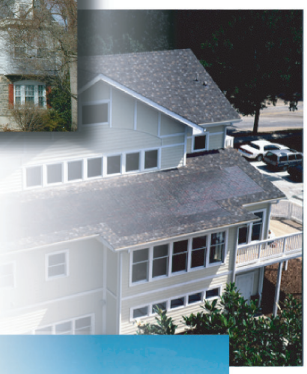
Laying the Foundation for a Solar America: The Million Solar Roofs Initiative

Final Report October 2006

MILLION Solar ROOFS



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U.S. Department of Energy
Energy Efficiency and Renewable Energy

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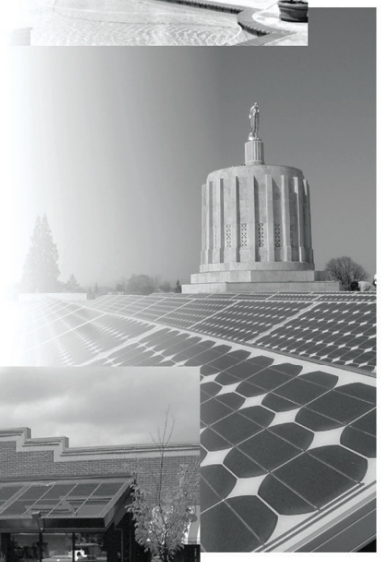

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Contents

1 Introduction and Background

As the U.S. Department of Energy's Solar Energy Technology Program (SETP) embarks on the next phase of its technology acceptance efforts under the Solar America Initiative (SAI), there is merit to examining the program's previous market transformation effort, the Million Solar Roofs Initiative (MSR). The goal of the MSR was to transform markets for distributed solar technologies by facilitating the installation of solar systems. This necessitated a diffuse, essentially grassroots, program approach. In contrast, SAI's goal of achieving cost parity with conventional electricity generation by 2015 demands a distinctly different programmatic approach and an accelerated pace of marketplace acceptance.

Nevertheless, lessons learned in MSR have relevance to SAI. Moreover, an important part of MSR's legacy is the 971 partners nationwide that constitute advocates who are schooled in the technologies and knowledgeable about their local and regional markets. This marketplace expertise will be useful in SAI.

The purposes of this report are to provide a retrospective on MSR and to summarize the best practices that emanated from it. MSR has established a foundation on which SAI can build to meet SETP's goals.

Investing in solar equipment directly would have required a large amount of funding to make an impact, so the Million Solar Roofs Initiative (MSR) invested in people instead. Between 1997 and 2005, 94 coalitions across the country signed on with the U.S. Department of Energy (DOE) as official MSR partnerships. These partnerships comprised 971 private sector firms, electric utilities, builder-developers, nonprofit organizations, and governmental entities—all voluntarily committed to facilitate the installation of a specified number of "solar roofs."[1] This fundamental metric, embedded in the program name, gave the program an outcome-oriented focus.

Key areas where MSR made significant contributions were in addressing barriers to technology acceptance and market expansion efforts, and developing best practices examples for market transformation.

The national network of local partnerships imbued the program with a grassroots nature and exemplified successful public-private collaboration. DOE invested 68% of its program funding in competitively awarded grants to these partnerships, which focused on reducing barriers to technology acceptance and on expanding the market for solar technologies.

The remaining funds supported the participation of the Interstate Renewable Energy Council (IREC), technical experts, and national laboratories in the core program team, providing expert underpinnings for the program, as well as a built-in feedback mechanism from the marketplace to the R&D community and solar industry.

[1] Eligible technologies were not strictly relegated to roofs. They included distributed PV, solar water heating, transpired solar collectors, solar space heating and cooling, and pool heating.

When the program concluded, the federal government's investment of $16 million had leveraged roughly $7.1 million in cash; it also leveraged in-kind resources and incentive programs throughout the country. This synergy has contributed to the following outcomes:[2]

- Installation of the equivalent of more than 377,000 solar water heating, photovoltaics (PV), and solar pool heating systems
- Installation of 200 megawatts (MW) of grid-connected PV capacity and 200 MW_{th} of solar water heating capacity[3]
- Dramatic growth in PV technology acceptance, from 8% of solar installations in 1997 to 41% in 2005
- Economic and environmental benefits that resulted from grid-connected PV installed between 1997 and 2005, including:
  - Health benefit savings of $90 million[4]
  - Decreased CO_2 emissions of 3.3 million tons
  - Cumulative GNP increase of $1.6−$2.6 billion, depending on installed cost (range of $8–$10/Watt)
  - Increase in job-years of 23,000 to 31,000.
- MSR conducted more than 26 peer exchange workshops, attended by more than 650 people. More than 79% of MSR's partners attended at least one workshop. Between 2003 and 2005, some 910 people participated in 10 interactive telephone seminars. (For more information on the seminars and workshops, see Appendix A.)

In addition, MSR efforts contributed to the body of knowledge about best practices for facilitating market transformation and technology diffusion. (See Appendix A for a list of the many documents and publications produced for MSR, and instructions on how to locate them.) Also, MSR evolved as a best-practices program.

As input to the Solar America Initiative (SAI) Technology Acceptance (TA) effort, this report will:

- Summarize best practices for technology diffusion and market transformation.
- Highlight selected partnership efforts to address market barriers.
- Highlight selected partnership efforts to expand markets.
- Describe the MSR program: design and operational approach, partnerships, programmatic best practices.
- Draw conclusions and make recommendations.

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[2] Direct attribution is difficult to ascertain with specificity, as outcomes occurred in many local and regional markets across the country. Nevertheless, the efforts of MSR partners heightened consumer awareness of these technologies, assisted in the adoption of facilitating public policies, and in general helped condition markets to accept these technologies. Data cited are from L. Sherwood, *Million Solar Roofs Initiative: Metrics*, Interstate Renewable Energy Council, 2005.

[3] 1998−2005. L. Sherwood, U.S. Solar Market Trends, Proceedings of the Solar 2006 Conference, ASES, 2006.

[4] Calculations based on information in L. Gillette, C. Herig, and S. Gouchoe, "Analysis of State Solar Economic Trade-Offs (ASSET) Databank," Proceedings of the 2005 Solar World Congress, International Solar Energy Society, 2005.

2 Market Transformation and Distributed Solar Technology Diffusion: Best Practices

MSR partners were not the only marketplace participants working to transform the market for distributed solar technologies. Arguably, however, they were among the most effectively networked and supported. Consequently, they made significant contributions to the community of best practices for market transformation and distributed solar technology diffusion. Following are some examples.

Value analysis: Simple payback is not the sole criterion for investments in new technologies. (If it were, the market for bottled water would be less robust.) Distributed solar technologies possess a wealth of values for different investors. For example, electric utilities value the peak load clipping value of PV and solar water heating, and their potential to improve distribution system reliability. Customers that depend on electricity for their businesses, like IT-and communications companies, value the reliability that distributed PV and storage can lend to their operations. Ratepayers value the fact that PV can diversify the generating portfolio, thus providing a hedge against the risk of price increases. Environmentalists value the lack of airborne emissions and low water use of solar technologies.

Net metering rules and interconnection standards*:* These must be simplified and standardized for distributed generators. Rules and extensive paperwork that are appropriate for utility-scale generators are inappropriate for small ones. Poorly designed net metering and interconnection standards can create rather than remove barriers.

Net metering must be capped at a level to allow a full policy cycle and result in full retail value to the customers. Under their net metering statutes, some states have capped the allowable amount of net metering. In some cases, however, this cap is reached before incentive funding for PV is fully expended.

Financial incentives must be coupled with net metering, interconnection standards, public awareness campaigns, and tariffs that capture the value of solar. MSR partners have provided feedback to states and localities on their incentive programs that helped make them more effectively. If incentives are difficult for consumers and equipment manufacturers to understand and apply for, they won't be used. Even the best incentives can be stymied by the "hassle factor" involved in interconnecting, inspecting, and learning about the program.

Incentive funding for PV should be structured to reduce payment levels over time, as markets become established. This provides the impetus for PV suppliers, builders, utilities, and consumers to reduce dependence on incentives and move toward sustainable markets where PV's real economic value is commensurate with its costs.

Considerations of solar's possible revenue impacts must be balanced with assessment of potential economic development impacts. Solar installations are likely to provide economic development boosts, although they could negatively affect taxes, sales, or general revenues. Utility partners with MSR are finding ways to make solar an effective part of their business plans, finding value to offset any reduction in electricity sales. Measures of economic health

such as gross regional product, jobs, health cost savings, and environmental quality are likely to benefit from solar installations.

Programs intended to stimulate market transformation should remain in place for at least a decade. Customarily, it takes at least 10 years to realize the secondary and indirect economic development gains, as well as the primary ones, from market transformation efforts. It also takes that long for solar system suppliers and consumers to fully develop and accept the value of solar technology and build the institutional knowledge and market delivery mechanisms that will sustain solar growth.

Permitting, insurance, and interconnection requirements should be related to system size. Smaller systems create less liability and exposure, and consequently should not be subject to the same requirements of larger systems. Their economics are also disproportionately influenced by one-time, fixed, up-front costs involved with permits and interconnection.

Capacity building—a well-trained workforce, recognized and understandable equipment certification, and knowledgeable code officials and building inspectors—is an integral part of market transformation and technology diffusion. If these supporting factors are absent, new technologies will not take hold in the marketplace. Building codes and homeowner association covenants, in particular, should facilitate solar installations, or at least not pose obstacles.

The marketplace must have informed consumers to function rationally. "Lack of knowledge" was cited as one of the most significant obstacles facing more than one MSR partnership.[5]

[5] Pulaski and Sherwood, "Power Roofs: Seven Years On, The Million Solar Roofs Initiative is Fostering Adoption Nationwide," *Solar Today, July/August 2004.*

3 Addressing Barriers to Technology Acceptance

Local and regional situations—and accordingly, barriers to technology acceptance—vary across the country. This was the rationale for MSR's grassroots approach. Nevertheless, such barriers share many common characteristics; local and regional differences are merely variations on the theme. Consequently, efforts to address barriers in Washington State are of interest in Florida and vice versa. Following is a list of key barriers and a sampling of MSR's efforts to address them. Many more MSR efforts are aimed at each barrier than can be recounted here. (For more detail, see Appendix B.)

High costs. Great Lakes (Michigan) reduced solar system costs in Ann Arbor through an aggregated purchasing program. Solar Boston (Massachusetts) purchased the green attributes of systems. Santa Barbara (California) created a "sunny day" fund to augment state and federal incentives.

Lack of consumer awareness and understanding. Arizona produced a video and documentary, "Sunrise," which received local television play. Marin County (California) produced a technical assistance template that provides information to residents and businesses about the details of solar purchases (shading, system costs, etc.) Several partnerships installed PV at highly visible locations such as the National Aquarium in Baltimore.

Inhibiting interconnection standards and net metering policies. Several partnerships, including Philadelphia, Delaware, and Texas, conducted workshops for interested parties. With the help of partnerships, several states, including New Jersey and Kentucky, passed laws to facilitate net metering.

Lack of trained installers, inspectors, and manufacturing workforce. Several partnerships, including New York, Montana, Idaho, and Florida, conducted training. Oregon created solar electric and solar water heating licenses.

Lack of solar-friendly building practices, standards, and zoning. Arizona reached out to homeowner associations whose covenants had precluded rooftop solar in desert communities. Bay Area (California) worked to pre-certify small PV systems.

Lack of knowledge about integrating solar in building design. Alaska published the *Alaska Solar Design Manual*. Aspen (Colorado) held an architect-teach-architect workshop. Maui (Hawaii) works with contractors to ensure that solar water heating is incorporated in housing vacated by the military.

Minimal financing options. Tucson (Arizona) created third-party financing. Delta-Montrose (Colorado) launched financing for a limited number of grid-connected PV systems in its rural electric cooperative. It also developed a simplified economic analysis tool to compare monthly and annual cash flows of mortgages for standard versus zero energy homes (ZEHs), and the associated utility savings.

4 Market Expansion Efforts

Attention to barriers to market penetration results in market expansion. In addition, however, MSR partnerships undertook a number of market expansion efforts unrelated to barrier reduction. Following are examples.

- **Encouraged production builders to incorporate solar in their developments, either voluntarily or through building codes.**
  - San Diego (California), Aspen (Colorado), Tucson (Arizona)

- **Created demand for solar in government and other public entities (e.g., the military and schools).**
  - The City of Anaheim (California) installed solar on carports for its fire department.
  - Oahu (Hawaii) encouraged the military to install solar water heating on military housing.

- **Installed solar on high profile, high traffic facilities.**
  - San Francisco (California) installed PV on the Moscone Convention Center.
  - Philadelphia (Pennsylvania) helped its zoo assess the potential of solar.

- **Expanded the universe of applications for solar.**
  - Montana employs PV in emergency operations, installing PV on fire stations to provide uninterruptible power.
  - Delaware, Maryland, and Virginia partnered with the poultry industry to evaluate the potential to incorporate solar thermal in their operations.
  - Brockton (Massachusetts) installed PV on a brownfield, converting it to a "brightfield."
  - New Hampshire partnered with the Low-Income Weatherization program to provide solar water heating for eligible residences and conduct installer training.
  - Marin County (California) used infrared detection and geographic information systems tools to identify commercial roofs with potential for rooftop PV.
  - Maine reached out to the faith community to involve it in promoting and developing solar energy.

5 Million Solar Roofs: The Program

5.1 Program Design and Operational Approach

MSR's goals were to overcome technology acceptance barriers for distributed solar technologies, especially PV, and to expand the market for the suite of distributed solar technologies. Because the program received relatively modest federal funding that was even less than originally planned, key strategies were to leverage resources and link to other federal, state, and local programs.

DOE established the program framework and goals, and provided funding. Federal appropriations were received for six of the eight years of program operation, totaling $16 million. Through its network of six Regional Offices (ROs), DOE enrolled partnerships; issued competitive solicitations; and disbursed modest grants, ranging from $10,000 to $50,000 per award. Over the years, grants totaling $9.2 million were awarded to partnerships, accounting for an estimated 68% of MSR funds disbursed.

The market transformation and technology diffusion work of MSR was conducted by the partnerships. To succeed, they received multifaceted support from the core MSR team:

DOE's Solar Energy Technology Program (SETP) personnel at headquarters provided program direction and budgetary leadership. They also served as a critical conduit between Washington, D.C., and partnerships across the country. SETP's systems-driven approach considered deployment an integral part of the R&D continuum, from fundamental science through technology acceptance. MSR's program design provided opportunity for feedback from the real world of solar technology users, marketers and installers back to laboratory scientists and program professionals at DOE.

DOE's ROs, situated in the field and close to markets and MSR partners, were the primary points of contact for partnerships wishing to obtain information and technical assistance. ROs filtered assistance requests and referred those requiring expert technical or analytical support to the national laboratories. ROs also ran annual grant solicitations, made awards, monitored and reported on the progress of their partnerships, and hosted annual peer exchanges for partnerships in their regions.

National laboratories: A hallmark of MSR was the technical and analytical support provided by two of DOE's national laboratories, the National Renewable Energy Laboratory (NREL) and Sandia National Laboratories. In addition, a private-sector contractor provided specialized economic and value analyses, as well as a suite of data-based tools for analysis of specific markets.[6] This expert assistance was provided free of charge to partnerships upon RO approval and provided critical intellectual and technical underpinnings for the program. Assistance ranged from troubleshooting hardware problems to analyzing the impact of public policies on local and regional markets. Technical support often was provided on a short turnaround basis and was not provided if the private sector could better meet the need.

[6] Segue Energy Consulting, Christy Herig, Principal

Interstate Renewable Energy Council (IREC) supplied critical knowledge and communications support, including information sharing among partnerships, and tracking MSR program metrics. IREC performed the following services:

- Arranged interactive telephone seminars on topics of interest to partnerships including tax exempt solar financing, energy surety, utility solar hot water programs, interconnection and net metering, federal resources for solar from the U.S. Department of Agriculture and Housing and Urban Development, ZEHs, solar for disaster response and recovery, PV module supply issues, PV impacts on peak loads, inspector guidelines for PV systems, and solar affordable housing.
- Produced a bi-weekly "news you can use" electronic newsletter.
- Produced materials for and managed the MSR Web site, showcasing partnership success stories as well as informational materials presented at telephone seminars, regional and annual meetings, and technical papers produced by the laboratories and contractors.
- Helped the ROs arrange regional peer exchanges.
- Tracked and reported MSR's metrics.
- Helped plan and arrange the MSR annual meeting, held in conjunction with IREC's annual meeting.
- Helped disseminate information developed by IREC and other organizations on critical issues, including model interconnection and net metering policies, employment and local economic benefits of solar development, and information/analysis on certification and training issues.

The core MSR support team provided essential, ongoing support to the many partners nationwide. This multifaceted support enabled partnerships to function as "honest brokers" in local markets—knowledgeable and without vested financial interest.

"The Solar Boston Partnership has evolved into a trusted broker representing the industry to the public and the public to the industry – something no one else has done."
Richard Michaud, DOE[7]

5.2 Partnerships

By the time MSR concluded, 971 partners across the country had joined the 94 official MSR partnerships and were working to meet the specific goals of the individual partnerships. Figure 1 shows the diversity of MSR partners, but even within these groupings there is a broad spectrum of interested organizations, including:

- Electric and gas utilities
- Architects
- Builders
- Developers

[7] Pulaski and Sherwood, "Power Roofs: Seven Years On, The Million Solar Roofs Initiative is Fostering Adoption Nationwide," *Solar Today, July/August 2004.*

- Solar equipment manufacturers (including inverters)
- Aggregators, retailers, and distributors
- Banks and financiers
- A labor union
- Municipalities and their associations, as well as mayors' offices; government agencies such as housing authorities and planning departments
- State energy offices, environmental regulators and economic development agencies
- Federal government agencies
- Non-governmental organizations
- Agricultural agencies and associations; and a host of other organizations ranging from the Nez Perce tribe to Shea Stadium.

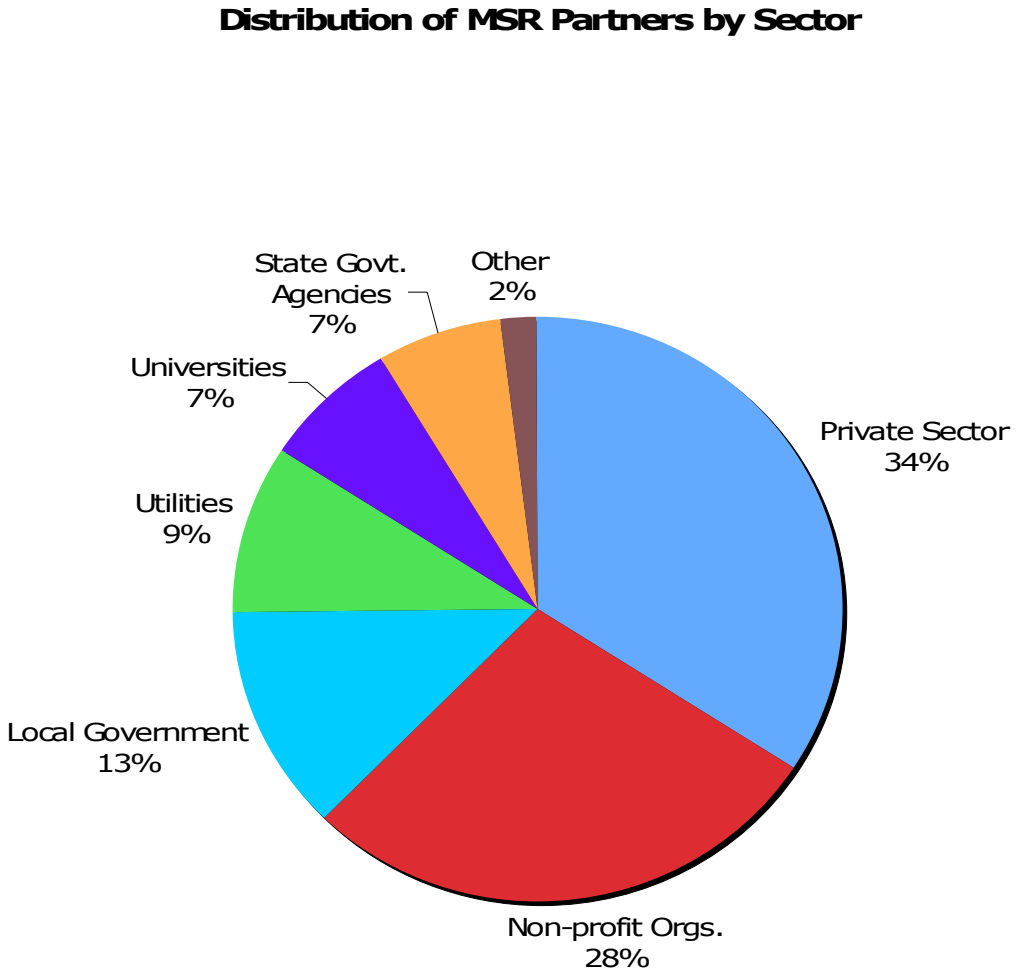

Figure 1. MSR partner characteristics

Official partnerships consisted of organizations that shared a commitment to fulfilling the goal of the partnership; that is, facilitating the installation of a voluntarily chosen number of "solar roofs." The customary commitment ranged between 500 and 100,000 roof equivalents.[8] This commitment was made with the DOE ROs and was a prerequisite to official partnership status. Each partnership also developed an implementation plan to outline how it planned to achieve its goals. Eligibility to apply for competitive grants, free technical and analytical support, and peer exchange information were the incentives to attain official partnership status. Partnerships ranged in size from one affiliated organization (for example, the Department of Natural Resources in Iowa) to 63 affiliated organizations and companies (Bay Area Solar Consortium in California). As the SAI TA effort develops these partnerships, the roof commitments they made, and their implementation plans can be a starting point for new technology acceptance efforts. In locations where they worked effectively, new activities should go beyond previous efforts. If past experience is a selection criterion for involving organizations in the TA effort, performance as MSR partners can help demonstrate capabilities. The implementation plans developed by the partners in many cases provide useful insights to the barriers and market conditions in target locations.

The private sector accounted for about a third of partnerships. Nonprofit organizations comprised more than a quarter, followed by local government entities with 13% and utilities at 9%. (For a detailed list of partner categories and types, see Appendix C; a list of MSR partners is included as Appendix D.)

Understanding the different levels of sophistication and capability among the MSR partnerships can be useful to the new TA effort. The same types of partners are likely to come forward for the new program, and the TA effort will have to make similar tough decisions about where its resources will have the greatest impact in the short and long terms. There will always be a tension between investing in "sure bets" with very experienced partners where there is less risk, and also less direct impact, and investing in efforts with higher risk, but where federal resources are more critical to success. As MSR developed over time, it became apparent that three types of partners had emerged and constituted something of a "pipeline" in terms of best programmatic practices:

Experienced partners with access to significant resources outside of DOE, substantial expertise and an established history of working with solar energy.[9] Experienced partners benefited MSR by leveraging MSR funds with access to substantial outside resources. They also shared their experience and successful methods with other partners. They joined other MSR partners to develop best practices on issues like net metering policies and interconnection standards. They used MSR funding mainly to fill gaps in their own resources. For example, MSR funds were used when system benefit funds failed to provide adequate resources to publicize rebates and incentives, or to inform customers about how to purchase solar equipment.

[8] "Roof equivalents" was the metric devised to account for the difference in size between a small residential installation and one on a large commercial structure, such as a convention center or hotel.
[9] DeGroat, Kevin, *Personal Communication*, July 20, 2006.

Intermediate partners with financial or policy mechanisms to support solar, but with less experience with the technical aspects of solar energy or knowledge of how to organize a successful solar program. Intermediate partners also leveraged MSR funding to fill gaps in their own resources. However, they were even more engaged than the experienced partners in leveraging the network of experts and solar information that MSR helped sustain. This enabled them to expand their efforts and build more effective solar programs.

Emerging partners with little experience in solar energy and limited resources, but motivated organizations and enthusiasm for solar energy. For emerging partners, MSR provided a small amount of seed money to help them organize and begin to assemble the components of an effective solar effort, based in part on what they learned from more experienced MSR partners.

MSR's multifaceted support, including grants, sustained all parts of this pipeline of solar deployment partners. MSR helped emerging partners grow to intermediate levels, and intermediate partners to become experienced. Moreover, it helped experienced partners move even further by helping them address new issues and opportunities.

5.3 Best Programmatic Practices

In addition to the emergence of a pipeline of partners, a suite of best practices evolved in actual program operations:

- **Minimize transaction costs.** MSR's operations have been described as "lean and functional" and "free from layers of bureaucracy."[10] This is key to minimizing transaction costs. Bi-weekly meetings of the core team were conducted via conference calls rather than incurring time and travel costs for face-to-face meetings. The annual meetings of IREC and MSR were combined to reduce travel costs. The electronic newsletters of MSR and IREC also were combined, which cut production costs by half.

  The MSR Web site was an enormously cost-effective information transfer mechanism. It included a broad array of materials, from success stories of MSR partnerships to the latest technical studies produced by national laboratories and the solar industry. In 2004, the Web site averaged 18,000 unique hits every month.

  Finally, even though partnership grants had low dollar amounts, transaction costs were optimized by running the grants through DOE's ROs. The ROs were geographically dispersed and, consequently, close to partnerships and markets. Small, self-contained offices, the ROs incurred minimal bureaucracy and red tape. Applying this same "lean and functional" approach to larger investments would leverage federal resources even more, and the new TA effort should be able to reach new levels of "bang for the buck."

[10] Pulaski and Sherwood, "Power Roofs: Seven Years On, The Million Solar Roofs Initiative is Fostering Adoption Nationwide," *Solar Today, July/August 2004.*

- **Supply technical, analytical, and knowledge underpinnings for program actions.** National laboratories and a contractor[11] provided individualized expert assistance, free of charge, in response to requests forwarded by the ROs. Often requests for assistance required immediate response and swift turnaround. Information generated from this assistance was made available to all partnerships and was posted on the MSR Web site. In addition, the laboratories and contractors conducted technical and analytical studies, which also were placed on the Web site.[12]

- IREC provided topical information through interactive telephone seminars, as well as speakers obtained for regional and national meetings. The telephone seminars informed participants about subjects pertinent to partnership success and were accompanied by power point presentations sent to participants in advance of the seminar. The new TA effort will find a substantial demand for analysis and information that could be a useful outlet for technology and knowledge transfer from the activities it supports.

- **Arrange opportunities for partners to learn best practices from one another and to inform others in the broader community of decision-makers outside of program parameters.** Ongoing information exchange was created through the Web site, which showcased partnership successes, and the bi-weekly electronic newsletters, both managed by IREC. Opportunities for direct interaction were provided through yearly regional peer exchange meetings (which sometimes included more than one region) and the annual national meeting. Now that this network is in place, it is another potential outlet for the results of TA activities and projects.

- **Provide partner funding.** The competitively awarded grants ranged in size from $10,000 to $50,000. This was sufficient to bridge gaps, but not much else for the experienced partners. However, if such funding were not available, efforts might have foundered. For emerging partners, the funding was often key to the development of a solar program. There were lessons learned in the way MSR structured and managed its grants that the TA effort can adapt to its needs.

  With modest funding from the DOE, the Million Solar Roofs Initiative has proven Malcolm Gladwell's "Tipping Point" theory that "little things can make a big difference."[13]

- **Leverage resources—financial, human, program, information, and in-kind.** At the federal government level, MSR teamed with other federal programs to leverage knowledge and efforts. Among the federal programs leveraged were DOE's TEAM-

[11] Segue Energy Consulting
[12] Topics included, but were not limited to, analysis of how state and Federal incentives combine, and implications for taxation, analyses of program designs, approaches to incorporate solar into city planning and development, local economic benefit valuation, solar valuation for different customer applications, solar and RPS provisions, how to specify and solicit solar projects, and many other large and small analysis requests.
[13] Pulaski and Sherwood, "Power Roofs: Seven Years On, The Million Solar Roofs Initiative is Fostering Adoption Nationwide," *Solar Today, July/August 2004.*

UP project,[14] the Federal Energy Management Program, Rebuild America, Weatherization Assistance Program, and Zero Energy Homes. MSR's San Diego Partnership became involved with Zero Energy Homes, to the benefit of all, including local production builders. The Wisconsin MSR Partnership published a report on the value of ZEHs in the Midwest.

Other federal agencies with which MSR partnered—either from DOE headquarters or through partnerships—included the Environmental Protection Agency, Housing and Urban Development, the Small Business Administration, the Federal Emergency Management Agency, and the General Services Administration.

In addition, MSR leveraged the resources of the partnerships, including state and local programs to which they had access. This included cash matches, in-kind matches, and leveraging of complementary resources. In 2003 alone, DOE's investment of $2.6 million leveraged more than $100 million of state and utility incentives.

These same resources are available for the new TA effort to leverage as well, and a lot can be learned from MSR's successes and limited successes. For example, the federal market potential for solar was explored on a limited basis, and the new TA effort might be able to work with the Federal Energy Management Program (FEMP) to leverage it more effectively through concepts such as large-volume purchases, Energy Savings Performance Contract funding, and exploiting energy reliability and security benefits.

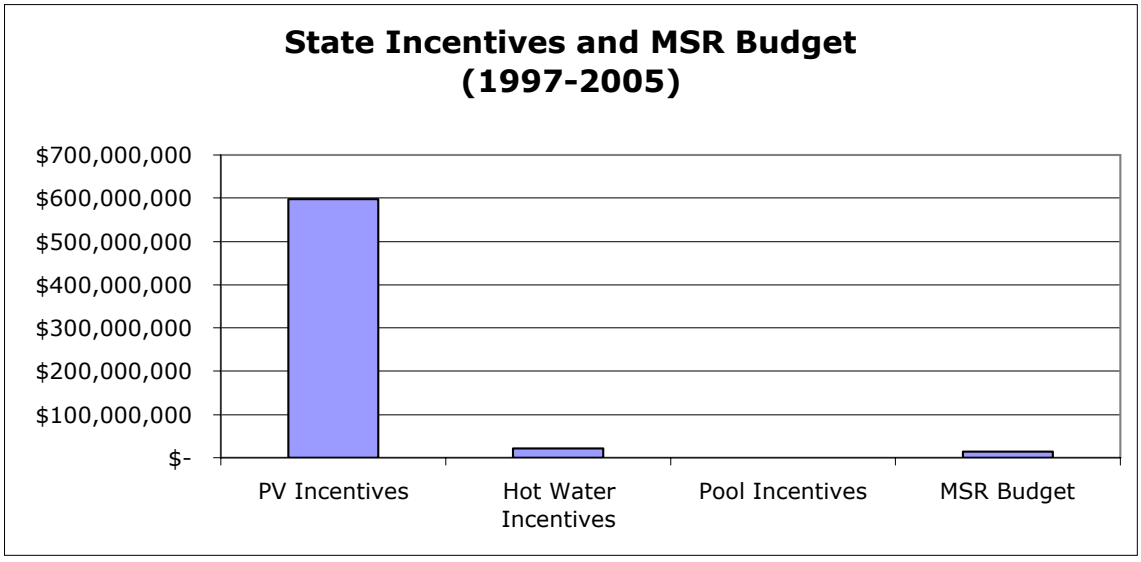

Figure 2. State incentives and MSR budget

[14] A solar deployment effort managed by the predecessor of today's Solar Electric Power Association

- ***Multiply program benefits by serving multiple objectives.*** Both DOE and individual partnerships leveraged MSR program success by serving other public policy objectives in the course of achieving MSR goals. For example, DOE advanced its Solar Schools program by assisting MSR partnerships that used schools as early adopters and models of solar leadership in their communities. The Nevada MSR partnership leveraged federal "No Child Left Behind" funding and the state's Green Power program to introduce solar education into the professional development courses for middle school teachers. The Aspen (Colorado) and Mississippi partnerships used MSR to advance affordable housing. North Carolina and Salt Lake City (Utah) used MSR to provide a hedge against the price volatility of fossil fuel-generated electricity. Boulder (Colorado) and New Jersey met environmental quality objectives, and the Greater Tucson Coalition strived for greater energy surety and Newton (Massachusetts) for reduced oil imports.[15] Partnerships' creative approaches to combining multiple programs with solar were sometimes surprising, which offers a valuable lesson to federal program developers: they should not try to overspecify what is expected from partners, to give them room for creative solutions.

- ***Define and track meaningful metrics of program success.*** The original metric for program outcome, embedded in the program name, was the installation of one million solar energy systems throughout the United States by 2010. This proved to be a difficult metric to measure. The varying sizes of systems (residential versus commercial) had to be accommodated. Moreover, privacy and proprietary issues made obtaining information about installations difficult. Over time, the MSR core team determined that installed capacity and translation of that figure to roof equivalents were preferable outcome metrics.

  In terms of outputs, MSR conducted more than 26 peer exchange workshops, attended by more than 650 individuals. More than 79% of MSR's partners attended at least one workshop. Between 2003 and 2005, some 910 individuals participated in 10 interactive telephone seminars.

  Relating outputs (workshops, seminars, etc.) to outcomes (solar roofs installed) is quite difficult. The new TA effort should carefully consider its performance metrics and what it will measure to make sure that its outputs are clearly contributing to the outcomes it wants to achieve.

- ***Provide consistent program leadership, informed by routine communication among those responsible for program direction and implementation.*** Routine bi-weekly phone calls were held among DOE headquarters program personnel, the ROs, IREC, the national laboratories, and the contractor. Information was exchanged, and opportunities or challenges were anticipated in timely fashion, even though the core team was widely dispersed geographically. This is good management practice that should apply to almost any activity the Solar Program supports.

[15] Some of New England's electricity is generated with imported oil.

6 Conclusions and Recommendations

In eight years of program operations, MSR established the foundation on which to create and grow markets for distributed solar technologies. Market barriers have been identified, along with best practices to address them. The grassroots and geographically diverse nature of MSR partners enabled all regions of the country to acquire fundamental experience with solar. MSR as a program also developed a suite of programmatic best practices.

Now DOE's SETP is initiating the next phase of its technology diffusion efforts. The changed nature of SETP's goal (i.e., cost parity with conventional technologies by 2015) suggests the need for a different programmatic approach to technology diffusion and market transformation with less emphasis on a market application (solar roofs) and more on broadly incorporating solar into the planning and development infrastructure of key partners. Nevertheless, the MSR core team recommends that SETP take advantage of, and build on, the work that has gone before. In particular, we recommend that SETP use the 971 partners located around the country: they are advocates for solar and experts in their local and regional markets. In addition, we encourage SETP to keep in place the communication tools that were developed under MSR. These tools are low cost and are proven to be successful in communicating timely information that can be used and useful in the marketplace.

We wish SETP well in the next phase, and offer our assistance and support. Following are some specific recommendations and suggestions based on lessons learned from the MSR Initiative:

Retain communications and networking. Maintain and incorporate MSR's distribution lists and some of its practices into a broad SETP distribution and communication strategy for disseminating program information and notices of updates in studies, Web information, etc. MSR's contact lists are a ready addition to SETP's network that can be maintained at a minimal cost to help disseminate the activities and results of the new TA effort. Although "seed money" grants for partners with emerging solar interests may not continue, maintaining an effective outreach effort can help retain some of the same beneficial "seeding" effect in the new program.

Incorporate MSR Web site information and structure into the SETP Web site along with other TA materials. An organized collection of tools, studies, and information on the MSR Web site can be incorporated quickly into the new TA effort. Many users are already familiar with the MSR Web site and its material and it provides familiar paths for them to find what they want.

Networking, at the management level of MSR, among the partners, and between the partners and management, was a key characteristic of MSR. This helped immensely in tracking results and performance and in sharing information and best practices. Similar networking through regular conference calls, teleconferences on targeted subjects, and focused meetings that coincide with other industry events should be considered in the new TA program to keep the effort on track and broadly engaged with SETP.

Employ MSR experience. As the new TA effort sets priorities for addressing barriers and opportunities, match the experience and best practices from MSR to those areas and be sure that follow-on efforts benefit from the baseline of experience MSR has in place.

MSR created greater awareness and visibility for critical SETP tools like the DSIRE database, SETP analyses and analytical capabilities, IREC's work on training, inspection, local energy security and environmental benefits, certification issues, and the ZEH effort supported by BT. The new TA activity should consider ways to keep these assets available and visible to the broad solar community when MSR is replaced. The fact that people were finding this information and using it on their own to advance solar was a free leveraging of SETP's investment in these efforts that is worth sustaining.

MSR partners were beginning to provide information on system performance, costs, and other data for use in the systems-driven approach. If that information is still a priority, the network of information providers and a structured approach for gathering and analyzing the information should continue in order to monitor whether problems are developing in fielded systems and what implications they have for research and technology.

Avoid MSR limitations. MSR struggled with reaching beyond the partnerships and engaging other key stakeholders in PV manufacturing, in R&D, and other areas of SETP. The new program should strive to improve integration and communication of its activities across SETP and into supporting programs like BT and FEMP so that its results are more broadly appreciated and used. MSR should have influenced R&D, and R&D should have influenced MSR plans and approaches more. The new TA effort can more effectively integrate with the broader Solar and Energy Efficiency and Renewable Energy (EERE) programs.

MSR struggled with limited funds that were spread purposely across six geographic regions, which created more and smaller grants than ideal. The principle of geographic and partner diversity to avoid risking too many resources on one track is still valid, but there needs to be a better balance between the number and size of grants or cooperative agreements and the diversity of partners. National competition for DOE resources and substantial awards to the best proposals should be the rule, but with some balance to engage different types of partners and provide some geographic diversity.

MSR partners were burdened by having to submit proposals annually and by the limited funds they could expect in return for their efforts. Larger awards, and if possible multiyear commitments or access to follow-on funds, would encourage continuity. Awards should be designed and managed in a way that reduces some of the administrative and management burden created by annual calls for proposals and management of awards that overlap because of delays in appropriations and awards.

The definition of a roof, and the focus on roofs, limited the scope of projects MSR could support. This limitation does not apply to the new TA effort. The new effort should make the most of its broader focus to encourage partners that have ideas or opportunities that didn't fit MSR.

Maintain best practices. One of the most useful features of MSR was its ability to respond quickly to opportunities or challenges as they arose by providing partners with access to NREL and Sandia expertise and the expertise of key service providers like Segue Consulting, IREC, and the staff who maintain the DSIRE database. The new TA effort should maintain that quick-response capability for new partners, and for seizing opportunities that naturally come from the fact that states, localities, utilities, and the solar industry are making things happen on their own initiative that create unexpected challenges and opportunities.

Solar water heating technology opened communities, utilities, and other partners to the possibilities of solar energy. Solar water heating is comparatively cost effective, is a well-established technology, and produces benefits that are comparable to solar electric technologies. Especially considering the potential for ZEHs, the new TA effort should encourage all types of solar energy technology acceptance, especially where technologies can create an effective package of options for a particular locality, state, or region. New partners in TA should be encouraged to pursue solar development broadly, and use the best approach to technology for their situation.

The most successful MSR partners institutionalized their solar efforts into state, local, or utility organizations by becoming integral parts of their overall planning and implementation efforts. Solar became more than an appendage or demonstration, it became part of the organizations' core businesses. The new TA effort should look for similar opportunities to ensure that the activities it supports have staying power beyond the period of DOE funding and support, and produce replicable models for technology acceptance. The new TA effort does not have the application limitations (solar roofs) of MSR. It is not committed to having many small grants geographically dispersed around the country. It does not have established partnerships with expectations of recurring funding opportunities or charters designed for MSR. Therefore, the new TA effort can be flexible and seek out creative, effective approaches to "institutionalizing" solar technologies into key businesses.

Appendix A: Million Solar Roofs Products and Documents

A large variety of outreach materials generated by and for MSR Partners, including, among other things, PowerPoint Presentations, papers from conferences, and reports from the national laboratories, can be found on the MSR Web site. From Quantifying Residential PV Economics: Payback v. Net Present Value (www.millionsolarroofs.org/articles/static/1/1131461063_1023713887.html) to the 2005 MSR Partnership Updates: Become One in a Million (www.millionsolarroofs.org/articles/static/1/1127919645_1023713887.html), partnerships and stakeholders can continue to take advantage of the technical expertise from the nation's leading solar experts.

Presentations:
www.millionsolarroofs.org/outreachtools_presentations/

Publications can be found at: www.millionsolarroofs.org/outreachtools_publications/
A list of titles is provided below to show the range of topics covered.

In addition, from 2003 to 2006, the MSR Conference Call Seminars and Peer-to-Peer (P2P) workshops featured targeted services and tools available to all MSR partnerships and members of MSR partnerships. A list of titles is provided below to show the range of topics covered.

The P2P workshop series began in 2002 with six workshops held in each of the six DOE regions. Relevant, timely issues were identified by each region and speakers were invited to address those issues. Partnerships shared successes and obstacles. In 2006, workshops have been held in Portland, Oregon, Atlanta, Boston, and Albuquerque. A list of titles is provided below to show the range of topics.

The Conference Call Seminars were intensive 1- or 1½-hour seminars on timely issues pertinent to MSR partnerships and their stakeholders. Expert speaker presentations were accompanied by PowerPoint presentations sent to all participants in advance of the call. In addition, both the PowerPoint and MP3 audio file were featured on the MSR Web site for those who were unable to attend. A list of titles is provided below to show the range of topics.

Information from all of the 2003−2006 seminars is posted on the MSR Web site (www.millionsolarroofs.org/seminars/).

Publication Titles and Abstracts

Gillette, L., Herig, C., and Gouchoe, S. "Analysis of State Solar Economic Trade-Offs (ASSET) Databank," Proceedings of the 2005 Solar World Congress, International Solar Energy Society, 2005.

Midwest Zero Energy Homes: Overview, Options and Resources
http://millionsolarroofs.org/articles/static/1/binaries/MidwestZEH.pdf
The greatest challenge for ZEHs in the northern tier states is providing space and water heating during the cold and cloudy months of November, December, and January. This report focuses on eight Midwestern states: Michigan, Ohio, Indiana, Illinois, Wisconsin, Minnesota, Iowa, and Missouri. However, the findings are relevant to ZEHs located in 24 states that have similar climates.

Pulaski and Sherwood, "Power Roofs: Seven Years On, The Million Solar Roofs Initiative is Fostering Adoption Nationwide," *Solar Today, July/August 2004.*

Quantifying Residential PV Economics: Payback vs. Net Present Value
http://millionsolarroofs.org/articles/static/1/binaries/PerezFinal.pdf
State energy offices and utility efficiency programs have long used the measure of simple payback to determine economic feasibility. However, when purchasing a high capital cost item such as a solar system, which is likely financed, and will provide a revenue stream for up to 30 years, simple payback does not capture the full economic value.

2005 MSR Partnership Updates: Become One in a Million
www.nrel.gov/docs/fy05osti/38587.pdf
Since 1997, when MSR was launched, some 94 partnerships from Massachusetts to Maui have constituted a significant force in promoting market acceptance of solar energy. As the program matures, capacity building in solar industries also has become a key objective. With limited government funding, MSR invests in people—its national network of official partnerships—by offering opportunities for them to compete for modest grants ($10,000−$50,000).

Sherwood, L., *Million Solar Roofs Initiative: Metrics*, Interstate Renewable Energy Council, 2005.

Sherwood, L. "U.S. Solar Market Trends," Proceedings of the Solar 2006 Conference, ASES, 2006.

Three New MSR Case Study Fact Sheets Feature New Jersey, Marin County and Florida
NREL recently produced three case study fact sheets about the Florida, Marin County, and New Jersey MSR partnerships for DOE's EERE.

2004 MSR Partnership Updates: Become One in a Million
http://millionsolarroofs.org/articles/static/1/binaries/MSRNationalUpdates2004.pdf

Through its many partners across the country, MSR is facilitating the sale and installation of solar systems in places where this might not otherwise have occurred. MSR helps to lower barriers through public-private collaborations and does not directly give grants or subsidies for solar equipment purchases. With a small expenditure, MSR has created extraordinary benefits across the country.

Are Solar Rebates and Grants for Homeowners and Businesses Taxable?
http://millionsolarroofs.org/articles/static/1/binaries/ASESTaxAvailibility.pdf
Financial incentives for solar installations are available in a growing number of states. MSR partners have questioned whether or not such grants and rebates are taxable at the federal or state level. If these incentives are taxable, it could mean as much as a 42% increase in a PV system's net cost for a homeowner relative to a case where the incentive is nontaxable.

State-by-State Incentives for Residential and Non-Residential Solar Projects
http://millionsolarroofs.org/articles/static/1/binaries/NonResIncentivesAug04.pdf
These summary tables show state-by-state availability of income, sales and property tax incentives; net metering; loans; grants; buydowns; and production-based incentives for solar technologies.

Technical Assistance Request: Quantifying Energy Production from Solar Water Heating Systems
http://millionsolarroofs.org/articles/static/1/1096993179_1023713887.html
There is growing interest by solar thermal industry stakeholders to develop metering and modeling protocols for quantifying energy from solar water heating systems. Dell Jones, director of Solar & Wind Technologies at Sterling Planet, a national green tag marketer and USH2O member, requested assistance from Dwight Bailey, MSR coordinator at DOE's Southeast RO, to define low-cost hardware or methods to quantify the energy delivered to a solar storage tank.

Solar Cities: Local Government and Utility Leaders in Solar Deployment
www.millionsolarroofs.org/articles//static/1/binaries/Solar%20Cities%20Report_fnl%203_22_04.pdf
Responding to concerns about increasing electricity costs, environmental quality, grid security, and disaster preparedness, many local governments have established policies and programs to foster renewable energy development. Some of these initiatives are directed at encouraging residents, businesses, and developers to install renewable energy systems; such initiatives include outreach and demonstration programs, solar access provisions in zoning and development guidelines, and top-of-the-stack permitting or other enticements for solar builders. In other cases, local governments have committed to using renewable energy resources for a portion of their own energy needs by participating in utility green pricing programs or issuing their own requests for service. And finally, a growing number of local governments are installing solar and other renewable energy projects on public buildings for their own use.
S. Gouchoe, L. Gillette, C. Herig. March 15, 2004. 18 pages.

Solar Cities: Local Government and Utility Leaders in Solar Deployment: Solar Audit Assistance Tool
This paper describes a software tool that was developed to assist with conducting solar energy audits. The Solar Audit Assistance Tool is a Microsoft Excel spreadsheet that includes macros and functions written in Visual Basic for Applications. It combines results from the Solar Pathfinder shading analysis tool and results from running the NREL PVWATTS simulation tool to estimate shading impacts and overall solar electric production for a PV system of given capacity. Electric billing data may also be entered and compared to the PV system production. Currently, the program is structured for the southeastern Pennsylvania area, but it can be modified to be used anywhere.
Submitted by Ron Celentano, Celentano Energy Services.

2*003 MSR Partnership Updates: Become One in a Million*
www.nrel.gov/docs/fy04osti/34009.pdf
Become One in a Million is the 2003 MSR partnership update publication, now available in PDF format. Also included in this issue is a two-page summary of MSR technical support opportunities provided to the partnerships by NREL and Sandia.

Comparing the Risk Profiles of Renewable and Natural Gas Electricity Contracts: A Summary of the California Department of Water Resources Contracts
http://eetd.lbl.gov/ea/EMS/reports/50965.pdf
Devra Bachrach
Different electricity generating technologies clearly impose different risks on electricity ratepayers. The purpose of this report is to look at a sizable and publicly available sample of electricity contracts, and to specifically compare how long-term contracts with natural gas-fired and renewable generators differentially allocate and mitigate certain risks.

Our contract sample comes from the California Department of Water Resources' electricity contracts. The risks that we consider include fuel price and supply risks, demand risk, performance risk, environmental compliance risk, and regulatory risk.

The full report is quite detailed and involved, but the executive summary can easily be read without venturing into the full paper. Perhaps the greatest value of this report is educational in nature: those who are unfamiliar with the detailed contents of power purchase contracts, or how risks are treated differentially in renewable energy and natural gas-fired electricity contracts, may well find this useful.
Ryan Wiser, Mark Bolinger, and William Golove, Lawrence Berkley Laboratory, report #50965. April 2003, 108 pages.

PV in Commercial Buildings−Mapping the Breakeven Turn-Key Value of Commercial PV Systems in the US
www.millionsolarroofs.org/articles//static/1/binaries/Commercial_CSPV_Paper_cph.pdf#search=%22PV%20in%20Commercial%20Buildings%E2%88%92Mapping%20The%20Breakeven%20Turn-Key%20Value%20Of%20Commercial%20PV%20Systems%20In%20The%20U.S.%20%22

Rapid market growth for customer-sited photovoltaics (CSPV) is the direct result of new policy, program and tariff related incentives developed by a variety of energy industry stakeholders. In previous publications, the authors investigated the geographical distribution of the economic feasibility of customer-owned commercial PV systems in the United States to assess the commercial market value. The market value is presented as a breakeven turn-key cost (BTC) by analyzing the installed and operating costs relative to incentives, energy savings, and externality values over the life of the PV system.

This paper provides an updated snapshot of the commercial BTC values for the United States. Included in the paper are:

- Current federal, state, and local policies, programs, and tariffs (production incentives)
- A tiered map of commercial BTC values
- Representative commercial BTC, in a chart for the 50 states plus the District of Columbia, with stacked values of policy, energy, and externalities
- A chart indicating the additional value of local government and utility policies.

The paper provides a measure of both the market value for industry targeting and the potential for incentives to affect market growth.
Christy Herig, Subcontractor, National Renewable Energy Laboratory; Richard Perez, ASRC, The University at Albany; Susan Gouchoe, North Carolina Solar Center; and Tom Hoff, Clean Power Research.
Paper presented at ASES in Austin, June 2003. Six pages.

The Role and Value of Utilities in Promoting PV
www.millionsolarroofs.org/articles//static/1/binaries/The_Role_and_Value_of_Utilities_in_Promoting_PV.pdf
Christy Herig, NREL
Invited paper PVSEC12, Proceedings of the 12th International Photovoltaic Science and Engineering Conference. Provides issues discussion and analysis to show the monetary benefits and minimum distribution system impact from PV to utilities. Three pages.

Other Publications

Credit Ratings and Photovoltaic Investments
http://millionsolarroofs.org/articles/static/1/binaries/Credit_Ratings_and_PV_Investments.pdf

Barriers and Solutions for Connecting PV to the Grid
http://millionsolarroofs.org/articles/static/1/binaries/Barriers_and_Solutions_for_Connecting_PV_to_the_Grid.pdf

Reduce, Reuse and Renew: One Possible Approach to Cut Carbon Emissions
http://millionsolarroofs.org/articles/static/1/binaries/Reduce_Reuse_and_Renew_One_Possible_Approach_to_Cut_Carbon_Emissions.pdf

Managing Risk Using Renewable Energy Technologies
http://millionsolarroofs.org/articles/static/1/binaries/Managing_Risk_Using_Renewable_Energy_Technologies.pdf

A Microgrid with PV, Fuel Cells and Energy Efficiency
http://millionsolarroofs.org/articles/static/1/binaries/Microgrid_with_PV_Fuel_Cells_and_Energy_Efficiency.pdf

Clean Distributed Resources on Block Island, Rhode Island
http://millionsolarroofs.org/articles/static/1/binaries/Clean_Distributed_Resources_on_Block_Island_RI.pdf

Distributed PV's Contribution to Energy Security: Tax Revenue Protection for the Federal Government
http://millionsolarroofs.org/articles/static/1/binaries/Distributed_PV_Contribution_to_Energy_Security_2003.pdf

Connecting to the Grid: A Guide to PV Interconnection Issues
www.irecusa.org/pdf/guide.pdf

Customer Sited PV: A State Market Analysis
http://millionsolarroofs.org/articles/static/1/binaries/Customer_Sited_PV_A_State_Market_Analysis.pdf

Remote Monitoring of PV Performance Using Geostationary Satellites
http://millionsolarroofs.org/articles/static/1/binaries/Remote_Monitoring_of_PV_Performance_Using_Geostationary_Satellites.pdf

An Assessment of Renewable Electric Generating Technologies in Florida
www.psc.state.fl.us/industry/electric_gas/Renewable_Energy_Assessment.pdf

A Consumer's Guide to Buying a Solar Electric System
http://millionsolarroofs.org/articles/static/1/binaries/Consumers_Guide_to_Buying_a_Solar_Electric_System_Template.pdf

Residential Solar Financing: Homeowners Save, Banks Profit
http://millionsolarroofs.org/articles/static/1/binaries/Residential%20Solar%20Financing%20Power%20Shift.pdf

Standard Technical Specification for PV Systems—John Wiles
http://millionsolarroofs.org/articles/static/1/binaries/The_Specification.pdf

Bid Specifications for PV Power System for Chula Vista PD
http://millionsolarroofs.org/articles/static/1/binaries/Chula%20Vista%20PD%20PV%20system.pdf

Bureau of Land Management (BLM) Specifications for PV Power System
http://millionsolarroofs.org/articles/static/1/binaries/BLMSpecification.pdf

Florida Solar Energy Center: Technical and General Bid Requirements for Procuring PV Systems
http://millionsolarroofs.org/articles/static/1/binaries/Technical%20Bid%20Specifications%2015%20Sept%202000.pdf

Technical Specifications for PV Lighting Systems—Virgin Islands Energy Office
http://millionsolarroofs.org/articles/static/1/binaries/VILightingSpecsRev3.pdf

Niche Markets for Grid-Connected Photovoltaics
http://millionsolarroofs.org/articles/static/1/binaries/Niche_Markets_for_Grid_Connected_PV.pdf

Antares Letter Report on Solar Hot Water Heating Metrics
http://millionsolarroofs.org/articles/static/1/binaries/Antares_Letter_Report_on_Solar_Hot_Water_Heating_Metrics.pdf

Excel Spreadsheet on PV Production at Various Orientations
http://millionsolarroofs.org/articles/static/1/binaries/Excel_data_on_PV_Production_At_Various_Orientations_Modeled_Using_Sandia_PV_FORM_Software_Algorithm.pdf

Sustained Orderly Development and Commercialization of Grid-Connected Photovoltaics: SMUD as a Case Example
http://millionsolarroofs.org/articles/static/1/binaries/Sustained_Orderly_Development_and_Commercialization_of_Grid_Connected_PV_Smud_as_a_Case_Example.pdf

Mid-Atlantic States Cost Curve Analysis; Analysis of PG&E's Electric Distribution, Marginal Cost, Revenue Allocation and Rate Design
http://millionsolarroofs.org/articles/static/1/binaries/Mid_Atlantic_States_Cost_Curve_Analysis.pdf

Investing in Renewables: Risk Accounting and the Value of New Technology
http://millionsolarroofs.org/articles/static/1/binaries/Investing_in_Renewables_Risk_Accounting_and_the_Value_of_New_Technology.pdf

Allocating Risks: An Analysis of Insurance Requirements for Small-Scale PV Systems
http://millionsolarroofs.org/articles/static/1/binaries/Allocating_Risks_Analysis_of_Insurance_Requirements_for_Small_Scale_PV_Systems.pdf

Financing Solar Energy in the U.S.: An Introduction
http://millionsolarroofs.org/articles/static/1/binaries/Financing_Solar_Energy_in_the_%20US.pdf

Final Report on Photovoltaic Valuation—Breakeven Turnkey Costs for PV
http://millionsolarroofs.org/articles/static/1/binaries/Final_Report_on_PV_Valuation_Report_on_Breakeven_Turnkey_Costs_for_PV_for_Residential_and_Commercial_End_Users.pdf

PV and Grid Reliability: Availability of PV Power during Capacity Shortfalls
http://millionsolarroofs.org/articles/static/1/binaries/PV_Grid_Reliability_Availability_of_PV_Power_During_Capacity_Shortfalls.pdf

An Assessment of Photovoltaic Energy Availability during Periods of Peak Power Prices
http://millionsolarroofs.org/articles/static/1/binaries/Assessment_of_PV_Energy_Availability_During_Periods_of_Peak_Power_Prices.pdf

Mapping the Value of Commercial PV Systems in the U.S.—Accounting for Externalities
http://millionsolarroofs.org/articles/static/1/binaries/Mapping_the_Value_of_Commercial_PV_Systems_in_the_US_Accounting_for_Externalities.pdf

Valuation of Demand-Side Commercial Photovoltaic Systems in the United States
http://millionsolarroofs.org/articles/static/1/binaries/Valuation_of_Demand_Side_Commercial_PV_Systems_in_the_US.pdf

Photovoltaics as a Long-Term Solution to Power Outages Case Study: The Great 1996 WSCC Power Outage
http://millionsolarroofs.org/articles/static/1/binaries/PV_as_a_Long_Term_Solution_to_Power_Outages_Case_Study_The_Great_1996_WSCC_Power_%20Outage.pdf

Quick Screen: A Distributed Resource Planning Tool
http://millionsolarroofs.org/articles/static/1/binaries/Quick_Screen_A_Distributed_Resource_Planning_Tool.pdf

Arizona Solar Portfolio Standard Analysis
http://millionsolarroofs.org/articles/static/1/binaries/Solar_Portfolio_Standard_Analysis_Arizona.pdf

Net Metering Brief for the State of Hawaii
http://millionsolarroofs.org/articles/static/1/binaries/Net_Metering_Brief_for_state_of_Hawaii.pdf

Clean Distributed Resources in the U.S. Residential Market
http://millionsolarroofs.org/articles/static/1/binaries/Clean_Distributed_Resources_in_the_US_Residential_Market.pdf

An Historic Opportunity for Photovoltaics and Other Distributed Resources in Rural Electric Cooperatives
http://millionsolarroofs.org/articles/static/1/binaries/An_Historic_Opportunity_for_PV_and_Other_Distributed_Resources_in_Rural_Electric_Coops.pdf

Distributed Resources: A Potentially Economically Attractive Option to Satisfy Increased Demand on Okanogan County Electric Cooperative's "Mazama Feeder" Line
http://millionsolarroofs.org/articles/static/1/binaries/Satisfying_Increased_Demand_on_Okanogan_County_Electric_Coop_Mazama_Feeder_with_Distributed_Resources.pdf

The Benefits of Distributed Resources to Local Governments: An Introduction
http://millionsolarroofs.org/articles/static/1/binaries/Benefits_of_Distributed_Resources_to_Local_Governments.pdf

Reliable, Sustainable and Affordable: Maintaining Public Benefits in Florida's Electric System
http://millionsolarroofs.org/articles/static/1/binaries/Reliable_Sustainable_and_Affordable_Maintaining_Public_Benefits_in_Florida_Electric_System.pdf

Residential Customer-Sited Photovoltaics Markets 1999
http://millionsolarroofs.org/articles/static/1/binaries/Residential_Customer_Sited_PV_Markets_1999_with_Emissions_Data.pdf

Mini Grids, Big Opportunities
http://millionsolarroofs.org/articles/static/1/binaries/Mini_Grids_Big_Opportunities_Page_3_EPRI_Signature_A_Power_Quality_Newsletter.PDF

Customer-Sited Photovoltaics: State Market Analysis
http://millionsolarroofs.org/articles/static/1/binaries/cspv2002final.doc

Workshops

2006 Workshops

Southwest P2P in Features Albuquerque's Successes
www.millionsolarroofs.org/articles/static/1/1144885436_1137083769.html
The Albuquerque Balloon Museum was the backdrop for the Southwest P2P Workshop held April 4−5, 2006. Though representatives from seven partnerships attended, from Texas to Hawaii, some 17 members of the New Mexico team, from the Governor's Office to the City's Office of Facilities, made an impressive showing.

Southeast P2P Workshop Focuses on Transitions
www.millionsolarroofs.org/articles/static/1/1143569387_1137083769.html
The Southeast P2P workshop, held in Atlanta on March 21−22, 2006, focused on regional cooperation and transitions. About 16 people representing seven partnerships were at the P2P.

Northeast P2P Workshop Draws Good Crowd; 14 Partnerships, 4 SBCs Represented
www.millionsolarroofs.org/articles/static/1/1142516461_1137083769.html
The Northeast P2P workshop, held on March 7 at the World Trade Center in Boston, drew a crowd of 30, representing 14 partnerships, four System Benefit Charge providers, and the new Executive Director of the New York Solar Energy Industries Association.

P2P Workshop in Portland, Oregon for Western and Central Regional Partnerships Draws Good Crowd
www.millionsolarroofs.org/articles/static/1/1141137864_1137083769.html
Portland, Oregon was the site of the first P2P for 2006. More than 20 people attended, representing partnerships from Oregon, Nevada, Marin County, Washington State, Anaheim, San Diego, and Boulder for the Western and Central Regions.

2005 Workshops

DOE's Mid-Atlantic Region Hosts MSR Peer-to-Peer Workshop in December 2005
www.millionsolarroofs.org/articles/static/1/1133754516_1073553349.html
The Mid-Atlantic Region's Solar P2P was held December 6−7, 2005 in Philadelphia, Pennsylvania.

Central and Western Region Host MSR P2P Workshop in Phoenix

The Southwest Solar P2P Workshop was held May 18−19, 2995 in Phoenix. 29 people attended include representatives from 18 MSR Partners.

2004 Workshops

All Colorado Partnership Meeting
www.millionsolarroofs.org/articles/static/1/1101670359_1073553261.html
Colorado's MSR partnerships met to discuss how their individual efforts could be combined and set a more cohesive direction for the program. Margie Bates, MSR

regional coordinator for DOE's Central Region, coordinated the first meeting. Nine Colorado MSR partnerships attended. The presentations from that meeting are available.

P2P Workshop in Vermont
www.millionsolarroofs.org/articles/static/1/1101659106_1073553261.html
The P2P workshop in Burlington, Vermont on October 12−13, 2004 for DOE's Northeast Region, provided information exchange between the partnerships, training, and briefings on important issues. More than 40 people from nearly all of the northeast MSR partnerships attended.

Midwest P2P Workshop Focuses on Regional Approach to Problem Solving
www.millionsolarroofs.org/articles/static/1/1096389629_1073553261.html
The MSR P2P workshop held in Minneapolis on September 14−15, 2004 for DOE's Midwest Region, provided information exchange between the partnerships, training, and briefings on important issues.

Mid-Atlantic P2P Workshop
www.millionsolarroofs.org/articles/static/1/1088090991_1073553261.html
The 3rd annual P2P meeting of Mid-Atlantic MSR Partnerships was held on August 4−5, 2004 at the University of Delaware in Newark, Delaware. The workshop focused on renewable portfolio standards, renewable energy credits, and net metering and interconnection standards.

SF P2P Workshop
www.millionsolarroofs.org/articles/static/1/1084552079_1073553261.html
Thirty-nine people representing 16 MSR partnerships attended the Northwest P2P workshop in May, 2004 focused on solar home tours, solar on public buildings and solar in new home construction. The presentations from that P2P are available.

Albuquerque P2P Workshop
www.millionsolarroofs.org/articles/static/1/1083237893_1073553261.html
Presentations from the March 24-25, 2004 P2P Workshop in Albuquerque, focusing on solar schools, renewable energy portfolio standards, and codes and standards issues, are now available.

Southwest P2P in Albuquerque Focuses on Solar Schools; Attendees View "Sunrise"
www.millionsolarroofs.org/articles/static/1/1080682126_1073553261.html
Presentations from the Workshop in Albuquerque, which focused on solar schools, renewable energy portfolio standards, and codes and standards issues, are available. More than 20 people came to the first MSR P2P of 2004 in Albuquerque, New Mexico on March 24−25. For this P2P, the Denver and Seattle ROs combined efforts to focus on solar schools. Attendees were able to preview the Arizona MSR partnership's production of "Sunrise," a documentary that was aired on Arizona Public television.

2003 Workshops

Southeast P2P Workshop
www.millionsolarroofs.org/articles/static/1/1068656635_1073553096.html
Weatherization, marketing, utility, and green power programs headlined the Southeast MSR P2P workshop on October 22−23, 2003 at the Florida Solar Energy Center in Cocoa, Florida. The workshop was organized by IREC for the MSR program.

Northeast MSR P2P Workshop
www.millionsolarroofs.org/articles/static/1/1065461240_1073553096.html
On September 25−26, 2003, Maine hosted the annual Regional MSR P2P Conference at the stately Eastland Park Hotel in Portland. More than 40 people attended, representing Maine, Massachusetts, Rhode Island, New York, and Vermont, and Ontario, Canada.

Portland P2P Workshop Highlights Public Awareness, Certification, Industry Perspective
www.millionsolarroofs.org/articles/static/1/1063320743_1073553096.html
The Northwest P2P workshop, held September 4−5, 2003 in Portland, Oregon, attracted 20 participants representing eight MSR partnerships. Presentations on certification of solar practitioners, public awareness strategies, an industry track, and impacts of local solar policies filled the day-and-a-half workshop.

Seminars

2006 Seminars

September 12, 2006 Telephone Call Seminar: Performance-Based Incentives
www.millionsolarroofs.org/articles/static/1/1155082768_1137083754.html
The next IREC Telephone Seminar will be Tuesday, September 12. The seminar will last for 1 hour and 15 minutes.

June 27 Telephone Seminar: PV Impacts on Peak Loads
www.millionsolarroofs.org/articles/static/1/1149179899_1137083754.html
This MSR Telephone Seminar was held on Tuesday, June 27. Ninety-one people attended the seminar, led by Rob Hammon.

May 3 Seminar, PV Module Supply Issues, Has Largest Attendance Yet
www.millionsolarroofs.org/articles/static/1/1147288047_1137083754.html
The May call seminar for the Solar Powers America program on "PV Module Supply Issues," by Michael Rogol, drew one of the largest audiences ever to the seminar series. Some 110 people attended.

May 3, 2006 Telephone Seminar: PV Module Supply Issues
www.millionsolarroofs.org/articles/static/1/1145316491_1137083754.html
The Solar Powers America (formerly Million Solar Roofs) Telephone Seminar lasted for 1 hour and 15 minutes.

Financing for Public Sector Renewable Energy Projects, Tuesday, 2/14/06
www.millionsolarroofs.org/articles/static/1/1138196910_1137083754.html
The Solar Powers America (formerly Million Solar Roofs) Telephone Seminar was held on Tuesday, February 14.

2005 Seminars
December 8th Telephone Seminar—Solar for Disaster Response and Recovery
www.millionsolarroofs.org/articles/static/1/1131554528_1073553284.html
Solar Powers America (formerly MSR) Telephone Seminar on Solar for Disaster Response and Recovery was held on December 8, 2005. Many solar energy applications are appropriate for the response and recovery operations. This seminar taught appropriate solar applications and how to work with disaster agencies.

Telephone Seminar—Solar in the Energy Bill
www.millionsolarroofs.org/articles/static/1/1125585187_1073553284.html
The MSR Telephone Seminar, held on September 27, was one of the more heavily attended telephone seminars sponsored by MSR. More than 150 people attended the seminar, presented by the Solar Energy Industry Association's President, Rhone Resch.

March 23 Seminar on Local Code & Building Inspectors on Solar Electric PV Guidelines
www.millionsolarroofs.org/articles/static/1/1108514516_1073553284.html
The third MSR Phone Call Seminar of 2005 was held on March 23. The seminar, Inspector Guidelines for PV Systems, and a follow-up to a seminar held last November, lasted 1 hour and 15 minutes. Bill Brooks, of Brooks Solar Engineering, led the seminar.

Telephone Seminar, Zero Energy Homes, February 16, 2005
www.millionsolarroofs.org/articles/static/1/1105727215_1073553284.html
The MSR Telephone Seminar had 130 attendees. ZEHs optimally combine renewable technologies with highly energy efficient building envelopes, appliances, lighting, automated controls, and HVAC systems.

Telephone Seminar, PV Industry Roadmap, January 13, 2005
www.millionsolarroofs.org/articles/static/1/1102958141_1073553284.html
The MSR Telephone Seminar lasted for 1 hour and 15 minutes. The topic was PV Industry Roadmap. Rhone Resch, executive director of the Solar Energy Industries Association, led the seminar. The seminar was free for Million Solar Roof partners.

2004 Seminars
November 10 Phone Call Seminar on Inspector Guidelines
www.millionsolarroofs.org/articles/static/1/1097592491_1073553225.html
The MSR Phone Call Seminars resumed on November 10. The seminar was led by Bill Brooks, Endecon Engineering. More than 80 phone lines participated.

February 26 Conference Call Seminar on USDA and HUD Assistance for Solar
www.millionsolarroofs.org/articles/static/1/1076611401_1073553225.html

The second MSR Conference Call Seminar of 2004 Seminar was held on February 26. The topic was Federal Resources for Solar from USDA and HUD.

January 29 Conference Call Seminar on Interconnection and Net Metering
www.millionsolarroofs.org/articles/static/1/1074006729_1073553225.html
Solar Roofs Conference Call Seminar was on interconnection and net metering.

2003 Seminars
The November 6 Conference Call Seminar Focused on Energy Surety
www.millionsolarroofs.org/articles/static/1/1066225738_1073552950.html
The MSR conference call seminar focused on using distributed energy resources to improve energy surety in communities. David Menicucci, Sandia National Laboratories, and Valerie Rauluk, Greater Tucson Coalition for Solar Energy, presented the seminar.

July 31 MSR Seminar Addressed Utility Solar Hot Water Programs
www.millionsolarroofs.org/articles/static/1/1057240297_1073552950.html
The MSR program hosted the third in a six-part Conference Call Seminar series. The topic, Utility Solar Hot Water Programs, featured presentations from Maui Electric (Hawaii), Eugene Water and Electric Board (Oregon), and Sterling Energy.

The MSR Conference Call Seminar on Solar for Affordable Housing was held on Wednesday, April 16, 2003
www.millionsolarroofs.org/articles/static/1/1050326841_1073552950.html

February 19, 2003 MSR Conference Call Seminar—Tax Exempt Financing for Solar Projects for State and Local Governments
www.millionsolarroofs.org/articles/static/1/1046965861_1073552950.html
This seminar, held on February 19, 2003, focused on the most common form of public sector financing—the tax-exempt lease from private sector finance companies.

Appendix B: Barriers and Million Solar Roofs Partnership Accomplishments

Barrier to Solar Deployment	Examples of MSR Partner Accomplishments
High costs	▪ Helped develop incentive programs ▪ Launched Solar Projects Fund ▪ Developed sample business plan for utilities considering green power marketing strategies ▪ Prepared report on new funding mechanism for residential solar
Lack of consumer awareness and understanding	▪ Implemented Solar in Schools programs ▪ Organized teacher training workshops ▪ Conducted solar home tours ▪ Created videos ▪ Created displays to go with solar installations in public places ▪ Published directories and consumer guides ▪ Conducted workshops ▪ Worked with the media ▪ Ran solar hot lines and responded to inquiries ▪ Developed Web sites ▪ Created displays and traveling exhibits ▪ Conducted annual solar events and fairs
Interconnection standards that inhibit solar electric development and disincentives against net metering	▪ Organized interconnection and net metering workshops for utilities ▪ Worked to develop interconnection and net metering standards
Lack of trained installers and inspectors and manufacturing workforce	▪ Conducted training for code officials, building inspectors, installers, contractors, and electricians ▪ Established solar licenses ▪ Launched 2-year renewable energy degree at community college
Lack of solar-friendly building practices, standards, and zoning	▪ Worked with homeowner associations on codes, covenants, and restrictions ▪ Worked on revisions to building codes ▪ Worked to pre-certify small PV systems ▪ Worked with government agencies to change permitting and licensing rules ▪ Published directory of local building codes, fees, and permits required for solar installations
Lack of knowledge and best practices to architecturally integrate solar into overall designs	▪ Organized technical workshops for architects, contractors, engineers, and real estate professionals ▪ Created solar potential map ▪ Provided technical assistance for pilot ZEH ▪ Surveyed builders on ZEH concept ▪ Worked with privatization contractors to ensure that privatized military housing includes solar hot water

Barrier to Solar Deployment	Examples of MSR Partner Accomplishments
Lack of financing options and no well-defined value analysis	▪ Created third-party financing mechanism for institutional solar thermal projects ▪ Launched financing of grid-connected PV systems ▪ Created low or zero interest loan programs ▪ Analyzed PV energy forecasts compared with actual kWh output
Inconsistent government policy related to PV and lack of access to System Benefit Funds for Solar Thermal.	▪ Commissioned CPA review of tax incentives ▪ Worked with local and state governments to develop policy initiatives
Lack of Energy Star® and other validations of performance	▪ Resolved technical difficulties with early systems ▪ Developed model ZEHs for affordable housing
Consumer accessibility issues: lack of standard products and purchasing channels	▪ Conducted market study on selling solar to commercial customers ▪ Investigated co-op to aggregate purchases ▪ Funded PV installers and dealers to develop innovative marketing materials

Appendix C: Categories of Million Solar Roofs Partners

Following are examples of the kinds of partners enrolled in MSR Partnerships:

Electric and Gas Utilities: investor-owned utilities, rural electric cooperatives, municipal utilities, and other energy providers

Private Sector Partners, Building Trades: construction firms, builders and developers, plumbers, electricians, architectural and design firms, builder associations, individuals

Private Sector Partners, Solar Energy Industry: solar equipment manufacturers and aggregators, inverter manufacturer, distributors, retailers, installers, corporations, individuals, solar contractors

Private Sector Partners, General: banks, financiers, trade associations, property management, graphics

Labor: International Brotherhood of Electrical Workers

Government, Local: municipalities and associations; mayors' offices' housing authorities; departments of parks and recreation, planning, natural resources, brownfields agencies

Government, State: energy offices, economic and community development agencies, consumer advocates, departments of environmental quality; NY Board of Fire Underwriters

Government, Federal: Environmental Protection Agency, Western Area Power Administration, USDA Forest Service, national laboratories

Nonprofit Organizations: Chambers of Commerce, Habitat for Humanity, Low-Income Weatherization providers, environmental groups

Agricultural: resource conservation and development districts, poultry associations

Academia: colleges and universities, community colleges, science centers, schools and school districts

High Visibility: National Aquarium, Baltimore; Shea Stadium, New York City

Appendix D: Million Solar Roofs Partners

Alabama	Alabama
Alaska	Alaska Sun
American Samoa	American Samoa
Arizona	Arizona Solar Initiative Greater Tucson Coalition for Solar Energy North East Arizona Salt River Project
Arkansas	Little Rock
California	Alameda County Solar Partnership Bay Area Solar Consortium California Clean Energy Partnership City and County of San Francisco City of Anaheim City of Los Angeles Great Valley Solar Partnership Humboldt County Marin Solar Program Sacramento Municipal Utility District San Diego Regional Energy Office Santa Barbara County Santa Monica Solar Potential Study Tahoe-Nevada Area Ventura County
Colorado	Boulder Community Partnership Colorado Renewable Energy Society Colorado Solar Energy Industries Association Colorado Western Slope Community Office for Resource Efficiency Denver Front Range Area – IBEW Farm Focus Colorado Northern Colorado SolarBound Northwest Colorado Partnership San Luis Valley Southeast Colorado Solar Energy Coalition
Connecticut	Solar Connecticut North Solar Connecticut South
Delaware	Delaware Million Solar Roofs Coalition
District of Columbia	District of Columbia Solar Initiative
Florida	Florida SunSmart
Georgia	Georgia

Hawaii	Island of Hawaii Island of Kauai Island of Maui Island of Oahu
Idaho	Idaho PV4You Solar Working Group
Illinois	Chicago Solar Partnership
Iowa	State of Iowa
Kentucky	Kentucky Solar Partnership
Maine	State of Maine
Maryland	State of Maryland
Massachusetts	Brockton Solar Champions Partnership Cape Cod Massachusetts National Grid USA Newton SUNERGY Solar Boston Vineyard Energy Project
Michigan	Great Lakes Renewable Energy Association
Minnesota	Solar Minnesota
Mississippi	Mississippi
Missouri	Missouri
Montana	Montana
Nebraska	Farm Focus Nebraska
Nevada	Nevada
New Hampshire	New Hampshire
New Jersey	New Jersey
New Mexico	Neighborhood Solar State of New Mexico
New York	Big Apple Solar Installation Commitment City University of New York MSR Collaborative Long Island New York State Energy Research and Development Authority
North Carolina	North Carolina
Ohio	Solarize Ohio
Oregon	Oregon Million Solar Roofs Coalition
Pennsylvania	Pennsylvania Philadelphia
Puerto Rico	Island of Puerto Rico
Rhode Island	State of Rhode Island
South Carolina	South Carolina

Tennessee	Big Frog Mountain Corporation Tennessee
Texas	Solar San Antonio Texas
Utah	ONASI Solar Partnership Salt Lake City Utah Energy Office
Vermont	Vermont
Virgin Islands	Virgin Islands
Virginia	Virginia
Washington	Washington Whatcom County
West Virginia	West Virginia Solar Energy Initiative
Wisconsin	Wisconsin

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As the U.S. Department of Energy's Solar Energy Technology Program embarks on the next phase of its technology acceptance efforts under the Solar America Initiative, there is merit to examining the program's previous market transformation effort, the Million Solar Roofs Initiative. Its goal was to transform markets for distributed solar technologies by facilitating the installation of solar systems.

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