CESA State Program Guide

STATE STRATEGIES TO FOSTER SOLAR HOT WATER SYSTEM DEPLOYMENT

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ABSTRACT

Clean Energy States Alliance (CESA) believes that now is the time for states to pursue programs that bring the benefits of solar hot water (SHW) technology to home and business owners. Solar hot water programs are an effective strategy for states to help end users acheive financial and energy savings, reduce natural gas use, and lower greenhouse gas emissions. This report describes a number of straightforward strategies that states can implement to support adoption of SHW technologies, including provision of finanical incentives, training for installers, and education to help customers make informed decisions.

ACKNOWLEDGEMENTS

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The findings and conclusions expressed in this paper are those of the author alone.

This report provides CESA members with recommendations for the development of effective solar hot water (SHW) incentive programs. This memorandum addresses SHW's potential, obstacles to the realization of this potential, and mechanisms by which states can overcome these obstacles.

INTRODUCTION

Solar hot water energy systems use collectors to gather heat from the sun to heat water for use in commercial or residential buildings. The most common applications are to heat water for domestic purposes and for swimming pools and spas.

SHW in the U.S. grew significantly in the 1970s and early 1980s as a result of generous tax credits and increasing energy prices. However, the expiration of these tax credits and decreasing energy prices nearly eliminated the U.S. market in the mid-1980s.

Recently, increasing energy prices, concerns regarding greenhouse gas emissions, and improved solar thermal technology have reinvigorated the market worldwide. For example, the European solar thermal market grew 47% in 2006 and is forecasted to continue growing in 2007.[1] In the U.S., several states have instituted incentive programs to stimulate the SHW market.

This report provides states with information, resource materials, and recommendations on program design and strategies to promote solar hot water technology applications.

TECHNICAL POTENTIAL OF SOLAR HOT WATER

According to a 2007 report by NREL[2], liquefied natural gas (LNG) imports are projected to increase 500% between 2004 and 2020. Solar water heating is one of the readily deployable technologies available to reduce LNG demand. (A recent study by KEMA-Xenergy determined that SHW could save more natural gas in California than any other technology.) By assessing solar thermal system performance and regional rooftop availability, NREL has estimated the technical potential of SHW in terms of end-use energy reduction, primary energy reduction, and carbon emissions reduction.

- *End-Use Potential*. Nationally, NREL estimates that 657 trillion BTU could be saved. At 2004 energy prices, this amounts to an annual savings of $8.4 billion per year.
- *Primary Energy Displacement Potential.* Calculating direct and indirect displacements, NREL estimates that between 2.6% and 4.1% of total U.S. gas production could be displaced by SHW systems.
- *CO_2 Emissions Reduction Potential.* SHW has the potential to reduce the U.S. total carbon emissions of 5900 million metric tons by somewhere between 50 and 75 million metric tons. This would constitute a 1% reduction, or 2%–3% reduction within the residential and commercial building sectors.

MARKET OBSTACLES

As a result of federal and state tax incentives, the solar thermal industry expanded in the 1970s and early-1980s; however, since then, solar thermal's market has been flat with little growth in demand in the last ten years. The reason for this lack of market penetration is the combination of poor-quality installations and unstable financial incentive structures.

The good news is that, since the early 1970s, SHW systems have become more reliable, more efficient, and less expensive. Nonetheless, several recent studies[3] describe barriers to SHW's penetration of the market. These barriers include high capital costs, a lack of skilled installers, a lack of consumer-oriented information, and negative public perception.

Cost

The payback period on a SHW system depends on several factors, including the size and efficiency of the system, climate, energy prices, and available financial incentives. The cost of installing a SHW system on an existing home ranges from $6000 to $10,000 for a two panel system, depending on the vendor and the siting complexity. New home installations are somewhat less expensive (10-20% less). However, prices are currently rising due to material cost increases and higher labor costs. The solar equipment generally accounts for 60-70% of the total system cost and installation accounts for 30-40%. The existing federal tax credit reduces the effective cost by 30%.

According to a 2005 assessment of Oregon's SHW program[4], the average residential SHW system owner saves $177.70 per year. At that rate it would take over 23 years to recover the cost of a $4200 system. More encouragingly, a 2007 report by the Environment California Research and Policy Center[5] estimates an eight-year payback period at current California energy prices.

Cost is a barrier. However, as energy prices continue to rise, the payback period on SHW system investment will continue to shorten. States can stimulate this process through financial incentives.

The Challenge of the Commercial Sector

SHW programs around the country have had limited success in promoting these systems in the commercial sector. Because of the long payback and the interest of most businesses in seeing a 2-3 year payback on capital investments, the commercial sector presents a big challenge for state incentive programs. In response, one suggestion is for state programs to focus efforts in the commercial sector on pools at schools, health clubs, and hotels because pool-heating systems are one of the most cost effective types of solar installation for the commercial sector.[6]

Education

On the demand side, consumers often are unaware of the costs and benefits of SHW systems. According to a recent Oregon report, many Oregon SHW system owners had either previously owned a system or knew someone who had. The report finds that most consumers think SHW systems are uneconomical, unattractive, and not effective in a climate such as Oregon's. These concerns do not reflect the industry's recent efficiency and aesthetic improvements.

A 2007 paper prepared by the San Diego Regional Energy Office (SDREO) for its SHW pilot program made the same observation – that consumers lack knowledge about the financial benefits of solar water heaters. The SDREO paper notes that potential customers have to solicit information from many sources, including libraries, websites, local utilities, and contractors. The time and effort spent obtaining this information can be a substantial cost in installing a SHW system.

Education is also needed on the supply side. Not only is there a shortage of skilled SHW system installers, but those who are skilled often discourage consumers from purchasing them. This industry resistance reinforces itself, since the fewer SHW systems that are installed, the more likely it is that those installed will be done so inefficiently or incorrectly.

Reputation

Another market barrier is the poor reputation that SHW acquired in the 1970s. State programs need to create a more positive public association with SHW systems.

SOLUTIONS

Developing an Industry

The current solar thermal industry is small and localized. To support growth in demand, states need to support efforts to expand the local industry while maintaining high quality and credibility. The following are ways in which state programs can facilitate this growth.

Standards, Certification, Warranties, and Inspections

It is important that state programs ensure both quality equipment and installation. Since the 1970s, the efficiency and reliability of solar heating systems have increased greatly and costs have dropped. Today, the technology is robust and stable and expected to remain so.

To protect against past and perceived system performance issues, the U.S. Solar Rating & Certification Corporation's (SRCC) now has developed certification, rating, and labeling programs for solar collectors (OG100 operating guidelines) and for complete solar water and swimming pool heating systems (OG300 operating guidelines), to ensure product safety, reliability, and performance.[8] The programs require nationally accepted equipment tests on solar equipment by independent laboratories, which are accredited by the SRCC. Equipment, which is certified and rated by SRCC,

is required to bear the SRCC certification label to show the performance rating. These equipment standards are well accepted by the market today.[9] To receive a SRCC certification, a system also must meet the Department of Housing and Urban Development's minimum properties standards in addition to the SRCC's own rigorous review.

Currently, many state-based incentive programs for solar hot water require 1 to 5 year warranties. The San Diego pilot program has the most protective warranty requirement today. The program requires a minimum warranty of 10 years on the solar collectors, 5 years on the balance of system components, and 1 year on installation labor and workmanship.

Solar water heating programs vary considerably with respect to inspections. The range includes no inspection (Arizona Public Service Company), leveraging other inspections, and a detailed inspection of each installed system (Energy Trust of Oregon). In Oregon, the cost of 100% system inspections is somewhat costly, at about $325 per inspection.

Training and Support for Installers

Installers play an important role in market development. Today, the industry lacks a broad network of motivated, experienced installers. Heating and roof installers lack knowledge and motivation, so often do not propose solar thermal systems to their customers. Therefore, state programs should promote special initiatives focused on installers, including encouraging participation in specific training courses. Plumbers are the largest group of potential installers. A state program may want to target recruitment of new contractors by educating a cross-section of contractors about the business opportunities that solar water heating can offer, and provide associated tools and information. In addition, the North American Board of Certified Energy Practitioners now has implemented a Solar Thermal Installer Certification which states can rely on to support educated installers.

Ensuring Program Stability

Similar to ensuring the effectiveness of solar PV programs, SHW incentives will be ineffective if there is no guarantee that they will last for a significant duration so that the industry can plan and invest in a durable market. Only a stable incentive program will promote the industry investment needed.

Creating Demand

Creating demand for SHW systems requires information and education, marketing, and financial incentives.

Marketing

Current state and utility efforts to market SHW systems are limited. Installers have little time for marketing. Utilities generally do not promote their SHW programs. Therefore, creating demand will require targeted marketing efforts to raise awareness of programs.

- Marketing messages should balance an environmental, economic, and security rationale for SHW systems. Using only environmental messages overlooks important market segments.
- Make the business case by providing credible information and analysis tools to businesses that address the costs and benefits of SHW systems.
- Target likely buyers first, such as pool and spa owners and purchasers of other energy efficient products.
- Consider funding cooperative advertising efforts with solar water heating manufacturers, distributors, and contractors to promote system installation.
- Consider funding demonstration projects with large new home builders to spur consumer interest and builder acceptance.
- Target large and consistent users of hot water, such as the hospitality, athletic and health industries. Develop and distribute outreach materials and campaigns with appropriate business associations.

Information and Education[10]

Education that personalizes the SHW experience should be provided through strategic partnerships with community groups, local governments, utilities, and environmental groups.

- Employ experience-based education, including displays that show how systems operate, demonstrations at home shows, tours, and profiling of highly visible solar applications.
- Provide easy access to information. This might include a website with up-to-date information on technology, application, cost, reliability, and safety of SHW systems; and lists of licensed installers.
- Promote successful applications – through demonstration projects or by installing a SHW system at community swimming pools, for example.
- Partner with business organizations to showcase SHW systems' business applications. Today, commercial business applications of SHW are almost non-existent.

Financial Incentives

Incentives can help to overcome the relatively high costs for SHW systems – the barrier that system purchasers most often mention. States have taken a variety of approaches, using a combination of tax incentives, capacity- and performance-based rebates, and loans. For a complete summary of state-sponsored financial incentives, see the "State-By-State Incentives for Solar Water Heating Projects"[11] at http://www.cleanenergystates.org/JointProjects/PV/SWH_Incentives_August07.doc. Several incentive structures used by CESA member states are described below. In particular, the programs in Oregon and a recent pilot project launched by San Diego Regional Energy Office represent particularly comprehensive efforts.

Recommendations for an Effective State Program Format

- Commit to a multi-year program. Establish a long-term, stable incentive program to ensure contractor and manufacturer investment in building capacity for this market.
- Develop financing options. Even with significant subsidies, solar water heating systems have significant up-front costs and long payback periods. Developing new financing methods will allow more consumers to install systems. See NYSERDA's EnergySmart Loan Program for an example of an effective financing approach, *http://www.nyserda.org/loanfund/*.

EXAMPLES OF LEADING STATE-BASED SHW PROGRAM APPROACHES

OHIO DEPARTMENT OF DEVELOPMENT

The Ohio Department of Development's Advanced Energy Program offers grants for SHW systems on a first-come, first-serve basis. Applicants for non-residential systems are eligible for $30 per kilo-BTU per day with a maximum grant of $150,000. Applicants for residential systems are eligible for $30 per kilo-BTU per day or 50% of the total project cost, whichever is less, with a maximum grant of $25,000. For more information, see *http://www.odod.state.oh.us/cdd/oee/elfgrant.htm.*

ARIZONA PUBLIC SERVICE COMPANY

Through its Solar Partners Incentive Program, the Arizona Public Service Company offers residential SHW system owners the opportunity to receive a one-time incentive of $0.50 per kilowatt hour of the estimated first-year savings, based on OG-300 for up to a maximum of $10,000. For more information, see *http://www.aps.com/main/green/choice/choice_2.html.*

WISCONSIN FOCUS ON ENERGY

Wisconsin Focus on Energy's Renewable Energy Program now targets solar water heating as one of its five targeted market segments. Residential SHW is included in the Renewable Energy Program portfolio because solar water heaters deliver three times as much energy per unit of collector area as solar electric systems and have better customer economic returns. The Program's intervention occurs in four areas: marketing, infrastructure development, rewards, and quality.

- ***Marketing*** – Because customers lack knowledge of solar water heating opportunities, Wisconsin's market for SHW systems is being increased through the following activities:
  - — Participation in a public awareness campaign
  - — Providing return on investment information through fact sheets
  - — Participation in outreach activities with targeted groups that are most likely to install SHW, including social organizations, the hospitality, health care and health enhancement industries, and municipalities

— Providing additional rewards of $500 to prior participants in the RE/EE program

— Implementation of a Wisconsin solar water heating conference

- ***Infrastructure Development*** – Wisconsin is supporting expansion of the supply chain infrastructure by increased interaction with the traditional plumbing and HVAC trades and their existing training process, with such activities as:

  — Participation and promotion in contractor sponsored trainings

  — Support of professional education training programs

  — Support of the site assessment process and training of site assessors

  — Cost shared funding for business development and marketing

  — Issuance of a RFP for specific demonstration and development of south wall heating to explore the economics and installation infrastructure needs

- ***Rewards*** – Rewards have been reassessed to provide about 25% of the installed cost of systems, based on expected annual energy saved by the system as determined by RETScreen solar hot water modeling software, available free and accessed through a link to the program website. The rebates are determined based on a sliding scale, with larger systems receiving smaller rewards per therm delivered than smaller systems. Nonprofit organizations receive higher incentives because they are not eligible for federal tax incentives.

- ***Quality*** – Wisconsin believes that customer confidence in the quality of the solar heating products and installation is critical to market expansion. The program, therefore, supports quality through required SRCC or equivalent equipment, inspections by third party inspectors on the majority of systems installed, support and promotion for installers to become NABCEP certified, and support of a collector testing facility.

ENERGY TRUST OF OREGON

Energy Trust of Oregon (ETO) began its Solar Water Heating Buy-Down Program in October, 2003. The program offers incentives to utility customers of Pacific Power, Portland General Electric (PGE), NW Natural and Cascade Natural Gas that install SHW systems.

- ***Financial Incentives*** – Oregon's SHW program provides the following residential financial incentives *directly to contractors*, who then pass on the savings to the customer. Commercial financial incentives are, by default, paid to the customer. Customers may opt to have the incentive paid directly to the contractor if it is preferred. The incentives are based on estimated first-year savings of a system:

  — Residential hot water with electric back-up heating: $0.40/annual kWh saved ($1500 cap).

- Residential hot water with gas back-up heating: $0.30/annual kWh saved ($1500 cap)
- Residential pools with electric back-up heating: $0.10/annual kWh saved ($1000 cap)
- Residential pools with gas back-up heating: $0.07/annual kWh saved ($1000 cap)
- Commercial hot water with electric back-up heating: $0.40/annual kWh saved, capped at 35% of project cost
- Commercial hot water with gas back-up heating: $6.00 annual therm saved, capped at 35% of project cost
- Commercial pools with electric back-up heating: $0.10/annual kWh saved, capped at 35% of project cost
- Commercial pools with gas back-up heating: $1.50/annual therm saved, capped at 35% of project cost

Oregon also provides the following tax credits, limited to 50% of system cost:[12]

- Residential hot water: $0.60/annual kWh saved (capped at $1500)
- Residential pools: $0.15/annual kWh saved (capped at $1500)
- Commercial: 50% of eligible system cost.

The current residential hot water incentive cap offered by ETO is $1500. This incentive, when combined with the state tax credit, can account for almost 50% of a residential customer's total system cost. This incentive is among the most generous among programs nationally.

- ***Contractor Support*** – To be eligible for the Oregon SHW incentives, a contractor must attend an ETO-sponsored training session. All contractors receive the following support:
  - Promotional materials, including program literature
  - Publicity, by being listed on the ETO website, and via case studies, news releases and events that promote the entire ETO program
  - Cooperative advertising funding, by sharing the costs of advertising, websites, business cards, and other marketing opportunities
- ***Consumer Support; Contractor Requirements*** – ETO assists customers by referring them to contractors in their trade ally network. The contractor helps the customer select the SHW system and provides a system quote estimating annual performance, installation date, and the cost after incentive deductions. Finally, the contractor will explain maintenance and warranty details and how to apply for any available tax credits.

  To participate in the program, a contractor must comply with several conditions, including

attending an ETO-sponsored solar water heating training, completing at least two projects per year, meeting specific insurance requirements, providing warranties of at least 2 years from final inspection on equipment and workmanship, and meeting inspection and evaluation requirements.

- ***Eligible Systems & Standards***[13] – Residential solar water heating systems must be SRCC OG-300 certified. In addition, the program has adopted the quality control requirements of *The Bright Way To Heat Water Program* (a program established by the Eugene Water and Electric Board to promote installation of energy saving residential solar water and pool heating systems in the Pacific Northwest's climate). A system also must be included on the ETO approved list of eligible systems.

  Commercial SHW systems may be engineered and do not require SRCC certification. However, collectors must have OG-100 certification, and the ETO requires a custom energy model to estimate annual energy savings.

  ETO uses a prescriptive per-square-foot yield for residential solar pool heating systems, while commercial solar pool systems must be engineered with custom energy modeling.

  The Program has set several minimum criteria for SHW systems to ensure the systems are long-lasting and meet or exceed performance expectations. For example, if the system collector is roof-mounted, the roofing material must have at least 15 years of useful remaining life.

  Prevention of excessive shading is another focus of the system requirements. The effect of shading on annual system savings must be calculated using a pre-approved method. Total Solar Resource Fraction, or the solar resource available after considering losses due to shading, and suboptimal tilt and orientation of the collectors must be no less than 75%. Other major requirements include protections against freezing conditions and leakage.

- ***Inspections*** – All projects must be pre-approved by ETO before installation of the system begins. ETO then inspects the majority of installations before paying incentives.

- ***Progress*** – The following list of SHW installations in Oregon shows the program's significant and growing progress and success:

  - 2003: 0 installations
  - 2004: 31 installations
  - 2005: 101 installations[15]
  - 2006: 203 installations

CALIFORNIA & SAN DIEGO SHW PILOT PROGRAM

California is an interesting case study because it is currently in the process of designing a new and comprehensive program. In October, California adopted the "Solar Water Heating and Efficiency Act of 2007," or AB 1470. The legislation creates a 10-year program aimed at installing 200,000 solar water heaters in homes and businesses, using a $250 million fund. The law authorizes

the California Energy Commission to "impose the surcharge at a level that is necessary to meet the goal." The surcharge will be applied to natural gas consumption on a per BTU basis, and it is estimated that it will cost the average residential natural gas user an additional 13 cents per month.

The rebates established by the Commission are to decline over time, providing early adopters with larger incentives. Similar to California's incentives for solar electric projects, the declining incentives are structured in an effort to increase demand and drive down the cost of the solar water heating technologies. The payments will be paid out as performance-based incentives so that they are earned based on the actual energy savings, or on predicted energy savings as established by the Commission. California estimates that the average residential SHW system costs from $3,000-$6,000. Depending on how much natural gas consumption is avoided and what the cost of that fuel is, paybacks could range between 5-10 years.

The state level program will be modeled after the San Diego Solar Water Heating Pilot Program approved by the California Public Utilities Commission in February of 2007. As of July 1, 2007, the San Diego Regional Energy Office (SDREO) is running an 18-month SHW rebate program. The pilot program is providing financial incentives, installer training, and consumer education. For a description of the pilot program, see *ftp://ftp.cpuc.ca.gov/puc/energy/solar/070413_sdreo_swh_pilot_rev.pdf; www.sdenergy.org/ContentPage.asp?ContentID=409&SectionID=440.*

To access the new California SHW pilot program handbook, application forms, contractor participation form, brochure, incentive claim form, and project cost affidavit, see *http://www.sdenergy.org/ContentPage.asp?ContentID=409&SectionID=440#handbook.*

- ***Financial Incentives*** – The SDREO pilot program offers customers two incentive options: a prescriptive method and an area method. The prescriptive method is used for residential or small commercial SHW systems and is based on estimated system performance. System performance is estimated using the SRCC OG300 system ratings, solar orientation factors, and other inputs. Rebates are capped at $1500 per the prescriptive method system. The area method is used for larger or innovative systems. For these systems, incentives are calculated on a "per square foot of collector basis", incorporating factors for system type and solar orientation. Area method systems must pass a 30-day inspection process before receiving financial assistance. The rebates are capped at $75,000 for these systems.

- ***Quality Assurance*** – The San Diego pilot program will use the following methods to ensure quality performance:

  — **Inspections.** The SDREO will inspect every system under the program.

  — **Incentives paid to installers**. By paying the installer, and not the consumer, the installer is responsible for system performance. The SDREO can withhold payment if a system was improperly installed.

— **Recorded Project Costs.** Publicizing breakdowns of project costs will assure transparency for the consumers while enabling accurate program evaluation.

— **Installer licensing and training.** All installers must take a one-day training workshop and be licensed by the California licensing board. Self-installers need not be licensed, but must have attended the one-day training workshop.

— **Metering.** All area method systems and at least 100 prescriptive method systems will be metered for at least one year. In addition, the first three systems installed by each installer will be metered. The data from metering will be used to evaluate system performance, assess energy savings, and devise incentive structures.

— **Owner's Manual.** Installers must provide each customer with a detailed owner's manual.

- ***Education, Outreach, and Marketing*** – To promote the program to potential customers, the pilot SDREO program will do the following:

  — **Target Customers.** Targeted customers will include homeowners, condominium associations, apartment building owners, commercial and public facilities managers, and SHW contractors, installers, and manufacturers.

  — **Education.** Education tactics include developing materials and curricula, conducting seminars and trainings for both customers and manufacturers, maintaining information on the SDREO website, and conducting public demonstrations.

  — **Outreach.** Outreach tactics involve promotions at workshops, co-marketing with other renewable energy programs such as solar PV, media events, newsletter coverage, and white papers and case studies.

  — **Marketing.** Marketing tactics include brochures, advertisements, contractor support materials, and cooperative marketing with other organizations.

CONCLUSION

Solar water heating will play a central role in the drive to decrease our reliance on fossil fuels. As the market grows, the technology will continue to improve. States can stimulate this process by creating stable financial incentive programs that encourage SHW installation. Some states, notably Wisconsin, Oregon and California, have taken the lead on this front. Although each state's market challenges are unique, much can be learned from the actions already taken by states to promote SHW systems. CESA staff is available to assist states in SHW program design.

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CLEAN ENERGY. LET'S MAKE MORE.

Clean Energy States Alliance (CESA) is a national nonprofit coalition of state clean energy funds and programs working together to develop and promote clean energy technologies and markets. CESA provides information sharing, technical assistance services and a collaborative network for its members by coordinating multi-state efforts, leveraging funding for projects and research, and assisting members with program development and evaluation.

Many states across the U.S. have established public benefit funds to support the deployment and commercialization of clean energy technologies. Eighteen states make up the core base of CESA membership. Though these clean energy funds, states are investing hundreds of millions of public dollars each year to stimulate the technology innovation process, moving wind, solar, biomass, and hydrogen technologies out of the laboratory and toward wider use and application in business, residential, agricultural, community and industrial settings. State clean energy funds are pioneering new investment models and demonstrating leadership to create practical clean energy solutions for the 21st century.

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