be screened for orientation and shading.

Warranty Requirements

States have taken different approaches to the duration and type of system and component warranty requirements. For example, California, Delaware, New Jersey, Massachusetts, and Pennsylvania all require systems to carry 5-year warranties, but of varying comprehensiveness. California, New Jersey, and Delaware require full 5-year warranties on entire systems, while Pennsylvania and Massachusetts require a full parts and labor warranty for 2 years, and a more limited parts warranty for an additional 3 years. Montana, meanwhile, has required 20-year module warranties and 5-year inverter warranties. Such requirements have forced manufacturers to strengthen and lengthen their product warranties, providing a good example of how system-benefits charge funded PV programs are pushing the PV industry towards maturity. That said, experience in California suggests that system and warranty requirements alone may be insufficient, motivating the interest of other states to apply additional installer and installation requirements, and/or performance incentives. New York, meanwhile, requires its PV contractors to have at least a 2-year service contract with their customers.

Performance Incentives

As described in a separate case study on buy-down programs, several states have begun to experiment with tying incentive levels to performance, rather than installed capacity; this outcome is in part a reaction to experience in California that has shown some performance problems.

- Pennsylvania's SDF offers an initial $3/W buy-down, as well as a second payment at the end of the first year of production of $1/kWh (up to $2,000) to the system owner. At the same time, the system installer is paid $0.10/kWh (up to $250). These delayed, performance-based payments provide an incentive to both the owner and installer to ensure that the system is operating at high levels. (Note that performance-based incentives require that the system be metered separately from the building, rather than through the building's existing meter, as is common practice with net-metered applications; this adds modestly to the cost of a PV system.)
- Massachusetts has also announced a performance-based buy-down, where 70% of a $5/Watt incentive will be paid after 30 days of successful system operation, with the remaining 30% paid down quarterly over three years based on system performance at a rate of 38 cents/kWh (with a capped amount on the total incentive of $5/Watt). The Massachusetts Renewable Energy Trust has issued a solicitation to develop the production tracking and registry system necessary to administer these production payments.

- Wisconsin takes a slightly different approach: their buy-down program offers PV systems $1 per projected annual kWh of generation up to 25% of project costs. While at first glance this appears to be a 1-year production incentive, the fact that it is tied to *projected* rather than *actual* kWh production means that only efficient siting is encouraged.
- Finally, New York requires systems that it has funded to be monitored for 2 years, and holds back a portion of its payments until the systems have operated as designed for 12 months.

Voluntary Training and Certification Programs

Debate in the PV industry has long centered on the need for PV training and certification requirements. While not often *required* by state clean energy funds yet (PA is the exception so far), a number of states have begun to develop *voluntary* installer training programs; these include California, New York, New Jersey, and Wisconsin. Massachusetts, meanwhile, recently issued an RFP for a "needs assessment" of training and certification requirements within the PV industry in the Northeast (this document should be finalized by the end of 2002), and has budgeted funds for training and certifying PV installers.

At the same time, the North American Board of Certified Energy Practitioners, the Interstate Renewable Energy Council, the Institute for Sustainable Power and others have begun a stakeholder process to develop a national PV installer certification program. Such a program has the following goals: (1) ensure the portability of the credential, (2) encourage reciprocity among the states, (3) reduce redundancy and costs in development, (4) reduce costs in administration, and (5) support an open market for certified practitioners. To become certified, an installer would need to meet training and experience prerequisites, pass a written exam, and pass a physical skills exam. (www.irecusa.org/certifications/index.html).

Other Options

In addition to these options, other creative approaches to assuring quality being considered include:

- Massachusetts has explored the development of an insurance fund to cover special circumstances, such as if the equipment manufacturer or installer goes out of business.
- California has considered requiring customer-friendly metering such that PV owners can more easily monitor system performance.

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IREC National Certification Effort:
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Massachusetts: www.mtpc.org/massrenew/
New York:
www.nyserda.org/energyresources/renewableprogramlist.html
Pennsylvania SDF: www.trfund.com/sdf/
New Jersey: www.njcep.com/
Montana: www.montanagreenpower.com/
Wisconsin: www.focusonenergy.com/

ABOUT THIS CASE STUDY SERIES

A number of U.S. states have recently established clean energy funds to support renewable and clean forms of electricity production. This represents a new trend towards aggressive state support for clean energy, but few efforts have been made to report and share the early experiences of these funds.

This paper is part of a series of clean energy fund case studies prepared by Lawrence Berkeley National Laboratory and the Clean Energy Group, under the auspices of the Clean Energy Funds Network. The primary purpose of this case study series is to report on the innovative programs and administrative practices of state (and some international) clean energy funds, to highlight additional sources of information, and to identify contacts. Our hope is that these brief case studies will be useful for clean energy funds and other stakeholders that are interested in learning about the pioneering renewable energy efforts of newly established clean energy funds.

Twenty-one total case studies have now been completed. Additional case studies will be distributed in the future. For copies of all of the case studies, see:
http://eetd.lbl.gov/ea/ems/cases/ or http://www.cleanenergyfunds.org/

ABOUT THE CLEAN ENERGY FUNDS NETWORK

The Clean Energy Funds Network (CEFN) is a foundation-funded, non-profit initiative to support the state clean energy funds. CEFN collects and disseminates information and analysis, conducts original research, and helps to coordinate activities of the state funds. The main purpose of CEFN is to help states increase the quality and quantity of clean energy investments and to expand the clean energy market. The Clean Energy Group manages CEFN, while Berkeley Lab provides CEFN analytic support.

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DISCLAIMER