NREL/TP-472-7295 • UC Category: 1300 • DE95000221

Barriers to Solar Process Heat Projects: Fifteen Highly Promising (But Cancelled) Projects

Clifton Carwile
U.S. Department of Energy

Russell Hewett
National Renewable Energy Laboratory

Prepared for the ASME/JSME/JSES International Solar Energy Conference, Maui, HI, March 19–24, 1995

National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, Colorado 80401-3393

A national laboratory of the U.S. Department of Energy
managed by Midwest Research Institute
for the U.S. Department of Energy
under Contract No. DE-AC36-83CH10093

October 1994

Available to DOE and DOE contractors from:
Office of Scientific and Technical Information (OSTI)
P.O. Box 62
Oak Ridge, TN 37831
Prices available by calling (615) 576-8401

Available to the public from:
National Technical Information Service (NTIS)
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161
(703) 487-4650

Printed on paper containing at least 50% wastepaper and 10% postconsumer waste

BARRIERS TO SOLAR PROCESS HEAT PROJECTS: FIFTEEN HIGHLY PROMISING (BUT CANCELLED) PROJECTS

Clifton Carwile
Office of Industrial Technologies
U.S. Department of Energy
Washington, D.C.

Russell Hewett
National Renewable Energy Laboratory
Golden, Colorado

ABSTRACT

We analyzed technical, economic, and institutional barriers encountered by the solar industry in penetrating the market of solar thermal systems as applied in industry, commerce, and government. The barriers discussed are not theoretical or developed by conducting marketing research surveys of potential users. Rather, they are barriers that precluded implementing actual solar projects for 15 "highly promising" prospective users. The efforts to determine their technical and economic feasibility were funded by the U.S. Department of Energy (DOE) Solar Process Heat (SPH) program.

Each year, the SPH program conducts a prefeasibility studies activity—an engineering assessment of the technical and economic feasibility of a solar system for a specific application for a specific end-user. These studies also assess institutional issues that impact the feasibility of the proposed project and develop an action plan for the project's implementation. In FY 1991 and FY 1992, the program funded a total of 11 studies in which solar projects were investigated for 21 potential users. Of these 21 potential users, only three have made firm commitments to acquire solar systems, yielding a 14% success rate (decisions by three other companies are still pending). The low success rate is disappointing because the solar companies had complete freedom to select "highly promising" potential users. We therefore evaluated the reasons for the low success rate and the implications for market penetration.

OBJECTIVE AND BACKGROUND

We investigated 15 "highly promising" proposed projects involving solar process heat systems—projects for which technical and economic feasibility was assessed but did not result in the systems being implemented. We hope to articulate and characterize the reasons why the projects were not implemented.

The technical and economic feasibility assessments for the proposed projects were performed by solar companies and architectural and engineering (A&E) firms in FY 1991 and FY 1992, as part of the prefeasibility studies activity of DOE's SPH program. Each year, the program conducts a prefeasibility studies activity—a program-funded engineering assessment study that assesses the technical and economic feasibility of a solar system for a specific application for a specific potential user. The study also assesses institutional issues (e.g., financing, insurance availability) that impact the feasibility of the proposed project and develops an implementation action plan if solar is viable.

The main objective of the prefeasibility studies is to assist the solar industry in identifying and marketing the technology to "highly promising" potential users for commercially available systems; the intention is to foster the early development of niche markets that are economically viable. Studies are selected for program funding through competitive solicitations. In FY 1991 and FY 1992, a total of 11 studies were funded, in which SPH system projects were investigated for 21 potential users. Of these potential users, three made firm commitments to acquire solar systems, and decisions for three others are still pending; thus, the success rate is 14%. We consider this percentage disappointing because the solar companies and A&Es—in submitting their responses to the prefeasibility studies solicitation—had complete freedom to select "highly promising" potential users for investigation.

Our analysis seeks to understand why the project implementation success rate to date has been low and to identify the lessons learned. By using these lessons, we are attempting to formulate a better definition of "highly promising" potential users—users on which market development efforts should focus to make the success rate significantly greater than 14%. A higher success rate will also result in better yield from SPH task funds devoted to the prefeasibility studies activity.

DESCRIPTIONS OF THE PROPOSED SOLAR PROJECTS

Table I provides information about 15 proposed solar projects investigated by solar companies and A&Es as part of the SPH program's FY 1991 and FY 1992 prefeasibility studies—proposed projects *not* resulting in the implementation of solar systems.

Eight of the 15 projects were investigated by Conserval Systems, Inc. (Buffalo, NY). Conserval specializes in developing and marketing transpired solar collector systems for preheating ventilation air for large open facilities (e.g., industrial plants, warehouses) that require large volumes of outside air for ventilation. The company's strategy, in its prefeasibility studies subcontract, was to identify and conduct feasibility assessment for *multiple* promising potential users to make at least *one* project happen. (One Conserval prefeasibility study will result in implementing a $100,000, 7000-ft^2 ventilation air pre-heating system for an aircraft maintenance hangar at Fort Carson U.S. Army Base near Colorado Springs, Colorado.)

Except for Conserval and United Solar Technologies (which investigated two promising prospective users, one of which is resulting in implementation of a SPH system project), all of the other subcontractors focused on a *single* promising potential user that they themselves identified. With respect to markets, the 15 proposed projects were as follows: industry (12 projects), commerce (1 project), and government (2 projects). All commercially available products were proposed, specifically, transpired solar, flat-plate, evacuated-tube, and parabolic trough collectors.

All 15 proposed projects were to be installed in existing facilities, with the existing fossil energy system to be reconfigured to serve as the backup/auxiliary subsystem for the solar. No projects incorporated solar systems for new facilities that were in the design stage. The proposed projects included the following types and number of applications: ventilation air pre-heating (8 projects), process hot water (2), cooling and domestic hot water (2), process hot air (1), process steam (1), and materials heating (1). And the type and number of the existing conventional energy systems were as follows: natural gas (9 projects), electricity (3), multiple fuel systems (2), and fuel oil (1).

RESULTS OF ECONOMIC FEASIBILITY ASSESSMENT

All 15 proposed solar projects were technically feasible and compatible with operations at the facilities. Table II lists the projects and shows the estimated capital costs, capital equipment decision-making criteria used by the prospective users, the results of the economic feasibility assessment, and the reasons the projects were not implemented.

With respect to capital investment decision-making, 14 prospective users used a years-to-payback criterion—typically demanding a payback of less than 3 years. Only one potential user used the criterion of life-cycle cost-effectiveness, which is "most favorable" to solar projects having higher initial capital cost but long streams of annual fuel-expense savings.

The reasons that the 15 projects were not implemented fall into three categories:

Reason		Number of Projects
Category 1:	The project did not meet the end-user's investment requirements.	8
Category 2:	The project did not meet the end-user's investment requirements, but the end-user considered implementing the project. However, the project was not implemented for exogenous reasons.	2
Category 3:	The project met the end-user's investment requirements, but the end-user chose to defer implementation indefinitely.	5

Category 1 Projects: Did Not Meet Investment Requirements

Of the 15 projects, eight did not meet the end-users' capital investment criteria: seven potential users rejected the project based on years-to-payback, and one potential user rejected the project based on life-cycle cost-effectiveness/net present value (NPV).

Our analysis of the economic performance assessments by the subcontractors for the Category 1 projects showed that they did not meet the end-users' investment requirements for two main reasons, both of which operated simultaneously: low cost of natural gas (and expectations that it would remain low) and high initial cost of the solar system.

An important issue for Category 1 projects is what it would take to make them economically viable. This issue will be analyzed by focusing on years-to-payback as the principal criterion for capital investment decision-making (because it is used by 14 of the 15 prospective users).

There are two ways to make the Category 1 projects viable: (1) get potential users to increase the number of years in the years-to-payback criterion (e.g., federal agencies are required to use a 10-year payback period, compared to 3–5 years for industrial and commercial firms), and (2) reduce the number of years needed for the solar system to pay for itself through fuel-expense savings.

Because it is unlikely that the DOE SPH program will be able to influence decision-making processes of potential users, our analysis focused on reducing the years-to-payback for the Category 1 projects.

The basic formula for computing the simple payback period is as follows:

Simple payback period = [(System installed-cost) – (Tax credits) – (Cost-sharing)] ÷ [(Annual energy-expense savings due to solar) – (Annual O&M cost)].

Our analysis of the years-to-payback formula shows that, excluding tax credits and cost-sharing, there are three ways

TABLE I. PROPOSED SOLAR PROJECTS NOT RESULTING IN IMPLEMENTATION

Potential User (Prefeasibility Study Contractor)	Location	Proposed Solar Project	Solar Collector Type	Solar Collector Area (sq ft)	Conventional Alternative
1. Saginaw Steering Gear/ General Motors (Conserval Systems, Inc.)	Buffalo, NY	Solar ventilation air preheating system for an industrial plant	Transpired Flat- Plate	15,800	Gas-fired and oil-fired central steam boiler
2. Eastman Kodak Company Building 9 (Conserval Systems, Inc.)	Rochester, NY	Solar ventilation air preheating system for an industrial plant	Transpired Flat- Plate	3,000	Gas-fired steam system
3. State University of New York Helm Warehouse (Conserval Systems, Inc.)	Buffalo, NY	Solar ventilation air preheating system for a warehouse	Transpired Flat- Plate	4,100	Electricity and natural gas forced-air systems
4. Lozier Corporation (Conserval Systems, Inc.)	Omaha, NE	Solar ventilation air preheating system for an industrial plant	Transpired Flat- Plate	15,800	Natural gas forced-air heating system
5. Olin Defense Systems Building No. 1 (Conserval Systems, Inc.)	Independence, MO	Solar ventilation air preheating system for an ammunition manufacturing plant	Transpired Flat- Plate	9,680	Natural gas forced-air heating system
6. Olin Defense Systems Building No. 2 (Conserval Systems, Inc.)	Independence, MO	Solar ventilation air preheating system for an ammunition manufacturing plant	Transpired Flat- Plate	9,680	Natural gas forced-air heating system
7. Olin Defense Systems Building No. 3 (Conserval Systems, Inc.)	Independence, MO	Solar ventilation air preheating system for an ammunition manufacturing plant	Transpired Flat- Plate	9,680	Natural gas forced-air heating system
8. Olin Defense Systems Building No. 4 (Conserval Systems, Inc.)	Independence, MO	Solar ventilation air preheating system for an ammunition manufacturing plant	Transpired Flat- Plate	12,100	Natural gas forced-air heating system
9. Koch Materials Company (Industrial Solar Technology Corporation)	Fontana, CA	Solar system for heating asphalt in bulk storage tanks	Parabolic Trough	15,000	Natural-gas-fired steam boiler
10. Maui Economic Development Board (Bechtel Corporation)	Maui, HI	Solar cooling and water-heating system for an 8000-sq-ft office building	Evacuated-Tube	1,175	Electric compression air conditioning and electric resistance water heater
11. Morgan State University (E.A. Engineering, Inc.)	Baltimore, MD	Solar water-heating system for the four buildings in the Science Complex at Morgan State University	Hydronic Flat-Plate	2,470	Fuel oil-fired central boiler plant
12. Barbers Point Naval Air Station (United Solar Technologies)	Honolulu, HI	Solar absorption cooling system (100 tons) for avionics systems maintenance and repair facility	Parabolic Trough	14,400	Electric-driven reciprocating chiller system
13. Cyprus Minerals Company (Industrial Solar Technology Corporation)	Near Tucson, AZ	Solar system for providing process hot water for a copper refining plant	Hydronic Flat-Plate	9,000	Natural-gas-fired boiler
14. Timberland Company (Shooshanian Engineering Associates, Inc.)	Isabela, PR	Solar system for providing process hot air for a shoe factory	Evacuated-Tube	2,141	Electric resistance furnace
15. Inland Empire Foods, Inc. (Solar Kinetics, Inc.)	Los Angeles, CA	Solar system for generating steam to provide process hot air for drying grain in a food processing plant	Parabolic Trough	6,720	Natural-gas-fired boiler

TABLE II. COST INFORMATION AND ECONOMIC FEASIBILITY ASSESSMENT RESULTS FOR 15 PROPOSED SOLAR PROJECTS

Potential User (Prefeasibility Study Contractor)	Solar System Installed-Cost	Economic Decision-Making Criteria	Economic Performance Assessment Results	Reason(s) Solar Project Not Implemented by Potential User
1. Saginaw Steering Gear/ General Motors (Conserval Systems, Inc.)	$130,000 ($8.23/sq ft)	Simple payback of 3 years or less	Simple payback period of 4.4 years	Project did not meet required economic performance criterion
2. Eastman Kodak Company, Building 9 (Conserval Systems, Inc.)	$62,000 ($20.67/sq ft)	Simple payback period of 3 years or less	Simple payback period of 5.2 years	Project did not meet required economic performance criteria
3. State University of New York Helm Warehouse (Conserval Systems, Inc.)	$75,000 ($18.29/sq ft)	Simple payback period of 3 years or less	Simple payback period of 5.2 years	Project recommended for inclusion in capital budget for 1993 but no action taken as of 1994
4. Lozier Corporation (Conserval Systems, Inc.)	$225,000 ($14.20/sq ft)	Simple payback period of 3 years or less	Simple payback period of 1.0 year	Lozier was not able to implement the project because capital budget funds were committed for 1993. Decision regarding the proposed project was deferred to 1994. Possible concerns by the potential user of being the first user "south of Chicago" and concerns about the credibility of the analysis.
5. Olin Defense Systems, Building No. 1 (Conserval Systems, Inc.)	$230,000 ($23.76/sq ft)	Simple payback period of 3 years or less	Simple payback period of 2.8 years	Project recommended for approval by the plant manager for the capital projects budget. Expected decision was 1993; action still pending.
6. Olin Defense Systems, Building No. 2 (Conserval Systems, Inc.)	$230,000 ($23.76/sq ft)	Simple payback period of 3 years or less	Simple payback period of 2.8 years	Project recommended for approval by the plant manager for the capital projects budget. Expected decision was 1993; action still pending.
7. Olin Defense Systems, Building No. 3 (Conserval Systems, Inc.)	$230,000 ($23.76/sq ft)	Simple payback period of 3 years or less	Simple payback period of 2.8 years	Project recommended for approval by the plant manager for the capital projects budget. Expected decision was 1993; action still pending.
8. Olin Defense Systems, Building No. 4 (Conserval Systems, Inc.)	$280,000 ($23.10/sq ft)	Simple payback period of 3 years or less	Simple payback period of 2.8 years	Project recommended for approval by the plant manager for the capital projects budget. Expected decision was 1993; action still pending.
9. Koch Materials Company (Industrial Solar Technology)	$378,300 ($25.22/sq ft)	Simple payback period of 7 years or less	Simple payback period of 12 years	Project did not meet the required economic performance criteria.
10. Maui Economic Development Board (Bechtel Corporation)	$822,000	Simple payback period of 10 years or less	Simple payback period exceeded 20 years	Project did not meet the required economic performance criteria.
11. Morgan State University Science Complex (E.A. Engineering, Inc.)	$119,210 ($48.26/sq ft)	Life-cycle cost-effectiveness	Negative cash flow for first 17 years and negative net present value	Project did not meet the required economic performance criteria.
12. Barbers Point Naval Air Station (United Solar Technologies)	$572,400 ($39.75/sq ft)	Simple payback period of 10 years or less	Simple payback period of 20 years	Solar system did not meet the required economic performance criteria. Furthermore, even if the project met the criteria, it would not have been implemented because the base is scheduled to be closed as part of Department of Defense downsizing.
13. Cypress Minerals Company (Industrial Solar Technology Corporation)	$158,500 ($17.55/sq ft)	Simple payback period of 5 years or less	Simple payback period of 8 years	Concerns by Cypress that it would have to shut down operations at the plant because high-grade ore supply was running out.
14. Timberland Company (Shooshanian Engineering Associates, Inc.)	$67,400 ($31.48/sq ft)	Simple payback period of five years or less	Simple payback period of 8 years	Timberland expressed willingness to implement the project (with 10% SPH program cost-sharing) because of its public relations value. They chose not to implement the solar project because of their decision to relocate the plant to the Dominican Republic.
15. Inland Empire Foods, Inc. (Solar Kinetics, Inc.)	$223,533 ($33.26/sq ft)	Simple payback period of 5 years or less	Simple payback of between 9 and 13 years	Solar system did not meet economic performance criteria for inclusion in the capital budget

(individually or in combination) to reduce the payback period: (1) significantly reduce the capital cost of the system, (2) significantly increase the fossil-energy expense savings, and (3) reduce annual O&M expense (e.g., insurance, parasitic electricity requirements).

In particular, the fossil-energy expense savings can be increased in either or both of two ways: (1) increase the percentage of the annualized load met by solar without increasing its capital cost (i.e., improve the technical efficiency of the solar system), and (2) identify a situation where the cost of the competing fuel (natural gas for nearly all of the proposed projects) is very high (i.e., at least \$8–\$10/million Btu).

We will use the proposed solar project for Koch Materials (investigated by Industrial Solar Technology and with information provided in Table III) to perform "what if" analyses; specifically, what would be required in the solar project to meet its 7-year payback requirement? To achieve the 7-year payback—all other factors in Table III remaining the same—the solar system cost would have to decrease from \$340,470 (net) to \$158,291 (net), which is a \$182,179 or 54% reduction. This decrease is likely to be achieved only in mass production.

As for the impact of the price of natural gas, if the price were to increase—with all of the other factors in Table III remaining constant—it would have to increase to \$10.70/million Btu to attain the 7-year payback period. This price is 78% greater than the current marginal price of \$6.00/million Btu.

And as for the impact of the technical efficiency of the solar system on the payback period, the highest likely annualized efficiency for the solar system is about 60%—compared to its expected 43.7%. If the 60% efficiency were achieved, the annual load met by solar would be about 4564 million Btu. With the 60% boiler efficiency, natural gas displacement would be 7607 million Btu; at a natural gas cost of \$6.00/million Btu, the natural gas savings expense would be \$45,642. These savings would result in a simple payback of 9.7 years—exceeding the required 7 years.

One other variable we investigated regarding its impact on the economic viability of proposed solar projects is *cost-sharing*—sharing of a fraction of the system installed-cost by the DOE SPH program (or perhaps a state energy office) to make projects economically viable on the basis of the end-user's investment. For the Koch Materials project, Table IV shows the simple payback periods for various levels of cost-sharing. Our analysis of this table shows that for the solar system to satisfy Koch Materials' 7-year payback period, cost-sharing of about 50% would be required, all other factors remaining the same.

Category 2 Projects: Not Implemented for Exogenous Reasons

Category 2 projects did not meet the end-users' required payback period, but the end-users seriously considered implementing them; ultimately, however, the projects were not implemented for exogenous reasons. Two such projects are Cyprus Minerals' solar system for providing process hot water for a copper refining plant, and Timberland Company's solar system for providing process hot air for a shoe manufacturing plant.

They were not economically viable for the same reasons that applied to the Category 1 projects. For the Cyprus Mineral plant, the solar system had an expected payback period of 8 years—compared to its required 5 years. The Timberland project's expected payback period was also 8 years—compared to the required 5. Nevertheless, both companies (both very profitable) were willing to consider implementing the solar projects for the following reasons: (1) The projects did not involve large sums of money; (2) They were interested in investigating solar now—just in case—as a future source of energy; and (3) They were intrigued at the public relations possibilities, using their interest in solar to show their commitment to being "green."

Unfortunately, neither project was implemented. For Cyprus Minerals, the project was not implemented because the company was concerned that the quality of the copper ore was declining; they might have to shut down operations at the ore processing plant. For Timberland, the company decided to move operations at the Puerto Rico facility to the Dominican Republic. Although the projects were not implemented, the crucial point is the existence of persons in the companies that championed solar. Such persons may be the key to facilitating market acceptance and penetration.

Category 3 Projects: Implementation Deferred Indefinitely

These projects met the potential end-users' capital equipment decision-making criteria, but were not implemented and typically were delayed indefinitely. Of the 15 projects, five projects—all developed by Conserval Systems—fell into this category: four solar ventilation air pre-heating system projects for Olin Defense Systems, and one solar ventilation air pre-heating system in an industrial plant for Lozier Corporation.

The four projects for Olin Defense Systems were "borderline"—they just barely made the required 3-year payback period, but Olin chose not to implement the projects for two major reasons: (1) Available funds in the capital budget had already been allocated; the projects would have to be considered for inclusion in the 1993 capital budgeting process, and (2) The company was concerned about future operations at the facilities because of Department of Defense downsizing.

The proposed project for Lozier convincingly met its capital equipment decision-making criteria, but the company chose not to implement it immediately for two reasons: (1) The company's capital equipment budget had already been committed for the year; they stated they would consider the project in developing the capital budget for the next year; and (2) The company was concerned that the project was risky; Lozier expressed this concern by stating that there were no similar projects in the Midwest outside of Chicago. Both Olin and Lozier wanted the option to consider implementing the projects in the future.

For the SPH program and the SPH industry, the Category 3 projects provide the following message as to initial market penetration: even though solar can be shown to meet the prospective user's capital equipment investment criteria,the solar projects will not necessarily be implemented. As the above examples show, the reasons for not implementing the projects can be varied. Perhaps what is needed, in addition to demonstrated economic feasibility, is a "champion"—a specific person that makes the project happen (as in the case of the Category 2 projects). The SPH Task has had this experience in several previous collaborative projects.

TABLE III. TECHNICAL AND ECONOMIC PERFORMANCE AND COST INFORMATION FOR PROPOSED SOLAR SYSTEM FOR KOCH MATERIALS

Solar system installed-cost	$378,300
Net solar system installed-cost (System installed-cost – 10% tax credit)	$340,470
Total annual thermal load (*million Btu*)	9087
Annual load met by solar (*million Btu*)	3324 (37%)
Natural gas savings due to solar (*million Btu*)	5540
Solar-to-thermal net conversion efficiency (*annualized percent*)	43.7
Annual O&M cost (excluding gas)	$10,627
Cost of natural gas (*per million Btu*)	$5.36–$6.00
Boiler efficiency (*percent*)	60
Payback period demanded by Koch (*years*)	7
Expected payback period of solar system (*years*)	15

TABLE IV. IMPACT ON PAYBACK PERIOD OF SHARING COST OF KOCH MATERIALS' SOLAR PROJECT BY A GOVERNMENT PROGRAM

*Cost-Sharing Percentage to End User, (%)**	*Net Cost of Solar System to End User, ($)***	*Simple Payback Period (Years)*
0	340,470	15.0
10	302,640	13.4
20	264,810	11.7
30	226,980	10.0
40	189,150	8.4
50	151,320	6.7

* Percentage of system installed-cost.
** System installed-cost – (Tax credits + Cost-sharing).

CONCLUSIONS

The primary reason the proposed solar projects were not implemented was that the 15 "highly promising" prospective users, in retrospect, were not "highly promising." In the case of the ten Category 1 and Category 2 projects, the prospective users were not "highly promising" because the solar projects did not meet their principal capital equipment investment criterion—simple payback period. The projects did not meet their investment criteria for three major reasons: (1) high capital costs of solar systems, (2) availability of cheap natural gas—the primary conventional alternative, and (3) demands for a very short payback period (typically 3 years or less). Of these three reasons, only one has the potential to be influenced by the SPH program and industry—the high capital cost of solar.

In the two Category 2 projects, poor economics was compounded by exogenous events unique to the two prospective users (i.e., Timberland's moving plant operations from Puerto Rico to the Dominion Republic and Cyprus Minerals' concern about shutting down its plant because of low-grade copper ore).

In the five Category 3 projects, the prospective users were not "highly promising" even though the projects met their capital investment criteria; the users were unable to implement the solar projects because of their capital budgeting processes. For those potential users, solar projects would, at best, have to be considered for implementation in the next year's capital budget. Furthermore, even though solar was shown to be economically attractive, there still was reluctance to invest in solar for other reasons (e.g., concerns about riskiness). Consequently, economic viability alone does not guarantee solar market acceptance and penetration. Perhaps what is needed are "champions" for solar.

Consequently, to increase the number of prefeasibility studies projects that result in implementing solar systems, the SPH program and industry should formulate a new definition of "highly promising potential users" and focus marketing activities on such users. One possible definition might be prospective users having the following attributes:

(1) Use life-cycle cost-effectiveness or years-to-payback (with a 10–12 year period) as their principal capital equipment decision-making criterion.

(2) Have flexibility in making capital investments (i.e., do not have to wait until the next fiscal year to implement solar projects that are economically viable).

(3) Use expensive natural gas (i.e., $8.00/million Btu or higher) or expensive electricity (at least $0.065/kWh) for their thermal processes.

(4) Have no exogenous issues pending that would preclude implementing economically viable solar projects (e.g., plans to move or shut down facilities).

(5) Have "champions" for solar in their decision-making processes.

(6) Have been properly "conditioned" regarding solar (i.e., all their concerns and questions about solar have been resolved).

The lesson learned and the new definition of "highly promising" potential user will be used, starting in FY 1995, to recast the prefeasibility studies activity and to guide other activities conducted by the SPH task that focus on identifying and developing near-term markets. Other activities include, for example, the collaborative programs that the SPH task has with electric utilities; these programs involve identifying opportunities for solar projects and helping to make the projects happen. Specifically, with respect to the prefeasibility studies activity, the lessons learned and insights gained will be used to help the solar industry develop *workable, low-financial-risk* strategies for identifying potential users and classes of users for which the probability of success should be significantly greater than 14%. Developing improved strategies will be a SPH task/solar industry collaborative effort.

REFERENCES

Bechtel Corporation, September 1992, "Task 4 Report: Draft Final Report of Solar Absorption Air Conditioning System for the Maui Research and Technology Center," Bechtel Corporation, San Francisco, CA.

Conserval Systems, Inc., May 1992, "Final Report: Solarwall Process Heat Feasibility Study for NREL," Conserval Systems, Inc., Buffalo, NY.

E.A. Engineering, Science and Technology, Inc., June 1993, "Solar Process Heat Prefeasibility Study for the Morgan State University Science Complex, Baltimore, Maryland," EA Engineering, Science and Technology, Inc., Silver Spring, MD.

Industrial Solar Technology Corporation, June 1993, "Solar Process Heat Prefeasibility Study: Process Heating for Solvent Extraction-Electrowinning of Copper: Final Report," Industrial Solar Technology Corporation, Denver, CO.

Shooshanian Engineering Associates, Inc., May 1993, "Task 3 Report: Solar Process Heat Prefeasibility Study at the Timberland Company Isabela, Puerto Rico," Shooshanian Engineering Associates, Inc., Boston, MA.

Solar Kinetics, Inc., April 1994, "Solar Process Heat Prefeasibility Study: Task 3 Report," Solar Kinetics, Inc., Dallas, TX.

United Solar Technologies, Inc., April 1993, "Prefeasibility Study for Solar IPH Task 2 Report: Barbers Point Naval Air Station, Solar Cooling System," United Solar Technologies, Inc., Cabin John, MD.

United Solar Technologies, Inc., November 1993, "Prefeasibility Study for Solar Industrial Process Heat Final Report: Hawaiian Military Facilities," United Solar Technologies, Inc., Cabin John, MD.