NREL/TP-253-4675 • UC Category: 231 • DE92001205

NREL/TP--253-4675

DE92 001205

Utility Solar Water Heating Workshops

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A Division of Midwest Research Institute
Operated for the U.S. Department of Energy
under Contract No. DE-AC02-83CH10093

Prepared under Subcontract No. CJ-1-11167-1

January 1992

Acknowledgments

The author wishes to thank Terry Penney, Craig Christensen, and Nancy Carlisle of the National Renewable Energy Laboratory for their leadership and support. They were available, innovative, and committed to the success of this project.

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Executive Summary

Introduction

Electric utilities are increasingly looking to energy efficiency as an alternative resource to capacity additions. Some utilities are spending more than 5% of revenues on energy efficiency programs with a few of the larger utilities allocating more than $100 million per year to such programs. These developments have grown in concert with adoption by utilities of integrated resource planning, which is also known as least-cost planning. A central feature of integrated resource planning is demand-side management (DSM), which refers to actions on the demand- or customer-side of the electric meter stimulated by the utility. DSM is expected to meet 20% of the forecast growth in demand for capacity.

Renewable energy resources in general and solar water heating in particular have potential to help achieve the forecasted savings in energy and demand. Utilities can play an important role with solar water heating as with other residential options. Therefore, it is important to better understand the views of utilities on residential solar water heating as a DSM measure.

The objective of this project was to explore the problems and opportunities for utility participation with solar water heating as a DSM measure. Expected benefits from the workshops included an increased awareness and interest by utilities in solar water heating as well as greater understanding by federal research and policy officials of utility perspectives for purposes of planning and programming. Ultimately this project could result in better information transfer, increased implementation of solar water heating programs, greater penetration of solar systems, and more effective research projects.

Approach

The National Renewable Energy Laboratory (NREL) held two workshops on solar water heating as a DSM measure. The first workshop was held in Boston, Massachusetts in August, 1991 as an adjunct to the Electric Power Research Institute (EPRI) 5th National DSM conference. The second workshop was held at NREL in Golden, Colorado in November, 1991 after the American Public Power Association meeting. Both workshops were designed to be small to allow for maximum individual participation. The workshops were conducted in a focus group format to provide an opportunity for sharing information, ranking perceived problems and opportunities for solar water heating, and giving utility participants an opportunity to design program concepts that would overcome the perceived problems.

Results

Twenty utility participants from 17 utilities and 2 power marketing authorities attended the two workshops. Many other utilities were interested in participating but were not able to attend the workshops.

Benefits of Solar Water Heating: Participants were asked to bring to the workshops a list of reasons for adopting a solar water heating program. Numerous benefits were identified, and the participants recognized that the benefits would vary from utility to utility. The benefits may be grouped into the following categories: customer service, public relations, load management, conservation, environment, market share, profitability, and technology development.

Perceived Problems with Solar Water Heating: Participants were also asked to list the problems with solar water heating from a utility perspective. The individual lists were combined, posted, discussed, and ranked. The top ten problems were ranked by the participants at each workshop. In summary, the

problems may be categorized as follows: system costs, reliability, infrastructure, reputation, information, incentives, risk, and aesthetics.

Conceptual Program Designs for Solar Water Heating: The next phase of the workshops was for the participants to design a utility DSM program to address as many problems as possible. Where some problems were considered beyond utility control or influence, the participants were advised to make whatever assumptions they felt appropriate about how these problems would be addressed.

The participants were divided into teams of three or four persons. The objective for each team was to design a utility program for residential solar water heating for implementation in 2 years. Common characteristics that emerged from the workshops regarding utility DSM programs for solar water heating were system costs, reliability, infrastructure, reputation, information, incentives, and risk.

Next Steps

The final phase of the workshops was for participants to suggest next steps that could be taken in two categories. The first category was next steps the participants would take in their utility. The second category was next steps the participants recommended for NREL regarding solar water heating.

Next Steps for Utilities: The next steps planned by utility participants included conducting further analysis, undertaking pilot programs, implementing full-scale programs, expanding existing programs, and such other steps as improving consumer information and building codes.

Next Steps for NREL: The participants offered many suggestions for next steps by NREL in technology development and technology transfer. Proposed activities included advanced solar systems, system performance monitoring and analysis, program coordination, program evaluation, utility information, and public education.

Conclusions

The objective of the workshops was satisfied. Each workshop succeeded in exploring the problems and opportunities for utility participation with solar water heating as a DSM option. The format and the size of the workshops led to valuable sharing and cooperation among the participants regarding benefits, problems, and solutions. The participants provided a range of ideas and suggestions regarding useful next steps for utilities and NREL. According to evaluations, the participants believed the workshops were very valuable, and they returned to their utilities with new information, ideas, and commitment.

The long-term success may be judged in part by the adoption of solar water heating programs by utilities. In the near term, it appears that several participating utilities are interested in adopting full-scale programs. Several more are exploring pilot programs. All utilities indicated a willingness to become more informed and keep abreast of developments in solar water heating programs and research.

1.0 Introduction

1.1 Background

Electric utilities are increasingly looking to energy efficiency as an alternative resource to capacity additions. Some utilities are spending more than 5% of revenues on energy efficiency programs with a few of the larger utilities allocating more than $100 million per year to such programs.

These developments have grown in concert with adoption by utilities of integrated resource planning, which is also known as least-cost planning. Integrated resource planning (IRP) has been defined by the U.S. Department of Energy in the *National Energy Strategy* as "...a process for meeting customer electricity needs by demand reduction or supply addition, whichever is most cost-effective." (p. 7). A central feature of IRP is demand-side management (DSM). The relatively new concept of demand-side management has been defined as "...actions on the demand- or customer-side of the electric meter, either directly caused or indirectly stimulated by the utility." (Gellings and Chamberlin, *Demand-Side Management: Concepts and Methods*, 1988, p. 2).

DSM is expected to meet 20% of the forecast growth in demand for capacity. One analyst has calculated that 45 GW of capacity will be acquired over the next 10 years through DSM at an average cost of $650 per kW for a total commitment of $30 billion. (Mike Reid, Barakat & Chamberlin, in a presentation to the National Association of Regulatory Utility Commissioners, *Electric Power Alert*, Oct. 16, 1991, p. 7.)

Renewable energy resources in general and solar water heating in particular have potential to help achieve the forecast savings in energy and demand. However, there has been limited DSM activity regarding solar water heating in recent years compared to a decade ago. Now, the most common residential DSM measures are water heater control, water heater wrap, weatherization programs, electric thermal storage, appliance efficiency, external shading, time-of-use rates, high-efficiency new house system design, and cycling programs. (Martin Schweitzer and others, *Key Issues in Electric Utility Integrated Resource Planning: Findings from a Nationwide Study*, Oak Ridge National Laboratory, April, 1990, p. 54.)

Utilities can play an important role with solar water heating as with other residential options. Therefore, it is important to better understand the views of utilities on residential solar water heating as a DSM measure.

1.2 Objective

The objective of this project was to explore the problems and opportunities for utility participation with residential solar water heating as a DSM measure.

The objective recognizes that utilities have been less active in solar water heating compared to other DSM measures. The objective seeks to understand why this may be the case. Also the objective seeks to foster greater interest from utilities by exploring opportunities for solar water heating programs.

There were several expected benefits from the project. One expected benefit was that utilities would become more aware and interested in solar water heating. It was hoped that the project would stimulate utilities to undertake further activities resulting in the adoption of solar water heating programs where feasible. Another expected benefit was that federal research and policy officials would gain a greater understanding of the utility perspective for purposes of planning and programming.

The project was also expected to benefit manufacturers and others by documenting the problems and opportunities with solar water heating from a utility perspective. Furthermore, the project was expected to help identify those utilities with significant interest in working with the solar industry to expand the market for equipment and services.

Ultimately, this project was expected to result in better information transfer, increased implementation of residential solar water heating programs, greater penetration of solar systems, more effective research projects, and improved technology development.

2.0 Approach

In order to more clearly learn the utility views, it was determined that two workshops with utility DSM professionals would be conducted. Each workshop was planned for a limited number of selected utilities with an active interest in DSM and a current or potential interest in solar water heating. Each workshop was also planned to exchange information between participating utilities that previously had or were currently operating a solar water heating program. This was expected to provide an additional value to utilities to aid the development or enhancement of programs at their utility.

The utility DSM professionals were drawn from various perspectives including program planning, program design, implementation and marketing, customer service, and program evaluation. The utilities that were represented covered all regions of the country and ranged in size from small municipals to large investor-owned organizations.

The workshops were designed for maximum exchange of information and ideas. Accordingly, the workshops were small in size. This allowed in-depth exploration of utility needs and perspectives. One workshop was held at a hotel in Boston in August, 1991 as an adjunct to the 5th National DSM Conference of the Electric Power Research Institute. The second workshop was held at NREL in Golden, Colorado in November, 1991 the day after an American Public Power Association customer service and marketing conference in Colorado Springs.

Each workshop was divided into several parts. Appendix A includes the agenda for the workshop at NREL. The first part of each workshop was an introduction by the participant of their utility, individual responsibilities, and views on the expected benefits of residential solar water heating. Participants were encouraged to describe past or current programs. As the second part, NREL provided an overview of the status of solar water heating.

The third part was conducted using the nominal group technique. It called for participants to present short statements on the benefits of and problems with solar water heating. These statements were requested in advance, and they were posted at the workshops. Attention was directed toward the problem statements. After reviewing the problem statements, the participants were encouraged to think of others. Once the participants exhausted all their ideas of the perceived problems with solar water heating, a discussion ensued to review their understanding and feelings about the problems. At the end of the discussion the problems were ranked.

The fourth part began with a review of the ranked problems. Then the workshop participants divided into teams of three or four with the assignment to design a program to address as many of the problems as the team wished. The challenge was for participants on each team to combine their collective experience and information as utility DSM professionals in order to develop a program concept for solar water heating that could be offered to customers. This part concluded with each team presenting its conceptual design to the rest of the workshop.

The last part was for participants to indicate what benefit they derived from the workshop and would take back to their utility. Participants were also asked to indicate their needs that could benefit from NREL assistance. The workshops closed with the organizers thanking participants for their assistance and encouraging them to contact NREL for further assistance.

3.0 Workshop Results

Twenty participants from 17 utilities and 2 power marketing authorities were recruited for the two workshops. A list of participants, with addresses and phone numbers, is included in Appendix B. Many utilities that were invited to attend could not. Most of these utilities expressed an interest in the subject of the workshops and requested more information about residential solar water heating and the results of the workshops. These utilities are listed in Appendix C. Participating utilities included:

Arizona Public Service
Boston Edison
Fort Collins Light and Power
Iowa Power
Los Angeles Dept. of Water and Power
New England Electric System
Northeast Utilities
Pacific Gas and Electric
Public Service of Colorado
Public Service of New Mexico
Puget Power
Sacramento Municipal Utility District
Santa Clara Utility Department
Sierra Pacific Power Company
Southern California Edison
Tennessee Valley Authority
Tuscon Electric Power
Union Electric
Western Area Power Administration.

3.1 Benefits of Solar Water Heating

Participants were asked to bring to the workshop a list of reasons for adopting a solar water heating program. Numerous benefits were identified, and the participants recognized that the benefits would vary from utility to utility. The benefits may be grouped into several categories as follows:

- Customer service: Supplying customers with information and choices to reduce monthly energy bills
- Public relations: Creating good will with consumers, legislators, and regulators
- Load management: Reducing peak demand in the winter and, to a more limited extent, in the summer
- Conservation: Reducing fuel usage
- Environment: Improving air quality
- Market share: Retaining part of electric water heating load compared to losing entire load to natural gas
- Profitability: Improving net income based on regulatory incentives for conservation load management
- Technology development: Advancing innovative technologies

3.2 Perceived Problems with Solar Water Heating

Participants were also asked to list the problems with solar water heating from a utility perspective. The individual lists were combined, posted, discussed, and ranked. The top ten problems at the first workshop were:

1. Other means of heating water (natural gas or electric heat pump) are more cost-effective
2. Solar is perceived as costly (1st cost) and as troublesome and unreliable—based on some shoddy installers during 1975-85
3. Lack of good data on domestic hot water consumption (especially hourly) on which to base peak reduction and energy savings estimates
4. No supporting industry - service, manufacturer, dealer
5. Utilities on-going liability problems/concerns
6. Persistence of savings (related to reliability)
7. Poor coincidence with summer peak loads
8. Lack of information on system advances
9. Poor aesthetics—not attractive to neighbors, impact on property, inability to market homes
10. Lots of sales loss for minimum demand reduction.

Participants in the second workshop listed their top ten problems as follows:

1. Dealer network does not exist to supply and install products
2. Too expensive to customer and utility
3. Units are not cost-effective
4. Benefit cost ratio low compared to other DSM options
5. Bad track record and reputation for mechanical failure
6. Maintenance and reliability (e.g., freezing)
7. Need to find a way to make solar as profitable as conventional electricity
8. Utility funding and management support may be a problem with some utilities
9. Requires large rebates or incentives to be feasible for consumers
10. For utilities with excess capacity, the technology may be viewed as a threat to load.

After the problems were ranked there was further discussion. Participants noted that many of the problems are interrelated. In summary, the problems may be categorized as follows:

- System Costs: High first cost and low benefit/cost ratio relative to other DSM options
- Reliability: Low durability and poor performance if systems are not properly maintained

- Infrastructure: Lack of dealer network to effectively deliver and maintain equipment
- Reputation: Bad track record from past overzealous marketing and business practices
- Information: Lack of credible, unbiased information on solar technology and performance
- Incentives: Negative impacts on revenues unless Public Utilities Commissions (PUCs) provide incentives for utilities
- Risk: Utility reputation and perhaps liability at stake
- Aesthetics: Unattractive appearance to consumers or communities

3.3 Conceptual Program Designs for Solar Water Heating

The next phase of the workshop was for the participants to design a utility DSM program to address as many problems as possible. Where some problems were considered beyond utility control or influence, the participants were advised to make assumptions about how these problems would be addressed.

The participants were divided into teams of three or four persons. The objective for each team was to design a utility program for residential solar water heating for implementation in 2 years.

Each team retired to draw a program concept on a flip chart. The program concepts were then presented by each team to the other participants. Presented below is a written summary of each team's program concept.

Team 1. The objective of this team was to reduce the cost and extend the life of residential solar water heating. Systems incorporating the latest technology would be installed on the home of the customer by the utility in cooperation with the manufacturers. The system would be designed and maintained to achieve water heating benefits and operated in a manner that would be transparent to the homeowner. The premise was that hot water is expected to be readily available with minimal attention from the customer. Part of the system package would include a warranty on performance from the manufacturer to assure both the customer and the utility of long-term reliability.

The systems would be monitored to determine energy and demand savings. Benefit-cost analyses would be performed using simple personal computer systems. Analyses would also be conducted to calculate reduced fuel consumption at the power plant and reductions in environmental pollution. Financing and the use of incentives was left unresolved deliberately until further analysis demonstrated what the customer was willing to pay and what costs the manufacturers would incur.

Team 2. The objective of this team was to transform the market for solar waterheaters by a large-scale utility program. Large numbers of solar water heating systems would be installed by the utility at no cost to the customer. The installation of a large number of systems would be expected to reduce the costs through economies of scale and improve the competitive nature of solar water heating.

The target customers would be those in larger homes or with swimming pools since energy use for water heating would be higher and, therefore, the benefits would be greater. The utility would handle the installation and maintenance. Contractors would be hired by the utility to perform these services using trucks carrying the utility program logo. The trucks would continue the energy efficiency theme of solar by carrying photovoltaic cells to help power the vehicles.

Apartment buildings would be included along with single family homes. Marketing themes would stress low-cost energy from the sun and the environmental benefits by avoiding the construction and operation of power plants. Utilities would receive cost recovery and be rewarded for energy savings performance from rate-making regulatory authorities.

Team 3. The objective of this California-based team was to obtain a significant number of residential solar water heating installations both in the near term and the long term. The implementation strategy had three parts: (1) DSM bidding to establish markets for solar water heating in the near term, (2) a "Golden Carrot" type of program to encourage long-term development of the technology, and (3) monitoring to verify results and calculate payments.

In the DSM bidding program, the utility would be responsible for marketing, bulk purchase, and warehousing. The solar equipment supplier would be responsible for manufacturing, distribution, installation, and maintenance. Quality control would be achieved with the cooperation of the Northern California Solar Energy Association.

The long-term program would be patterned after the "Golden Carrot" for high efficiency refrigerators. The objective would to reduce the cost of installed systems from the current level of about $2,500 to $1,500. It is expected that electric solar water heating would then be competitive with natural gas water heating. The program would offer a cash prize to a manufacturer to build or retool a factory to supply the new solar water heating systems at the target cost. Funding would be supplied by California utilities, energy agencies, research groups, and others.

Expected benefits included savings of 2,500 kWh per year or half the annual 5,000 kWh per year for electric water heating. The effective cost to the utility over a 15-year life was calculated at $.035/kWh including the cost of capital. It was assumed that the utility-avoided cost was $.11/kWh compared to an average rate of $.05/kWh. In addition to the financial benefits, the utility would further improve the environment by reducing the need for new peak-power plants.

Monitoring and evaluation would be important for both programs. The purpose would be to verify performance of the equipment and to serve as the basis for payments under the bidding program and the "Golden Carrot" program. NREL would have technical and financial roles.

Team 4. The objective of this team was to operate a large-scale program for the installation of solar water heating on targeted customer homes. Target customers would be those most likely to adopt innovative and new technologies, where price was not so important. As the program became accepted over time, the target customer would be the larger population where price is more important. As a variation, the target population of customers initially could be in a part of the service area where the distribution system was being strained or was growing faster than the rest of the service area.

The program would be designed in a collaborative process where the various stakeholders and parties interested in energy issues would have an opportunity to participate. The product of this effort would be a request for proposals made to solar manufacturers. The manufacturers would bid on providing a turnkey product including maintenance services to the homeowner. The winning bidder would obtain the contract to supply all the participating customers in the program.

Incentives would be provided to the customer by the utility, however, it is expected that by mass production, the manufacturer costs would be reduced substantially from current levels to about $1,500 per system. Incentives would also be provided to the customer in the form of tax credits and to the utility in terms of enhanced earnings potential.

Marketing would be managed by the utility. Advertising and promotion in the mass media would be used to build customer awareness and participation.

Monitoring would be conducted by the utility in cooperation with NREL. Installations would be metered and data analyzed for reliable performance of the systems. Also the data would be analyzed and published to encourage more efficient and effective solar designs and operation.

Team 5. The objective of this team was to demonstrate the feasibility of solar water heating on institutional buildings. The target customer would be a prison, although others could be considered such as nursing homes, hospitals, and public housing apartment buildings. The solar collectors would be placed on the roof of the building in a large array to satisfy hot water needs of the facility.

Eligible facilities would be identified through a competition. The utility would pick those facilities most suitable for solar water heating applications.

A limited number of manufacturers would be selected to participate in the program based on a competition. Costs of solar equipment should be reduced because of the large volume of work arranged by the utility and the limited number of participating manufacturers.

The program delivery would be through a manufacturer under contract to the utility to provide a turnkey installation. The manufacturer would be responsible for design, installation, operation, and maintenance. This would include responsibility for training of the on-site staff for operation and maintenance of the facility.

Costs would be shared between the utility and the institution. Savings would be split between the institution and the solar supplier. Benefits to the environment would result in burning less coal in the power plant.

Team 6. This team summarized the questions that would need to be answered by the key players. Vendors and manufacturers would have to satisfy questions regarding standards, product cost, quality/reliability, installation, and service. The utility would need to consider questions pertaining to costs, savings, reliability, and liability. The utility would have to translate these questions into answers about returns on investment, impacts on load profiles and dispatching of different types of units. The homeowners would have to answer questions about alternative systems such as gas and return on investment. Also the homeowners and utility would have to determine how responsibilities would be split regarding maintenance and service as well as how costs for these aspects would be split. The willingness of the utility to proceed may depend on the avoided costs of capacity, which will vary from utility to utility. The utility will also have to take into account capacity expansion with and without considering environmental effects relative to residential solar.

3.4 Common Program Characteristics

Common characteristics emerged from the workshops regarding utility DSM programs for solar water heating.

- System costs: Costs for solar systems would be reduced through large-scale purchases coordinated by the utility.
- Reliability: Improvements would be achieved through guarantees, turnkey installations, and performance contracting.

- Infrastructure: No one organization can be expected to make solar water heating a reality. Partnerships and collaboration are needed.
- Reputation: Utilities will take an active role in certification and delivery of solar water heating.
- Information: Utilities will take the lead in advertising and promotion of solar water heating.
- Incentives: Until solar water heating becomes more cost-effective incentives will be needed for consumers and utilities.
- Risk: Performance monitoring will increase customer confidence, allow payment based on delivered energy, and improve planning for future utility programs.

4.0 Next Steps

The final phase of each workshop was for participants to suggest next steps that could be taken in two categories. The first category was next steps the participants would take when they returned to their utility. The second category was next steps the participants recommended for NREL regarding residential solar water heating.

4.1 Next Steps for Utilities

The next steps planned for utility participants may be grouped into phases. These phases include conducting further analysis, undertaking pilot programs, implementing full-scale programs, expanding existing programs, and other steps such as improving consumer information and building codes.

Analysis. Virtually all participating utilities committed to examining further solar water heating as a DSM option. This included plans for the participants to discuss solar water heating with other departments in the utility. One utility proposed to examine solar as a DSM option in the current planning process. Several planned to evaluate their discontinued solar program of a decade ago to document lessons learned. Some indicated that while no immediate program was likely they would prepare for the time when the utility was more interested by keeping up with the literature on residential solar water heating.

Pilot Programs. Many utilities indicated an interest in reviewing the merits of a pilot program. One participant announced plans to conduct a 100-system pilot project. Another utility planned to consider a program targeted to one community to demonstrate the effectiveness of the infrastructure to delivery and maintain residential solar water heating systems. It was suggested that a possible example as a model for this type of pilot program was the Hood River Project sponsored by the Bonneville Power Administration that weatherized all homes in one community. Several utilities indicated an interest in installing a few different systems to document performance in their utility service area. One utility with an existing program planned to monitor new solar water heating products for suitability with their customers.

Full-Scale Programs. Two participants planned to undertake a full-scale program. Both utilities are in an area with favorable solar characteristics and a supportive regulatory environment for solar technologies. The plan is for large-scale implementation to bring the costs down in collaboration with the manufacturers and incentives provided to the customer that were fully covered by the rate-making regulatory authorities. Several other participants from one region of the country proposed to explore a joint program covering their separate but contiguous service areas.

Program Expansion. Expanding a new home program was a possibility indicated by one participant. This utility operates a program to encourage the construction of energy-efficient homes. One program feature gives credit to passive solar. This participant planned to investigate the addition of solar water heating as a qualifying item for the energy efficient home program.

Information and Code Programs. Participants also indicated an interest in pursuing other steps to reduce barriers to implementation through increased information and more favorable building codes. One utility expressed a desire to develop technical manuals with the latest information on the performance of residential solar water heating systems. Another utility expected to work toward zoning changes that protected solar access. Finally, a utility expressed an interest in examining the application of solar in conjunction with electric as a means to qualify a new home under building performance standards that favor natural gas water heating.

4.2 Next Steps for NREL

The participants offered many suggestions for next steps in technology development and technology transfer. Proposed activities included advanced solar systems, system performance, program coordination, program evaluation, utility information, and public education.

Advanced Systems. Research on advanced systems was proposed as a next step. The expectation was voiced that advanced or new systems would be more cost effective.

System Performance. Monitoring, analysis, and documentation of system performance was suggested by several participants. More specifically information was requested on sizing, flow rates, energy savings, demand savings, changes in load profiles on an hourly basis, and transferability of data from one climate region to another.

Program Evaluation. Monitoring is an important activity in DSM programs. Suggestions included developing protocols for monitoring installed systems, recommending measurement equipment, and advising on methods for evaluating programs.

Utility Information. Utilities also need more information on ongoing solar water heating activities such as a newsletter directed toward utility DSM professionals. Another suggestion was to coordinate a working group of utilities, solar suppliers, and researchers.

Public Education. Public information on solar water heating was suggested as a need. It was suggested that more public awareness was needed through strategically placed items in the mass media. Also of interest was to collect the data and prepare information that could be used by utilities in public education brochures. More information on available technologies and manufacturers was also suggested.

Program Coordination. A coordinated mass marketing program that involved multiple utilities and solar suppliers was suggested. The analogy with the "Golden Carrot" program for refrigerators was mentioned as a model for an activity regarding residential solar water heating systems.

5.0 Conclusions

The objective of the workshops was satisfied. Each workshop succeeded in exploring the problems and opportunities for utility participation with solar water heating as a DSM option.

The format and the size of the workshops led to valuable sharing and cooperation among the participants regarding benefits, problems, and solutions. The composition of the workshops served the objective well by fostering open identification of problems and frank discussion of their importance. The utility participants cooperated easily in designing DSM programs for residential solar water heating. The program concepts were creative, varied, and practical for the participants. According to the evaluations, the participants believed the workshops were very valuable, and they returned to their utilities with new information, ideas, and commitment.

The long-term success may be judged in part by the adoption of residential solar water heating programs by utilities. In the near term, it appears that several participating utilities are interested in adopting full-scale programs. Several more are exploring pilot programs. All utilities indicated a willingness to become more informed and keep abreast of developments in solar water heating programs and research.

Utility participants look to government programs for leadership in research, technology transfer, and fostering cooperation with various interests in residential solar water heating. The participants see NREL as a credible resource, and they provided a range of ideas and suggestions for further activities.

In summary, utility participants left the workshops with new or renewed interest in residential solar water heating.

Appendix A

Workshop Agenda

Utility Solar Water Heating Workshop
National Renewable Energy Laboratory (NREL)

November 7, 1991
Golden, Colorado

Agenda

Objective: To explore the problems and opportunities for utility participation with residential solar water heating as a DSM measure.

8:00 - 8:30 **Registration** (Coffee and Donuts)

8:30 - 9:00 **Introductions**
- Introduction - Craig Christensen, NREL
- Welcome - L.M. Murphy, NREL
- Utility Introductions - participants

9:00 - 10:10 **Overview Presentations**
- Overview of Current Solar Technology - Craig Christensen
- Santa Clara's Solar Rental Program - Robin Saunders
- SMUD's Solar Rebate Program - Eileen Glaholt

10:10 - 10:25 **Break**

10:25 - 12:00 **Discussion Topics** - Larry Barrett, Facilitator
- Identify and Discuss Utility Solar Issues

12:00 - 1:10 **Lunch**

1:10 - 3:00 **Discussion Topics** (continued)
- Review utility Priorities
- Develop and Present Program Concepts (3-person teams)
- Conclusions and Next Steps

3:00 - 5:00 **NREL Tour**
- NREL Overview
- Compact Vacuum Insulation (CVI) Laboratory
- Solar Furnace (video presentation)
- Outdoor Photovoltaic Testing
- Transpired Collector Experiment

Appendix B

Utility Participants

Participants Listed Alphabetically by Utility

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Western Area Power Administration
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Golden, CO 80401

303-231-7504

Appendix C

Interested Utilities Unable to Attend Workshops

Interested Utilities Unable to Attend Workshops
Listed Alphabetically by Utility

Mr. Michael Myers
Manager, Energy Services
Department of Environmental and Conservation Services
206 E. 9th St.
Austin, TX 78701

512-499-3508

Mr. John Saenz
Director of Marketing
Central Power and Light Company
P.O. Box 2121
Corpus Christi, TX 78403

512-881-5696

Mr. Nick Sinos, Manager
Residential Energy Management Services
Central Vermont Public Service Corporation
77 Grove Street
Rutland, VT 05701

802-773-2711

Mr. Robert W. Taylor, Manager
Residential Energy Services
Duke Power Company
P.O. Box 1006
Charlotte, NC 28201

704-373-7636

Mr. Nelson Hawk
Director of Marketing Planning
Florida Power and Light Company
8700 West Flagler Street
Miami, FL 33174

305-227-4351

Ms. Christy Herig
Florida Power Corporation
P.O. Box 14042
St. Petersburg, FL 33733

813-866-4998

Mr. Dave Goldfarb
Project Manager, Demand-Side Programs
Georgia Power Company
P.O. Box 4545
Atlanta, GA 30303

404-526-1917

Mr. Thomas Simmons
Senior Planning Engineer
Hawaii Electric Company
P.O. Box 2750
Honolulu, HI 96740

808-543-7398

Mr. Joseph A. Lopez, Manager
Marketing, Conservation and Load Control
Houston Lighting and Power Company
P.O. Box 1700
Houston, TX 77251

713-660-3851

Mr. Kenneth Johnson
Energy Conservation Supervisor
Imperial Irrigation District
P.O. Box 937
Imperial, CA 92251

619-339-9487

Mr. Dave Levy
Director, Energy Services
Iowa-Illinois Gas & Electric Company
319 18th Street
Rock Island, IL 61201

309-703-3737

Mr. Robert Sadrakula
Manager of Marketing and Customer Services
Board of Public Utilities
700 Minnesota Avenue
Kansas City, KS 66101

913-573-9000

Ms. Gail Doxtader
Energy Services Coordinator
City of Loveland
200 N. Wilson
Loveland, CO 80537

303-669-2470

Mr. Jim Niewald
Director of Conservation Division
Lower Colorado River Authority
P.O. Box 220
Austin, TX 78767

512-473-3386

Mr. Ed Anderson, Manager
Energy Conservation and Load Management
Nevada Power Company
P.O. Box 230
Las Vegas, NV 89151

702-367-5142

Mr. Tom Laing
North Carolina Membership Corp.
3400 Sumner Blvd.
Raleigh, NC 27306

919-872-8000

Ms. Lora Rooke
Mr. Doug Boleyn
Portland General Electric
121 S. W. Salmon St.
Portland, OR 97204

503-464-7017

Mr. Ted Turner
San Diego Gas & Electric
P.O. Box 1831
San Diego, CA 92112

619-696-4737

Ms. Cindy Pentecost
Salt River Project
P.O. Box 52025
Phoenix, AZ 85072-2025

602-236-4078

Mr. James Dean
Energy Manager
City Electric Department
City Hall
Tallahassee, FL 32301

904-599-8504

Mr. Howard Bryant
Tampa Electric
P.O. Box 111
Tampa, FL 33601

813-228-4115

Mr. Dal Frandsen, Jr.
Director
Conservation and Load Management
Texas Utilities
P.O. Box 660268
Dallas, TX 75266

214-954-5160

Document Control Page	1. NREL Report No. NREL/TP-253-4675	2. NTIS Accession No. DE92001205	3. Recipient's Accession No.

4. Title and Subtitle

Utility Solar Water Heating Workshops

5. Publication Date
January 1992

6.

7. Author(s)
Larry B. Barrett

8. Performing Organization Rept. No.

9. Performing Organization Name and Address

Barrett Consulting Associates, Inc.
P.O. Box 60429
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10. Project/Task/Work Unit No.
DO13.3010

11. Contract (C) or Grant (G) No.

(C) CJ-1-11167-1

(G)

12. Sponsoring Organization Name and Address

National Renewable Energy Laboratory
1617 Cole Blvd.
Golden, CO 80401

13. Type of Report & Period Covered
Technical Report

14.

15. Supplementary Notes
NREL Technical Monitor: Craig Christensen (303) 231-1024

16. Abstract (Limit: 200 words)

The objective of this project was to explore the problems and opportunities for utility participation with solar water heating as a DSM measure. Expected benefits from the workshops included an increased awareness and interest by utilities in solar water heating as well as greater understanding by federal research and policy officials of utility perspectives for purposes of planning and programming. Ultimately, the project could result in better information transfer, increased implementation of solar water heating programs, greater penetration of solar systems, and more effective research projects. The objective of the workshops was satisfied. Each workshop succeeded in exploring the problems and opportunities for utility participation with solar water heating as a DSM option. The participants provided a range of ideas and suggestions regarding useful next steps for utilities and NREL. According to evaluations, the participants believed the workshops were very valuable, and they returned to their utilities with new information, ideas, and commitment.

17. Document Analysis
a. Descriptors
solar water heating; utility; demand-side management

b. Identifiers/Open-Ended Terms

c. UC Categories
231

18. Availability Statement
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161

19. No. of Pages
29

20. Price
A03

Form No. 0069E (6-30-87)

END

DATE
FILMED
2/20/92

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