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CONSUMER PROTECTION ISSUES IN THE DEVELOPMENT OF SOLAR ENERGY

GOVERNMENT
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HEARING

BEFORE THE
SUBCOMMITTEE ON
OVERSIGHT AND INVESTIGATIONS

OF THE
COMMITTEE ON
INTERSTATE AND FOREIGN COMMERCE
HOUSE OF REPRESENTATIVES

NINETY-FIFTH CONGRESS
SECOND SESSION

SEPTEMBER 21, 1978

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CONSUMER PROTECTION ISSUES IN THE DEVELOPMENT OF SOLAR ENERGY

THURSDAY, SEPTEMBER 21, 1978

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON OVERSIGHT AND INVESTIGATIONS,
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE,
Washington, D.C.

The subcommittee met, pursuant to notice, at 10 a.m., in room 2322, Rayburn House Office Building, Hon. John E. Moss, chairman, presiding.

Mr. Moss. The committee will be in order.

This morning's hearing on consumer protection issues in the development of solar energy systems continues the subcommittee's review of solar technologies which can be used by consumers now. A previous hearing focused on passive solar systems. This hearing will deal with the better known active systems.

These systems hold out the possibility of substantially displacing traditional fossil fuels in a number of important applications, such as in water and space heating.

Based on this bright promise, the President directed on Sun Day, May 3, 1978, that a Domestic Policy Review Group be established to develop policy options and recommendations for the effective development and maximum economic use of solar energy.

Approximately 7,000 residential units and 200 commercial units have already been funded by the Federal Government under the national solar heating and cooling demonstration program, and the President, as an interim measure, has recommended that \$100 million be added to the Federal solar energy budget for fiscal year 1979.

If this is accomplished, the Federal solar energy budget would climb over the \$500 million mark. These figures, moreover, do not reflect the cost to the Government in lost revenues that would result from a tax credit for solar systems.

If, as seems likely, the tax credits pass in this Congress, and Federal spending for solar continues to expand, an increasing number of consumers will buy solar systems. Consumer experience in the next few years will, depending on the reliability and the energy savings of the systems, determine whether or not solar heating and cooling will displace a significant volume of fossil fuels by the year 2000.

The subcommittee has received a number of disturbing reports in recent weeks concerning the number of problems that have been experienced by solar consumers in various areas of the country. We will examine these cases this morning, as well as the adequacy of existing standards and other mechanisms to protect solar consumers. One need

only recall the heat pump experience, however, to realize the negative effect that bad consumer experience can have on the commercialization of an emerging energy technology.

If the Federal Government is encouraging the use by consumers of solar or any technology, I believe that the Government incurs an obligation to take care that the consumer is protected from ineffective or hazardous merchandise.

Our witnesses today are drawn from both the public and the private sectors. Their diverse experience and considerable expertise will help us to probe these important issues.

Our first witnesses, appearing as a panel, will be Dr. Marvin Yarosh, director of the energy systems analysis division of the Florida Solar Energy Center; Sheldon Butt, president of the Solar Energy Industries Association based in Washington; and Jack Meeker, manager of consumer projects of the New England Electric System.

Would you gentlemen please come forward and take your seats?

Mr. Butt, I believe you have a statement.

STATEMENTS OF SHELDON H. BUTT, PRESIDENT, SOLAR ENERGY INDUSTRIES ASSOCIATION; MARVIN M. YAROSH, DIRECTOR, ENERGY SYSTEMS ANALYSIS DIVISION, FLORIDA SOLAR ENERGY CENTER; AND JACK MEEKER, CONSUMER PROJECTS, NEW ENGLAND ELECTRIC SYSTEM

Mr. BUTT. Yes, Mr. Chairman, I have submitted a written statement. I will not try to read the whole thing.

Mr. Moss. We will place the entire statement in the record [see p. 4]. You may proceed to summarize in whichever fashion best serves you.

Without objection, so ordered.

Mr. BUTT. I think our basic approach to the whole subject of consumer protection relates primarily to what we see as the reality of the marketplace. Nobody has to own a solar system. It perhaps is necessary that you have a heating system in your house, but it is not necessary that it be solar.

That means if we are to grow and prosper as an industry, we need to develop consumer credibility and acceptance. The only way we can do that is through adequate consumer protection.

As far as we are concerned the situation is really quite simple. If we are going to become a substantial industry, one of the prerequisites for doing that is protecting the consumer.

We can separate the measures involved in accomplishing this into three categories: standards, codes, and warranties.

At the present time the bulk of the standards are in preparation. We do have some that are in use, including standards developed in the private sector and also the minimum property standards and the installation standards which were developed with Government funding.

In the area of codes, much remains to be done. The DOE is sponsoring—or plans to sponsor—the development of a solar model code. They are preparing to contract with various model code organizations for that purpose.

I suppose that the code organizations will be the major workers in this endeavor, through the trade associations and through the

individual members, representing both small and large business. Consumers will be represented as well as other interested parties.

We are pleased with this because we feel the code-writing exercise will be carried on in a manner so that input and participation from everybody who has an interest will be assured.

In the area of warranties, most of our members and most of the installing contractors who install their products do indeed provide warranties. These are of a diverse nature. We have been working to develop, again with HUD, a series of proposals to develop a system of warranty reinsurance as a means of solidifying and backing up the warranties.

This, I think, is important, particularly since many of the organizations in the solar business are not large companies and are not very strong financially. There perhaps needs to be someone standing behind them so that the consumer may be assured that warranty service will, in fact, be rendered and any problems encountered taken care of.

I think that pretty well states our position and summarizes where we feel we are today. I would like to sign off on that note.

[Testimony resumes on p. 85.]

[Mr. Butt's prepared statement and attachments follow:]



SOLAR ENERGY INDUSTRIES ASSOCIATION Suite 800 1001 Connecticut Avenue, NW Washington, DC 20036 202 293 2981

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CONSUMER PROTECTION - PROBLEMS AND ISSUES
 RESIDENTIAL APPLICATION OF ACTIVE SOLAR SYSTEMS
 PRESENTED BY SHELDON H. BUTT, PRESIDENT
 SOLAR ENERGY INDUSTRIES ASSOCIATION
 TO THE OVERSIGHT SUBCOMMITTEE OF THE COMMERCE COMMITTEE
 UNITED STATES HOUSE OF REPRESENTATIVES
 SEPTEMBER 21, 1978

The Solar Energy Industries Association welcomes this opportunity to present its views on this subject. S.E.I.A. is the trade association representing the solar industries, including manufacturers, installers and design professionals, involved in the business of solar energy. We have approximately 850 members, including both very small and large business organizations, although 80% of the membership falls into the small business category.

Our Association is most vitally concerned with the issue of consumer protection and the closely related issues of consumer acceptance and consumer credibility.

I believe we can best document our concern simply by reference to the realities of the marketplace. Such things as basic shelter, heating equipment, hot water heaters and, in many areas, air-conditioning are regarded as necessities. Solar devices are not. Therefore, if we, as an industry, expect to grow and prosper, we must develop consumer credibility and acceptance, and it is obvious that we cannot accomplish these objectives unless we adequately protect the consumer. Thus, these three closely related issues are the key to our industry's very survival. If your neighbor's conventional heating plant malfunctions, you will not build a house without a heating plant, although you may insist on a different manufacturer's product. If your neighbor's solar system malfunctions, you may refuse to consider a solar installation regardless of the manufacturer.

The measures important to consumer protection and, thereby, to consumer credibility and acceptance can be categorized as:

1. Standards.
2. Codes.
3. Warranties.

Although interrelated, each of these areas has a specific role to play:

Standards. Standards provide a means of defining the characteristics of a product and/or its installation. They provide a means of assuring that the product or installation will perform satisfactorily and give satisfactory service if it complies with the standards. They provide a means by which the purchaser may measure and compare the merits of competing products.

Codes. In a sense, code provisions, usually adopted at the state or local level as regulatory measures, are designed to assure that the equipment and its installation fulfill minimum code requirements. These requirements often are defined in terms of standard or mandate compliance with standards.

Warranties. In the presence of adequate standards and code provisions, generally satisfactory performance, reliability and durability are assured by compliance with the standards and codes. Under such circumstances, the real purpose of warranties is to protect the user against the eventuality of an individually defective product or installation (as opposed to a generically unsuitable product or installation).

In all three areas, we are in a position in which tradeoffs are often necessary. If standards are unnecessarily rigorous or rigid, the gain in terms of performance, reliability and durability which may be derived may be small as compared to the added cost which the user would have to accept. Furthermore, their effect may be to stifle innovation and retard progress towards increasingly cost-effective installations. Unnecessarily rigorous or restrictive codes may have the same effect and particularly so in the area of restraining innovation and product improvement. Unusually lengthy or comprehensive warranty provisions may add more to the cost to the consumer than they are truly worth to him.

Labeling and certification programs are a means by which compliance with standards and/or with codes is attested to and by means of which performance information is presented and verified. In effect, labeling and certification programs are often the means by which standards are implemented and used.

It is fortuitous that these hearings are being held during the week following the Second National Conference on Standards for Solar Energy Use, which was held in New York, September 13-15. This Conference provided a general update on the status of solar standards activities and pointed out the need for accelerating these efforts. Because of its relevance to this testimony, a copy of the program book which contains abstracts of the papers presented is appended to this testimony (Appendix A).

The writer's keynote address at this Conference pointed out the necessity of accelerating the development of needed standards and in a

separate presentation, a number of the highest priority standards activities were called out. (Abstracts of these two presentations appear on Pages 12 and 16 of Appendix A.)

Standards

At present, there are relatively few solar standards which have been completed and are in place. A.S.H.R.A.E. has developed and issued two standards; ASHRAE 93-77 which provides a method for measuring the thermal performance of solar collectors and ASHRAE 94-77 which provides a method for measuring the thermal performance of thermal storage subsystems. We also have H.U.D. Intermediate Minimum Property Standards and "Installation Standards" prepared by S.M.A.C.N.A. (Sheet Metal and Air-Conditioning Contractors National Association) with funding from H.U.D. Although both of these latter two "standards" represent substantial progress, they are by no means final documents. In their present state, they are more in the nature of guidelines requiring careful and skilled interpretation in use.

Based upon ASHRAE 93-77, the Solar Energy Research and Education Foundation (S.E.R.E.F.), under contract to D.O.E., has been developing a program for solar collector rating, labeling and certification. Key elements of this work are nearly complete. S.E.I.A. intends to implement the S.E.R.E.F. program commencing later this year. When implemented, this program will provide consumers and other users with a structured and meaningful basis upon which to judge and compare the thermal performance of different collectors. The test procedure involved will also include tests which bear upon some aspects of durability, although they do not by any means cover the entire area.

The National Bureau of Standards has developed what amounts to a checklist of various tests which might ultimately be standardized and used as a means of establishing the reliability and durability of solar collectors. This is NBSIR-1305. As it stands, this document must be regarded primarily as an outline of areas to be investigated and is being treated as such in the Department of Energy's ongoing solar collector test program. Sample collectors representative of the generality of the various collectors on the market are to be subjected to the series of tests outlined by N.B.S. and the results of the testing program analyzed to determine:

a. First of all, is a test in a specific area needed or can the same effect be achieved more simply and economically through the establishment of standard design criteria?

b. If a test in a specific area is, indeed, required, what modifications or changes from the test procedure proposed by N.B.S. should be made?

The entire series of tests whose basic applicability and whose specific requirements are being investigated would, if applied as now

written, have serious effects. It is our opinion that many of the proposed tests are unnecessarily rigorous and that adopting them as standards without further investigation would thereby substantially increase the cost of collectors.

A.S.T.M. is also developing standards relating to collector reliability and durability. S.E.I.A. intends to introduce requirements for compliance with reliability and durability standards into their Solar Collector Rating, Labeling and Certification Program when and as adequate and reasonable standards become available as the result of the present D.O.E.-N.B.S. work and/or as a result of the work in A.S.T.M. and elsewhere. We in S.E.I.A. have continued to urge that standards development work in this area is one of the areas of standards activity which is of very high priority.

Solar collectors are the "most unique" components of solar systems. We believe that this fact is ample justification for the priority which has been assigned to the development of standards relating to collectors and to the development of solar collector rating, labeling and certification programs. Certainly, this does not mean that the objective of providing comprehensive consumer protection will have been met only by collector standards and the rating, labeling and certification programs based upon them. The thermal performance characteristics of the collectors in a solar system are only one factor among several which define the overall thermal performance of the system. Poor system design may result in poor system performance regardless of the thermal performance of the collectors. Other components in the system may fail and the system become inoperative and, indeed, malfunction of other system components may cause the premature failure of the collectors even though they may intrinsically be both durable and reliable. Thus, there is an as yet unfilled need for system standards as well as for collector standards.

The largest residential solar applications are in water heaters and pool heating systems. A.S.H.R.A.E. is well along with development of thermal performance measurement standards for both. As soon as these standards become available, work will begin to add these to the S.E.I.A. rating, labeling and certification system.

A thermal performance measurement standard for single-family residential hot water systems is practical since they are usually produced and marketed as "packaged" systems. Solar swimming pool heaters are basically very simple and typically, do not involve separate heat exchangers or thermal storage capability since they normally heat the pool water directly. Solar space heating is a different matter. Typically, a solar space heating system is sized to the job and collector area, storage capacity and other system elements are selected based upon the specific requirements of the individual application. Furthermore, the size of the collector arrays and other parts of the system are normally such that existing test facilities would not be capable of testing an assembled heating system. On site testing is not the answer. The cost of performing the test, including the cost of the special instrumentation which would be required, would be altogether prohibitive. Solar heating system performance and rating must rely

upon an analytical method in which the measured thermal performance characteristics of the collector, heat exchanger, storage and other components, together with load characteristics, are used as input to computer performance simulation which then becomes the basis for rating. There are a number of such analytical methods in use, notably "Solcost" and "F-Chart." Considerable work has been done to evaluate both of these through instrumented tests. It will be necessary to evaluate the results of these test programs and perhaps assemble additional test data so that, ultimately, a "standard method" of predicting and rating performance can be adopted. It will then be possible for the "system packager" or installer to certify to the results of this rating procedure.

Considering factors affecting reliability and durability, complete systems consist of both generally "standard components" which are usually adequately covered by existing standards and "unique components" which are not. The most important and "most unique" is the collector which has been discussed above. Heat exchangers and control devices are similar to "standard" equipment used for other applications and for such use are covered by existing standards. In many cases, they may be sufficiently different from the "standard" items to justify development of separate or modified standards. The American Society of Mechanical Engineers (A.S.M.E.) has begun work on solar heat exchanger standards. As yet, no particular standardization effort has been initiated to cover solar system control devices.

System interactions not only have a great effect upon system thermal performance but also may be the cause of reliability and durability problems even though the individual components and subsystems, both "standard" and "unique," are themselves entirely suitable for solar system use. System design criteria or standards and installation standards are needed. The questions of system design and the interaction of system components are addressed by the H.U.D. Intermediate Minimum Property Standards and by the S.M.A.C.N.A. Installation Standard. As noted, neither of these are finished documents.

Since the assembly of components into a complete system and their installation generally takes place at the level of the installing contractor or the distributor-dealer, it is probable that one of the most effective means of standardization in this area is the mechanism of the development of model building code provisions for solar heating systems. The subject of model codes will be discussed later.

There is relatively little present activity in the area of solar-driven residential air-conditioning systems. Generally, these systems are combination heating and air-conditioning systems. We may look upon them as being heating systems to which thermally-driven air-conditioning equipment has been added. Thus, the comments made previously concerning standards for heating systems apply to solar air-conditioning systems as well, with the additional need for standards to cover the air-conditioning unit itself.

Codes

Building codes have a dual role. In the first place, they are very often the final step in the implementation of component and system standards. They call out and reference these standards and often require compliance with them. Secondly, and most importantly, the building codes are generally the means by which compliance with installation standards or the use of good installation practices is mandated.

Many of the conventional materials and standard components used in a solar system are, in fact, covered by existing code provisions. Existing plumbing codes may apply to the piping associated with liquid systems. Existing electrical codes apply to electrically-driven components and their installation. This seems simple; however, there are instances in which the unique characteristics of the solar system make it desirable that the existing code provisions covering the relatively conventional aspects of a solar system be modified. For example, many solar heating systems make use of a separate heat transfer loop to conduct heat from the collector array to storage. Characteristically, the heat transfer loop operates at relatively low pressure and very often, circulates a mixture of water and antifreeze or a nonaqueous heat transfer fluid rather than plain water. Existing plumbing codes are written to cover plain water at relatively high pressure. Because of these differences, the existing code may be too restrictive--by not recognizing the lower pressure at which the heat exchanger loop operates--but on the other hand, may not adequately recognize the special precautions which must be taken with water-antifreeze mixtures or with nonaqueous heat transfer fluids.

There have been some efforts to develop special code provisions for solar installations. The International Association of Plumbing and Mechanical Officials (I.A.P.M.O.) has developed a model solar code. Los Angeles County has adopted a solar code. Both represent a laudable effort to develop code provisions specifically for solar installations but both have serious deficiencies.

Some months ago, the Department of Energy made known their intention to fund the development of a comprehensive National Solar Model Building Code, working through the major code organizations and with input from other Government Agencies, from the solar industry and from design professionals.

Work in this area has not yet been initiated. We are told that one of the impediments has been opposition from some of the organizations representing design professionals who perceive of model solar codes as limiting innovation. It is our position that the need for a National Model Solar Code must take precedence over the desires of the design professionals although, of course, the code should make adequate provision for consideration and recognition of innovative design as it develops. We also suggest that the position of these professionals is unrealistic. Blocking or delaying the development of a National Solar Code simply encourages the development and adoption of a variety of state or local codes which may be expected to vary substantially from each

other. Furthermore, specialized solar expertise is not uniformly and universally available, and the separate state or local codes which may develop will often be ill-conceived.

This will place an added burden upon manufacturers and installers. It will result in a proliferation of types and models of solar equipment to meet the requirements of different codes which will increase cost. Through omission and through ignorance, it is certain that many such codes will not adequately protect the user while others will overspecify and add further to the user's cost.

Warranties

The final element required for consumer protection is the warranty. Warranties are customarily offered by equipment manufacturers and by installation contractors for all sorts of consumer equipment. Warranties are offered by manufacturers and installers of solar equipment.

There is considerable diversity in the warranty provisions now offered by different individual solar manufacturers and installers. The offering of a warranty which is somewhat superior to a competitor's warranty is one form of competition between manufacturers. Therefore, the development of a "standard" warranty is thought of as anti-competitive and we do not propose development of a "standard" warranty. Many consumer groups, as well as State and Federal Agencies concerned with consumer protection, have sought to impose minimum warranty requirements upon manufacturers and installers of solar equipment. We do not disagree with the concept of a "minimum warranty." However, we have noted a tendency for some of these organizations to utilize the leverage provided by the regulations adopted to regulate incentives programs to force the adoption of warranty provisions substantially more stringent than those normally applying to similar consumer products, such as conventional heating and cooling systems, water heaters, etc. These requirements may simply take the form of a longer warranty term or they may include new and "innovative" warranty provisions which may appear to offer the consumer more protection but which, in actuality, may ultimately cost the consumer more than they are worth.

Certainly, we recognize the importance of warranties in providing for consumer protection and thereby developing consumer credibility and consumer acceptance. However, the temptation to utilize the newness of the solar industries as an excuse for "experimenting" with new and innovative forms of warranties whose cost and effectiveness have not been researched or even reasonably considered must be resisted.

The writer recently had an interesting discussion with an official in the Consumer Agency of one State Government who was proposing legislation which would require that the solar equipment manufacturer and installer warrant the percentage of the actual hot water requirements which a solar water heater would provide for each individual purchaser. I tried to explain that it would soon be possible for the manufacturer

to certify the thermal output of a water heater under standard conditions and that this output would equal some percentage of the normal hot water requirements of a "typical" family. I pointed out that most actual families varied substantially in one direction or another from the "typical" family. This didn't satisfy him so I explained further that, in order to provide the sort of warranty he wanted, it would be necessary for the manufacturer or the installer to carefully study the living habits of the individual family and that such studies would necessarily be rather expensive. If properly done, their cost would add substantially to the basic cost of the water heater. His response was that he felt that it was entirely reasonable to require that such individual studies of the living habits of specific families be made. He also proposed that this warranty be passed along to subsequent owners of the property and, of course, was unable to suggest any means by which the manufacturer and the installer could provide for the unknown characteristics of a second owner warranting performance. Of course, there is a means by which this can be accomplished. It is really very simple. One sells the consumer a water heater which is twice as large as he probably needs and warrants its performance at a level far below what normally might be expected. Of course, this doesn't really meet the needs of the consumer for protection--it just adds to his cost. I did not suggest this alternative since, by this point in the conversation, I was afraid that he might accept it as being "reasonable."

In the development of a new industry, such as the solar industry, the uncertainties and risks associated with relatively extended warranty provisions are less well known than in other older industries which have considerable experience with warranty costs. Furthermore, many of the firms now engaged in solar business are still small and are not financially strong. This has led to the suggestion that a "warranty reinsurance" program be developed, underwritten by the Federal Government, which would serve the dual purpose of guaranteeing the consumer's warranty coverage and limiting the warranty risk exposure of the manufacturer and installer to reasonable proportions. A copy of industry proposals made to H.U.D. by the industry in July is attached as Appendix B. In it, we propose that the Federal Government assume the position of "warrantor of last resort," standing behind the private insurer and underwriting part (but not all) of the risk of underwriting loss.

Summary

Standards, codes and warranty provisions fit together into a system of consumer protection which will also enhance consumer credibility and consumer acceptance of solar energy. Considerable progress has been made in the brief period during which the solar industry has existed. It is in the National Interest to accelerate the development of solar energy as a renewable resource replacing nonrenewable energy resources. Accelerated growth of the industry requires that the growth and development of the standards, codes and warranty provisions required for consumer protection also be accelerated. One of the important tasks which

the Department of Energy and other Federal Agencies have before them is the development of the means of accelerating these developments. D.O.E. and other agencies have supported some of these efforts but much more needs to be done.

Industry Viewpoint on Solar Energy Standards—Industry Standards

Sheldon H. Butt
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Sheldon H. Butt is presently President of the Solar Energy Industries Association. The Solar Energy Industries Association is a trade association formed by manufacturers, contractors, consulting engineers, architects and interested individuals. The objectives are to foster and accelerate development and marketing of solar energy conversion systems through public, Governmental and industry communications. Another objective is to develop public interest positions with respect to legislation and regulation and to advise opinion leaders in Government, industry and the scientific community.

Mr. Butt has a Master's degree in Chemical Engineering from the University of Louisville. He has been employed by the Olin Brass Group of Olin Corporation for over 30 years and is presently Director of

Market Research and Planning for the Olin Brass Group.

ABSTRACT

Since solar collectors are the most unique component of solar systems, it follows that the first order of business has been the development of a solar collector rating, labeling and certification program initially addressing thermal performance, since the thermal performance test standard is available, and later, to address durability and reliability as testing and/or prescriptive standards become available. This activity is well underway. Implementation of a collector rating, labeling and certification program by SEIA will be based upon the SEREF labeling and certification program development which is being undertaken with DOE funding and which is to be discussed in Session 4 on September 14.

Following this activity, industry believes that the very highest priority must be assigned to developing the underlying standards and implementing programs for rating and certification of the thermal performance of solar hot water systems, solar heating systems and solar pool heating systems. The inclusion of reliability and durability

factors in system certification programs is of comparable importance and also deserves very high priority. The proposal that thermal performance rating and certification come first simply reflects the probability that the underlying standards will be ready for a thermal performance rating and certification program before they are ready in the durability and reliability area.

Industry also believes that high priority should be directed towards defining areas for specific standards for passive solar systems and the development of these standards. This is a complex subject area and the first step is to break down the general area of passive standards activity into a matrix of individual passive "features" or "components". Once this has been accomplished, the individual proposed standards can be prioritized, reflecting their individual importance and their individual need.

To avoid the problem of active marketing of photovoltaic devices for commercial application before standards become available, industry believes that high priority should be accorded photovoltaic standard development.

Keynote Address

Sheldon H. Butt
 President
 Solar Energy Industries
 Association
 Washington, D.C. 20036

ABSTRACT

At the time of the First National Conference on Standards for Solar Energy Use, the process of solar standards development by voluntary standards writing organizations had just begun. It is now well underway. Although only a few standards have been completed, progress has been made and a number of standards are approaching completion.

Should we be satisfied? On the one hand, the solar industries are very new and standards development is more advanced than has historically been the case in other new industries at a comparable stage in their development. However, there is a national mandate for accelerated development of solar energy applications. Accelerating solar development involves many activities in many areas which interact upon each other and impact upon progress towards our national goals. The development of adequate standards is one of the key activities. If we ask the question: "Would solar applications be moving ahead more rapidly if standards activities were more

advanced?", the answer must be "Yes." If we had made more progress in development of solar standards, solar applications would have made more progress. It follows that we cannot be satisfied with the progress made.

In the paper presented in Session One, specific industry proposals addressing the problem of accelerating standards development were offered. They are intended to be effective within the framework of the voluntary consensus standards system which we perceive to be the best means of developing sound standards to best meet the needs of the consumer and industry. In this presentation, I will dwell upon the alternatives.

We must accept as "given" that, in this era of increased consumer awareness, the alternative of tolerating delay in standards development needed for consumer protection is not viable. We can't simply wait.

Thus, the alternative is that standards will be developed by some other mechanism and the only other mechanism immediately available is Government at the Federal, State and local levels. What does this mean? Some Government groups, such as N.B.S., have good technical knowledge of solar systems. However, most Government groups at other levels do not. By their nature, no

Government organization can fully appreciate and recognize the effect of restrictive standards upon product cost and upon the flexibility needed to accommodate product innovation. In themselves, excessive product cost and delayed introduction of new products are contrary to the consumer's interest. Furthermore, Governmental bodies can no more directly represent the consumer interest than the industry interest. D.O.E. and other Federal Agencies recognize these problems and fully support solar standards development through the voluntary consensus procedure. There are consumer organizations who advocate Government standards making as an alternative to the voluntary standards process. I believe that, if their wishes were granted, they would find that they were worse off.

This alternative scenario offers standards which would be less responsive to the needs of both industry and consumers and, most importantly, contrary to the national mandate to accelerate solar application.

We must accept the challenge to evolve the means of accelerating development of solar standards within the voluntary consensus standards system and assuring that it is fully responsive to the needs of consumers and industry. This must be our goal.

*Confidential*WARRANTY/RISK
REINSURANCE PROGRAM

This paper suggests a government supported warranty/risk reinsurance program to stimulate the development of a viable solar energy market with a minimal impact on the federal budget. A significant barrier to development of the industry is the perception of high risk by both sources of capital and consumers. Accordingly a program of warranty/risk reinsurance for any financial losses that may result from defective or improperly installed solar products will make a significant contribution to overcoming both consumer reluctance to purchase and investor reluctance to support solar energy and will complement other federal efforts.

Programs that commit the federal government to guarantee loans or to provide insurance or reinsurance as a means to achieve certain goals are not uncommon and have proved to be successful in the past. Some interests that the government has furthered in this way include: stabilizing agricultural economy; improving the balance of payments with foreign countries; encouraging investment in other countries (Ex-Im Bank); encouraging investment in American cities (FIA Riot Insurance); building consumer confidence in the safety of investment (FDIC, FSLIC, Federal Credit Union Administration); developing safety and health standards (FIA Flood Insurance); assisting small investors and consumers (HUD Housing Insurance, Ex-Im Bank); nurturing new energy industries (Price Anderson Act); and protecting necessary channels of commerce (Maritime Administration War Risk Insurance).

In each of these programs, and in others, government involvement is needed either to overcome unreasonable or unknown risks or to furnish incentives which ensure the development and pursuit of market choices that would otherwise be unattractive to individual consumers and industry.

While a degree of risk, both perceived and actual, exists with each consumer purchase, consumers can generally assess the risk involved (e.g., whether the product will or will not function properly) as a result of familiarity with the product through personal experience or knowledge gained as a result of purchases by others. The risk involved in any consumer purchase increases as the price of the product increases. Thus, with a high priced item, with which there is little consumer familiarity, such as solar energy, the risk, both perceived and actual, can result in a consumer postponing a purchasing decision, perhaps indefinitely. While warranties have been useful in reducing the actual and, therefore, perceived risk involved in the purchase of many consumer products, they are of questionable value (without federal support) as a purchase incentive, where not only the product, but the manufacturer is unknown to the consumer. For similar reasons, basically resulting from the lack of historical data which shows a "track record" for solar energy systems, sources of investment capital have been reluctant to invest in solar and private in-

insurance companies have been reluctant to provide protection to manufacturers and installers of solar equipment against the risk of unknown loss. This is particularly true where the manufacturer or installer is a small and relatively new company.

In such cases, the government has provided loan or credit guarantees, insurance, or reinsurance. Examples include the danger of nuclear accident (Price Anderson Act), damage from civil disturbances (FIA Riot Insurance), damage from flooding (FIA Flood Insurance), dangers that investment property will be damaged or expropriated (War Risk Insurance), or destroyed by natural causes (Federal Crop Insurance). These programs illustrate that it is also important and effective to provide incentives (either directly or through protection against financial loss) so that sources of capital, manufacturers, installers, and consumers will make desired investments, when less risky and, therefore, more attractive alternatives exist.

Federal insurance or reinsurance will also provide additional positive incentive. Examples of existing federal incentives in other areas include: encouraging savings over other forms of investment (FDIC, FSLIC, Federal Credit Union Administration), encouraging the development of inner cities (FIA Riot Insurance), encouraging American investment in developing countries (Ex-Im Bank) and encouraging investment in and development of nuclear energy (Price Anderson Act).

It is the announced goal for the present administration to foster development of the solar energy industry. A key ingredient to this development is illustrated by a Department of Energy study released in January 1978 which concludes in part that perceived risks are too high and present incentives are inadequate for substantial industry growth.

Sources of capital lack adequate, long-range information about solar energy and, because of the resulting uncertainty, are reluctant to invest in solar energy. Private sources are particularly reluctant to make capital commitments to small companies because of fear that they will be "squeezed" as major companies enter the market. Builders are usually relatively small and have difficulty assuming the risks of product defects or installation errors and may feel (along with consumers) that manufacturer or installer warranties, particularly from newer or smaller companies, offer little real protection.

The financial community is unlikely to provide adequate investment and expansion capital until practical experience can be gained from installed solar systems. Until then, smaller manufacturers, builders and installers will have difficulty obtaining both capital and obtaining insurance to protect against possible financial losses from defective equipment or improper installation. Furthermore, newer and smaller companies will be less successful in overcoming the risk factor than larger companies which have consumer-recognition and the ability to self-insure. A new government program should make sure that an adequate financial base exists to support warranties (protection against risk) through government reinsurance. With federal reinsurance the private insurance industry would have the incentive to back up solar warranties and, at the same time, carry less risk. The result in an open market should be insurance premiums affordable to small manufacturers and installers.

The most feasible option would be to establish a federal corporation or a new program within an existing federal agency, for a fixed time period, to provide reinsurance to protect against possible financial losses resulting from defective products or improper installation. Participation in the reinsurance program would be conditioned upon minimum warranty requirements and the requirement that products and installers meet certain minimum standards.

In order to insure responsible manufacture and installation, the warrantor would be required to absorb at least 20% of the total cost of any service, repair, replacement etc., that would be required to remedy a product or installation defect. At the same time, the program could be designed to insure that the consumer would be completely protected against financial loss.

A second option is a direct insurance program for solar products. However, this is a less desirable choice because it would involve much higher administrative costs and the expertise of the private insurance industry as well as its in-place facilities and manpower would be lost. Finally, a federal reinsurance program which actively involves the private insurance industry will give the insurance industry valuable experience in and familiarity with solar equipment. Thus, private carrier involvement should greatly facilitate the eventual conversion to a non-governmental warranty insurance program.

A solar warranty/risk reinsurance program could be designed to accept new risks (i.e. a new installation) for a seven year period, thereby making it consistent with other federal solar programs. A period of, e.g., five years */ could be "reinsured" by the federal government for each system.

Although available data is limited, indications are that the problems that do occur with a solar system are detected within the first year from date of installation. At the end of the seven year period, sufficient consumer experience and hard data will have been developed which, coupled with the direct experience of private insurance carriers in the program, should provide for a relatively smooth phase-out of the federally supported warranty/risk reinsurance program. By conditioning the reinsurance program upon minimum warranty requirements on equipment and installation, consumer incentive to postpone a purchasing decision because of "unknown" risks will be greatly diminished.

CONCLUSION

It is recommended that the Department support a federal reinsurance program for a fixed period of seven years. This program would support warranty/risk insurance for manufacturers and installers at reasonable rates since the Federal government will be able to divert from private carriers a substantial share of the risk of underwriting solar warranty insurance. The program would reduce consumer reluctance to purchase solar equipment by giving federal support to a warranty program covering the cost of remedying product and installation defects. The program would also contribute to the viability of small manufacturers in the solar industry who would then be able to offer, with substantially increased credibility and less financial risk, warranty protection competitive with that offered by larger, well known companies.

*/ One year on installation and product defects and the remaining four years on product defects only. Another option would be a three year reinsurance with a condition that the manufacturer offer a service contract for the following two years, thus providing a five year protection package. The service contract would not need to be federally reinsured since the first three years with a particular system should provide sufficient data for a private insurance carrier to offer reasonable premium rates to a warrantor.



Second National Conference
on Standards for Solar Energy Use.

September 13-15, 1978
The Roosevelt Hotel, New York City



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on behalf of
AMERICAN NATIONAL
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National Bureau of Standards
National Solar Heating and
Cooling Information Center
Solar Energy Industries
Association
Solar Energy Research Institute

Solar Lobby
U.S. Department of Energy
U.S. Department of Housing and
Urban Development



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Introduction

The purpose of the Conference is to emphasize the development and use of standards for the materials, products, and services that are necessary for bringing the benefits of solar energy to the national economy and standard of living.

It is becoming increasingly imperative that solar energy needs to be employed to the fullest possible extent, in order to ease the burden of energy costs on individuals and to reduce the dependence of the public upon insecure fuel supplies.

While sound standards are essential for the protection of homeowners, investors, and the operators of small businesses, they are no less important to the orderly development of the solar energy industry and the transfer of new technology from the research community to the market place. Most of the standards that are required are being fashioned by the organizations that make up the voluntary consensus standardization system under democratic processes that insure that the national interest is advanced and that every point of view has been taken into account. Other necessary standards are set by federal, state, and local authorities. All these standards, to be effective, must take into account the most recent advances in technology as well as the needs of the public for

economical and reliable installations.

The Conference will focus on the current availability of standards, the urgent need for further standards to insure that installations will be durable and safe, and the institutional and environmental considerations that are involved in the widespread utilization of solar energy to heat and cool commercial as well as residential buildings.

The benefits of mass production and reliability have to be brought as rapidly as possible to the entire solar-energy field, and in particular to solar heating and cooling.

Voluntary consensus standards, in the form of practices, definitions, test methods, and specifications are a powerful means of making these benefits—and many others—real. Furthermore, as reliability improves, the trend among designers, users, and manufacturers is increasingly away from "specials" in favor of more economical and more available standard items. The development and continual improvement of voluntary standards is a dynamic process. Its effectiveness depends on the cooperative efforts of all who are concerned or knowledgeable.

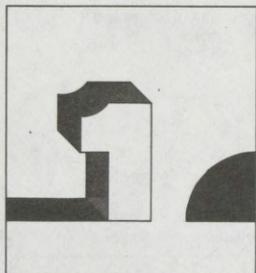
The performance of solar equipment and installations needs to be measured by impartial test methods not only to assure that

users are getting value for money, but also so that innovators, designers, and inventors can mark their progress. The objective gathering and factual analysis of factual data is the surest and usually the fastest way of transferring technology as it emerges from the laboratory to the marketplace, while at the same time tending to shield from that market products that are shoddy or ill-conceived.

Voluntary consensus standards that can be adopted by building code authorities and other regulatory bodies help assure the safety and durability not only of the solar equipment itself, but of the whole structure in which it was installed.

It is because all of the previously-mentioned aspects are of importance that this Second National Conference on Standards for Solar Energy Use has been structured to elicit the viewpoints of small business, industry, labor, consumers, governments at the State, local and federal levels, researchers, and technologists. One of several tasks of the Conference is to gauge the progress that has been made to date. A much more important task is to underscore and so prepare for the future standards needs of this highly important and fast-growing field.

Sessions



Status of Solar Standards Development

Session Chairman: Ronald D. Scott, Assistant Director for
Solar Heating and Cooling, Department of Energy

LUNCHEON SESSION

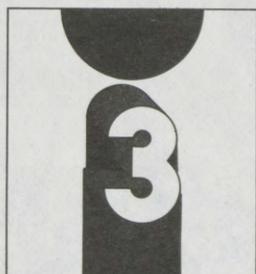
Presiding: Walter V. Cropper, American Society for Testing and Materials
Conference Co-Chairman

Keynote Address: Sheldon H. Butt, President, Solar Energy
Industries Association



Thermal Performance Standards

Session Chairman: Stanley F. Gilman, Professor of
Architectural Engineering, The Pennsylvania State University



Durability and Reliability Standards

Session Chairman: William J. Heidrich, President,
Revere Solar and Architectural Products

LUNCHEON SESSION

Presiding: Susannah Lawrence, Executive Director, Solar Lobby
Address: William T. Cavanaugh, Managing Director, American Society
for Testing and Materials



Safety, Codes, and Certification Standards

Session Chairman: Robert D. Dikkers, Chief, Solar Criteria and Standards Program, National Bureau of Standards

CONFERENCE DINNER

Presiding: Joseph G. O'Grady, President, American Society for Testing and Materials

Ms. Esther Peterson, Special Assistant to President Carter for Consumer Affairs "Solar Realities and Their Importance to the Nation"



Looking Ahead

Session Chairman: Charles Grosskruetz, Assistant Director of Research, Solar Energy Research Institute

CONFERENCE ADJOURNMENT

Program
Wednesday,
September 13, 1978

7:30-9:00 a.m.

Registration

9:00 a.m.-Noon

Session One:
Status of Solar
Standards Development

Session Chairman: Ronald D. Scott,
 Assistant Director for Solar Heating
 and Cooling, Dept. of Energy

Welcoming Remarks: Donald L.
 Peyton, Executive Vice President,
 American National Standards
 Institute

The DOE Role in Solar
Standards Development—Ronald D.
 Scott, Department of Energy

The HUD Solar Energy
Program—David C. Moore,
 Department of Housing and Urban
 Development

Moving Solar Energy into the
Market Place—Ronald Doctor,
 Commissioner of Resources,
 State of California

The Industry Viewpoint on Solar
Energy Standards—Sheldon H. Butt,
 Olin Brass, Olin Corporation

The Consumer Viewpoint in Solar
Standards Activities—Susannah
 Lawrence, Solar Lobby

The ANSI Steering Committee on
Solar Standards Development—
 Robert D. Dikkers,
 National Bureau of Standards

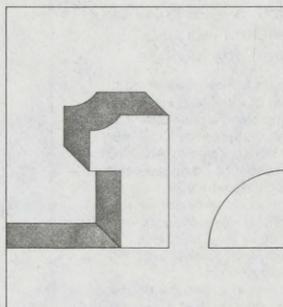
Question-and-Answer Period

Noon-2:00 p.m.

Luncheon Session

Presiding: Walter V. Cropper,
 ASTM, Conference Co-Chairman

Keynote Address: Sheldon H. Butt,
 President, Solar Energy Industries
 Association



Status of Solar
Standards Development

Donald L. Peyton
Executive Vice President
American National
Standards Institute

Donald L. Peyton assumed the position of chief staff executive of the American National Standards Institute on September 1, 1966.

Mr. Peyton came to ANSI from the Chamber of Commerce of the United States where he held the position of Government Relations General Manager. He was formerly Secretary of the Chamber's Committee on Science and Technology.

Mr. Peyton joined the Chamber staff in January, 1961 after serving on Capitol Hill as Administrative Assistant to the late Congressman Keith Thomson of Wyoming.

In 1968, Mr. Peyton was elected to the Executive Committee of the International Organization for Standardization (ISO)—the 80-country non-treaty organization developing international standards. ANSI is the U.S. member of ISO.

Mr. Peyton is a graduate of Northern Colorado University. He also attended Montana State College and the College of William and Mary.

The DOE Role In Solar Standards Development

Ronald D. Scott
 Assistant Director for Solar
 Heating and Cooling
 Department of Energy
 Washington, D.C. 20545

Ronald D. Scott was born in Cheyenne, Oklahoma, in 1935. He graduated from Southwestern State College, Oklahoma, with a B.S. in Physics and Mathematics in 1957. He received a MPA in Public Administration from the University of Indiana in 1971.

His professional life has been involved in research and development, technology transfer, and program management activities with the Army Ballistics Missile Agency (in the 1950's), NASA (during the 1960's and early 1970's), the Energy Research and Development Administration (ERDA), and the Department of Energy (DOE).

Mr. Scott joined ERDA in 1975 as Chief of the Projects Branch of the Division of Solar Energy, and now is Assistant Director for Heating and Cooling, Office of the Assistant Secretary for Conservation and Solar Applications.

ABSTRACT

The office of solar applications of the Department of Energy is responsible for implementing federal programs seeking to accelerate the development of standards, codes, and certification programs relating to solar energy. These programs are aimed at protecting consumers, aiding industry through uniform requirements, and assisting states and localities in carrying out their responsibilities in the administration of codes and standards.

In this effort, the DOE and its sister agencies, HUD and NBS, have been working very closely with the voluntary standards system, through the ANSI Steering Committee on Standards for Solar Energy. We greatly appreciate the positive solar related standards by the various professional societies, trade associations, consumer groups, and model code organizations who have been cooperating in the partnership between this public and private sector.

In addition to aiding the acceleration of standards-making activities, DOE has been promoting the adoption of consistent programs at all levels of government, from federal agencies to state and local communities. For example, some states recently adopted certification programs which appeared to differ from one another and from the industry program currently supported by the DOE. In cooperation with those states, the DOE has taken the initiative in developing a uniform approach towards certification by public agencies which will remove uncertainties and unnecessary cost to industry. The approach taken by DOE recognizes the traditional responsibility of the voluntary standards system in conducting certification programs for components of solar systems.

Our experience with the voluntary standards system has convinced us that this fruitful partnership between government and industry is the most effective way to meet the nation's need for consistent uniform standards relating to solar energy.

The HUD Solar Energy Program

David C. Moore
Program Manager
Solar Heating and Cooling
Demonstration Program
Division of Energy, Building
Technology and Standards
Office of Policy Development
and Research
U.S. Department of Housing
and Urban Development

David C. Moore is responsible for the residential portion of the U.S. Department of Housing and Urban Development's national solar heating and cooling of buildings program. The activities of this program include demonstrations, standards development, market studies, and information dissemination.

His prior assignments at HUD included management of the neighborhood preservation research program, technical assignments in Operation BREAKTHROUGH involving identification and development of industrialized housing technology, and management of the "In-Cities" R & D Program.

Mr. Moore began his professional career with United Engineer and Constructors, Inc. in 1949 as a construction field engineer working on electric generating stations, and structural design of industrial plant facilities. Then, in 1955, he joined the Massachusetts Institute of Technology's Lincoln Laboratory as a leader of the Construction Engineering Group responsible for the design and construction of Lincoln Laboratory field facilities.

From 1965 until joining HUD in 1968, Mr. Moore was a project engineer for General Electric

Company, Real Estate and Construction Operation. In this capacity he was responsible for design of various Company facilities, including the instrumentation of an atomic fuel manufacturing plant and manufacturing facilities for computer, motor, aircraft turbine, and television projects.

A registered Professional Engineer in Pennsylvania and Massachusetts, Mr. Moore received his SB degree in Building Engineering and Construction and SM degree in Economics and Engineering from the Massachusetts Institute of Technology.

ABSTRACT

The specific objective of the HUD residential solar heating and cooling demonstration program is to encourage the development of a residential market for solar systems. There are four main program elements—demonstrations, standards, market development studies, and information dissemination.

Because consumer confidence is essential to such a market, standards have been a major activity center from the inception of the program. Actual standards activities at NBS were initiated by HUD even before passage of the Solar Heating and Cooling Demonstration Act of 1974 (PL 93-409). This first activity resulted in the Interim Performance Criteria, published in January, 1975, in compliance with the requirement of PL 93-409.

HUD's continuing interest in solar standards has taken two courses. First, work and coordination is continuing between HUD and the standards community, primarily through the ANSI Steering Committee and through

coordinated activities of DOE. Second, HUD expedited the development of a supplement to the HUD/FHA Minimum Property Standards to incorporate effective solar standards in this document. NBS provided technical staff to work with HUD research and HUD/FHA in developing this document. The Intermediate Minimum Property Standards Supplement: Solar Heating and Domestic Hot Water Systems was promulgated in July, 1977, and has been used to evaluate solar applications in the fourth HUD solar demonstration cycle.

NBS is now working with HUD to develop a revised set of Intermediate Performance Criteria and to develop a revision to the solar Minimum Property Standards Supplement, based on information from the demonstration program.

Supporting the whole area of standards development and the quality of the solar product, HUD is collecting performance and other information from the demonstration program and has begun publishing technical information to assist the solar industry and its customers. In the demonstration program HUD has also required a standard minimum warranty to provide further assurance to the buyer that the product is appropriate for its use, and that the manufacturer and installer will stand behind it.

Finally, in the residential hot water initiative program, HUD and the industry obtained experience on what is necessary to evaluate solar systems against standards and criteria. The work of the Polytechnic Institute of New York provided a base of experience which can help guide the development of certification and testing programs.

Moving Solar Energy Into The Market Place

Ronald D. Doctor
Commissioner
California's Energy
Resources
Conservation and
Development
Commission
Sacramento, CA 95825

Ronald D. Doctor was appointed by Governor Edmund G. Brown, Jr. as one of five full time Commissioners on the California Energy Resources Conservation and Development Commission. In this capacity he is responsible for the following docketed activities:

Development of mandatory residential energy conservation standards.

Joint Investigation with California Public Utilities Commission on methods to accelerate implementation of solar energy systems.

Claim of Exemption for gas turbine power plant by Sacramento Municipal Utility District.

Fossil Fuels Issues Report of Commission's first Biennial Report.

Conservation Plan of Commission's first Biennial Report.

Emergency evacuation plans for nuclear reactor accidents.

Dr. Doctor is also involved in many other activities of the Commission which include the following: economics of alternative technologies for electricity generation; clean fuels technologies; energy mandatory standards for replacing standing gas pilot lights with intermittent ignition devices.

He began his career with Atomics International as a Nuclear Engineer in 1961. From 1965 to 1975 he was a member of the Staff of the Rand Corporation, during which time he led two major energy assessment projects resulting in Rand publications "California's Electricity Quandary: Slowing the Growth Rate" and "Energy Alternatives for California: Paths to the Future". The former was the focus of legislative hearings which led to the Warren-Alquist Act creating the

California Energy Commission. The latter established a basis for state action on major energy issues facing California.

Among his many professional and community activities, Dr. Doctor is a member of the Editorial Boards of *Energy—The International Journal* (published in England) and *Energy and Building* (published in Switzerland). He is also a past member of the Sierra Club National Energy Committee and has, for three years, been an AEC and NSF Science and Engineering Fellow.

An author of over 15 published articles and reports, Dr. Doctor has been invited to make comments and statements to congressional and legislative committees on energy conservation and coastal zone planning.

He received his B.S. degree in Engineering, and an M.S. and Ph.D. degree in Nuclear Engineering from the University of California, Los Angeles (UCLA).

ABSTRACT

Since the early 1920's public subsidies to encourage the use of oil, gas, coal and nuclear have averaged \$5 to \$8 billion dollars a year. Simply put, every family in this country has contributed more than \$100 dollars yearly to subsidize the development of conventional, nonrenewable energy forms.

Unknowingly citizens have subsidized the development of an energy economy which is becoming more and more costly to maintain and is creating environmental problems that threaten our health and the well-being of our children, our rights to clean air, livable land and tolerable economic conditions.

If the President and the Congress are serious about developing a sustainable energy future which places maximum emphasis on clean, benign and renewable resources then rapid commercialization of solar energy must become a major economic priority, not a subject of meaningless political rhetoric. If solar energy is to compete fairly with conventional forms of energy, it must be subsidized.

Overcoming the biases and subsidies of the past (as well as today's continuing subsidies) which favor oil, gas and nuclear power will be expensive and will require pooling national, state and local

resources; financial, technical and programmatic resources.

The strategy to achieve our collective goal must be initiated through a mobilization of all federal agencies, reprogramming existing budgets and adding new funds for creative solar programs.

Concurrently, there must be an intensified effort for total coordination with state and local governments. I recommend four specific guidelines for immediate action.

- 1) Concentrate on removing existing barriers to rapid commercialization; create new and varied incentives and actively market solar energy.
- 2) Create high visibility, joint-involvement action programs—complemented, but not dominated by ancillary studies.
- 3) Coordinate with state governments at every step. Implement plans through state governments so that local government plans and programs are developed and supported as expeditiously and thoroughly as possible.
- 4) Develop an effective regional networking program so that all new developments, plans and programs are immediately transferred.

If the Domestic Policy Review will adopt these guidelines, the programs that have been initiated in California and a few other states, can be expanded to a full scale national effort. Programs such as the 55% tax credit, solar testing and certification and the operation of municipal solar utilities can become a reality in every state. Additional programs such as low interest loans, add-on mortgages, depreciation and investment tax credits for commercial purchases of solar can make the economic availability of solar a reality for all citizens who have equally shared the costs of subsidizing non-renewable, deleterious energy forms.

I urge the Domestic Policy Review to act immediately in pursuing this course of action. Otherwise, the states will have to join together to pool their resources, but the task will be infinitely more difficult if solar subsidization is not a national economic priority.

Industry Viewpoint on Solar Energy Standards—Industry Standards

Sheldon H. Butt
Director
Market Research and Planning
Olin Brass
Olin Corporation
East Alton, Illinois 62024

Sheldon H. Butt is presently President of the Solar Energy Industries Association. The Solar Energy Industries Association is a trade association formed by manufacturers, contractors, consulting engineers, architects and interested individuals. The objectives are to foster and accelerate development and marketing of solar energy conversion systems through public, Governmental and industry communications. Another objective is to develop public interest positions with respect to legislation and regulation and to advise opinion leaders in Government, industry and the scientific community.

Mr. Butt has a Master's degree in Chemical Engineering from the University of Louisville. He has been employed by the Olin Brass Group of Olin Corporation for over 30 years and is presently Director of

Market Research and Planning for the Olin Brass Group.

ABSTRACT

Since solar collectors are the most unique component of solar systems, it follows that the first order of business has been the development of a solar collector rating, labeling and certification program initially addressing thermal performance, since the thermal performance test standard is available, and later, to address durability and reliability as testing and/or prescriptive standards become available. This activity is well underway. Implementation of a collector rating, labeling and certification program by SEIA will be based upon the SEREF labeling and certification program development which is being undertaken with DOE funding and which is to be discussed in Session 4 on September 14.

Following this activity, industry believes that the very highest priority must be assigned to developing the underlying standards and implementing programs for rating and certification of the thermal performance of solar hot water systems, solar heating systems and solar pool heating systems. The inclusion of reliability and durability

factors in system certification programs is of comparable importance and also deserves very high priority. The proposal that thermal performance rating and certification come first simply reflects the probability that the underlying standards will be ready for a thermal performance rating and certification program before they are ready in the durability and reliability area.

Industry also believes that high priority should be directed towards defining areas for specific standards for passive solar systems and the development of these standards. This is a complex subject area and the first step is to break down the general area of passive standards activity into a matrix of individual passive "features" or "components". Once this has been accomplished, the individual proposed standards can be prioritized, reflecting their individual importance and their individual need.

To avoid the problem of active marketing of photovoltaic devices for commercial application before standards become available, industry believes that high priority should be accorded photovoltaic standard development.

The Consumer Viewpoint in Solar Standards Activities

Susannah Lawrence
Executive Director
Solar Lobby
Washington, D.C. 20003

As executive director of Solar Lobby, Susannah Lawrence is involved with the promotion of energy conservation and the use of renewable sources of energy for what was formerly known as Consumer Action Now, Inc. Ms. Lawrence joined the CAN staff as a researcher, writer, and editor in 1972 and became involved in numerous consumer and environmental issues.

Ms. Lawrence lobbied extensively in 1975 for:

- the Energy Conservation and Production Act
- increased authorizations and appropriations for solar energy research, development, and demonstration in the 1977 Energy Research and Development Administration (now the Department of Energy)
- eight energy conservation and solar energy bills coordinated by CAN that appeared before the 95th Congress.

She has submitted testimony before the U.S. House of Representatives Science and Technology Committee,

the Subcommittee on Energy Research, and before the House and U.S. Senate Committees on Banking, Housing and Urban Affairs, and for the Subcommittees on Housing, commenting on the National Energy Act and the dissemination of energy information.

Ms. Lawrence is an honors graduate of the University of Wisconsin.

ABSTRACT

Ms. Lawrence's presentation will revolve around the work she has done and is currently doing in the fields of consumer protection and standards regarding solar energy.

The following questions have been raised by her work on the Federal Trade Commission's paper on solar standards and consumer protection and the Solar Energy Industries Association, Solar Energy Research and Education Foundation (SEREF) Standards Oversight and Steering Committee. These questions will be pursued in varying degrees in her presentation.

What is being done to protect the consumer buying solar equipment? What should be done? What are states doing about developing standards? Are the HUD Minimum Property Standards becoming the accepted ones for all collectors and

uses? Are localities including voluntary standards in building codes, thereby making them mandatory? Are small businesses being kept out of the market due to their inability to meet high standards? Who is developing these standards? How will the standards allow for innovation and invention in this newly growing field?

Will states issue certification for standards? What kinds of fees will be involved for the initial certification, for modifications to certified products? If different states have different certification qualifications, will manufacturers have to have products tested in each state? How would this action affect the cost to consumers, to small businesses? What about certification for components other than collectors, for total systems?

Besides quality of systems, consumers worry about the quality of installation. How can the consumer be protected against faulty installations? What will be the effect on owner-built, low cost systems if licensed installers are required? Who would be responsible for licensing the installers?

The question of passive systems can not be overlooked. Can there be standards for passive? How should tax credit qualifications and building code inspections be dealt with if these systems are not specified?

The ANSI Steering Committee on Solar Standards Development

Robert D. Dikkers
Center for Building Technology
National Bureau of Standards
Washington, D.C. 20234

Since September 1974, Mr. Robert D. Dikkers has managed solar energy program activities being carried out by the Center for Building Technology at the National Bureau of Standards (NBS). These activities provide technical support for the national solar heating and cooling research, development and demonstration programs being conducted by the Department of Housing and Urban Development.

Mr. Dikkers joined NBS in July 1969 and has been responsible for the conduct of various masonry structural research projects and has also participated in several surveys to investigate damage to buildings and other structures caused by natural disasters. From June 1970 to October 1971, he also served as a Technical Representative on the NBS Operation Breakthrough Evaluation Team. From 1971 to September 1974, Mr. Dikkers was Manager of the Coordinated Evaluation System Project and helped develop model documentation to assist state building regulatory agencies in establishing a uniform evaluation, approval and inspection system for manufactured buildings.

Mr. Dikkers received a B.S. degree in Civil Engineering from Northwestern University and an M.S. degree in Civil Engineering from California Institute of Technology. He is a registered professional engineer (Illinois and Maryland) and a member of the American Society of Civil Engineers, American Concrete

Institute, American Society for Testing and Materials and International Solar Energy Society. Mr. Dikkers is also a member of the ANSI Steering Committee on Solar Energy Standards Development and served as first Chairman during 1976 and 1977.

ABSTRACT

In June 1975, the Federal Energy Administration called a meeting of government, industry, and standards-writing organizational representatives to discuss "the acceleration of performance criteria for solar heating and cooling together with the procedures and milestones involved." At this meeting, the National Bureau of Standards (NBS) in cooperation with the American National Standards Institute (ANSI), was asked to develop a work plan for the development of standards for solar heating and cooling applications. The work plan, which was distributed at the First National Conference on Standards for Solar Heating and Cooling, October 1975, recommended that ANSI organize a steering committee to coordinate and expedite the development of national consensus standards for solar heating and cooling applications.

In January 1976, the ANSI Executive Standards Council approved and established a Steering Committee on Solar Energy Standards Development with the following scope and purpose:

"Without engaging in standards-writing activities, identify needs and formulate specific tasks leading to the development of national consensus standards for utilization of solar energy for

heating and cooling. Assign standards development projects to competent standards-writing organizations, and maintain a continuous overview of their activities in order to assure an orderly and effective process which will avoid duplication of effort and conflicting standards."

Currently, there are 23 organizations represented on the ANSI Steering Committee. They are: Air Conditioning and Refrigeration Institute, American Gas Association, American Institute of Architects, Architectural Aluminum Manufacturers Association, American Society of Heating, Refrigerating and Air-Conditioning Engineers, American Society of Mechanical Engineers, American Society for Testing and Materials, Consumer Action Now, Department of Energy, Department of Housing and Urban Development, General Services Administration, Institute of Electrical and Electronics Engineers, International Association of Plumbing and Mechanical Officials, Manufactured Housing Institute, Mechanical Contractor's Association of America, Inc., National Aeronautics and Space Administration, National Conference of States on Building Codes and Standards, Sheet Metal and Air-Conditioning Contractor's National Association, Solar Energy Research and Education Foundation, Solar Energy Industries Association, and Underwriters Laboratories.

This presentation will review the primary work of the ANSI Steering Committee during the past two years to define needed standards and standards development and implementation activities.

Walter V. Cropper
Special Assistant to the
Managing Director
American Society for Testing
and Materials
Philadelphia, PA 19103

Upon receiving his M.S. in Organic Chemistry in 1940 from the University of Kentucky, Walt joined the Servel, Inc. research-engineering team that developed the lithium bromide absorption air-conditioner, now an element in some solar-

powered cooling systems. He holds several (expired) patents on these types of devices. He later was employed by Standard Oil Co. (Ind.) at its Whiting, Ind. and Casper, Wyo. refineries and from 1956-1960 was Chief Chemist and an Assistant Director of Research.

After several years with Precision Scientific Company, Walt practiced as a consultant on automatic instrumentation and continuous quality control.

In 1970, he came on the staff of ASTM as Manager of Project

Threshold and in 1974 was named Director, Developmental Operations. He was promoted to his present position in May, 1978.

He is the author of nearly two dozen technical articles on refining processes, analytical methods and instruments, automatic process control, and the measurement of major pollutants in ambient air and stationary emissions. He is an active member of the American Chemical Society, the Air Pollution Control Association, and the Instrument Society of America.

Keynote Address

Sheldon H. Butt
 President
 Solar Energy Industries
 Association
 Washington, D.C. 20036

ABSTRACT

At the time of the First National Conference on Standards for Solar Energy Use, the process of solar standards development by voluntary standards writing organizations had just began. It is now well underway. Although only a few standards have been completed, progress has been made and a number of standards are approaching completion.

Should we be satisfied? On the one hand, the solar industries are very new and standards development is more advanced than has historically been the case in other new industries at a comparable stage in their development. However, there is a national mandate for accelerated development of solar energy applications. Accelerating solar development involves many activities in many areas which interact upon each other and impact upon progress towards our national goals. The development of adequate standards is one of the key activities. If we ask the question: "Would solar applications be moving ahead more rapidly if standards activities were more

advanced?", the answer must be "Yes." If we had made more progress in development of solar standards, solar applications would have made more progress. It follows that we cannot be satisfied with the progress made.

In the paper presented in Session One, specific industry proposals addressing the problem of accelerating standards development were offered. They are intended to be effective within the framework of the voluntary consensus standards system which we perceive to be the best means of developing sound standards to best meet the needs of the consumer and industry. In this presentation, I will dwell upon the alternatives.

We must accept as "given" that, in this era of increased consumer awareness, the alternative of tolerating delay in standards development needed for consumer protection is not viable. We can't simply wait.

Thus, the alternative is that standards will be developed by some other mechanism and the only other mechanism immediately available is Government at the Federal, State and local levels. What does this mean? Some Government groups, such as N.B.S., have good technical knowledge of solar systems. However, most Government groups at other levels do not. By their nature, no

Government organization can fully appreciate and recognize the effect of restrictive standards upon product cost and upon the flexibility needed to accommodate product innovation. In themselves, excessive product cost and delayed introduction of new products are contrary to the consumer's interest. Furthermore, Governmental bodies can no more directly represent the consumer interest than the industry interest. D.O.E. and other Federal Agencies recognize these problems and fully support solar standards development through the voluntary consensus procedure. There are consumer organizations who advocate Government standards making as an alternative to the voluntary standards process. I believe that, if their wishes were granted, they would find that they were worse off.

This alternative scenario offers standards which would be less responsive to the needs of both industry and consumers and, most importantly, contrary to the national mandate to accelerate solar application.

We must accept the challenge to evolve the means of accelerating development of solar standards within the voluntary consensus standards system and assuring that it is fully responsive to the needs of consumers and industry. This must be our goal.

Program

Wednesday, September 13

2:00-5:00 p.m.

Session Two: Thermal Performance Standards

Session Chairman: Stanley F. Gilman, Professor of Architectural Engineering, The Pennsylvania State University

ASHRAE Standard 93-77: Testing Procedure to Determine the Thermal Performance of Solar Collectors—John I. Yellott, College of Architecture, Arizona State University and Byard Wood, College of Engineering, Arizona State University

ASHRAE Standards 94-77, 95 and 96—Harold G. Lorsch, Franklin Institute Research Laboratories

Results and Analysis of a Round-Robin Test Program for Liquid-Heating Flat-Plate Solar Collectors—James Hill, National Bureau of Standards

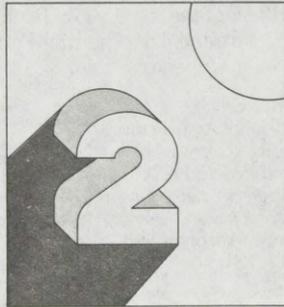
Performance Testing to ASHRAE Standard 93-77—Gene A. Zerlaut, Desert Sunshine Exposure Tests, Inc.

Proposed Standards for Testing and Reporting Results for Solar Heating and Cooling Equipment—Stanley F. Gilman, The Pennsylvania State University

Passive System Standards—Michael J. Holtz, Solar Energy Research Institute

Components Testing vs. System Testing—Alwin B. Newton, Consulting Engineer

Question-and-Answer Period



Thermal Performance Standards

ASHRAE Standard 93-77: Testing Procedure To Determine The Thermal Performance Of Solar Collectors

John I. Yellott
College of Architecture
and
Byard Wood, Ph.D.
College of Engineering
Arizona State University
Tempe, Arizona 85281

John Yellott is a professional mechanical engineer who received his two degrees in that specialty from the Johns Hopkins University. His entire professional career, now spanning nearly fifty years, has been devoted to the field of energy. He entered the world of engineering education in 1934 at the University of Rochester, and then progressed through the ranks at Stevens Institute of Technology until 1940, when he became professor and head of department at Illinois Institute of Technology. In 1943, he became director of the Institute of Gas Technology, and, during the war years, he served as a consultant to the Manhattan Project at the University of Chicago. From 1945 through 1955, he was director of research for the Coal-Burning Gas Turbine Locomotive Project of Bituminous Coal Research Inc. Early in 1956, he turned his attention to solar energy, and that subject has occupied his attention for the past two decades. He has been active in ASHRAE since he joined that society in 1957, and he has served as chairman of the technical committees on Fenestration and Solar Energy Applications. He was the chairman of the committee which prepared the ASHRAE Standard for Collector Testing, 93-77. He is currently Professor in Architecture at Arizona State University in Tempe, Arizona. He is a Fellow of ASME, ASHRAE, and the Royal Society of Arts, London.

Byard Wood has combined educational instruction, industrial consultation, and research on various aspects of solar energy throughout his professional career. Most recently, he was principal investigator of the two year "Evaluation of the Steady-State and Dynamic Performance of a 3-ton Absorption Water Chiller for Solar Applications" project that was funded by the Arizona Solar Energy Research Commission. He has also served as principal investigator for programs on performance testing of solar collectors, solar retrofit for state buildings, and design analysis for solar-air turbine

power generator.

The author of over 20 presentations and reports dealing with solar energy including "Solar Energy Measuring Equipment" which appears in *Solar Energy Engineering* (Academic Press, 1977), Dr. Wood was a member of the Arizona Solar Energy Task Force of the state's Solar Energy Research Commission in 1975. He was also secretary of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) project committee that developed ASHRAE Standard 93-77.

ABSTRACT

ASHRAE and its predecessor societies have a twenty-five year record of standards development in the fields of heating and air conditioning. Thus when the Energy Research and Development Administration began to implement the Solar Heating and Cooling Demonstration Act of 1974, it was logical for ERDA to turn to ASHRAE for assistance in establishing the collector testing and evaluation procedures that were required by that Act. When ERDA's request was received by ASHRAE late in 1975, it was referred to the Standards Committee which in turn authorized Technical Committee 6.7, Solar Energy Applications, to form Project Committee 93-P to create a Solar Collector Testing Standard. An eighteen member committee made up of individuals experienced in this field was appointed and their organization session was held at the annual ASHRAE meeting in January, 1976.

After reviewing the testing procedures already in use in Australia, Israel, South Africa, and the U.S., it was decided that the projected ASHRAE standard should be based on National Bureau of Standards Interim Report 74-635. This document had been prepared by the NBS at the request of the National Science Foundation which, in 1974, was the agency responsible for the Federal Government's early efforts to establish a viable solar energy industry. NBSIR 74-635 had already been informally reviewed several times by ASHRAE groups and so most of the members of the newly-formed Committee 93-P were familiar with its provisions.

The Committee held four day-long meetings during the early months of 1976 during which NBSIR 74-635 was carefully reviewed. Particular

attention was paid to the instrumentation requirements to make sure that they were both reasonable and adequate to ensure accurate testing. In addition to the thermal testing procedure contained in the NBS document, it was decided that tests should be added to determine the collector's time constant and the variation of collector efficiency with changes in the incident angle. Provision was also made for indoor testing with a solar simulator similar to that developed at NASA's Lewis Laboratory in Cleveland.

At its fourth meeting, held in May, 1976, the members of Committee 93-P completed their work on Provisional Standard 93-P, entitled "Methods of Testing to Determine the Thermal Performance of Solar Collectors." It was transmitted to the ASHRAE Committee on Standards which, in June of 1976, referred it to the ASHRAE Council with the recommendation that it be put out for public review. Provisional Standard 93-P then went through the review process which resulted in the submission to ASHRAE headquarters of approximately sixty written comments, all of which were answered in writing by the Chairman.

None of the comments was considered to require the changing of more than a few words in 93-P and so, at the Winter Annual ASHRAE meeting in 1977, Committee 93-P submitted its work to the ASHRAE Standards Committee and they in turn forwarded it with a favorable recommendation to the ASHRAE Board of Directors. With the Board's approval, the completed document became officially known as ASHRAE Standard 93-77. Subsequently, the American National Standards Institute approved it as ANSI B198.1-1977, and it was subsequently published in the familiar ASHRAE blue and white format. A corrected edition of that publication is currently in press to correct a number of typographical errors which were detected in the first printing.

Committee 93 is continuing its work under the chairmanship of Professor Byard Wood of Arizona State University, to monitor the operation and effectiveness of 93-77 and to determine whether substantive changes should be made, particularly in the area of high temperature concentrating collectors.

ASHRAE Standards 94-77, 95, and 96

Harold G. Lorsch
Franklin Institute
Research Laboratories
Philadelphia, Pa. 19103

Dr. Harold G. Lorsch is the Manager of the Energy Laboratory of the Franklin Institute Research Laboratories in Philadelphia, Pennsylvania. He is responsible for research, development and design projects on solar energy utilization, energy conservation, and the utilization of unconventional energy sources. He has done pioneering work on solar heating including the design of a number of solar heated buildings in the Philadelphia area, on the use of heat pumps with and without solar assistance, and on novel methods of storing energy.

Prior to assuming his present position, Dr. Lorsch performed similar activities at the University of Pennsylvania's Energy Center. He has a varied background in industrial design, consulting, research, and teaching in the fields of structures,

materials, and aerospace engineering.

After undergraduate studies at the Swiss Federal Institute of Technology in Zurich, Dr. Lorsch obtained a Master's Degree from MIT and a Doctorate from Columbia University. He has been a Licensed Professional Engineer for 30 years, has authored more than 50 technical articles and reports, and is a frequent speaker on energy subjects.

ABSTRACT

The American Society for Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) has a successful history of the preparation of standards for measuring the thermal performance of HVAC components and systems. It was therefore logical for ASHRAE to undertake the preparation of similar standards in the solar heating and cooling area.

ASHRAE Standard 94-77, "Methods of Testing Thermal Storage Devices Based on Thermal Performance" is a standard developed from an earlier NBS document in response to the

need for a uniform method of testing solar storage devices. The standard, however, is applicable to any storage device which is charged and discharged by thermal means. It is currently being extended to devices that are charged electrically and discharged thermally: so-called off-peak electric storage units.

ASHRAE Standard 95 on "Methods of Testing Solar Energy Portable Water Heaters" is still in preparation. This standard will pertain to a complete system rather than a component, as do all other ASHRAE solar standards.

A draft version of ASHRAE Standard 96 on "Methods of Testing to Determine the Thermal Performance of Liquid Type Solar Collectors to Heating of Swimming Pools" was issued for public review in May, 1978, and will be published shortly in final form. It closely follows the specifications of ASHRAE Standard 93-77 (Solar Collectors) with minor modifications pertaining to the special purpose of swimming pool collectors.

Results and Analysis of a Round Robin Test Program for Liquid Heating Flat-Plate Solar Collectors

James E. Hill
Chief, Thermal Solar Program
Center for Building Technology
National Bureau of Standards
Washington, D.C. 20234

Dr. Hill is Chief, Thermal Solar Program in the Center for Building Technology at the National Bureau of Standards.

He received a B.S. degree in Mechanical Engineering from Virginia Polytechnic Institute in 1963 and M.S. and Ph.D. degrees from Georgia Tech in 1967 and 1968, respectively. He served as Assistant Professor of Mechanical Engineering at the University of Maryland for three years before joining the National Bureau of Standards in 1972.

Dr. Hill is a member of ASME, ASHRAE, the Society of Sigma Xi, and the International Solar Energy Society. He held student memberships in Tau

Beta Pi, Pi Tau Sigma, Omicron Delta Kappa, and Phi Kappa Phi. He is listed in the 11th edition of *American Men of Science*. He received the Crosby Field Award from ASHRAE for the best overall Technical Paper in 1975 and received an additional ASHRAE award in 1976 for the best Technical Paper presented at the 1976 Seattle semi-annual meeting. He was given a 1976 Department of Commerce Silver Medal for "significant national and international contributions to the development of efficient solar energy systems." He has authored over twenty technical papers in the building research/energy areas.

ABSTRACT

A round robin test program was conducted to determine the intercomparability of thermal performance data on two liquid-heating flat-plate solar

collectors. Efficiency tests were performed at 21 test facilities, distributed across the United States, using a common test procedure. The results were statistically analyzed and showed a relatively large spread in the measured values of collector efficiency. Data from approximately half the facilities were selected for detailed analysis. A collector analytical model was used to show that less than 1/3 of the spread could be attributed to different environmental conditions from facility to facility. In general, data from a single facility were consistent and the majority of scatter was attributed to systematic uncertainties from facility to facility. When the data from six participants reportedly adhering to the requirements of ASHRAE Standard 93-77 were analyzed, the scatter was found to be within normal limits expected for the test procedure.

Performance Testing to ASHRAE Standard 93-97

W. T. Dokos, W. J. Putnam,
G. A. Zerlaut and
R. D. Whitaker
Desert Sunshine Exposure
Tests, Inc. (DSET, Inc.)
Box 1850, Black Canyon Stage
Phoenix, Arizona 85029

Mr. Zerlaut, a graduate of the University of Michigan, is a co-owner of DSET where he is engaged in solar device testing, solar materials testing, accelerated weathering and solar radiation measurements. Prior to joining DSET in 1973, he was employed by NASA's Marshall Space Flight Center and later by IIT Chemistry Research. His memberships include: ISES, AIC, ACS, AIAA, SPE, SAE, and ASTM. He is an ASTM representative for the U.S. to the International Standards Organizations ISO/TC 61 Plastics Committee, and was recently elected Chairman of ASTM Committee E-44 on Solar Energy Conversion. He is an officer and member of the Board of Directors of the Solar Energy Industries Association, is Vice-Chairman of the Board of the Solar Energy Research and Education Foundation, and is a past Director of the American Institute

of Chemists (for whom he developed a national accreditation/certification program for Chemists and Chemical Engineers in 1967-1975).

ABSTRACT

During the past 2 years Desert Sunshine Exposure Tests, Inc. (DSET) has performed several hundred tests of solar collectors representing nearly all of the major classes of collector designs. These tests have been performed in accordance with the methods and procedures described in ASHRAE 93-77, and its precursors ASHRAE 93-P and NBSIR-74-635. Experience obtained in utilizing this method, and from discussions with other test organizations, manufacturers and users of the data, indicates that the majority of the solar community is well served by the standard and obtain useful and meaningful data from it. This is not to say that either improvements or expansions in the document are not needed or desired. Indeed, the published standard has been beset with some nagging errors. However, it is important to note that the consensus opinion we have encountered and indeed share, is that ASHRAE 93-77 is philosophically and technically adequate for determining the thermal performance of collectors

within the constraints stated in the document, and that it is either applicable or had the potential of being applicable to a wide variety of solar collectors.

Specific areas of concern in testing to ASHRAE 93-77 that will be covered include: (1) the time constant and the fact that it measures the plate response and not the thermal stabilization time of the collector, (2) the need for normal incident determination of efficiency, η , couples with the proper assessment of bidirectional incidental angle effects in order to define all types of collectors such as classical flat-plate, tubular, concentrators, etc., (3) the recognition that air is not a fluid of uniform composition and that its thermal capacity changes from day to day, as well as within a test day, (4) the need to define clearness factor limits for determination of both efficiency and the incident angle modifier, and the concomitant need to develop a diffuse sky modifier, or model, to more thoroughly define the operating characteristics of collectors, and (5) a discussion of the arithmetic significance of the employment of linear, second order, and higher curve analyses to describe the field data obtained.

Proposed Standards for Testing and Reporting Results for Solar Heating and Cooling Equipment

Stanley F. Gilman, Ph.D., P.E.
 Professor of Architectural Engineering
 The Pennsylvania State University
 University Park, Pa.

Professor Gilman held several positions involving research, development, and engineering management in the heating, ventilating, and air-conditioning (HVAC) industry over a period of twenty years. He was responsible for residential and commercial products, including a wide range of heat pumps.

Subsequent to joining the faculty at Penn State, he was Principal Investigator on an ERDA-sponsored

research project on Solar Energy-Assisted Heat Pump Systems in 1974. In 1975, he was Project Director and Proceedings Editor of a Workshop on Solar Energy Heat Pump Systems, sponsored by ERDA. During that same year, he was a participant in the First National Conference on Standards for Solar Heating and Cooling, Philadelphia, Pa. Professor Gilman is also Director of a "short course" on Design of Solar Energy Heat Pump Systems for the Heating and Cooling of Buildings.

Professor Gilman is the author or co-author of more than 50 publications on HVAC systems and heat pumps.

A Fellow of the American Society of Heating, Ventilating, and Air-conditioning Engineers, Dr. Gilman served as President of that Society, 1971-1972.

ABSTRACT

Past and present methods of testing and reporting results of tests of solar heating and cooling equipment are examined. Although high refrigerant evaporating temperatures and low refrigerant condensing temperatures substantially increase the Coefficient of Performance of the equipment, the overall effect on the entire system can be a substantial increase in both initial and operating costs. Recommendations are made for uniform Standard Rating Points to avoid these costs as well as provide a basis for comparing the performance of different equipment designs.

Passive System Standards

Michael J. Holtz
 Passive Technology Branch
 Solar Energy Research Institute
 Golden, CO.

Mr. Holtz earned a Bachelor's Degree in Architecture at Ball State University and a Master's Degree in Architecture at the State University of New York at Buffalo.

His experience prior to joining the SERI staff was gained at the American Institute of Architects' Research Institute and at the U.S. National Bureau of Standards.

Mr. Holtz is also a registered architect.

ABSTRACT

With the growing interest and application of passive systems for the heating and cooling of buildings and the accelerated rate of standards development for active solar heating and cooling, the need for passive system standards has been recommended by some quarters of the building industry. The primary reason for their recommendation appears to come from a concern for equal consideration for proposed solar energy tax credits or property tax assumptions. There is a danger that this reason for standards development is ill-founded and may result in retarding the application of passive

solar technologies.

Passive systems are architectural responses to climatic conditions for the purpose of saving fuel and providing human comfort. As such, one is dealing with a diversity in design approaches that is beyond the bounds of standards. What may be appropriate would be specific product or assembly material and test standards that would allow comparative evaluation of the same functional element. (e.g. glazing performance, movable insulation, etc.). Therefore, it is in the area of materials and assemblies that existing standards need to be evaluated and new standards proposed in light of the passive design techniques.

Components Testing vs. System Testing

Alwin B. Newton
Solar Consultant
York, PA 17403

Alwin B. Newton received his B.S. from Syracuse University in 1930 and his M.S. from Massachusetts Institute of Technology in 1932. He has managed research and development for York, Honeywell, Airtemp and Coleman, returning to the York Division of Borg-Warner in 1958 as Vice President of Research. He retired in 1972 and became a consultant to industry and government in the solar heating and

cooling fields. Newton first became interested in solar in 1932 when he developed design methods for solar water heaters in Florida. In 1937 he designed residential systems and did research with them which led to early patents in latent heat storage, and to both liquid and boiling type collectors. He is a charter member of I.S.E.S. and has written many papers in the solar heating and cooling fields. He is a member of the ANSI Steering Committee on Solar Standards, secretary to ASHRAE's TC-6.7 on Solar Energy Utilization, and has been active in developing the ASHRAE Standards for testing collectors, hot water heaters, and solar heating of swimming pools.

ABSTRACT

Standards are now available for testing the major new component of solar systems, the collector—in such a way that its performance in any location can be predicted to an accuracy equal to that of other components of HVAC systems. Furthermore any collector whose performance has been certified by the Air Conditioning and Refrigeration Institute program will perform as tested. Hence tests of the components make it possible to use the tried and proven design procedures of the HVC industry in meeting the heating and cooling requirements of all types of buildings. The methods are summarized in this paper.

Program
Thursday,
September 14, 1978

9:00 a.m.—Noon

**Session Three:
Durability and
Reliability Standards**

Session Chairman: William J. Heidrich, President, Revere Solar and Architectural Products

Materials Standards—Elizabeth Clark, National Bureau of Standards

The Consumer Viewpoint on Durability and Reliability—Charles W. Hyer, The Marley Organization

DOE Interim Solar Collector Testing Program—Carl W. Conner, Department of Energy

ASTM Standards on Durability and Reliability—Elmer R. Streed, National Bureau of Standards

Corrosion in Solar Systems—Edward F. Smith, Olin Corporation

ASME Solar Standards—Allen J. Baldwin, Honeywell, Inc.

Warranty Requirements and Effects on Materials Used and Life Expectancies—Walter Cohen, Walter Cohen Associates

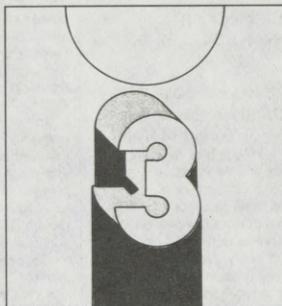
Question-and-Answer Period

Noon—2:00 p.m.

Luncheon Session

Presiding: Susannah Lawrence, Executive Director, Solar Lobby

Address: William T. Cavanaugh, Managing Director, American Society for Testing and Materials



**Durability and
Reliability Standards**

Session 3

William J. Heidrich
Chairman—Session
Three

President, Revere Solar &
Architectural Products, Inc.
Rome, New York 13440

William J. Heidrich is President of Revere Solar and Architectural Products, Inc., a subsidiary of Revere Copper and Brass Incorporated. With headquarters in Rome, New York and fabricating plants in Rome, Los Angeles and Kenly, North Carolina, the subsidiary is responsible for the entire solar energy program including new development, manufacturing and sales of its products. It is also responsible for new product

development and marketing of specialty building products for the parent Corporation and also for all technical services related to the use of the Corporation's products in building applications.

Revere was one of the first corporations in the country to become involved in development programs and subsequent marketing of solar energy collectors. For more than four years Revere has been fabricating proven solar energy collectors on a continuous basis and is today one of the leading fabricators in this growing market.

A civil engineer graduate of Syracuse University, Mr. Heidrich has been employed by Revere in several R & D, technical and marketing

positions. He represents Revere on several industry organizations related to the use of copper, brass and aluminum products in building construction. He is a member of the Board of Directors of the Solar Energy Industries Association, chairman of its Statistics Committee and a member of its Standards Committee. He is also a member of International Solar Energy Society, the New England Solar Energy Association and the Eastern New York Solar Energy Society. He is Vice-Chairman of ANSI's Steering Committee on Solar Energy Standards and also serves on solar energy task groups of the Copper Development Association, the Aluminum Association and the Architectural Aluminum Manufacturers Association.

Materials Standards

Elizabeth J. Clark
 Building Materials Program
 Center for Building Technology
 National Bureau of Standards
 Washington, D.C. 20234

Elizabeth J. Clark is a Materials Engineer in the Building Materials Program of the National Bureau of Standards' Center for Building Technology (CBT). She is responsible for laboratory-based activities in the area of materials used in solar energy systems. At the present time, this encompasses two projects funded by the Department of Energy (DoE) to develop standard methods of testing and evaluating solar collector cover plate materials and plastic materials in contact with heat transfer fluids.

Ms. Clark received her undergraduate training in Chemistry at

the University of Dayton and has pursued graduate studies in Materials Engineering at the University of Maryland.

Since joining the staff of the Center for Building Technology in 1969, she has engaged in research on a variety of building materials and has written reports relating to paints, waterproofing materials, vinyl wallcoverings and aluminum wiring. She has also contributed to the development of the Interim Performance Criteria for Solar Heating and Cooling Systems prepared for DoE, and to the Intermediate Minimum Property Standards for Solar Heating and Domestic Hot Water Systems prepared for the Department of Housing and Urban Development.

ABSTRACT

Standards for materials used in solar energy systems are urgently needed because the reliability of solar energy systems is dependent upon the durability of the materials. Solar energy systems place unique demands upon materials which are being put to new uses. Although many standards are available to evaluate materials in conventional applications, new standards are needed to assess the performance of solar energy material properties and the environmental factors that cause deterioration of these properties.

Standards for various materials used in solar heating and cooling systems are being developed by ASTM Committee E-44 on Solar Energy Conversion. A description of the standards under development will be provided.

The Consumer Viewpoint on Durability and Reliability

Charles W. Hyer
The Marley Organization, Inc.
Ridgefield, Connecticut 06877

Mr. Hyer is the publisher of *TMO UPDATE*, a bi-monthly reporter service concerned with activities of government, industry, consumers, and trade associations relating to commercial testing, certification accreditation, standards, specifications, and product liability.

A graduate of St. John's University, he began his career as a specialist in accounting (small business), management systems and, as a staff member of U.S. Industries, Inc. market research and acquisition studies. Mr. Hyer later became a Vice President of York Research Corporation, in which capacity he managed a transformer specialty manufacturing facility, directed laboratory operations and guided York's acquisition and diversification program.

His work as an administrative assistant to the President, Electrical Testing Laboratories, Inc. included contract administration and liaison on the President's behalf with industrial, governmental and other clients for ETL's testing, inspection, certification, labelling, and listing services.

Mr. Hyer is a member of several societies and associations, notably the Institute of Environmental Sciences and the National Small Business Association. He is a member of the ANSI Board of Directors and Chairman of the ANSI Consumer Council, as well as a member of the Advisory Committee of the U.S. Consumer Product Safety Commission. He also holds membership on ASTM Committees, E-5 on Fire Tests of Materials and Construction, E-36 on Criteria for the Evaluation of Testing and/or Inspection Agencies, F-15 on Consumer Product Safety, F-22 on High-Visibility Materials for Individual Safety.

ABSTRACT

This paper examines the past use of standards and related efforts such as certification and labeling in satisfying consumer expectations for reliability and durability. Actual cases are cited and comparisons drawn with solar energy system needs.

Elements of standard work in the international scene are examined to determine if there are on-going guidelines for standards activities aimed at consumer satisfaction in the areas of durability and reliability.

Next, the author's experiences in interviewing consumers who have made solar installations and their comments, as they relate to the subject of satisfaction with reliability and durability are discussed. Further, interviews with manufacturers and installers of varying size and capability are compared in their efforts with consumer attitudes.

A conclusion is then drawn as to what the consumer sees as a reasonable expectation for reliability and durability considering the product, its pay-out period and current marketing literature. A conclusion is then drawn comparing standardization and certification efforts with consumer attitudes.

Finally, based on the author's conclusions and previous experience, some specific recommendations are made as to the approach, nature and content of standards intended to promote reliability and durability. These recommendations extend to the roles of government, industry, consumers and users in the standards development process and the compliance after development, with certification programs, labeling and educational-instructional material.

DOE Interim Solar Collector Testing Program

Carl W. Conner
 Program Manager
 Demonstration Program
 Branch
 Office of Assistant Secretary
 Conservation and Solar
 Applications
 Department of Energy
 Washington, D.C.

Mr. Conner is a native of Old Hickory, Tennessee. He attended Vanderbilt University where he earned a B.E. in 1962 and a M.S. in 1964 in Civil Engineering. He joined the Atomic Energy Commission in 1964 at the Nevada Operations Office as a Project Engineer. In 1968, he received a National Institute of Public Affairs Fellowship and attended Indiana University, earning an M.P.A. degree. In 1971, he transferred to the Division of Construction at AEC Headquarters where he worked until coming to the Energy Research and Development Administrations' Division of Solar Energy in March, 1975, and to the Department of Energy in October, 1977. He is currently responsible for the management of the solar heating and cooling demonstration projects.

Mr. Conner is a registered

professional engineer and a member of the National Institute of Public Affairs, the National Society of Professional Engineers, the American Society for Testing and Materials, and the American National Standards Institute.

ABSTRACT

The purpose of the DOE Interim Solar Collector Testing program is threefold: to generate performance test data on as many commercially available solar collectors as possible, to provide these test results to industry for use in establishing uniform performance ratings and certification requirements, and to gather data for use by consensus standards writing organizations, thus aiding formulation of test procedures for collector reliability, safety, and durability.

The program provides a means by which collector manufacturers can have their solar collectors tested and the results published without having to bear prohibitive costs. The program encourages a uniform testing capability, including facilities, procedures and reporting format as well as the development of additional needed test procedures.

The program consists of several elements:

- (1) DOE contracts with qualified private testing laboratories.
- (2) Invitation to all collector manufacturers to participate on a cost shared basis.
- (3) Development of standard test procedures using NBS and industry input.
- (4) Intercorrelation between laboratories of test results using the SEREF LITE equipment.
- (5) Random sampling of collectors to be tested, and
- (6) Publication of test results.

Requirements for manufacturer participation include:

- (1) A production rate in excess of 10000² annually.
- (2) Manufacturer willingness to cost share expenditures and
- (3) Agreement to allow publication of test data resulting from the program.

The Program goal is to produce a set of basic thermal performance test data, to develop increased experience and capability on the part of the collector test industry, to determine validity/sufficiency of the proposed provisional tests, and with SEREF's aid, to produce an industry-sponsored catalogue of thermal performance ratings which will aid state and local collector certification programs.

ASTM Standards on Durability and Reliability

Elmer R. Streed
Thermal Solar Program
Center for Building Technology
National Bureau of Standards
Washington, DC 20234

Mr. Streed is currently assigned to the Solar Energy Program Office for the development of data requirements, performance criteria and standards for the Solar Heating and Cooling Demonstration Program. Other duties at NBS include the development and evaluation of standard test methods for the thermal performance and durability of solar collectors. Prior to joining NBS, he performed development studies of the performance of a transparent honeycomb modified flat plate solar collector at the Lockheed Palo Alto Research Laboratory. He has 25 years experience in both industry

and government laboratories related to the measurement and characterization of material thermophysical properties.

Mr. Streed graduated from the University of Washington with a BS degree in Physics. He has served on the AIAA Thermophysics and the ASTM E-21 Space Simulation Committees. Presently Chairman of ASTM E-44.05 Subcommittee on Solar Heating and Cooling Subsystems, Mr. Streed was the Founding Chairman of ASTM Subcommittee E-21.10 on Solar Energy Applications.

ABSTRACT

A brief review of the matrix procedure used by ASTM to identify reliability and durability standards for solar heating and cooling applications will be presented. Extension of this approach to other solar technical disciplines is

indicated to establish basic standards broad enough to accommodate several activities and to provide for the development of new standards as the need is established.

The extensive ASTM expertise in materials durability and reliability has provided industry and government with test procedures to perform most routine laboratory and field evaluations. However, additional standards are needed at the component, subsystem, and system level to provide user and consumer groups with design, installation, and operational data needed to select and maintain performance goals. Current ASTM Committee E-44 on Solar Energy Conversion activities related to the development of durability and reliability standards for components, subsystems, and systems will be described.

Corrosion In Solar Systems

Edward F. Smith III, Ph.D.
Olin Metals Research
Laboratory
New Haven, Connecticut

Dr. Smith is currently employed at the Olin Metals Research Laboratory in New Haven, Connecticut and serves as a supervisor with responsibility for solar related research. His projects include testing of selective and non-selective absorber coatings, surface durability testing, corrosion testing of metal/fluid compatibility for solar applications, and thermal performance testing.

He is the current chairman of the Laboratory Accreditation Committee for the Solar Energy Research and Education Foundation (SEREF). He is also active in solar standards development on ASTM Committee

E-44 on Solar Energy Conversion and the ASME Solar Standards Committee.

Dr. Smith received his BS degree in Materials Science, his Masters in Management, and his Ph.D. in Materials Science from Rensselaer Polytechnic Institute in New York.

ABSTRACT

Metallic corrosion can have a very dramatic effect upon both the efficiency and lifetime of a solar energy system. For this reason, it is essential that data be provided to the solar industry regarding the mutual compatibility of various heat transfer media with the metals used in solar systems. Historically, this process has been accomplished by noting the conditions that have produced catastrophic failures of installed

systems. Currently, however, efforts are being made to provide laboratory procedures which can serve as either screening or simulated service tests for solar applications. These tests are designed to provide assistance in selecting a fluid for use in a solar system.

Efforts will be made to identify the various forms of corrosion historically found in solar applications. With this background, a series of proposed test techniques will be reviewed to show the applicability (and limitations) of the test to various conditions encountered during operation of a solar system. For at least one of the proposed tests, data will be presented which shows the ability of the test to provide both absolute pass/fail criteria and relative ranking of fluids for use in solar systems.

ASME Solar Standards

Allen J. Baldwin, Jr.
Energy Resources Center
Honeywell, Inc.
Minneapolis, MN 55413

Mr. Baldwin operates the test laboratories of Honeywell's Energy Resources Center. These facilities include thermal test facilities for flat plate and concentrating collectors and facilities for testing hydronic components such as heat exchangers and storage vessels. The laboratory has one of the few solar simulators in private industry. He has been responsible for operation and quality control of a black chrome selective coating facility and an acid etch facility for anti-reflective coatings of glass.

Other responsibilities include participation in solar standards

activity. Mr. Baldwin chairs the ASME Solar Codes and Standards Committee and participates in several other national standards activities including the American National Standards Institute and the American Society for Testing and Materials.

Mr. Baldwin has taught solar heating and cooling seminars at several Universities, Colleges and Technical Schools.

His background consists of a Mechanical Engineering education, several years of mechanical test experience and design of refrigeration and heat pump systems. He is also a licensed professional engineer.

ABSTRACT

The American Society of Mechanical Engineers has organized its solar codes and standards committee into two subcommittees. They are the solar power subcommittee and the heating and cooling subcommittee.

The solar power committee is primarily concerned with central generation of electricity with solar energy. Accordingly they are operating in the traditional ASME fields of boilers and pressure vessels as well as looking at the need for heliostat and control standards.

The heating and cooling subcommittee is concerned with technical areas which are in ASME's domain as they relate to heating and cooling of buildings both commercial and residential. These areas include pressure vessels, heat exchangers and the safety aspects of high temperature solar collectors used primarily for cooling applications.

Warranty Requirements and Effects on Materials Used and Life Expectancies

Walter Cohen
Walter Cohen and
Associates, Inc.
Atlanta, Georgia 30308

Walter Cohen has taken an active part in a number of larger projects involving the use of solar energy. These include:

George A. Towns School solar heating and air conditioning system addition of flat plate collectors to an existing school HVAC system. His prime responsibility was the equipment installation, piping and balancing of the systems with close coordination with the engineers.

The Shenandoah Community Center in Coweta County, Georgia, incorporates flat plate collectors for solar energy heating, air conditioning and domestic water heating in a new community facility housing a gymnasium, ice rink and office space for the Shenandoah Community. Mr. Cohen worked closely with the design team in the preliminary stages and was instrumental in piping design concepts used in the system. His prime responsibility was the construction management of HVAC, plumbing and solar energy systems.

Kennilworth Manor, Crystal Lake, Georgia, is a HUD-funded project

which was placed in operation in May 1978 to demonstrate the use of solar energy for heating domestic water for an existing mid-rise and high-rise apartment complex. Walter Cohen and Associates had the responsibility of construction management of the project.

Mr. Cohen is currently a member of the Advisory Board for the State of Georgia HVAC Code. He is a past president and continues to serve on the Board of Directors of the Georgia Subcontractors Association. He also serves on the Solar Energy Standards Committee of the Sheet Metal and Air-conditioning Contractors National Association.

Among many other professional affiliations, Mr. Cohen holds membership in the American Subcontractors Association and is President of the Atlanta Chapter of ASHRAE. Mr. Cohen is also a member of the Board of Directors of the National Conference of Christians and Jews.

Mr. Cohen has earned Bachelor's Degrees in Industrial Engineering (Georgia Institute of Technology) and Laws (Atlanta Law School) and the Masters of Business Administration (Georgia State University). He is a registered Professional Engineer.

He was recognized "1978 Engineer of the Year in Construction" by the Engineering Societies of Metropolitan Atlanta.

ABSTRACT

The subject of warranty requirement and the effects on materials used and life expectancies is discussed from the viewpoint of the contractor.

The contractor is vitally interested in this subject since mechanical and HVAC contractors will furnish and install most solar systems under future mass market conditions. The contractor will likely be the consumer's only contact, and guarantees and warranties will flow through him.

Experienced contractors know that manufacturers' warranties are no better than the integrity of the manufacturer. All warranties leave the issuer with sufficient loopholes to wiggle out of any warranty. Contractors believe that reliable manufacturers will assume responsibility for defective designs, materials, or workmanship. This is preferable and far less costly than warranties for both the contractor and the consumer.

William T. Cavanaugh
 Managing Director
 American Society for Testing
 and Materials
 Philadelphia, PA 19103

William T. Cavanaugh, a native of Newark, N.J., received his Bachelor's degree magna cum laude from Seton Hall College in 1942. He then entered the U.S. Navy and served on destroyers in the Pacific Fleet, reaching the rank of Lt. Commander.

Returning to private life, Mr. Cavanaugh taught history, public law, and government at Seton Hall College where he became an assistant professor. He was concurrently a graduate student at the Columbia University School of Public Law and Government. This program was interrupted by the Korean War during which Mr. Cavanaugh functioned as operations

officer of destroyer divisions in the Atlantic Fleet. He achieved the rank of Commander USNR.

Returning again to private life, Mr. Cavanaugh became assistant executive director, and in 1956 executive director of the Engineering Manpower Commission, Engineers Joint Council. In these capacities he served as government representative for EJC preparing and presenting testimony for congressional committees, serving on study committees of the National Science Foundation, Office of Defense and Civilian Mobilization, and so on.

From 1959 to 1966 Mr. Cavanaugh was executive director-secretary of the Administrative Management Society. In that capacity he restructured the organization, redefined the goals, developed a new fiscal structure, and developed and fostered the concept of professionalism of

middle management in North America.

Mr. Cavanaugh is a member of the American Society of Association Executives, and was honored by the Association for achievement in 1964. He was named by the United Business Schools Association as a National Honorary Life Member in 1963 in recognition of his contributions to the field of association management. Mr. Cavanaugh is also a member of the Council of Engineering and Scientific Society Executives and is a member of the American National Standards Institute's Board of Directors, Executive Standards Council and the Executive Committee of the Organizational Member Council. He received the Leo B. Moore Medal from the Standards Engineers Society in 1976.

Mr. Cavanaugh joined the ASTM staff in 1967 and was appointed Managing Director in 1970.

Program
Thursday,
September 14

2:00-5:00 p.m.

**Session Four:
Safety, Codes, and
Certification Standards**

Session Chairman: Robert D. Dijkers, Chief, Solar Criteria and Standards Program, National Bureau of Standards

Product Safety Standard for Solar Collectors—C. B. Schramm, Underwriters Laboratories

SEREF Rating, Certification, and Labelling Program for Solar Collectors—Don L. Kirkpatrick, Solar Energy Research and Education Foundation

Air-Conditioning and Refrigeration Institute Certification Program—G. R. Munger, Air-Conditioning and Refrigeration Institute

Solar Standards—What Do We Mean?—Marvin Yarosh, Florida Solar Energy Center

Consumer Requirements for Safety and Certification—Thorn, Peter J. (Massachusetts) State Solar Action Office

Environmental and Safety Considerations for Solar Heating and Cooling Applications—David Waksman, National Bureau of Standards

Energy Codes, Standards and Implementation—T. H. Carter, International Council of Building Officials

Question-and-Answer Period

6:30-7:30 p.m.

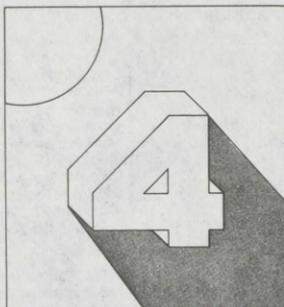
Conference Reception
(cash bar)

7:30 p.m.

Conference Dinner

Presiding: Joseph G. O'Grady, President, ASTM
Esther Peterson, Special Assistant to the President for Consumer Affairs

Theme: Solar Realities and Their Importance to the Nation



Safety, Codes,
and Certification
Standards

Product Safety Standard for Solar Collectors

C. B. Schramm
Managing Engineer
Heating, Air-conditioning
and Refrigeration Department
Underwriters Laboratories, Inc.
Northbrook, Illinois 60062

Mr. Schramm's entire career has been spent with Underwriters Laboratories, beginning in 1949 as an Assistant Engineer. He became, successively, Division Engineer and Senior Project Engineer, working on room and central air conditioners, refrigerators, icemakers and similar refrigeration equipment.

In 1967, he was transferred to the Heating, Air-conditioning and Refrigeration Department as Associate Managing Engineer. He was named to his present position in 1976 and is responsible to the Chief Engineer, Fire Protection Division for the department's equipment and operations.

Mr. Schramm holds active memberships in the American National Standards Institute, the American Society of Heating, Refrigeration, and Air-conditioning

Engineers, the International Association. Besides the foregoing, he serves on the ANSI Steering Committee on Solar Energy Standards as well as the Reliability-Durability Committee of the Solar Energy Research and Education Foundation. Mr. Schramm is a member of ASTM Committee E-44 on Solar Energy Utilization.

ABSTRACT

The Plan for the Development and Implementation of Standards for Solar Heating and Cooling Applications, NBSIR-76-1143, identified the need for a standard covering methods of test for solar collectors with regard to electrical, fire, structural and environmental safety as of the highest priority. Discussions of this Plan within the ANSI Steering Committee on Solar Energy Standards Development subsequently identified Underwriters Laboratories, Inc. (UL) as the organization responsible for development of the draft standard. After discussions with the Standards Committee of the Solar Energy Industries Association, UL initiated the development of such a standard

in early April, 1978.

This standard is being developed by UL with the assistance of a Technical Advisory Group (UL-TAG) and a Standards Development Committee (UL-SDC). The development plan schedule anticipates adoption as a Product Safety Standard by UL in early adoption as an American National Standard.

Since the primary heat transfer fluid is circulated through the collectors during operation, some requirements pertaining to the fluid to be used will be included in the standard.

While glass breakage and rain damage are clearly durability considerations, there are safety considerations, under certain conditions associated with them, which are to be detailed in the Standard.

Solar collectors will commonly be mounted on or become an integral part of a building structure. The standard will, therefore, include provisions related to the fire and structural requirements contained in building codes.

The SEREF Rating, Certification, and Labeling Program for Solar Collectors

Don L. Kirkpatrick
Solar Energy Research
and Education Foundation

Don Kirkpatrick graduated from the University of Michigan, BSME, in 1956, and was employed by Univac where he designed high speed mechanisms for computer mass memory (pre-bubble technology). In 1961 he joined General Electric's Space Division and for the next 12 years was responsible in project and line management positions for the development of a broad range of electromechanical and electro-optical equipment for spacecraft, including solar PV array tracking and deployment drives, active infrared horizon sensors, and other optical and thermal-related mechanisms.

In 1973 Don joined GE's then embryonic terrestrial solar group and worked actively in proposals, systems studies and solar hardware development and applications. For the next three years he was Manager of Solar Collector Development, with responsibility for development and testing, including design of flatplate collectors, and initial development work on evacuated and focusing systems. In early 1976 he gained the small manufacturer's perspective when he left GE to become a founder and Technical Director of Heliotherm, Inc. designing, building and installing several active DHW and spaceheating systems, including ERDA and HUD projects. Don disposed of his Heliotherm interests and joined SEIA-SEREF in mid-1977 and has served as RCL Program Manager since that time.

Professional activities/memberships include ASHRAE 93-77, 95-P, and 96-P Solar Standards Project

Committees; ANSI Solar Standards Steering Committee; ISES nominee for Engineering Director, 1978; SEIA, elected Director 1977-78; ASTM; President, Sun Desigis, Inc. Mr. Kirkpatrick is an active speaker on solar energy to public and technical groups, and has had published a number of papers on mechanisms and solar topics.

ABSTRACT

The Solar Energy Research and Education Foundation (SEREF) is developing a Collector Rating, Certification, and Labeling (RCL) program for the use of the Solar Industry. This DoE-funded program is unique in having the extensive participation of consumers, design professionals, technical societies, and other concerned groups, and state government representatives; as well as the active and broad-based participation and support of the solar industry.

The RCL development program which was begun in October of 1977 is scheduled for completion in December 1978, when it will be available for implementation by a recognized, suitably constituted authority. Important aspects of the program which will be discussed in the presentation are summarized below.

Laboratory Accreditation:

The accreditation of collector testing laboratories is an integral part of the SEREF-planned program. SEREF's Laboratory Interrelation Test Equipment (LITE), and laboratory evaluation procedures are currently being employed in the Department of Energy's current solar collector test program. These SEREF intercorrelation activities, performed now for DoE with NBS supervision, will provide a

demonstrated prototype for similar activities in a planned industry RCL program.

Collector Thermal Performance Rating:

The proposed thermal rating method being developed by SEREF provides the predicted all-day energy output of the collector. The derived all-day output ratings are based on the ASHRAE 93-77 measured instantaneous efficiency, a standard ASHRAE insulation profile and one or more combinations of ambient and outlet temperatures. These ratings are intended to provide maximum direct usefulness of the rating data, both to the prospective purchaser and the system designer. Development of localized output and cost-benefit algorithms is also in process.

Ongoing Certification

Program Development:

Label designs, which will provide maximum utility and understandability to the prospective purchaser/user, are being studied. The overall certification process and the structure of an ongoing RCL program is now being designed. In this development activity, the structures of several existing certification programs in related industries are being carefully studied to adapt proven concepts to the specific and unique needs and characteristics of the solar consumer and the solar industry. Expertise from personnel in these related programs, as well as of users and manufacturers, is being employed to achieve this goal.

Discussion of important elements of each of these program areas will supplement an overview of the proposed program at its current state of development.

Air-Conditioning and Refrigeration Institute Certification Program

G. R. Munger
President
Air-Conditioning
and Refrigeration Institute
Arlington, Virginia 22209

Mr. Munger began his professional career in 1951 with Hiatt Engineering Company as a design engineer and was successively technical director for the American Society of Refrigerating Engineers from 1953-1955, product manager for Owens-Corning Fiberglas Corp. from 1955-1964, managing director of Mineral Fiber Products Bureau from 1964-1967, general manager of the Society of the Plastics Industry from 1967-1974. Since 1974 he has been president of the Air-Conditioning and

Refrigeration Institute.

Mr. Munger graduated from California State Polytechnic University with a B.S. degree in engineering. He is a member of the American Society of Heating, Refrigerating and Air-Conditioning Engineers and a registered professional engineer in the State of Ohio.

ABSTRACT

Under contract to the U.S. Department of Commerce, the Air-Conditioning and Refrigeration Institute Foundation delivered a program for the organization of a certification program for solar collectors in January, 1978. The documents contained therein formed the basis of the ARI Solar Collector

Thermal Performance Program

Announcement of the ARI program was made on January 19, 1978 and on January 25, some 200 manufacturers were sent the program documents.

A review will be made of the development of those documents which include:

- 1.-Rating Standard
- 2.-Certification Laboratory Contract
- 3.-Operational Manual
- 4.-Manufacturer's License Agreement
- 5.-Format for a Directory

In addition, a program calendar and budget will be discussed, as well as an analysis of the factors influencing the program's level of success.

Solar Standards—What Do We Mean?

Marvin M. Yarosh, Director
Energy Systems
Analysis Division
Florida Solar Energy Center
Cape Canaveral, Florida 32920

Marvin Yarosh is the project manager and principal investigator for the U.S. Department of Energy's contract to develop solar energy consumer protection mechanisms. He is also co-principal investigator for the southeast regional assessment study for the deployment of solar electric generation options.

He is a member of the Laboratory Accreditation Committee of the Solar Energy Research & Education Foundation, a participant in the Southeastern Region Solar Energy Planning Group, on the Advisory Board of the Institute on Man and the Oceans, Inc., on the Governor's Council on Fuel Allocation and Energy Conservation, a member of the Technical Advisory Committee for the Florida Solar Energy Center, and a member of the Governor's Task Force on Solar Energy (SERI).

Prior to becoming director of the Energy Systems Analysis Division of the Florida Solar Energy Center, Mr. Yarosh was the executive director of the Florida Energy Committee and, for four years, was on the staff at the University of Minnesota. He was also on the Senior Staff of the Oak Ridge National Laboratory.

A registered professional engineer, Mr. Yarosh received his masters degree in Mechanical Engineering from the University of Minnesota.

ABSTRACT

Federal and state governments are acting to create incentives to

encourage more rapid commercialization of solar energy. In a new and still infant industry possessing few standards, where insufficient industry infrastructure and limited local government capabilities exist, efforts to accelerate commercialization increase the potential for both honest system failures and consumer rip-offs. Some states such as Florida have seen more rapid deployment of solar energy systems and thus problems in these states have already begun to surface. In Florida, solar activity during the second quarter of the century was very extensive, and renewed activity starting in 1974 accelerated rapidly. By 1976, the state legislature passed a law requiring that a voluntary testing, standards, and certification program be established by the Florida Solar Energy Center. The legislation was in response to the concern that many systems were being installed without any programs for testing or standardization. The 1976 legislation specifically required that:

- 1.—The Center shall develop and promulgate standards for solar energy systems manufactured or sold in this state.
- 2.—The Center shall establish criteria for testing the performance of solar energy systems and evaluating the performance of solar energy systems.
- 3.—All solar energy systems manufactured or sold in the state, which meet the standards established by the Center, may display accepted results of approved performance tests in a manner prescribed by the Center.

The entire program was on a voluntary basis.

In response to that legislation the FSEC established a system for testing, certification and labeling for solar collectors. The program determines the thermal performance of collectors using ASHRAE 93-77, slightly modified. Collectors are rated on a label according to temperature at which they operate for average insulation of a typical Florida day. We did not attempt to develop system standards or system rating criteria.

This year, the legislature has made the voluntary program in Florida mandatory and this action has created a whole new set of problems for the FSEC in determining an appropriate and realistic response to the legislation. While specific standards for performance testing components such as solar collectors seems sensible, it is not at all clear that we are prepared for standardization on system design or performance. Our experience suggests that the promulgation of recommendations of good practice rather than true standards may be more closely tuned to present solar needs.

There are conflicting concerns raised by the rapid deployment of units now being sold and installed and the concurrent desire that users of these systems be adequately protected. Because of the rudimentary stage of the industry, the premature establishment of too many standards for equipment design, performance, and installation may also seriously affect the successful process of commercialization. The resolution of this conflict will take extreme wisdom on the part of all those involved in the standards setting process.

Consumer Requirements for Safety and Certification

Peter Thorn
Deputy Director
Massachusetts State
Solar Action Office
Boston, Mass. 02108

Biography and abstract not available

Environmental and Safety Considerations for Solar Heating and Cooling Applications

David Waksman
Assistant Chief, Solar Criteria
and Standards Program
Center for Building Technology
National Bureau of Standards
Washington, D.C. 20234

Dr. Waksman was born and educated in the public schools in New York City, graduating from the Bronx High School of Science in 1955. He received both a B.S. degree in Ceramic Engineering with Departmental Honors and a Ph.D. degree in Ceramics from the State University of New York College of Ceramics at Alfred University in 1959 and 1966, respectively.

Following the receipt of his Ph.D. degree, Dr. Waksman was employed by the Certain-teed/Saint Gobain Insulation Corporation and its affiliates in various capacities as Senior Glass Technologist, Product Development Engineer, and finally, Manager of New Products. In the latter capacity, he was responsible for the development, testing and qualification of glass fiber insulation and air handling products. Following his employment with Certain-teed/Saint Gobain, Dr. Waksman spent six months as a Post Doctoral Fellow at the Ames Laboratory, operated for USAEC by Iowa State University, where he studied the elastic properties of hafnium oxide.

Dr. Waksman joined the National Bureau of Standards (NBS) in August 1971 and served as Assistant Manager of the Lead Paint Poisoning Project until June 1974 when he joined the solar energy program. He is currently Assistant Chief of the Solar Criteria and Standards Program in the Building Economics and Regulatory Technology Division of the Center for

Building Technology at NBS. Since joining NBS, Dr. Waksman has been the author of more than twenty papers concerned with solar performance criteria and standards, and procedures for eliminating the lead paint hazard in housing. He is a member of the American Ceramic Society, Keramos (the national honorary ceramic engineering fraternity), and the American Society for Testing and Materials where he served for two years as the chairman of the ASTM E-21.10.20 subcommittee on materials performance. Dr. Waksman has also been active on the ANSI Steering Committee on Solar Energy Standards Development on which he serves as the alternate representative from the National Bureau of Standards and has served as a member of an ASTM Ad-Hoc Group formed to coordinate ASTM efforts in the development of standards for solar heating and cooling.

ABSTRACT

The "Intermediate Minimum Property Standards" (MPS) and the residential and commercial "Interim Performance Criteria" (IPC) prepared by the National Bureau of Standards (NBS) address many health and safety considerations that are frequently overlooked by system designers. For example, factors such as the flammability and toxicity of heat transfer fluids are often not considered. Similarly, adequate consideration is seldom given to the safe disposal of these fluids. This problem is compounded by the lack of clear guidelines as to which fluids constitute a hazard that warrants special consideration.

This paper will discuss the various health and safety considerations presented in the MPS and IPC

documents. Emphasis will be placed on the safety provisions in the MPS document which are consistent with those in the commercial IPC document. The provisions in these two documents which were prepared in November 1976 and March 1977 represent an update of the provisions in the residential IPC document which was prepared in January 1975. The provisions in the MPS document are somewhat more prescriptive than those in the performance based IPC document. Safety related issues related to both active and passive solar energy systems are addressed by both documents.

In applying the MPS and IPC standards, recognition must be given to the type of project under consideration: single family, multi-family, institutional or commercial. Though very few of the requirements note any difference in treatment for a specific hazard (for example, a safe potable water system is considered essential in any type of occupancy) they often include by reference standards that do embody significantly different treatment for different types of building. For example, fire resistance requirements vary with different occupancies and solar components which form part of a fire resistant building element must be able to meet the various requirements.

Some of the areas that will be discussed in the paper include: structural safety, heat transfer fluid toxicity and flammability considerations including the protection of potable water, effects of solar equipment on the fire resistance of building, mechanical system protection, and protection from physical hazards.

Energy Codes, Standards and Implementation

T. H. Carter, P.E.
Executive Director
International Conference
of Building Officials
Whittier, California 90601

As executive director of the International Conference of Building Officials, Mr. Carter is responsible for the direction of all its activities including headquarters and national involvement.

Mr. Carter has served as consultant for the International Conference of Building Officials; Building Officials and Code Administrators International, Inc.; and the Southern Building Code Congress International, Inc. in the development of the one- and two-family Dwelling Code. He has also served as prime contractor with the Department of Housing and Urban Development in developing a report for the Douglas Commission on the building code situation in the United States as well as a Secretariat for the Model Code Standardization Council, Council of American Building Officials and the One- and Two-Family Dwelling Code Changes Committee. He has also been on the

Advisory Council for the Development of Operation Breakthrough for the Department of Housing and Urban Development.

Mr. Carter began his career in 1945 as a senior structural engineer and research engineer for the Building and Safety Department, City of Los Angeles. In 1958 he became the first technical director of the International Conference of Building Officials.

A registered civil and structural engineer in California, Mr. Carter received his B.S. degree in civil engineering from the California Institute of Technology. He is a member of the American Concrete Institute, American Institute of Architects, American National Standards Institute, American Society of Civil Engineers, American Society for Testing and Materials, National Fire Protection Association, and the Structural Engineers Association of Arizona, California, Oregon, and Washington.

ABSTRACT

A status report on the code officials involvement in energy codes and standards, including their implementation through national education programs.

The Council of American Building Officials, composed of Building Officials and Code Administrators International, Inc.; the International Conference of Building Officials; and the Southern Building Code Congress International, Inc. joined forces in 1977 with the Energy Research and Development Agency and the National Conference of States on Building Codes and Standards, Inc. to develop the Model Energy Conservation Code using as a basis ASHRAE 90-75. In addition, educational courses for legislative bodies, professionals, plan reviewers and inspectors were developed. This material is now being used to educate qualified instructors.

The report will also cover a similar program for solar energy being proposed by the Council of American Building Officials to the Department of Energy. The program will be a continuation of work done by the model code groups under a contract to the National Bureau of Standards. Emphasis will be placed on the greater need for new material and test standards to be developed.

Joseph G. O'Grady
President
American Society for Testing
and Materials
Philadelphia, PA 19103

Joseph G. O'Grady is the 1978 President of the American Society for Testing and Materials (ASTM). He is also the vice president of the PSE&G Research Corporation Energy Laboratory in Maplewood, New Jersey.

A native of North Bergen, New Jersey, Mr. O'Grady received a B.E.E. degree from the College of Engineering, New York University in 1954. The registered Professional Engineer in the State of New Jersey has been associated for approximately 30 years with the Energy Laboratory of the PSE&G Corporation, a subsidiary of the Public Service Electric and Gas Company.

Prior to 1961, his area of specialization included the

development of new test methods required in the investigation and solution of power systems engineering problems. He was appointed laboratory engineer in 1969 and assigned the responsibility of directing the six divisions of the laboratory that perform a considerable portion of the test work required during the design, construction, and operation of power system company facilities, including a variety of environmental test programs such as ambient air monitoring and stack emissions testing.

O'Grady assumed the position of manager of the Energy Laboratory in 1974. He was named a vice president of the PSE&G Research Corporation Energy Laboratory in early 1978.

A former secretary of ASTM Committee D-22 on Methods of Sampling and Analysis of Atmospheres, O'Grady was past chairman of the Project Threshold Co-Sponsors Advisory Committee.

The project was a national program conducted by ASTM to study the precision and accuracy of ASTM standard test methods used to measure air pollution.

O'Grady is a member of the Environment and Energy Committee and Vice-Chairman of the Codes and Standards Committee of the Edison Electric Institute, and is the Institute's representative on the Organizational Member Council of the American National Standards Institute (ANSI). In addition, he is a member of the Advisory Task Force on the Environment to the Electric Power Research Institute.

A senior member of the Institute of Electrical and Electronics Engineers (IEEE), O'Grady served as the first chairman of the Metropolitan Section of the Advisory Council in 1970. He received the North Jersey Award of IEEE for "distinguished service to the membership of the section" in 1971. He was also the recipient of the IEEE Region I Award in 1974.

Solar Realities and Their Importance to the Nation

Esther Peterson
Special Assistant to the President
for Consumer Affairs
The White House
Washington, D.C. 20500

On April 4, 1977, the White House announced the appointment of Esther Peterson as Special Assistant to the President for Consumer Affairs.

As Special Assistant to the President for Consumer Affairs, she will serve as a consumer spokesperson and advocate on the President's personal staff and advise the President on consumer-related matters.

She was born in Provo, Utah on December 9, 1906. She received an A.B. degree from Brigham Young University in 1927 and an M.A. from Teachers College, Columbia University in 1930.

She taught at Branch Agricultural College in Cedar City, Utah, and at Winsor School in Boston. She also taught at Bryn Mawr Summer School

for Women Workers in Industry from 1932 to 1939.

Ms. Peterson was assistant director of education of the Amalgamated Clothing Workers of America from 1939 to 1944 and served as their legislative representative in Washington from 1945 to 1948. She and her family lived overseas from 1948 to 1957 while her husband served as labor attaché in Sweden and Belgium.

In 1957, Ms. Peterson became legislative representative of the Industrial Union Department of the AFL-CIO. She continued in this post until 1961, when she was appointed director of the Women's Bureau in the Department of Labor by President John F. Kennedy. In August of that year, she became assistant secretary of Labor and held that position until 1969.

Between 1961 and 1963 Ms. Peterson served as executive vice chairman of the President's Commission on the Status of Women.

In 1964, President Lyndon B. Johnson appointed her to the newly created post of Special Assistant to the President for Consumer Affairs. She also served as chairman of the President's Committee on Consumer Interests. She held these posts until 1967.

Ms. Peterson joined Giant Food in 1970 as vice president of consumer programs and consumer adviser to the president. In that capacity, she spearheaded numerous consumer-related projects, and had her own professional staff, which developed consumer programs.

She is on the board of directors of many consumer, educational and civic associations, including the Institute for Public Interest Representation at the Georgetown University Law Center, the Women's National Democratic Club, the Center for Science in the Public Interest, and the National Center for Resource Recovery.

Program
Friday,
September 15, 1978

9:00 a.m.—Noon

Session Five:
Looking Ahead

Session Chairman: Charles Grosskreutz, Assistant Director of Research, Solar Energy Research Institute

Opening Remarks: Charles Grosskreutz, Solar Energy Research Institute

What's Coming From the Federal Government (DOE & NBS)?—Henry H. Marvin, Department of Energy

SERI and its Role in Standards Activity—Paul Rappaport, Solar Energy Research Institute

Consumers and the Solar Standards Future—Honorable James Jeffords, U.S. Congressman, Vermont

The Future of Solar Energy Standards in the Voluntary Consensus Standards

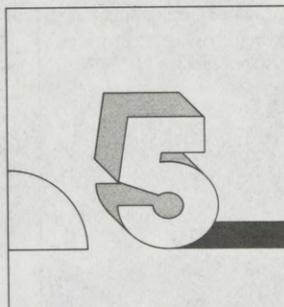
System—Walter G. Canham, Jr., ANSI Executive Standards Council

Question-and-Answer Period

Closing Remarks: Albert Weinstein, Chairman, ANSI Steering Committee on Solar Energy Standards Development

12:00 Noon

Conference Adjournment



Looking Ahead

Dr. Charles Grosskreutz
Chairman—Session Five
Assistant Director for
Research
Solar Energy Research
Institute
Golden, Colorado 80401

Dr. Grosskreutz is an internationally recognized expert in thermal power applications—most notable, the Power Tower concept. Before joining SERI, Dr. Grosskreutz was manager of solar programs at Black & Veatch, Consulting Engineers in Kansas City, Missouri.

He received a Bachelor of Science degree from Drury College in 1943, a Master's degree from Washington

University in St. Louis in 1948, and a Ph.D. in Physics from Washington University in 1950. He is the author of over 65 publications.

Dr. Grosskreutz is a member of the International Solar Energy Society, a Fellow of the American Physics Society, and a Fellow of the American Society for Testing and Materials. He earned the Award of Merit from ASTM in 1972.

What's Coming From the Federal Government (DOE AND NBS)?

Dr. Henry H. Marvin
Department of Energy
Division of Solar Technology
Washington, D.C.

Dr. Henry H. Marvin is the Acting Deputy Program Director for Solar, Geothermal, Electric and Storage Systems, and Acting Director, Division of Distributed Solar Technology of the Department of Energy.

Previously, Dr. Marvin was Director of the Division of Solar Energy at the Energy Research and Development Administration, which he joined in 1975-1977. He had been General Manager of the High Intensity and Quartz Lamp Department, General Electric Company, Cleveland, Ohio, since 1973.

Dr. Marvin has an extensive background in research, development, and business management. He began his career with the General Electric Company in Schenectady, New York, as a research associate and was named to successively higher positions, including Manager of Structure and Reaction Studies at GE's Research Laboratory, Schenectady; Manager of Engineering, Capacitor Department, Hudson Falls, New York; Manager of the Lighting Research Laboratory, Lamp Business

Division, Cleveland; and finally in 1973, General Manager of the High Intensity and Quartz Lamp Department.

Dr. Marvin, who was born in March, 1923, at Lincoln, Nebraska, is a World War II Army veteran. He received his BA degree in Chemistry, Mathematics and Physics from the University of Nebraska in 1947, and his Ph.D. degree in Physical Chemistry from the University of Wisconsin in 1950.

ABSTRACT

The development and commercialization of solar energy technology is receiving increasing emphasis from the Department of Energy. The Domestic Policy Review, the National Plan for Accelerated Commercialization, and President Carter's statement of commitment on Sun Day, May 3rd, are all recent components of this increased emphasis.

In addition to solar hot water and space heating, which has already received significant attention from the standardization community and at this conference, photovoltaic technology, wind, certain aspects of biomass conversion, and possibly ocean thermal energy conversion are all being reviewed within DOE with an eye toward accelerated commercialization. A particularly exciting prospect for rapid

implementation is the solar thermal repowering of existing oil—and gas—fired electric power generating stations in the southwest.

All of these activities will place a greater demand on the standards-setting community in the United States, and it is certainly not too early to begin the work of delivering such standards when they are needed.

The federal government anticipates continued support of the voluntary consensus system in the development of standards for all of the solar technologies. Because of (1) the widespread dollar commitment from the federal government for research, development, and demonstration programs; and (2) the need to not only increase consumer acceptance but also the need to develop a firm industry infrastructure, the federal government will take an active role in accelerating the standards-development process. From the National Bureau of Standards, this means research in developing the data to support interim performance criteria and test methodology. From HUD and from DOE, this means substantive cooperation with the voluntary consensus groups to speed up the frequency of meetings, and to allow greater participation from consumer groups and small business.

SERI And Its Role In Standards Activity

Dr. Paul Rappaport, Director
Solar Energy Research
Institute
Golden, Colorado 80401

Dr. Paul Rappaport, director of the Solar Energy Research Institute, is an internationally recognized pioneer in solar energy conversion and an authority on photovoltaic technology. Dr. Rappaport has helped formulate the national solar energy program through service on government research advisory committees for ERDA, NASA, the National Science Foundation, and the National Academy of Sciences. Before his appointment as SERI director, Dr. Rappaport was director of the Process and Applied Materials Research Center at RCA's David Sarnoff Research Laboratories in Princeton, New Jersey.

ABSTRACT

The Solar Energy Research Institute (SERI), now just over a year old, was organized on a broad scale to help solve the problems of bringing solar energy to early utilization. Research, Analysis and Assessment, Information Systems, Educational and Institutional programs, and Technology Commercialization are the elements of SERI's structure. During its first year of operation, it has already begun work in the area of solar standards.

SERI will continue its support of the voluntary consensus groups in developing standards for the solar technologies. SERI will not be writing standards, but it will participate in the process; and the effort will come from all divisions within the SERI organization.

The most visible effort will continue to be in photovoltaics solar conversion technology, where SERI is managing an Advisory Committee for the development of performance criteria and standard test methodology. The goal of this group

is to stimulate and accelerate standards-development activity within the private sector. The Advisory Committee, with balanced representation from the photovoltaics community, is developing an Interim Performance Criteria document in anticipation of passage of the McCormack Bill in December of 1978 for transfer to the voluntary consensus groups.

SERI will maintain a low profile in the heating and cooling area. However, we will examine the need for accelerated standards development in the other solar technologies.

Research activities will support the development of data used for developing test methods and standards for component performance measurements, reliability/durability information, and safety guidelines.

The Information and Education Division is in the process of making available a wide body of knowledge on standards and codes for use by all interested parties in the interest of making the solar community aware of the activity of all segments of the community.

Consumers And The Solar Standards Future

The Honorable James
Jeffords
U.S. Congressman
State of Vermont

Congressman Jeffords has held office in the U.S. House of Representatives since 1974.

A native of Vermont, he received a Bachelors of Science from Yale in 1956 in Industrial Administration, and he is a graduate of Harvard Law School, class of 1962.

Prior to serving in the House of Representatives, Congressman Jeffords was engaged in private practice in Law.

He served as National Director of the American Judiciary Society from 1973-1975 and also as President of

the Young Lawyers' Section of the Vermont Bar Association from 1966-1977.

ABSTRACT

Consumer acceptance of solar energy conversion applications is the key to the success of the industry. A major step to achieving consumer acceptance is the development of standards—the basis for warranties and an integral part of developing tax credit legislation. Solar systems compete with conventional systems which have proven performance and reliability/durability characteristics, and safety guidelines for use. The solar industry is now undergoing major standards development activities.

Consumer participation in these activities is vital. There needs to be much more participation of consumers in standards committees than that which presently exists. The key to achieving this is funding: providing the dollars so that those who represent the end-use consumer interest can have a strong voice in the process. It is essential that the voice of the consumer be an informed voice; and to develop that, we call upon the industry and the government to take an aggressive stand in disseminating information on solar and the alternative energy sources. We call upon and rely upon the voluntary consensus standards system to develop the give-and-take that will make the industry viable.

The Future of Solar Energy Standards in the Voluntary Consensus System

Walter G. Canham, Jr.
Engineering Standards Manager
Monsanto Company
St. Louis, Missouri 63166

Mr. Canham is Chairman of the Executive Standards Council (ExSC) of the American National Standards Institute (ANSI). The ExSC is responsible for managing and coordinating the development of American National Standards. It is also responsible for criteria to be met in approving those standards.

Other activities in national standardization include membership on ANSI's Piping and Process Equipment Standards Management

Board, extensive involvement in piping standards and codes, membership on ASME's Pressure Technology Codes and Standards Supervisory Committee, and membership on ASTM's Metric Committee E-43.

Mr. Canham is a chemical engineering graduate of the University of Virginia and a professional engineer registered in Missouri & West Virginia.

ABSTRACT

This paper outlines the kinds of resources offered by the U.S. voluntary consensus standards system for the development of standards needed to foster and

discipline the growth of technically, socially, and economically sound exploitation of solar energy for heating and cooling uses.

Evolutionary concepts in planning, implementing, and coordinating the creation of standards in areas of new technology are presented. Emphasis is placed on bringing technical, regulatory, and administrative expertise together at the closest possible level to the work that needs to be done, and on cooperative means of avoiding duplication and wasted effort.

Potential problems are identified, and potentially fruitful approaches to solving them are outlined.

Albert Weinstein
President
Westinghouse Solar Heating
and Cooling Company
Westinghouse Electric Corpo-
ration
Falls Church, Virginia 22041

Mr. Albert Weinstein is the President of the newly formed Westinghouse Solar Heating and Cooling Company for Westinghouse Electric Corporation, and has been with that Corporation for the past six years. He has served as the Program Manager for the Westinghouse contract with NSF on the Phase O Feasibility of Solar Heating &

Cooling of Buildings, and has supervisory responsibility for management of the design, installation, and operation of the experimental solar heating and cooling systems for the George A. Towns Elementary School in Atlanta, Georgia. This was the first large scale solar heating and cooling system and provided the basis for many subsequent designs.

In addition, he has management responsibility for the design and marketing of solar systems for residential, commercial and industrial application.

Mr. Weinstein is currently Chairman of the ANSI Steering Committee on Solar Energy

Standards Development.

Prior to joining Westinghouse, Mr. Weinstein spent 30 years with the Federal Government including duty with the Navy, the Department of Defense, and the Department of Housing and Urban Development.

Before joining the Navy in World War II, Mr. Weinstein worked for the Research and Development Department of Carrier Corporation for five years.

He holds a degree in Physics from Brooklyn College, is a Registered Professional Engineer, and has been granted six U.S. patents. He has authored many articles concerning solar systems and lectured at several universities.



Sponsoring organizations

Sponsors



The American National Standards Institute (ANSI) is a voluntary federation that includes many of the more than 400 standards-writing bodies in the United States, as well as some other organizations and corporations. This nonprofit organization has four primary functions:

- To be the national coordinator for standardization in the United States;
- To approve as American National (consensus) Standards, those standards that have been submitted by standards-developing organizations that are seeking or have already obtained public review;
- To serve as a clearinghouse for information on American National Standards, international standards of cooperating bodies of the International Organization for Standardization (ISO), and International Electrotechnical Commission (IEC); and
- To represent the standards position of the United States in international nontreaty organizations.

ANSI is financed by its members' dues, by specified project support from industry and government, and by the sale of American National Standards, ISO and IEC documents, and other technical publications.

More than 270 technical committees have been formed by ANSI during its 60 years to work on standards-development projects. Because ANSI may not, by its constitution, write standards, American National committees belong to the organizations of which they are comprised. Each has a Secretariat, usually an organization having a major interest in standards development in the field, which is responsible for administering the committee.

Some Questions-And-Answers About ANSI

What types of standards does ANSI approve?

Approved American National Standards, which now number approximately 8,500, encompass

virtually every field and every discipline. They deal with dimensions, ratings, terminology and symbols, test methods, and performance and safety specifications for materials, equipment, components, and products in some two dozen fields. These fields include construction; electrical and electronics; heating, air conditioning, and refrigeration; information systems; medical devices; mechanical; nuclear; physical distribution; piping and processing; photography and motion pictures; textiles; and welding.

Who uses American National Standards?

Users include producers; distributors; retailers; utilities; banks; insurance companies; consumers; architects and builders; federal, state, and local governments; schools; libraries; labor and safety organizations; testing laboratories . . . They provide a common language that can be used confidently by industry and its suppliers and customers, business, the public, government, and labor because each of these interests has either participated in the development of the standards involved or has been given the opportunity to comment on their provisions.

Is ANSI a government agency?

No. It is a private nonprofit organization operating in the public interest.

What is its relationship to government?

ANSI and government have close cooperative ties. Representatives of government serve on ANSI councils, boards, and committees and an ever-increasing number of ANSI-approved national consensus standards are being adopted or referenced by government agencies. These standards are used by government at all levels to provide for the health, safety, and welfare of the public; for procurement and cost reduction; and to provide such public services as transportation and communication. Among the principal federal users are: the Occupational Safety and Health Administration; the Nuclear Regulatory Commission; the

Departments of Health, Education, and Welfare, Housing and Urban Development, Defense, and Transportation; the General Services Administration; and the Veterans Administration. Local and state governments also adopt or reference American National Standards—for buildings, electrical installations, elevators, boiler and pressure vessels, and many others. These standards are used with confidence by government because they have achieved a high level of national acceptance.

Are consumers represented in the ANSI federation?

Yes. Primarily through the very active programs of ANSI's Consumer Council, which represents consumer interests at all Institute policy and technical levels. To meet consumer needs for safe products that perform satisfactorily, one of the Council's committees reviews all consumer product and service standards submitted to ANSI for approval to identify serious flaws and inadequacies and to stimulate corrective action. To foster strong and direct communication between individual consumers and standards-writing committees, the Council, in cooperation with several ANSI organizational members, has established a number of consumer sounding boards. They provide standards-writing committees with dependable information on consumer experience with and opinions about products for which standards are being developed. Interested sounding-board members will eventually be trained to participate directly in standards development.

What's the role of companies in the ANSI federation?

Company members help govern ANSI and determine policy, procedure, and long-range plans. They also help identify the needs of commerce and industry for standards—national and international—and stimulate ANSI to initiate new standards development activities, accelerate work under way, and promote review and improvement of existing standards. Their financial support is one of ANSI's principal sources of income.

American National Standards Institute
1430 Broadway
New York, N.Y. 10018
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Air-Conditioning and Refrigeration Institute



The Air-Conditioning and Refrigeration Institute (ARI) is a voluntary, non-profit organization comprised of manufacturers of air-conditioning, heating and refrigeration equipment. More than ninety percent of the air-conditioning and refrigeration machinery (including components) manufactured in the United States is produced by members of ARI.

ARI performs the following important functions:

Engineering Services—Preparation of ARI Standards for products and components which provide a reference between users and the industry as well as a basis of agreements *within* the industry and regulatory bodies (e.g. FTC, EPA, ERDA).

ARI also provides authoritative standards information and a *uniform* basis of specifications by architects, engineers, contractors and owners.

On behalf of its members ARI participates with groups like ASHRAE, GAMA, ANSI, UL and EEL in the investigation and recommendation of additional technical services. In this connection, it assists in the coordination, reviewing and up-dating of standards to facilitate their acceptance by the industry and the public.

One of the Engineering Department's most important functions is the administration of ARI's Certification Programs, which are being required by more and more specifiers in our industry. These are designed to assure the contractor and consumer that the product he is buying, which was manufactured by a Certification Program participant, has been thoroughly tested and accurately rated and is thus eligible for the coveted ARI seal.

ARI cooperates with other organizations in explaining certification programs. Members gain from the promotion which is distributed to industry and to the public about the benefits of the various certification programs.

Product Statistics—ARI is recognized as the most reliable source of manufacturing statistics in the

industry. Although many of the statistical programs are designed for participation and reporting for *members only*, some are disseminated to the trade press, to the government and other organizations as requested. There is, for example, constant coordination with government statistical agencies.

Legislative Affairs—As the demands of government have increased, the legislative activities of ARI have increased proportionately. ARI members are now very much aware of the influence of government—at all levels—on their daily business activities. They look to their association to represent them in this area and to disseminate promptly to them information on government legislative action that will directly affect them. Recently ARI formed the Legislative Network, a group of executives appointed by ARI member-companies to work with staff in monitoring legislation on a state level. ARI now has staff personnel specifically assigned to state legislative developments.

The Legislative Department is concerned not only with legislative developments but with various regulatory bodies (EPA, FTC, ERDA, FEA) that have increased impressively during the past few years. ARI staff is in daily contact with Members of Congress, staff personnel on the congressional committees and key departmental personnel. Oral and written testimony on matters affecting this industry are prepared and presented. On all levels of government ARI members are being heard and their interests are being monitored.

Government/Consumer Affairs—There is a rapid growth of efforts by both state and national governments to provide greater "protection" to the consumer. ARI is maintaining a continuing surveillance on behalf of its members of these developments. In the areas of:

Product safety
Warranties and guarantees
Energy conservation and utilization
Performance, reliability, quality control and designing for

accessibility and serviceability
... to mention a few ...

...ARI has member and staff activities that serve the interests of its members in these areas.

Traffic and Transportation—A unique program of ARI is a traffic and transportation activity that keeps members abreast of developments in railway, motor carrier and other common carrier tariffs. These reports on ratings and classifications affecting their products have produced sizeable savings over the years to ARI members.

Public Relations—ARI is constantly in contact with its members, industry executives and the public through an active public relations program. Members receive a monthly news letter that keeps them aware of Institute and industry events.

Increasingly, government, educational institutions, industry and the public seek information from ARI about industry developments. Each of these inquiries is answered by the Public Relations Department on an individual basis. Booklets, brochures, and pamphlets are constantly being updated and are available to members at cost for distribution for promotional purposes.

ARI maintains a library of technical and industry publications from which members may obtain information of value to them.

International Trade—As the trade between continents increases, ARI members grow more aware of the International aspects of this industry. ARI serves its members by close liaison with numerous government agencies interested in promoting foreign trade. A committee of the Institute has been established to promote the interest of members concerned with this activity.

1815 North Fort Myer Drive
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American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.



What Is ASHRAE?

In 1894 the first of ASHRAE's predecessor societies was founded to advance the arts and sciences of heating, ventilation, air conditioning and refrigeration for the benefit of the general public.

Today that general public has expanded to include the entire world, and ASHRAE has accepted the responsibility of developing new technology and a better indoor environment for international use.

ASHRAE, an organization of over 30 thousand members from 111 countries, has a professional staff of 55 and 23 international associate societies outside of North America. With a total 1976-77 budget of nearly \$3 million, over \$550,000 are earmarked for research.

The results of this research and the working experience of over 87 technical committees are reported on and disseminated through the Society's various publications. The monthly ASHRAE JOURNAL is the

most authoritative periodical on research, design, development and engineering news in HVAC&R field, and ASHRAE HANDBOOK & Product Directory, a four-volume handbook covering fundamentals, systems, applications and equipment, has been known as the "Bible" of the industry for over fifty years. One volume is revised each year, and along with the JOURNAL, it is distributed to members as part of their membership services. Other Society publications include a biannual TRANSACTIONS of technical and symposium papers presented at ASHRAE meetings; bulletins on such topical subjects as solar energy, energy conservation and fire and life safety in buildings; and 49 standards. ASHRAE Standard 90-75 "Energy Conservation in New Building Design" is the first in a series of documents which provides design requirements for improved utilization of energy.

Recognizing that an exchange among all members of the building

industry is necessary if energy conservation is to be achieved, ASHRAE sponsored a seminar series entitled "Energy Conservation in Existing Buildings" which traveled throughout the United States, Canada and Europe. Other projects undertaken during the past year include review of programs for the Federal Energy Administration, the Department of Housing and Urban Development, the Energy Research Development Administration, the National Bureau of Standards, and the National Science Foundation.

As our reliance upon machines and the energy sources needed to run them grows, the specialized knowledge that an ASHRAE member has will become more and more important. ASHRAE will respond to that challenge.

United Engineering Center
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The American Society for Testing and Materials (ASTM) is a non-profit corporation formed in 1898 for the development of standards on characteristics and performance of materials, products, systems, and services, and the promotion of related knowledge. In ASTM terminology, standards include test methods, definitions, recommended practices, classifications and specifications.

ASTM is our nation's primary management system for standards development, with more than 5700 standards under copyright. It currently has 130 main technical committees (about 1700 subcommittees and sections) working on equipment, consumer product safety, security systems and equipment, technical aspects of products liability litigation, surgical implants, meat products, etc.

ASTM standards are developed not by staff, but by those having expertise in specific areas who choose, voluntarily, to work within the ASTM system—producers, users, ultimate consumers, and representatives of government and academia. ASTM provides a forum within which these people can meet on a common ground to write standards that will best meet the needs of all interested parties. Most important, perhaps, the ASTM system adheres strictly to the principles of due process, assuring equal access to and equal voice in the standards forum and precluding discriminatory, anti-competitive effects.

Standards developed by the Society's committees are published in the 48-volume annual Book of ASTM Standards. The hundreds of technical papers and reports presented at ASTM symposia and meetings are published in books, the Society's monthly magazine "Standardization News", and in quarterly publications. All are distributed world-wide.

ASTM is autonomous, deriving its income from the sale of its standards and other technical publications (approximately 85%) and through administrative fees (approximately 15%). It is not subsidized by either industry or government. Current membership is about 27,000 including some 3,000 international members. Since many members serve on more than one committee, total unit participation is well over 65,000.

Facts About ASTM Committee E-44 On Solar Energy Conversion

This fact sheet gives you information about the committee, its scope, and structure.

PROPOSED SCOPE

The purpose of the committee shall be the promotion of knowledge, stimulation of research, and the development of standards concerned with the technology for conversion of solar energy to directly usable energy forms, and the application of such technology for the public benefit.

The areas of interest shall encompass standards relating to methods and applications of solar energy conversion. These methods and applications shall include, but shall not necessarily be limited to the following: heating of swimming pools and domestic hot water; active and passive space heating and cooling; process heating; thermal conversion power generation; photovoltaic generation of electricity; wind energy conversion; ocean thermal energy conversion; biomass conversion; and advanced energy conversion. Consideration shall be given to applicable materials, components, subsystems, and systems in each of these methods and applications.

This committee will serve as a coordinating agency for these activities and will maintain liaison with Committee E-21 on Space Simulation and Applications of Space Technology, other relevant ASTM committees, and other technical organizations.

Areas of standards development applicable to this scope, but under the jurisdiction of other ASTM Committees are excluded from development by this committee unless those other groups do not choose to act directly on the development of the specific standards which Committee E-44 determines to be necessary. In such cases Committee E-44 may elect to develop the needed standards with the appropriate liaison assistance of those other groups.

Subcommittees Of Committee E-44

- .01 Nomenclature
- .02 Environmental Parameters

- .03 Safety
- .04 Materials Performance
- .05 Heating and Cooling Subsystems
- .06 Heating and Cooling Systems
- .07 Process Heating Systems
- .08 Thermal-Conversion Power Systems
- .09 Photovoltaic Electric Power Systems
- .10 Wind-Driven Power Systems
- .11 Ocean-Thermal Power Systems
- .12 Biomass Conversion Systems
- .13 Advanced Energy Systems
- .14 Passive Heating and Cooling Systems

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PENNSYLVANIA 19103
(215) 299-5400

National Bureau of Standards



The National Bureau of Standards, an agency of the Department of Commerce, is the nation's physical science and measurement laboratory. Established by an act of Congress in 1901, NBS provides the basis for the nation's measurement standards. These standards are the language through which people and nations buy and sell goods, develop products, judge the quality of their environment, and provide guidelines for the protection of health and safety.

The Bureau also serves as a catalyst for the application of advanced technology and associated scientific methods to the solution of national problems. At NBS, a diverse staff representing dozens of scientific and engineering disciplines are engaged in more than a thousand projects.

Among the Bureau's activities is solar energy standards development. NBS was named in the Solar Heating and Cooling Demonstration Act (Public Law 93-409) to provide technical support to the Energy Research and Development Administration (now the Department of Energy) and the Department of Housing and Urban Development, the agencies responsible for carrying out the law.

• One of the first tasks NBS undertook was to formulate a plan to guide the development and implementation of standards for solar heating and cooling applications. The plan contained background information on the need, implementation, and general scope of standards that may be required. It also recommended actions for the early development and implementation of draft and national consensus standards for solar heating and cooling systems, subsystems, and components. The plan was revised and updated in

consultation with interested members of the building community so that needed standards can be developed or existing standards modified.

• Meanwhile, NBS engineers have been actively involved in the actual development of draft standards, which help provide the framework for national voluntary consensus standards. Two standards based on NBS drafts, one for the thermal performance of solar collectors and one for storage devices, were issued early in 1977 as American Society for Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) standards. NBS also initiated eight research projects to provide the technical basis for standards for materials used in solar heating and cooling systems.

• A key part of federal efforts is in producing and refining interim performance criteria intended for use in the various phases of the residential and commercial demonstration programs. These performance documents, along with Intermediate Minimum Property Standards developed for HUD, will ultimately result in definitive performance criteria that can be used to establish recommended building code provisions for incorporation into model, state, and local building codes and federal specifications.

NBS has developed interim performance criteria for the residential demonstration program and has nearly completed an update. The commercial performance criteria for solar heating and cooling systems, originally done by the National Aeronautics and Space Administration, have been revised by NBS. A further update of these criteria is expected late this year.

• A major accomplishment in the

standards area was the development of intermediate standards for solar hot water and space heating systems. These were issued in the summer of 1977 by HUD as a supplement to the FHA Minimum Property Standards. Developed for HUD by NBS, they establish quality levels for solar heating and domestic hot water systems for residential facilities designed and constructed under HUD programs, including nursing homes, intermediate care facilities, and single and multi-family residences. The standards will serve as the basis for mortgage insurance acceptance and may be used at a later date to qualify systems or components for acceptance under pending tax credit programs.

• The success of the demonstration program and the future of solar energy in the United States may ultimately depend on a certification system for solar energy components and systems. NBS is working with the Department of Energy, HUD, and independent organizations on procedures under which solar collectors can be tested, rated, and labeled in an industry-administered certification program. Such a program would provide an objective basis for consumer protection programs and would promote the use of solar energy systems by informed consumers. In addition, it would stimulate manufacturer competitiveness and accelerate product improvements.

Additional information on the NBS Solar Energy Program and a list of publications may be obtained by writing the Chief, Solar Criteria and Standards Program, Center for Building Technology, National Bureau of Standards, Washington, D.C. 20234.

National Solar Heating & Cooling Information Center



The National Solar Heating and Cooling Information Center was established by the Department of Housing and Urban Development (HUD), in cooperation with the Department of Energy (DOE), as part of a Federal program to foster American energy sufficiency.

The Center's role in this Congressionally-mandated (P.L. 93-409) effort is to collect, organize and disseminate information about solar energy applications, thereby encouraging and accelerating the use of solar technology in residential and commercial buildings.

The resources and services of the Center are many, varied and often tailored to meet the needs of specific publics. Levels of information provided to these publics will evolve and expand as interaction with members of the solar community continues, and the results of research, development and demonstration activities become available.

Inquiries are welcome from all—builders, architects, bankers, trade and professional associations, contractors, community planners, building code officials, insurance agents, manufacturers, zoning officials and homeowners.

Solar Professionals

If you are a builder who needs a solar architect, or an architect looking for a builder or engineer with solar experience, the Center can help you. Its computerized file of solar professionals lists the names, addresses, and areas of expertise of builders, architects, engineers, designers, contractors and others experienced or interested in using solar energy.

In addition, the Center offers you specialized information on building professional and trade associations, as well as lists of solar energy and related organizations.

Solar Buildings

If you want to know about existing solar installations, the Center can provide you with the most comprehensive lists of solar buildings, sources for solar house plans, solar design publications, and slides and photographs of completed installations.

For each solar building, the Center call tell you its location, its availability for public or trade viewing, whom to

contact, and details about the solar system itself, including its type and function.

Solar Grants

Since the 1974 Congressional Act authorizing residential and commercial solar demonstration grant programs, demonstration grants have given many builders and design professionals the chance to gain solar experience.

For each grant program, the Center can provide you with eligibility requirements, application forms and information about previously issued grants.

Solar Legislation

The Center maintains a computerized file of passed and proposed laws and regulations. Specialized information includes state solar legislation and studies on property tax exemptions and incentives, solar access and land use, standards and building codes.

Solar Educational Programs

The Center has information on courses in solar energy and its applications, as well as upcoming conferences, workshops, seminars and short courses. It also maintains names of qualified speakers, their biographical profiles, subjects of concentration and professional affiliations. These speakers are available to discuss solar heating and cooling topics at your conferences, seminars, workshops and meetings.

The Center can also provide you with multimedia exhibits, films, slides and working solar models—even a mobile exhibit available for pre-scheduled appearances throughout the country.

Equipment And Installation Standards

The development of industry-wide standards for solar energy equipment and solar energy systems installation is under way.

The Center has information on the development of standards by organizations including the American Society of Heating, Refrigerating and Air Conditioning Engineers, the National Bureau of Standards, the American Society for Testing and Materials, and the Sheet Metal and

Air Conditioning Contractors National Association.

Also available is information from HUD Intermediate Minimum Property Standards Supplement: Solar Heating and Domestic Hot Water Systems (Document 4930.2), which went into effect August 1, 1977, and applies to all FHA-insured solar projects.

Technical Information

You can obtain summaries of instrumented performance data from selected Federally-funded solar installations, as well as scientific and technical aspects of solar heating and cooling... criteria for performance... certification and testing of solar equipment, and the groups active in these areas... climatic data essential for calculating collector size and the feasibility of a given system in your part of the country... and information on computer programs available for sizing solar systems and determining their economic feasibility.

The Center also has its own engineering staff, which can be consulted free of charge on specific technical questions.

For questions of a more involved nature, write to the Center. Otherwise, a telephone call may suffice.

If you are not on any of our specialized lists, send us your name, address, professional area, product or service. Just call us at (800) 523-2929, or (800) 462-4983 in Pennsylvania.

The National Solar Heating and Cooling Information Center is operated by the Franklin Institute Research Laboratories for the Department of Housing and Urban Development, in cooperation with the Department of Energy. The National Center and the above organizations do not evaluate or endorse any organizations, individuals, products or services in any way. Because of the rapidly changing nature of the solar industry, the Center's lists and information are constantly being updated and revised. Therefore, exclusion from a listing does not imply a judgement of any kind by the Center, its employees, or sponsoring government organizations.



Solar Energy Industries Association

SEIA was formed in 1974 to improve the business climate of its members and give life to a budding industry. Since then, SEIA has been working in several areas and on innumerable programs to make this infant industry succeed and its members' businesses more profitable.

To accomplish these goals, SEIA realized it had to encourage government to be more responsive to industry needs to make solar energy more acceptable to the public.

In a few short years, SEIA's legislative input provided the impetus for government incentive programs—solar tax incentives, increased government purchases of solar equipment and more demonstration programs to encourage customers to use solar energy. Currently, SEIA's sister organization, the Solar Energy Research and Education Foundation (SEREF), is developing solar standards for the industry through a government financed solar collector rating, certification, and labeling program. And SEIA continues to educate the architects, engineers and contractors—the people making the purchasing decisions—about solar installations and maintenance, as well as the consumer about the economic benefits of converting to solar energy use.

In Washington, SEIA is a link to the government decision-makers. SEIA's legislative program combines the technical expertise of the association's leadership with the experience of its seasoned legislative staff. Together we keep Congress and the agencies informed about the latest developments and let them know what the industry needs to gain more wide-based support for solar energy.

Regularly, SEIA's staff monitors federal and state legislation and regulatory measures affecting the industry, as well as key publications.

Through the newsletter and special legislative bulletins, SEIA keeps members across the country informed about how these decisions affect your ability to do business.

The national office helps to answer questions that affect the industry, whether it's on inquiry about the status of a bill, how to deal with excessive regulations or updates on government proposals or grant funding.

Organizational Structure

SEIA's new organizational structure recognizes the potential growth of the industry and provides a place for

everyone involved with solar energy.

Eight separate divisions attend to the special needs of each segment of the industry, discuss common problems and determine the direction each business should be moving.

The divisions guarantee that everyone's best interests will be considered in association policymaking, with a division representative on the Board.

Divisions also help SEIA plan for the future, estimate the kind of demands this rapidly growing industry will put on the association, and how it can meet these demands.

Listed below are the association's current divisions:

Passive Division
Active Heating & Cooling Division
Component Products Division
Process Heat Division
Photovoltaics Division
Affiliate Organizations Division
Contractors/Dealers/Installers Division

"Others" Division

Along with the divisions, SEIA has 15 advisory and functioning standing committees to give members a more active voice in association activities. Committees are the backbone of an association. They're the channels members can work through to pursue their best interests, to have a hand in how their association operates, and the kind of impact it has on the industry and the public.

Standards Program

On September 29, 1977, the Federal Energy Administration awarded SEIA's sister organization, the Solar Energy Research and Education Foundation (SEREF), a contract to develop solar product standards for the industry. This one-year contract calls on SEREF to develop the nation's first solar collector rating, certification and labeling program for solar equipment combined with a laboratory accreditation program.

This standards contract resulted from months of voluntary efforts by members and staff who recognized the importance of developing these standards if the solar industry were to gain wide public acceptance. SEREF was created to provide the industry with a foundation to carry out the educational and scientific purposes related to solar energy and to stimulate public awareness of solar use.

Now the goals are to provide solar customers with uniform data to make intelligent, cost-performance comparisons of available solar equipment by the end of 1978.

Publications

SEIA News, the monthly newsletter for members only, keeps you informed of association activities and events. It alerts you of legislative actions and regulatory decisions affecting the industry. Sections of the newsletter also provide meeting updates and chapter news that can make a difference for your business.

Solar Engineering Magazine. As the official trade journal of SEIA, this magazine covers industry developments and trends, and highlights significant solar conferences and product developments. Available to all members, nonmembers may also subscribe for \$15 a year by writing: Solar Engineering, 8435 N. Stemmons Freeway, Suite 880, Dallas, TX 74247.

Solar Industry Index. This catalog includes over 230 product descriptions from member and nonmember companies and a SEIA member directory including their names, addresses and the services provided. Corporate members receive one complimentary copy. Others may purchase the index for \$10 prepaid (including postage and handling) by writing SEIA.

Solar Advertising Guidelines. Prepared by SEIA's legal counsel, the booklet explains the FTC's advertising standards and is a quick reference source when planning your advertising strategy.

Workshops, Conferences And Exhibits

SEIA semi-annual conferences and workshops have become well known for bringing together industry experts to share their knowledge with the contractors, builders, developers and engineers who make the purchasing decisions.

Year after year, these meetings have stood out among the others in offering members a chance to discuss the latest breakthroughs in the field, and to hear from the top industry specialists and government advisors about solar initiatives.

SEIA product exhibits that accompany all conferences and workshops are one of the best ways members have found to meet potential customers and to make new business contacts. SEIA exhibitions are growing every year. Now over 100 companies take part in what has been referred to as "the largest and most comprehensive total solar energy trade expositions around." Of course, members can take advantage of reduced rates when exhibiting.

Solar Energy Research Institute



History

A careful examination of the energy situation in the U.S. in the mid-1970's led to passage of several pieces of legislation designed to improve the nation's energy outlook. Among these legislative initiatives was the Solar Energy Research, Development, and Demonstration Act of 1974 (P.L. 94-473). It authorized a federal solar energy program aimed at developing solar energy as a viable source of the nation's future energy needs. As a part of this solar initiative, the Act established the Solar Energy Research Institute.

Based on the needs articulated by the Congressional mandate and on the results of planning studies commissioned by the Energy Research and Development Administration (ERDA), the decision was made to proceed with the establishment of a Solar Energy Research Institute of sufficient size to provide a major national focus for ongoing solar technology efforts. On March 12, 1976, ERDA issued a request for proposals for SERI seeking a manager-operator and an initial site with an option for a future site. In March 1977, following extensive evaluation of the many proposals submitted, ERDA announced that SERI would be managed and operated by Midwest Research Institute at a site in Golden, Colorado. The Solar Energy Research Institute formally opened on July 5, 1977. In October 1977, ERDA's functions were assumed by the newly created Department of Energy.

Mission

The Solar Energy Research Institute was created by Congress to provide the country with a national center of excellence dedicated to serving the needs of the public and industry in the development of solar energy.

SERI's primary mission is to function as the U.S. Department of Energy's lead institution for solar energy research, development, and demonstration (RD&D). To accomplish its broad mission, SERI will:

Assume principal responsibility for

the performance and management of solar RD&D programs and projects;

Provide planning support to DOE in the development of national solar energy policies, program plans, and strategies;

Conduct market analyses and assessments of institutional barriers to the introduction of solar technologies on a national and international basis;

Play a major role in the country's participation in international solar programs;

Collect and distribute information about solar energy, and conduct education and training programs.

Priorities

SERI programs are targeted to yield real, measurable progress geared toward the objectives of the nation's solar energy effort. Whereas each project carried out at SERI must fit this overall goal, certain factors must be considered in developing detailed program plans and priorities.

It is essential to develop a balanced program leading to increased use of solar technologies in both the near term (to 1990) and the long term (after 1990).

Cost/benefit analyses must also be used in determining program priorities. SERI looks hard at projected economics and true energy costs before advising which solar technologies warrant accelerated levels of funding.

Activities that promote the early involvement of private business and industry in solar development are stressed at SERI. Widespread commercial application of any solar option is ultimately the responsibility of the private sector.

Other considerations regarding the SERI program include assessment of which solar technologies have a higher probability of success, evaluation of potential environmental impacts, and assessments of other factors that affect the feasibility or desirability of solar energy use.

Operations

SERI has developed an organizational structure consisting of four main operating divisions and one support division.

Research

Provides advanced technical options for solar energy conversion, as well as the technical information needed for selection among these options. The division also supports DOE in the technical management of selected research programs and the development of major solar energy experimental test facilities. Also, the research division helps identify and reduce technical and cost barriers to specific solar applications.

Analysis and Assessment

Performs the analytical investigations required to support the development of national solar energy program plans and strategies. The division makes economic feasibility analyses and studies the environmental, institutional, and social factors that influence the utilization of solar technologies.

Information, Education and International Programs

Conducts substantial programs in solar energy information dissemination, education and training, and national conferences and workshops. SERI is establishing a comprehensive and accessible solar energy information data base and is helping foster U.S. participation in international solar energy programs.

Technology Commercialization

Maintains extensive communication links with all sectors of the solar community and assesses the market readiness of each solar technology. This division collects and distributes information on materials, markets, standards, regulatory requirements, business risks, market barriers and constraints, and consumer attitudes.

Administrative and Technical Services

Provides support for the technical divisions. This division includes secretarial services and the branches dealing with accounting, contracts, and procurement.

1536 Cole Boulevard
Golden, CO 80401
(303) 234-7171

Facts About Solar Lobby

In the two months following Sun Day, amidst campaign memorabilia and a barrage of press clippings, two organizations were formed to champion the solar age: the Solar Lobby and the Center for Renewable Resources.

The Solar Lobby comes together out of the need for a strong solar presence in Washington, D.C. While competing energy sources have large, well-financed lobbying operations, solar energy has been protected and advanced during the past two years by only one lobbyist, Susannah Lawrence, supported by Consumer Action Now. Lawrence is merging her Washington operations with the Solar Lobby whose staff will also include Herb Epstein, Joan Shorey and Valerie Dow. Epstein was formerly the Washington representative for the National Center for Appropriate Technology

(NCAT); Shorey worked as Representative Dick Ottinger's energy aide and as a consultant to Sun Day; Dow was editor of the Sun Day Times. Denis Hayes and Dick Munson will coordinate both the Lobby and the Center.

Even before the organization was finalized, the agenda for the Lobby was awesome.

The primary focus of the Lobby will, of course, be legislation. As this session of Congress comes to a close, much work remains to be done on the National Energy Act and the package of legislation prepared by the Solar Coalition (an ad hoc group of Senators and Representatives). Until November the Solar Lobby's legislative priorities will include:

- Substantial federal tax credits for people who buy solar equipment
- a Solar Bank to provide long-term,

low interest loans to solar purchasers

- a consumer protection program that discourages gimmickery and rip-offs without impeding technological innovation
- major federal solar procurement programs that will lower the cost of renewable energy sources for everyone by encouraging mass production
- the development of a healthy, competitive solar industry through measures to protect the field from monopoly control
- increases in the federal solar research and development budget
- a shift in emphasis from a few large projects toward many decentralized applications.

Solar Lobby
317 Pennsylvania Avenue, S.E.
Washington, D.C. 20003

U.S. Department of Energy DOE Activities with Respect to Solar Codes, Standards and Criteria



As part of its mission to assure the near-term availability of safe, reliable and efficient solar equipment, the Department of Energy, Office of the Assistant Secretary for Conservation and Solar Applications has been actively involved in assisting the development of codes, standards and criteria for solar energy systems and components. Current activities include:

(1) The development and adoption of intermediate standards for solar water and space heating systems which supplement the existing HUD/FHA Minimum Property Standards (MPS). These intermediate MPS form the basis for the acceptance by HUD/FHA of mortgage insurance on solar energy systems and components, and will be used to qualify systems or components for acceptance under proposed tax credit programs. The standards represent the current state-of-the-art, but they also allow for and encourage the development of innovative ideas. (2) The promulgation of Interim Performance Criteria for both residential and commercial systems for use in the demonstration program. The criteria for commercial systems have been updated and published and the criteria for residential systems are currently being updated.

Whereas the interim performance criteria are intended primarily for use

in procurement during the solar heating and cooling demonstration program, a set of definitive performance criteria will be developed to ensure the safety and reliability of solar heating and cooling equipment used by the general public, including the Federal sector. It is expected that they will serve as the basis for Federal specifications within the Solar in Federal Buildings Program. It is desirable that the definitive standards be nationally accepted as voluntary consensus standards that can be used for the certification of solar equipment.

(3) The monitoring of and assistance in the development and implementation of consensus standards, maintaining close coordination with the Steering Committee on Solar Energy Standards Development of ANSI and the standards-writing organizations.

(4) The establishment of a program for the accreditation of laboratories qualified to test solar energy heating and cooling subsystems and components in accordance with a similar national accreditation program recently established by the Department of Commerce. Procedures have been developed and will be submitted to the Department of Commerce by DOE and HUD requesting that an official

accreditation program be initiated through the National Volunteer Laboratory Accreditation Program.

(5) The completion of initial studies for the preparation of model building code provisions. Additional work will be undertaken in 1978 with a target for model code provisions by the end of the year. Organizations involved in this work include the National Conference of States on Building Codes and Standards, the Council of American Building Officials and several professional and trade associations.

(6) The undertaking of a program to develop procedures for certifying and labeling solar collectors. Initial work was done by the Air Conditioning and Refrigerating Institute Foundation. A competitive solicitation to build upon the ARIF work resulted in a contract award to the Solar Energy Research and Education Foundation (SEREF). In support of an interim certification program DOE has initiated a collector testing program fully coordinated with the SEREF activity. It is anticipated that test results and certification procedures will be available in the fall of 1978.

U. S. Department of Energy
20 Massachusetts Avenue, N. W.
Washington, D. C. 20545

U.S. Department of Housing and Urban Development, Washington, D.C. 20410



Principal Program Areas

The overall purpose of the Department is to assist in providing for sound development of the Nation's communities and metropolitan areas.

The Department was created to administer the principal programs which provide assistance for housing and for the development of the Nation's communities; to assist the President in achieving maximum coordination of the various Federal activities which have a major effect upon urban community, suburban, or metropolitan development; to encourage the solution of problems of housing and urban development through State, county, town, village, or other local and private action, including promotion of interstate, regional and metropolitan cooperation; to encourage the maximum contributions that may be made by vigorous private homebuilding and mortgage lending industries to housing, urban development, and the national economy; and to provide for full and appropriate consideration, at the national level, of the needs and interests of the Nation's communities and of the people who live and work in them.

Established by the Department of Housing and Urban Development Act of September 9, 1965, effective November 9, 1965, HUD is administered under the supervision and direction of the Secretary, assisted by an Under Secretary, Assistant Secretaries in the various program and functional areas, a General Counsel, an Inspector General, and several Administrators.

Community Planning and Development

The Community Development Block Grant (CDBG) program provides funds to cities, counties, towns, and States for the primary purpose of developing viable urban communities, by providing decent housing and a suitable living environment and expanding economic opportunities, principally for persons of low and moderate income.

HUD also assists State and local governments and metropolitan and nonmetropolitan areawide planning organizations by providing grant assistance for planning activities. Grants are made to develop an ongoing comprehensive planning process which will lead to the development of a locally determined

comprehensive plan; develop a system of policy planning and evaluation as part of the planning process; develop a management capability to implement the plan; and provide coordination among the various functional planning programs under way at all levels of government to prevent duplication of effort and provide a unified approach in addressing needs.

Housing—Federal Housing Commissioner

The Assistant Secretary for Housing—Federal Housing Commissioner directs housing programs and functions of the Department including the production, financing and management of housing and the conservation and rehabilitation of the housing stock. In addition, he directs the Department-wide functions to serve all programs of the Department in the areas of local agency administrative regulations and practices, private market financing, defense planning, disaster housing, liquidating programs and independent living for the disabled.

Under the provisions of the National Housing Act, mortgages are insured on single-family homes and multifamily rental and condominium and cooperative projects, as well as on land purchased for residential development, nursing homes, group practice facilities, and nonprofit and proprietary hospitals. HUD/FHA also provides loan insurance for property improvements and for the purchase of mobile homes under the provisions of Title 1 of the National Housing Act. Policy Development and Research

The Assistant Secretary for Policy Development and Research is the principal advisor to the Secretary for overall Department Policy, program evaluation, and research. As the research arm of HUD, the Office now focuses on six areas: the cost of housing; urban economic development and public finance; housing for special users—the elderly and the handicapped; neighborhood reinvestment and revitalization; and site selection for integration. The Office is also involved in two capacity-building demonstrations: to attract minorities and women to the urban public service, and to improve the fiscal management capabilities of State and local governments. Further, in its desire to be responsive to citizen concerns, the Office is not only making major efforts to disseminate the results of its research to the widest

public audience, but it is also in active and continuing dialogue with other Federal agencies to avoid waste and duplication in research areas of common interest.

Neighborhoods, Voluntary Associations and Consumer Protection

The Assistant Secretary for Neighborhoods, Voluntary Associations and Consumer Protection has primary responsibility for administering and enforcing central regulatory functions, for obtaining consumer participation in the development of the Department's policies and programs, and for increasing the opportunities for neighborhood, voluntary and other nongovernmental organizations to participate in the development, revitalization, and stabilization of urban and regional areas.

The regulatory responsibilities include registration and disclosure requirements on the sale of lands through the use of interstate commerce or the mails; mobile home construction and safety standards; real estate settlement practices; lead-based paint poisoning prevention; and energy conservation standards enforcement.

The consumer affairs responsibilities encompass activities to insure consideration of consumers' views in the Department's decision making process, including the conduct of open consumer forums and surveys, the operation of a consumer complaint system in cooperation with the Department's field offices; and the review and analysis of departmental rules and regulations. In addition, programs are administered to provide comprehensive counseling to current and prospective homeowners, home buyers, and renters of HUD-assisted or insured single- or multifamily housing and to marshal funds from Federal/State programs to bring the full range of social services to tenants of HUD-assisted multifamily housing.

The Assistant Secretary also directs activities to assist urban and regional areas by improving the management capabilities of neighborhood development organizations; by assisting in the formation of cooperative efforts among neighborhood organizations, local units of government, and the business community; and by encouraging voluntary and other nongovernmental organizations to work with the Department on areas of mutual interest and concern.

Conference Participants

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"ASME Solar Standards"
Session Three
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"The Industry Viewpoint on Solar
Energy Standards" Session One
Keynote Address, Luncheon, Sept. 13
- Canham, Walter G., Jr.
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"The Future of Solar Energy Standards
in the Voluntary Consensus System"
Session Five
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"Energy Codes, Standards and
Implementation" Session Four
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"Materials Standards" Session Three
- Cohen, Walter
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"Warranty Requirements and Effects
on Materials Used and Life
Expectancies" Session Three
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"DOE Interim Solar Collector Testing
Program" Session Three
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"The ANSI Steering Committee on
Solar Standards Development"
Session One
Chairman, Session Four
- Doctor, Ronald, Ph.D.
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"Moving Solar Energy into the
Market Place" Session One
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Chairman, Session Two
"Proposed Standards for Testing and
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and Cooling Equipment" Session Two
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"Results and Analysis of a
Round-Robin Test Program for
Liquid-Heating Flat-Plate Solar
Collectors" Session Two
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"Passive System Standards" Session
Two
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"The Consumer Viewpoint on
Durability and Reliability" Session
Three
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"Consumers and the Solar Standards
Future" Session Five
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"The SEREF Rating, Certification, and
Labeling Program for Solar
Collectors" Session Four
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"The Consumer Viewpoint in Solar
Standards Activities" Session One
Presiding, Luncheon, Sept. 14
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"ASHRAE Standards 94-77, 95 and
96" Session Two

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Storage Systems
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"What's Coming From the Federal
Government (DOE and NBS)?"
Session Five

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"The HUD Solar Energy Program"
Session One

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"Air-Conditioning and Refrigeration
Institute Certification Program"
Session Four

Newton, Alwin B.
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"Determination of Solar System
Performance from Component Tests
Made Under Applicable Standards"
Session Two

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"Solar Realities and Their Importance
to the Nation" Conference Dinner,
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"Conference Opening Remarks"
Session One

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"SERI and its Role in Standards
Activity" Session Five

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"Product Safety Standard for Solar
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Chairman, Session One
"Government Initiatives in Solar
Energy Development" Session One

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"Corrosion in Solar Systems"
Session Three

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Session Five

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"ASHRAE Standard 93-77: Testing
Procedure to Determine the Thermal
Performance of Solar Collectors"
Session Two

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"Solar Standards—What Do We
Mean?" Session Four

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"ASHRAE Standard 93-77: Testing
Procedure to Determine the Thermal
Performance of Solar Collectors"
Session Two

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"Performance Testing to ASHRAE
Standard 93-77" Session Two

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STATEMENT OF MARVIN YAROSH

Mr. YAROSH. Yes; I will submit a written statement.

Mr. MOSS. We will hold the record open to receive that statement.
[See p. 88.]

Without objection, so ordered.

Mr. Yarosh, do you have some remarks?

Mr. YAROSH. I appreciate the opportunity to speak today and would like to make some brief remarks that are not in the written comments.

The Government has made the decision apparently to accelerate commercialization of solar energy. It does not have a proven track record that it is able and competent to accomplish that.

At the present time, although there may be a national motivation to move toward solar energy, we have not created individual incentives to cause individuals to make decisions in favor of solar systems.

As Sheldon Butt mentioned, much of the present solar industry is extremely small. We did a survey 2 years ago, which I recognize is a long time in the solar field. At that time we found that 70 percent of our industry—and we have 77 companies in Florida in the business—had been in business less than 2 years. The average number of employees was three and one-half. So, when we say small, we mean very small.

On the issue of standards, we do not yet have any consensus standards, as Sheldon Butt mentioned. Real fine progress has been made in the area of testing.

I am concerned that the term "standard" is often misused. More often, we mean procedures for proper testing. In many cases what we mean is recommended good practice.

I think those of us who have seen the small industry in solar have concern that excessive zeal and standard setting conceivably could work to the disadvantage of small industry and to the advantage of large industry.

It also has the possibility of perhaps diminishing innovative designs and ideas at the very early stages of a new industry.

In the area of market research, many national studies have been done. These studies agree that through the year 1990 the vast majority of the market, as high as 90 percent, will be the residential sector.

That means that individual consumers will, in fact, be the people we should pay the most attention to. The number of installations in single family residences, for example, is estimated to be between 70 and 75 percent of the installations in the residential sector. This is the area, of course, that consumers are most vulnerable.

In the area of commercial installations, often the potential owners can afford to hire professional help to oversee the design and installations of systems.

We believe that many of the demonstrations that are carried out by the Department of Energy may not produce typical information of the kind that we will see in the many millions of private market sector transactions that will occur if we are successful in achieving solar energy applications in this century.

We think it is extremely important to look at the experience we are gaining, particularly in these early private market sector transactions. We are doing that in Florida. I would like to tell you a few things about what we have found out to date in our survey.

Currently we have located 1,500 solar owners in the State of Florida. We have gone out to them with a questionnaire. These questionnaires are coming back now currently at the rate of 100 a day. We have already received about 400 back.

It is an 80-question questionnaire with multiple parts to each. A copy is in the information I have submitted to the committee (see p. 93.)

We have previously done a lot of information gathering. The results of that information gathering, often by telephone, and often by virtue of initiatives that the individuals have taken to write us, have indicated the following.

The typical solar consumer at the present time is not, in fact, typical. He is better educated than the average citizen. His income is well above average. We have not yet penetrated what we think will be the average individual for the solar market.

We have found, as the chairman has indicated, that a high fraction of the people who have solar systems at the present time are, indeed, satisfied. But we have also found that many of them probably should not be satisfied. Many of them make allowances for the fact that they are pioneers in a new energy application and that errors must be tolerated. They are proud of their participation in this.

One of the major areas in which we found problems is in installation. Many solar installers are inadequately trained. This is an area where we think an acceleration of effort is required.

Trade licensing laws have not been effective as a mechanism for consumer protection. It apparently has been more effective in the eyes of consumers as a mechanism for protecting, perhaps, the trade licensees.

As Sheldon Butt mentioned, we have a very wide range of building codes, all the way from excessively rigorous to the point where they essentially preclude installation of systems, to the nonexistence of codes. That is the case in most places.

We have found no coherent program in place that sufficiently informs and educates the potential consumer about near-term technology. I recognize how difficult that is. That is an enormous challenge. Nonetheless, we do not believe we have an effective and coherent program.

An area of major concern which we have found on the part of solar consumers lies in the area of uncertainty about solar reliability and operation. The industry is young, fragile, and has not developed its infrastructure yet.

We think that one of the things we will recommend in the report which we are preparing—which will be available in December and, of course, the subcommittee will receive a copy of it—hopefully, is the establishment in the private sector of a warranty reinsurance program.

Here I would like to commend the program of solar water heater initiative established by the HUD people. It has moved a long way toward getting better warranties included in the installations.

We found the following major problem areas. I mentioned installation. In addition, there is inadequate system performance. Often this is due to poor sizing or excessive expectation on the part of the consumer often created by excessive claims on the part of the vendor.

Another is inadequate or unsatisfactory repair service. This is a result perhaps, in part, of the inadequate infrastructure within the industry.

As I mentioned, there is unsatisfactory information provided by the vendor. Let me quote a number. In our service we found out that 66 percent of the consumers had no operating or maintenance instructions on their solar systems. We think that is inexcusable.

There are unsatisfactory redress actions available to the consumer. I heard a quote that I like very much: "Consumers don't want warranties. They want systems that work. But in case they don't get systems that work, they ought to have redress."

What can the Federal Government do about these? Well, one of the areas I mentioned, I think, is a more coherent and extensive education program. I would like to see that program tell it like it is.

For instance, there are difficulties of solar being economic without much more extensive subsidies at the State, Federal, or local level—not to encourage people to go into solar without making them aware of the economics of solar.

Training of installers is an area where I think much more can be done. Yesterday I gave a lecture and a 3-day short course specifically on training installers and inspectors, building inspector officials from counties. We had to turn people away because we were oversubscribed. Much more of that needs to be done.

Incidentally, this was sponsored by the Department of Energy. Again, I commend that kind of thing. I would like to see it done much more extensively.

I mentioned warranties. We do need warranties. If we cannot do it by pooling the private sector—and there are a variety of schemes available—then this may represent an area where the Federal Government can take affirmative action.

I think in the area of testing, certification, and labeling—particularly for solar collectors—that the Solar Energy Industries Association, through the Solar Education Foundation, is doing an excellent job in moving that way.

Again, I would reiterate my caution concerning excessively rigorous standards that might impede innovation and might work to the disadvantage of smaller industry.

I suggest that we need to do much more in the area of securing private sector data. Here I will call attention of the committee to a problem we have found.

It is difficult, as a Federal contractor, to go out and conduct surveys because of the requirement of the Office of Management and Budget of securing approval to conduct such surveys.

As a result, for instance, the survey work which we have done, we have had to carry out under a State program, under State funds, because we were not permitted to do it under the Federal program. Apparently, it has to do with the time it takes to secure OMB approval. I am sure the committee is more aware of the reasons why this approval is required than I.

But in any event I think in a developing industry, such as solar, it is essential that we have freedom to go out and seek such information.

I appreciate the opportunity to make these remarks to the committee.

Thank you.

[Testimony resumes on p. 103.]

[Mr. Yarosh's prepared statement, and solar questionnaire follows:]

Remarks by Marvin M. Yarosh
Director
Energy Systems Analysis Division
Florida Solar Energy Center

given before

House Subcommittee on Oversight and Investigations Hearing
Washington, D.C., September 21, 1978

I appreciate the opportunity to appear before this committee and share with you our experiences in solar energy. Let me first establish some credentials by very briefly outlining some relevant factors.

Florida has a long history of use of solar energy systems dating back to the first quarter of this century. By the late 1930's, for every electric water heating system installed in the Miami area there were two solar units being installed. In those times of otherwise low prices, electricity was still 30 percent more than it is today, and a solar unit took only about two years to pay for itself. By the 1950's, the installation of new solar energy systems essentially stopped, largely because of significant reductions in the price of electricity and significant increases in labor costs associated with putting in the early systems. There were, of course, other contributing reasons.

In 1969, the price of electricity bottomed out nationally and began a rise which has continued to the present and will continue in the future. There has been a rebirth of interest in solar energy. In 1974, the Florida legislature passed legislation which led to the establishment of the Florida Solar Energy Center (FSEC), an institution devoted to all activities which will lead to successful commercialization of solar energy. In 1976, legislation was passed in Florida requesting the Center to establish a program of testing, of standards, of certification and of labeling of solar equipment. The program became effective October 1, 1976, and has been operating now for two years as a voluntary program. There are no requirements in Florida that solar energy equipment must be tested, but under legislation passed this year, the voluntary program is scheduled to become mandatory on January 1, 1980.

A major ultimate objective of federal efforts in solar energy, if solar is to displace fossil fuels, must be to get solar systems widely deployed. Thus the federal activities include efforts to accelerate the commercialization of solar energy. It is not at all clear, however, that the government has a proven track record or has demonstrated under similar circumstances any unique abilities to commercialize a similar product. If commercialization is to be at all

successful, it must provide a reliable product at a competitive cost.

Solar energy must be made more cost competitive by reducing its cost relative to other alternatives. This will probably not come about through cost reductions in present solar water heating systems. Other than the collector in such systems, the components are not generically new, and major cost reductions for collectors are not anticipated. Cost competitiveness will probably be achieved through a significant subsidization of the initial cost of such systems, and will be helped by a more rapid rise in conventional energy costs. The difficulties encountered in efforts to give away \$400 subsidy grants under the present HUD solar water heating initiative is abundant evidence that stronger subsidies are necessary. It is also unlikely that such subsidies can be withdrawn until competing energy costs rise significantly.

The problems of uncertainty in achieving quality and reliability may be more complex to solve than the subsidy problem. Certainly, if tax credits are provided, we would not like to subsidize poorly made, unreliable systems. On the other hand, the early imposition of rigorous standards that systems must meet may stultify a young, fragile, and struggling industry. Rigid standards could, if improperly developed and applied, stifle innovation and work to the disadvantage of the many small companies now in the solar field.

As an example, in 1976 we performed a survey of 77 solar companies doing business in Florida. We found that about 70 percent of them had been in business two years or less and that on an average they had only 3.6 employees. Many of these companies will not survive, but their failure should not be encouraged by any actions of government.

Under the testing program we have been operating in Florida for the past two years, the FSEC inspects solar collectors and determines their thermal performance. Those collectors passing the required tests and inspections are certified and carry labels which include a performance rating for the collector. We include a customer data sheet which explains the meaning of the data to the consumer.

Unfortunately, the inspection and determination of the performance of the solar collector does not adequately tell us how the solar system will perform nor how reliable the system will be, for the collector is only one component of the system. It does tell us how well the collector performs and if it appears to be made reasonably well.

For the past year we have been conducting a study under sponsorship of the Department of Energy (DOE) which is designed to examine the problems of consumer protection of solar users and potential users. Are there consumer problems?; if so, what are they?; and how can they be addressed?

We have found the following:

The present solar user is not representative of the average citizen—he is above average in income, he is better educated and highly motivated towards the use of solar. We have not yet penetrated the average market.

We have found that as high as 80 percent of the solar users we have surveyed are satisfied with their solar systems. In some cases, they probably shouldn't be satisfied, but many of the solar users allow for the fact that they are pioneers in a new energy application and errors must be tolerated. They are proud of their participation in solar energy.

An area where many problems occur is in the installation of systems. Many solar installers are inadequately trained, and the required skills overlap and lie between conventional trade areas. Increased effort is needed in the training of installers and also in the training of building inspectors to solar requirements.

Consumer experts tell us that trade licensing laws have not been an effective mechanism for consumer protection. In many cases these laws have protected the trade more than the consumer. State and local jurisdictions are now struggling with whether or not to establish new certifications for solar installers. Traditionally, this has been handled at the local level.

Building codes with respect to solar applications vary from non-existent to excessively restrictive. There is, in general, a lack of coherence in such codes, and there is need for stimulation to complete development of national model codes and then get them modified and applied to local jurisdictions. Right now codes on solar are often ignored when that is possible, or result in being a deterrent to solar use where that is not possible.

We have found no coherent program in place to inform and educate the potential solar consumer about near-term solar technology. Perhaps the government recognizes that if we educate the consumer at present, he will find that solar without subsidy is not sufficiently cost effective.

An area of major solar consumer concern lies in the uncertainty about solar reliability, about operation, and about availability of repair and maintenance for solar systems. We found from our studies, for example, that over 60 percent of solar users we surveyed had no operating and maintenance instructions on their solar domestic hot water systems. The HUD solar water

heating initiative is a good example of responding to that problem by requiring such instructions as part of the program.

The industry is still developing its infrastructure and, in some cases, adequate repair and maintenance is difficult to obtain. To allay consumer concerns about system reliability and the availability of adequate repair service, a more comprehensive warranty program is required. Specifically, we will recommend a warranty insurance program, preferably carried out by the private sector. Such a program would, through appropriate fees, guarantee that consumers could get their systems repaired even if their installer or system vendor when out of business. The latter occurrence has been unfortunately common in the solar field.

While we have not found any evidence of widespread frauds in the solar field, we have found widespread ignorance. The latter sometimes manifests itself through excessive expectations of consumers generated by over-enthusiastic advertising by system vendors. In some cases there is absolute deception in the advertising process.

We have found that the major problems associated with present solar consumers, in addition to installation problems, are:

- o Inadequate system performance—often due to poor sizing and excessive promises;
- o Inadequate or unsatisfactory repair service;
- o Unsatisfactory information provided by the vendor; and
- o Unsatisfactory redress actions available to the consumer.

Well, what can the federal government do?! I believe it can do a much better job in the public information field. It should develop a comprehensive, coherent program to tell the public about near-term solar technology, and it should tell it like it is. I do not think we should disguise the realities of the economics of going solar from potential solar consumers. If there is a national interest in going solar, then this must be translated into an individual interest through adequate incentives.

The federal government can do much more to encourage the training of solar installers and building officials who inspect systems. Yesterday I lectured in a short training course we are holding at FSEC for solar installers and building inspectors. The course is being supported by DOE, but we are turning people away because the demand exceeds the space available. We need to be able to offer such courses more often, and this should be supported.

We need warranty insurance programs, preferably through private arrangements. If we cannot do it that way, then some form of federal participation in a warranty insurance program should be developed.

Under development by the Solar Energy Research and Education Foundation (SEREF) and others are programs to test, certify, and label solar collectors, and hopefully soon, solar systems. The area of testing, certification and labeling represents one of the more useful areas of activity.

We know that if we are to be successful in solar commercialization, the vast majority of systems installed must be through private initiatives. We are suspicious of some of the data gathered on programs which have received extensive expert government oversight. We know that some of this experience is not representative of what occurs in private sector transactions where there are no paid experts to oversee what is occurring.

One area where some changes are needed is in the relaxation of rules of the Office of Management and Budget (OMB) concerning the conduct of survey and data collection on government-funded contracts. This has seriously impeded the gathering of information on solar experience. Currently we are completing an extensive survey of 1500 users of solar systems in Florida to determine their views and experience with solar energy. Because of difficulties in gaining approval to conduct surveys under federal programs, this latter survey is being done under state support. Information gathering is, however, critical at the present stage of solar development. It is difficult for the government to plan intelligent directions in solar commercialization if it is restricted in gathering information on what is occurring. Thus, some changes in OMB policy on solar survey are desirable.

We have extensive information which we are developing and organizing in the area of consumer protection and are now preparing a final report on much of these activities. I would be happy to supply that report to this committee when it is completed.

Again, I appreciate the opportunity to appear before you and offer my views. For the committee's record, I have included copies of a number of relevant documents.

SUBCOMMITTEE NOTE: Documents describing and illustrating the Florida Solar Energy Center's test program are available in the subcommittee's files.



Fall 1978

Dear Solar User:

As you probably know, the Florida Solar Energy Center has been conducting an extensive study to learn more about the experiences of Floridians who own and use solar energy equipment. You have previously indicated to the Center (either by letter, postcard or telephone) that as a member of that select group of owners of solar equipment you would be willing to help us in our information gathering activities. We have interviewed some owners of solar equipment (you may have been among them), and the enclosed questionnaire was developed using the information that was gathered from these interviews and early contacts. This questionnaire allows you, the solar owner, to tell us about your solar experience; whether you are satisfied or not satisfied with your solar system.

We know we have asked for your help in the past, and once again we are asking for your assistance. The information you provide will enable Florida to develop programs to protect solar energy consumers and will help accelerate the widespread use of solar energy. We have been promised extensive help in our efforts by many within the solar community, and with your cooperation you, too, will be helping to solve our national energy problems.

The specific answers you provide will be kept confidential; only aggregate information from respondents will be used in our work. Please help us in this effort by filling out the questionnaire and returning it in the enclosed, stamped, self-addressed envelope. If you would like to know the results of this questionnaire, please so indicate in the box provided on the questionnaire. Should you have questions concerning the questionnaire, call the Center on our toll-free telephone line -- 1-800-432-0575.

Sincerely yours,

Marvin M. Yarosh, Director
Energy Systems Analysis Division

Enclosures

FLORIDA SOLAR ENERGY CENTER

300 STATE ROAD 401 CAPE CANAVERAL, FLORIDA 32920 TELEPHONE 305/783-0300

STATE UNIVERSITY SYSTEM OF FLORIDA

AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER

14. Who selected the installer?
- We did
 - Dealer from whom system was purchased
 - Collector manufacturer/system vendor
 - Developer/contractor
 - Other. Please specify: _____
 - Don't know
15. Was a building permit obtained for your solar system?
- Yes
 - No
 - Don't know
16. Did a city or county building official inspect your solar system?
- Yes
 - No (Please skip to Question 18)
 - Don't know (Please skip to Question 18)
17. Did your system pass on the first inspection?
- Yes
 - No
 - Don't know. If no, please describe why it did not: _____
18. What was the approximate cost of your solar system?
- \$ _____
19. Did this cost include installation?
- Yes
 - No. If no, what was the cost of installation? \$ _____
20. Please indicate the information sources you used in deciding to buy a solar system (or home with a solar system). (Check as many boxes as apply)
- Had a solar system previously
 - A friend or neighbor who has one
 - Saw solar systems on new homes
 - Looked through Yellow Pages
 - Saw solar systems at fair or other exhibition
 - Saw newspaper ad or information from solar dealer
 - Talked to solar dealer
 - Talked to solar home builder or owner from whom property was purchased
 - Heard solar information programs on radio
 - Saw solar information programs on television
 - Read solar articles in newspapers or magazines
 - Read technical material or journal articles
 - Took college or technical courses
 - Other. Please specify: _____
21. Before you purchased, did you have an estimate of how long it would take to pay back the cost of your system through a savings in energy costs?
- Yes
 - No (Please skip to Question 23)
22. If such an estimate was made for your system, who made it?
- Solar salesperson
 - Installer
 - Independent engineer
 - Solar system manufacturer
 - Self
 - Developer/contractor
 - Other
23. At the time you purchased your system, were you planning to take advantage of any financial assistance (i.e., tax credit or rebate)? If so, please check all that apply.
- Expected nothing
 - Expected *only* to get a cash rebate. Please indicate amount: \$ _____
 - Expected *only* to get a tax credit. Please indicate amount: \$ _____
 - Expected to get a cash rebate *and* a tax credit. Please indicate amount of each: Cash rebate: \$ _____ Tax credit: \$ _____
 - Expected to get approximately a 20 percent federal tax credit, if Congress passes it
 - Other. Please specify: _____
24. Where did your information on rebates or tax credits come from? (Check as many boxes as apply)
- TV or radio program
 - TV or radio commercial for solar system
 - Newspaper article
 - Magazine article
 - Advertisement for solar system in newspaper or magazine
 - Government publications
 - Speeches by public officials
 - Talking with solar salesperson
 - Solar advertising brochures
 - Talking with home builder
 - Talking with real estate salesperson
 - Other. Please specify: _____
25. Before purchase, approximately how much did you expect to save on utility costs per month by installing this solar system?
- 0 - 10%
 - 10 - 25%
 - 25 - 50%
 - 50 - 75%
 - More than 75%
 - Don't know
26. On what did you base your expectations about utility cost savings? (Check as many boxes as apply)
- TV or radio program
 - TV or radio commercial for solar system
 - Newspaper or magazine article
 - Advertisement for solar system in newspaper or magazine
 - Government publications
 - Speeches by public officials
 - Talking with solar salesperson
 - Solar advertising brochures
 - Talking with developer/contractor
 - Talking with real estate salesperson
 - Talking with installer
 - Independent engineer
 - Technical, audit, engineering, or cost studies obtained or performed by me
 - Other. Please specify: _____
27. What percentage average utility cost savings (or increases) have you experienced per month?
- Savings: % _____
 - Increase: % _____
 - Don't know
28. Do you have an instrument on your solar device that indicates when the device is operating and/or what percentage of your hot water/heating/cooling is provided by solar power?
- Yes. Describe: _____
 - No
29. How did you pay for your solar system?
- Paid cash (Please skip to Question 31)
 - Financed through dealer
 - Financed through commercial bank or savings and loan
 - Financed as part of mortgage
 - Other. Please specify: _____
30. How much difficulty did you have in obtaining financing?
- None
 - Some problems
 - A lot of problems
 - Could not obtain
31. Please rank from 1 to 5 the importance of all of the following factors in your decision to install a solar system (or to buy a home with a solar system) (1 = most important; 5 = least important):
Note: Items may be ranked identically. For example, items b and d may be ranked as 4.
- Savings on utility costs _____

- b Helping national energy problem _____
- c Taking advantage of cash rebate or tax credit _____
- d Improving the environment _____
- e Just interested in solar _____
- f Other. Please specify: _____

32. Which of the following experiences have you had? (Check as many boxes as apply)
- a Neighbors and friends are anxious to see how your solar system works out before deciding to purchase one themselves
 - b Neighbors have complained about the appearance of your solar collector(s)
 - c Your property taxes have increased because of your solar system
 - d Your solar collectors were damaged by vandals
 - e Difficulty with local zoning laws, ordinances, or restrictive covenants when installing your solar system
 - f Neighbor has completed new construction or allowed vegetation to grow in a way that shades your formerly unshaded solar collectors
 - g None of the above

33. Were you given operating and maintenance instructions or an owner's manual for your solar system?
- a Yes
 - b No (Please skip to Question 34)

If yes, assess the adequacy of the manuals by checking the appropriate boxes. If more than one manual was provided, print the name of the component in the appropriate box (for example: pump, collector, control, storage, heat exchanger):

	(1) Excellent	(2) Adequate	(3) Inadequate	(4) Don't Know
a Instructions on system operation				
b Instructions on system maintenance				
c Instructions on diagnosing problems				
d Identifying where to obtain service				

34. Please assess the accuracy of claims made about your solar system at the time of purchase by checking the appropriate boxes.

	(1) Accurate	(2) Fairly Accurate	(3) Inaccurate	(4) Not Discussed	(5) Too soon to tell
a Life expectancy					
b Warranty coverage					
c Maintenance requirements					
d Utility cost savings					
e Experience of dealer/manufacturer					
f Experience of installer					
g System performance					

35. Does your solar system have an auxiliary unit to back it up during cloudy periods or at night?
- a No (Please skip to Question 40)
 - b Yes
 - c Don't know

36. What fuel powers your auxiliary unit?
- a Electricity
 - b Gas
 - c Oil
 - d Don't know
 - e Other. Please specify: _____

37. Does your auxiliary unit work automatically, or do you turn it on and off manually?
- a Automatically
 - b Manually
 - c Don't know

38. Have you ever tried shutting off your auxiliary unit on a sunny day to see if your solar system can work by itself?
- a No (Please skip to Question 40)
 - b Yes

39. Which of the following best describes what happens with your hot water (space heating/space cooling/pool heating) when the auxiliary system has been turned off for many hours on a sunny day (while you have continued normal usage):
- a Noticed no change
 - b Noticed only a slight change
 - c Found a significant change
 - d Had no hot water (space heating/space cooling/pool heating) after stored supply was used
 - e Other. Please specify: _____

40. Were any written warranties provided for your solar system?
- a Yes
 - b No (Please skip to Question 43)
 - c Don't know (Please skip to Question 43)

41. Who provided the written warranty? (Please provide a copy, if available - no originals, please). (Check all that apply)
- a Dealer
 - b Collector manufacturer
 - c Installer
 - d Other. Please specify: _____
 - e Don't know

42. Which of the following is covered by warranty? (Please check as many boxes as apply and indicate duration of coverage, if known, in space provided)
- a Installation _____ years
 - b Entire system _____ years
 - c Collector _____ years
 - d Don't know
 - e Other components (list) _____ years

43. Which of the following best describes your experience with your solar warranty(ies)?
- a Warranty service has not been needed (Please skip to Question 46)
 - b All requests for warranty service have been honored (Please skip to Question 45)
 - c Most requests for warranty service have been honored
 - d Most requests for warranty service have *not* been honored
 - e No requests for warranty service have been honored

44. Please indicate which, if any, of the following have failed to honor requests for service covered by warranty.
- a Manufacturer
 - b Dealer (if not franchised by manufacturer)
 - c Installer (if not franchised by manufacturer)

- d Dealer franchised by manufacturer
 e Installer franchised by manufacturer
 f Other. Please specify: _____
45. If a problem was not covered by your warranty, what reason(s) was (were) given? (Check as many boxes as apply)
 a Nature of problem specifically excluded from warranty coverage
 b Problem was with installation (and warranty covered *only* components of system)
 c Problem was with system components (and warranty covered *only* installation)
 d Warranty period had expired
 e Supplier of warranty was no longer in business
 f Other. Please specify: _____
46. Which of the following generally indicates the frequency of problems with your solar system?
 a Never have problems (Please skip to instructions for Question 58)
 b Seldom have problems
 c Occasionally have problems
 d Frequently have problems
 e Always have problems
47. How long after installation did problems occur?
 a Immediately
 b Within 2 weeks
 c 2 weeks - 1 month
 d 1 month - 6 months
 e 6 months - 1 year
 f 1 - 2 years
 g 2 - 5 years
 h After 5 years
48. Have you taken action to correct problems with your solar system?
 a Yes
 b No, not yet, but plan to (Please skip to Question 53)
 c No, and don't plan to. (Please indicate reason and then skip to Question 53) Reason: _____
49. Which of the following actions have you attempted? (Check as many boxes as apply)
 a To correct problem yourself
 b To obtain correction from installer
 c To obtain correction from dealer
 d To obtain correction from collector manufacturer/system vendor
 e To obtain correction from anyone I could find
 f Other. Please specify: _____
50. Has the problem been corrected?
 a Yes, completely
 b Yes, partially
 c Not sure
 d No, but problem(s) have lessened
 e No, problem is still the same
 f No, problem is worse than it was
51. If corrected, how soon after problem occurrence was it corrected?
 a Immediately
 b Within 15 days
 c 15 days - 1 month
 d 1 month - 6 months
 e More than 6 months
52. Was this problem covered by a warranty?
 a Yes
 b No
53. Was this problem covered by a service/maintenance contract?
 a Yes
 b No
54. What action to correct a new or persistent problem do you plan to take? (Check as many boxes as apply)
 a Correct problem yourself
 b Obtain correction from installer
 c Obtain correction from dealer
 d Obtain correction from collector manufacturer/system vendor
 e Obtain correction from any solar mechanic/engineer
 f Contact local or state government consumer protection officials
 g Contact Better Business Bureau
 h Retain your own attorney
 i Other. Please specify: _____
55. How would you describe your solar system problems, generally?
 a Always can correct them myself (Please skip to instructions for Question 58)
 b Usually can correct them myself
 c Minor, but requiring expert service
 d Major, requiring expert service
 e Very serious - I don't think they can be corrected
56. When you had a problem, how long did it take to obtain service?
 a Within a few days
 b 1 - 2 weeks
 c Longer than 2 weeks
57. How would you describe the quality of service provided?
 a Always satisfactory
 b Usually satisfactory
 c Sometimes satisfactory
 d Rarely satisfactory
 e Never satisfactory
- INSTRUCTIONS FOR QUESTIONS 58-63: Your answers to these questions will provide us with helpful information about your solar system. Some of the information may indicate a problem or a potential problem with your system; some may tell us your system has special features, or simply that it is working properly. Please answer these questions from your past observations. It is unnecessary to make a special effort to get this information (although you may if you wish). If you have not observed any of the circumstances listed, please so indicate.*
58. Have you observed any water or fluid leakage?
 a No
 b Yes (Please check as many boxes as apply)
 From pipe joint
 From roof
 From collector itself
 From storage tank
 Not sure of location
 Other. Please specify: _____
59. Have you observed any of the following regarding the operation of your solar system pump? (Check as many boxes as apply)
 a Pump operates on warm days when the sun is not shining
 b Pump operates noisily
 c Pump seems to be operating all the time
 d Pump seldom seems to be operating
 e Pump never seems to be operating
 f Pump operates to keep system from freezing in cold weather
 g Other. Please specify: _____
- h Have observed no problem
60. Have you observed any of the following regarding the operation of your solar system controller (the component that controls the operation of the pump)? (Check as many boxes as apply)
 a Controller has failed to activate pump to provide efficient operation of system
 b Controller has failed to activate pump to protect collector from freezing
 c Controller has been repaired and is now satisfactory
 d Controller has been replaced
 e Operation of controller is now satisfactory (no problems)
 f Other. Please specify: _____

61. Has piping frozen or ruptured?
a Yes
b No
62. Has solar collector frozen or ruptured?
a Yes
b No
63. Please check any of the following that you have observed:
a Condensation on inside of collector
b House or property damage during installation
c Corrosion or deterioration of collector
d Corrosion or deterioration of piping or pipe joint
e Corrosion or deterioration of pump
f Loose mounting of pipes or collector
g Discoloration of collector glass or plastic cover
h Collector glass or cover separated from collector box
i None of the above
64. How many solar collector panels do you have on your solar system?
a Number: _____
b Don't know
65. What is the approximate area of your collectors in square feet?
a Area: _____ square feet
b Don't know
66. Did you have a special storage tank installed for your solar system?
a Yes
b No
c Don't know
67. What is the approximate storage tank capacity in gallons of your solar system?
a Storage capacity: _____ gallons
b Don't know
68. Please provide the following information concerning your solar collectors:
a Collector name: _____
b Model number: _____
c Don't know
69. Which of these phrases best describes the direction your solar collectors face?
a South
b Mostly South
c East
d West
e Other. (Give direction: _____)
f Don't know
70. Are your solar collectors exposed to the sun most of the day?
a Yes
b No
c Don't know
71. Does your solar system have special features to keep it from freezing?
a No (Please skip to instructions for Question 73)
b Yes
c Don't know
72. What features prevent your solar system from freezing?
a System pump operates in freezing weather
b Special valves are provided to drain the system
c System has automatic drain down
d System has antifreeze
e Florida climate
f Don't know
- If you do not have a solar swimming pool heater, please skip to Question 78. If you do have a solar pool heater, please answer Questions 73 through 77.*
73. What is the approximate capacity of your pool?
a Capacity: _____ gallons
b Don't know
74. What are the approximate dimensions of your pool?
a Length: _____ feet
b Width: _____ feet
75. What is the total area in square feet of solar collectors used to heat your pool?
a Yes
b Collector area: _____ square feet
c Don't know
76. Do you use a pool cover to help maintain water temperature?
a Yes
b Sometimes
c No
77. How satisfactory do you think your solar pool heating system has been in providing the water temperatures you expected?
a Extremely satisfactory
b Very satisfactory
c Reasonably satisfactory
d Rather unsatisfactory
e Totally unsatisfactory
f It provides no heat at all
78. Prior to the purchase of your solar system did you or the previous owner(s) take any energy conservation measures (for example, insulate or reinsulate ceiling or walls, add storm windows, add or replace weather stripping or caulking)?
a Yes. Please list: _____

- b No
c Don't know
79. Which of the following best describes your overall view of your experience with your solar system?
a Very satisfied
b Generally satisfied
c Somewhat satisfied
d Somewhat dissatisfied
e Very dissatisfied
f Not yet sure
- Comments: _____

80. If you have indicated any dissatisfaction with your solar system in this questionnaire, please rank from 1 to 5 the importance of each of the following factors in contributing to that dissatisfaction (1 = most important, 5 = least important)
- | | RANK | | | | |
|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | 1 | 2 | 3 | 4 | 5 |
| Inadequate performance | <input type="checkbox"/> |
| Not reliable enough | <input type="checkbox"/> |
| Not saving as much on utility costs as expected | <input type="checkbox"/> |
| Capabilities not represented accurately at time of purchase | <input type="checkbox"/> |
| Warranty not adequate | <input type="checkbox"/> |
| Repair and maintenance service not satisfactory | <input type="checkbox"/> |
| Other _____ | <input type="checkbox"/> |

81. Would you buy a solar system again?

- a Definitely
- b Probably
- c Maybe
- d Probably not
- e No

82. We are interested in determining which income groups are buying solar energy systems. Please check the box that indicates your approximate family income:

- a Less than \$12,000
- b Between \$12,000 and \$20,000
- c More than \$20,000
- d Prefer not to answer

Thank you. Please indicate if you would like to receive a summary of the results of this study.

83. a Would like to receive study results.

84. Please indicate whether or not you would welcome a site visit to your system if we feel this is necessary.

- Yes
 - No
-
-

[An addendum statement was subsequently received from Mr. Yarosh as follows:]

Addendum to Testimony by

Marvin M. Yarosh, Director
Energy Systems Analysis Division
Florida Solar Energy Center

given before

House Subcommittee on Oversight and Investigation Hearing
Washington, DC
September 21, 1978

In my testimony given before this committee on September 21, 1978, and in the subsequent panel discussions there were a number of points on which I indicated that I would provide additional comments. These are included in the information below.

The data we have received to date indicates in general a very high level (approximately 75%) of consumer satisfaction with their solar energy systems. This same data shows that the percentage of customers satisfied with their pool heating systems is significantly lower (approximately 50%). We believe, in part, the reasons for the lower level of satisfaction with pool heating systems reflect the ability of consumers to determine whether or not those systems are operating satisfactorily to a greater degree than can be determined with their domestic hot water systems. In the latter case, if the solar systems are not providing adequate hot water, for most systems the backup heating (usually an electric element) automatically comes into play, and thus the homeowner has adequate hot water at his faucet. In the case of pool heating systems most often the solar system is the only method for heating the pool and if it does not do the job the consumer expects, he is much more likely to be aware of the problem.

In fairness I should say that we also believe that a significant fraction of solar pool heaters are undersized and this also could partially explain the dissatisfaction of consumers with their pool heating systems.

In the discussion concerning cost savings achieved by solar systems I believe there were indications that potential savings would exceed what we have found in practice in Florida. A properly designed solar domestic hot water system would supply about 70% of the domestic hot water needs of a typical family. In Florida hot water usage reflects about 20% of the

average energy costs in residential structures, and if one then assumes 70% of these costs are handled by solar it would mean a reduction of approximately 14% in the energy costs of the residence as a result of the installation of a solar domestic hot water system. With variations in use patterns and family characteristics, as well as variations among systems, it might be difficult to identify in all cases a reduction in actual energy costs. Typically, payback periods are at a minimum on the order of six to eight years and probably more often above ten years for the average homeowner. These lengths of time are probably not sufficiently attractive to encourage large numbers of homeowners to move on to solar.

In my testimony I indicated typical costs that we had identified for systems installed by the private market sector. In preliminary data on costs for the HUD Solar Water Heating Initiative we had indications that even though the HUD systems carried with them inspections and warranties above and beyond what was required in the private market sector (where no requirements existed), the costs of the HUD systems were not identifiably above those we found in the previous survey. What this is saying is that the cost of warranties provided under the HUD program was not significant.

I would like to reiterate that the Florida legislature, in 1978, passed legislation making mandatory the voluntary bill under which we have been operating the past two years. Specifically, the new legislation requires that all solar systems manufactured or sold within the state must meet standards established by the Florida Solar Energy Center. The ramifications and meaning of this legislation are still under study, and the legislation is to become effective January 1, 1980.

Our studies also indicate that the majority of sales now being made in the solar arena are to that segment of the consuming public who are already enthusiastic about solar energy; they are concerned about energy conservation and the depletion of resources, specifically oil and gas, or are interested in applying new technologies. We believe that some of the downturn recently seen in the rate of growth of the solar industry might reflect saturation of that consuming sector.

One additional comment I would like to make concerns the establishment of so-called standards for solar energy systems. We believe that recommendations of good procedures and practices to follow in the design, assembly and installation of systems would be useful. Such recommendations could include materials which we believe make sense to be included in the systems, and the kinds of components and designs that are suitable as well as recommended good practices to watch for in the installation of systems. I do not believe that recommendations should specify one and only one way of designing or installing systems, because our experience has been that there are a variety of good methods that can be used in the design, assembly and installations of systems. It is for this reason that I would hesitate to have standards which are so rigid and so specific that they would preclude alternative methods that would be suitable.

Mr. Moss. Mr. Meeker?

STATEMENT OF JACK MEEKER

Mr. MEEKER. Thank you, Mr. Chairman.

Briefly, I would like to explain what we have done. We began a 2-year program back in September 1975—which has been extended to 3 years—in solar hot water heating in the New England area.

At the end of the first full year for all 100 systems, I feel we identified the major problems associated with solar energy in freezing climates. To that end, we have worked with the Solar Energy Industries Association, the National Association of Solar Contractors, and various Government agencies to help correct those problems.

Basically what we found and what we identified last May and June—and I am going to repeat some of the remarks that some of the other gentlemen made—was that there has been inadequate training of solar contractors, people who put the equipment in.

I would like to take a second to say that we expected in the first year to have some problems. We look at it as a learning curve, not only for us, but for the industry and contractors who participated in the program with us. I do not think that we expected to find as many problems as we did, however.

The thing that we found was very important. It was the hands-on training. You cannot have a blackboard session and bring a crew of contractors in and even in 1 or 2 days say: "This is how to do it." That is all well and good. That has to be addressed.

But they actually have to have the field experience of putting the collectors and the system on the roof or on the ground or wherever. It is very critical. You cannot give a contracting crew a set of schematics and say: "Go ahead and put it in." More often than not he is going to foul the system up unintentionally.

Second, I think that while you are talking about standards—and standards for collectors are fine—but the major single problem we found were component parts. While some collectors did give some problems in the first year, and even in the second year, the major single problem, if the system was installed correctly, was with the component parts. By that I mean either controls, valves, or pumps—items of that nature.

Not enough dialog is going back and forth between the solar system manufacturer and the component part manufacturer. I know SEIA has formed a committee that I am serving on. They are attempting to address the problem.

But really to try to put it on a layman's view, if you have purchased a \$2,500 system installed, and you have a \$40 pump or a \$50 control malfunctioning, and you do not know about it, that is going to negate any savings that you could expect to receive from solar. Certainly in our area you can save anywhere from 40 percent to 60 percent at a reasonable cost. However, everything has to operate properly.

As I say, we work with the National Association of Solar Contractors, Mr. Butt's organization, and the Northeast Solar Energy Center. One thing we have helped them do is to train the contractors in the area and also the homeowners. I think the overall solar system then has to be addressed, not just collectors.

On the other hand, I think there has to be more realistic information coming out to the public. A year ago people were saying in the Northeast that you could put a solar package in for \$1,000 to \$1,200. Our experience then was \$2,200. It is roughly \$2,500 now.

I would like to break that down and I will do that in writing for you. But a system package for the average family of four, say in Massachusetts or central New England, roughly would cost \$1,400 to \$1,600.

The labor and overhead to put that system in on a retrofit basis now is roughly \$600. I am not talking about new construction because the market in New England is retrofit now. There is not much new construction going on.

Then you have associated equipment. Unfortunately pipes do not come with the system and insulation normally does not come with the system. Roof brackets or roof mounts do not come with the system.

So, you can get up to another \$500 or \$600 very easily. That gives you a total installed cost of around \$2,500.

I think the market has to be identified. Solar, in my opinion, has been hurt because people have been going around saying that everybody should put a solar system in. Well, that is all well and good, but I do not think everybody can afford it. But there are thousands, if not millions, of people out there that should have solar and should pursue solar, but they must identify the market further.

Without going too much further, perhaps I had best close and be available for any questions.

Mr. Moss. Mr. Greene?

Mr. GREENE. Mr. Chairman, would you please recognize Mr. Sims for a question?

Mr. Moss. Mr. Sims?

Mr. SIMS. Thank you, Mr. Chairman.

At this point I would ask that certain data be put into the record: Exhibits 1, 2, 3, and 4 and that a copy be given to each of the witnesses and made available to the press and to the audience.

Much of the discussion that follows will be based on these data. I think it will lead effectively into the discussion of standards, codes, and warranties.

Mr. Moss. Without objection, so ordered.

[Testimony resumes on p. 131.]

[Exhibits 1, 2, 3, and 4 referred to follow:]

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EXHIBIT 1

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BENJAMIN J. WUNDER
 SECRETARY

MEMORANDUM

DATE: September 18, 1978
 TO: John E. Moss, Chairman
 FROM: Subcommittee Staff
 SUBJECT: Summary of New England Electric Solar Water Heating Experiment

Introduction

The New England Electric System began a solar water heating experiment in September 1975 to test the performance of commercially available solar water heaters. The utility wanted to see if solar hot water heating could aid in leveling peak electric power demand. By December 1976, nearly all of the 100 test units were installed in single family homes in Massachusetts, Rhode Island, and New Hampshire.

Results

According to an October 1977 study of the experiment prepared by Robert O. Smith and Associates, a professional engineering firm from Newton, Massachusetts, "results are still undetermined about demand peak effects because so much difficulty was encountered in the mechanical functioning of the solar water heaters."

Specifically, the 100 installations functioned as follows:

I. Successful SystemsFunctioned Well

15

No Serious Breakdowns

23 (includes best 15)

II. Unsuccessful Systems

At Least One Major Stoppage Requiring Technicians to Repair	<u>Severely Interrupted and Unreliable Service</u>	<u>Very Low or No Savings</u>
77	20 (included in the 77)	27 (included in the 77)

Overall average energy savings were under 20 percent. The best 15 systems reduced water heating energy consumption by an average of 37 percent in a severe winter, and the worst 15 systems averaged less than five percent savings. The budget, originally set at \$250,000, nearly doubled. However, some systems were made to work well after major modifications.

According to the consulting engineers:

"Most of the troubles encountered in this project are due mainly to flaws in installation, secondarily to flaws in the selection of component sizes and types, (and) thirdly to lack of inspections and adjustments which are necessary after installation. Some problems can be associated with generic type of system..."

Conclusion

According to a report prepared for the New England Electric System by Arthur D. Little, Inc., the experiment suffered from "unreasonably high expectations." The report went on to observe that:

"The issue of high expectations is particularly relevant because of the government grant and incentive programs currently being established. Consumer frustration could impede the development of the solar market unless particular efforts are made to insure that systems installed with government or industry support address many of the difficulties encountered in this program. In addition, consumers must be cautioned in advance about the operating problems associated with these early installations."

REPORT
SUMMARY OF PERFORMANCE PROBLEMS OF
100 RESIDENTIAL SOLAR WATER HEATERS
INSTALLED BY NEW ENGLAND ELECTRIC COMPANY
SUBSIDIARIES IN 1976 AND 1977

PREPARED BY
ROBERT O. SMITH AND ASSOCIATES
PROFESSIONAL ENGINEERS

55 CHESTER ST
NEWTON HIGHLANDS, MASS.
02161

OCTOBER 1977

B.N.L. Contract No. 419 929-S

Prepared for the Solar Technology Transfer Program
at Brookhaven National Laboratory
and supported by the Solar Division
U.S. Department of Energy

N.E.E. Solar Water Heaters

IV-4

TABLE IV-B TROUBLE ANALYSIS

CODE	TYPE OF TROUBLE	TOTAL COUNT OF SYSTEMS	TYPES OF SYSTEMS AND COUNTS OF TROUBLES				
			EXPERI- ENCING THIS ONE OR MORE TIMES	Anti- frz.	Drain- back	Drain- out	Heated Air Pipe
A -	GENERAL SYSTEM: TOTAL	69:	14	0	34	20	1
6	Water hammer noise	9	1		6	2	
8	Froze	30	1		19	10	
10	Very low economy (below 10%)	27	10		8	8	1
29	Water seepage into house	3	2		1		
B -	COLLECTORS: TOTAL	23:	10	0	6	7	0
1	Leak at known joint	9	2		2	5	
2	Leak, unspecified	5	1		2	2	
4	Burst pipe	1			1		
17	Outer cover cracked	1	1				
20	Damaged by wind	3	3				
23	Wrong insulation mat. or th.	1	1				
26	Buckled casing	1	1				
28	Inner cover broken, adrift	2	1		1		
C -	PIPING: TOTAL	60:	8	0	33	18	1
1	Leak at unknown joint	16	3		6	7	
2	Leak, unspecified place	5	2		3		
3	Draindown reservoir overflow	3			3		
6,33	Water hammer	1			1		
7	Not pitched properly	15			15		
9	Became airborne	14	1		3	10	
23	Wrong insulation mat or th.	6	2		2	1	1
D -	VALVING: TOTAL	21:	9	1	8	3	0
1	Leak at known place	3	2		1		
5	Frozen or stuck	5	1	1	3		
12	Relieved too often	3	3				
25	Fault in valve	4	2		2		
36	Omitted or mislocated	6	1		2	3	
	PAGE TOTALS	173	41	1	81	48	2

N.E.E. Solar Water Heaters

IV-B

TABLE IV-B TROUBLE ANALYSIS, CONTINUED

CODE	TYPE OF TROUBLE	TOTAL	A.F.	D-B	D-O	HP	Air
E-	TANK, HT-EXCH, ELEC. HEATER	7:	6	0	1		0
1	Leak at known place	2	1		1		
2	Leak, unspecified place	1	1				
13	Failed elec. heating elem.	1	1				
14	Failed elec. heater thermostat	1	1				
16	Temp. control relay fault	2	2				
F-	PUMP OR BLOWER & MOTOR	20:	8	0	2	9	1
1	Leak in pump	2	2				
11	Motor malfunction	3	3				
22	Pump installed backwards	1	1				
24	Excessive noise	5	1		1	2	1
30	Pump didn't move water	2			1	1	
31	Overheated	7	1			6	
G-	TEMPERATURE SENSORS	7:	4	1	1	1	0
18	Fault in sensor	3	2	1			
35	Sensor became detached	4	2		1	1	
H-	CONTROLLER	33:	13	0	17	2	1
15	Ran continuously or cycled excessively	26	11		12	2	1
27	Wired backwards	2	1		1		
32	Freeze protection setting too low	3			3		
33	Settings not optimal or not in range	2	1		1		
I-	MISCELLANEOUS	1	1	0	0	0	0
	Antifreeze solution too weak	1	1				
	PAGE TOTALS, p. 2	68	32	1	21	12	2
	PAGE TOTALS, p. 1	173	41	1	81	48	2
	GRAND TOTALS	241	73	2	102	60	4
	PERCENTAGES	100%	30	1	42	25	2
	SYSTEM COUNT AND %	100	48	2	24	22	4

ROBERT O. SMITH AND ASSOCIATES, ENGINEERS, NEWTON, MA.

V. RECOMMENDATIONS FOR THE PROTECTION OF CONSUMERS

Consumers should be encouraged to protect themselves by taking such measures as:

1. Planning Stage

- a. Study the design and construction of solar water heaters. Literature on this is available from the National Solar Heating and Cooling Information Center, P.O. Box 1607, Rockville, MD., 20850.
- b. Compare offerings of several supplier-installers.
- c. Inspect existing systems installed by the installers you are planning to solicit.
- d. Seek an experienced supplier who provides everything, installs it, and guarantees it.
- e. Seek a long term warranty covering labor and parts, e.g., five years.
- f. Seek a long financing term and low rate.
- g. Set modest goals for economic performance, and be prepared for a lengthy startup and adjustment period when performance may be below expectations.
- h. Provide indoor drains large enough to carry away water from pipes around the equipment if any should accidentally burst.

2. Cost Estimating Stage

- a. Try to forecast all costs over a long period of ownership, e.g., ten years.

3. Contract Negotiating Stage

- a. Get legal assistance in writing your own terms into the purchase contract.
- b. Provide a holdback of some of the total payment for 12 months to see that the system is satisfactory in all seasons. Perhaps the greatest difficulty will be getting prompt repair service after the initial installation is made. A substantial holdback is about all that seems useful in this matter.
- c. Write into the contract that it is the seller's responsibility to provide the kind of equipment and installation arrangement and workmanship that will be approved by the local building officials.
- d. Specify that the installer is responsible for all plumbing, carpentry, electrical, painting, roofing, masonry, and landscaping work, and for procurement of all code permits and approvals of work.

- e. Be sure that the employees of the installer are covered by Workingmen's Compensation Insurance. Obtain and inspect this insurance policy.
- f. Make clear that the installer is required to restore disturbed roofing, siding, building insulation, and lawn and plants following the completion of the installation.
- g. Limit the duration of the installation project to some time such as two weeks to avoid a drawn-out job and limit the permissible interruption of hot water service to some time such as one day.
- h. Avoid having the installation made during freezing weather when work proceeds more slowly than in non-freezing weather.
- i. Specify design temperatures and gallons per day in the performance requirements. See p. 2 of the N.E.E. Specifications, Appendix C.
- j. Get a complete description of freeze-protection provisions in the system.
- k. Get a complete description of future maintenance work needed for long-term operation.
- l. Get a complete description of the procedures for vacation shutdown and startup.
- m. Get a neat legible set of drawings describing the piping and wiring of the individual system. Have any standard drawing set marked to show how the completed system as actually built differs from it.
- n. Get a list of all major components with name, count, make, model, size and capacity of each. This should include all valves, motorized dampers, temperature sensors, controllers, pumps, blowers, motors, heat exchangers, tanks, collectors, and any other main components. These may have to be repaired or replaced at any time.
- o. Specify that a mixing valve shall be installed and adjusted to prevent final delivery temperatures from exceeding 140° F.
- p. Specify where and by what means the collectors and the main pipe or duct runs to them shall be mounted and fastened.
- q. Some instrumentation : needed to determine whether the system is making the most of the sunshine. The principal item of instrumentation is a running time meter on the collector circulator motor. Thermometers and flow meters are a further help in determining whether the controller set points combined with the pump flow rate are set to capture the most heat from the sun.

- r. Closed loop systems should be equipped with a way to detect loss of the anti-freeze solution. Therefore have installed either a pressure gauge in a readable location in the anti-freeze loop, or a sight gauge tube on the side of the reserve supply tank.
- s. Reserve the right to inspect every part before it is installed and to reject any which do not meet contract terms.
- t. Demand that the system pass pressure tests on the collector loop, e.g. 25 p.s.i. for 24 hours, and on the domestic water loop, e.g. 125 p.s.i. for 24 hours, to appropriate values for appropriate durations before startup.
- u. If possible, obtain the services of an experienced solar engineer or solar system installer to act as an inspector at the time of startup. The system may have been installed by very inexperienced workmen with inadequate supervision.
- v. Be careful to learn what insulation will be provided: both the kind of material and the thickness at collector backing, pipe (or duct) runs outdoors, and pipe (or duct) runs indoors.
- w. Where anti-freeze is used, H.U.D. requires two walls of pipe or tank - two distinct layers of sealed metal - separating the anti-freeze solution from the domestic water. Most codes require this now.
- x. Get the city plumbing inspector to actually inspect the job for conformance with the plumbing code before the pipes are insulated or buried. He is employed to safeguard consumers' interests.

NINETY-FIFTH CONGRESS

EXHIBIT 2

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COUNSEL TO THE CHAIRMAN

EDWARD J. WOODS
IDENTITY COUNSEL

MEMORANDUM:

DATE: September 15, 1978

TO: Honorable John E. Moss, Chairman

FROM: Subcommittee Staff

SUBJECT: Summary of Florida Solar Energy Center
Survey of Solar Consumer Problems

INTRODUCTION

The Florida Solar Energy Center (FSEC) has, under contract to DOE, identified a number of solar users in Florida and completed a preliminary survey as to the experiences of these solar consumers. The work was undertaken as part of an effort by elements in the DOE to develop a consumer protection package to support solar demonstrations and commercialization efforts. The experiences of some 522 solar users are described in a May 18, 1978, Letter Progress Report from the FSEC to the DOE. Attachment D to that letter presents the findings. The letter and the attachment are appended to this memorandum.

RESULTS

In general, solar consumers reported that they were satisfied with their systems:

<u>Satisfied</u>	<u>Mixed</u>	<u>Unsatisfied</u>
67%	21%	12%

However, a large number of the respondents reported problems in the operation of their solar systems:

<u>Total Number of Owners Reporting Major and Minor Problems</u>	<u>Estimated Number of Owners With Major Problems</u>
239 (46%)	22%

A major problem is defined as one which (a) costs more than 5% of the initial system cost to repair, or (b) took more than 15 days to correct, or (c) was greater than that experienced with equivalent systems using traditional energy sources.

A survey of 216 of the owners revealed that 111 reported that the problems with their solar systems had not been corrected yet. 111 represents 46% of all the problems reported.

An owner's satisfaction level was not a reliable indicator of whether or not the solar system had experienced problems. For example, 28 owners were satisfied despite the fact that their systems had frozen and 10 owners were satisfied even though their units had suffered sensor failure.

The FSEC survey found that most of the problems occurred soon after installation, and almost 80% within one year of purchase. While over 80% of the systems were installed in or after 1974; and over 50% in 1977 and 1978, about 15% were installed prior to 1960.



May 18, 1978

Ms. Lynda T. Connor
Governmental Technical Representative
Department of Energy
12th & Pennsylvania Avenues, NW, Room 1422
Washington, DC 20461

Dear Ms. Connor:

SUBJECT: LETTER PROGRESS REPORT #4
Development of Solar Energy Consumer Protection Systems
Cooperative Agreement EM-77-F-01-8140

In accordance with Cooperative Agreement EM-77-F-01-8140 between the Department of Energy and the State of Florida (Florida Solar Energy Center), attached is Letter Progress Report #4 on the subject project.

An invoice of costs incurred on the project is being forwarded to your office from the Division of Sponsored Research at Florida Technological University.

Sincerely yours,

A handwritten signature in cursive script that reads "Marvin M. Yarosh".

Marvin M. Yarosh, Director
Energy Systems Analysis Division
Project Manager

MMY:kg

Attachment

FLORIDA SOLAR ENERGY CENTER

300 State Road 401, Cape Canaveral, Florida 32920

Telephone: 305 / 783-0300

State University System Of Florida

May 18, 1978

Letter Progress Report #4
 Cooperative Agreement EM-77-F-01-8140
 Development of Solar Energy Consumer Protection Systems

Introduction

Since Letter Progress Report #3, we have made significant progress on the various tasks defined in the work plan. These are discussed below.

Summary of Activities and Results

Contact With Agencies (Federal, State, Local, Private) Related to the Project:

The response to our efforts in establishing contact with agencies with interests related to our project has been described in Appendix A of Letter Progress Report #3. About 20 complaints were received from these agencies, and an analysis of these complaints is attached as Appendix A to this report. These complaints have been in the area of misrepresentation of system performance and in the sale of franchises, distributorships and dealerships; improper installation; inadequate repair service; and the vendor going out of business.

Identification of Solar Consumers:

As described in Letter Progress Report #3, efforts in this task have been continuing. We have now identified over 1,000 solar users in Florida, and a preliminary breakdown of the sources for information on these owners is shown in Figure 1.

FIGURE 1: Solar Owners Identified in Florida
 April 1978

Sources

Better Business Bureaus/Chambers of Commerce	4
Department of Consumer Services	~15
Permits	0
National Solar Heating & Cooling Information Center	0
News Media/Advertisements/Mail-Ins	~80
Industry Supplied	~200
HUD Program	~120
Toll-Free Hot Line	~600

TOTAL: ~1,000

The techniques used in owner identification were described in Letter Progress Report #3. Substantial efforts to advertise the "hot line" were performed, and a brief description of typical efforts associated with advertisement of the hot line is attached as Appendix B to this report.

Analysis of the Problem:

The letter and postcard shown in Appendix D of Letter Progress Report #3 were mailed to all identified solar users. The letter inquired of the interest of the solar user in cooperating with us on the project, and only 3 out of all users identified expressed an unwillingness to share their experiences. The postcard instructed users to assess their experience and report it to us as "Satisfactory," "Unsatisfactory," or "Mixed." A tabulation of the responses received for 950 users is shown in Appendix C. The data of Appendix C represents the solar owner's own

assessment of his experience as Satisfactory, Unsatisfactory, or Mixed, and such an assessment is, of course, highly subjective. To obtain additional insight into the meaning of these terms, we performed a detailed analysis of the hot line data points and also in-depth telephone discussions with about 65 owners. These 65 users were selected from the pool of names that had already contacted the Center via the postcard.

All owners that called the Center on the hot line were asked a set of questions on the form attached as Appendix F to Letter Progress Report #3. Some 500 of the responses to these questions have now been analyzed, and the results are shown in Appendix D to this report. Approximately three out of every four solar owners calling the Center indicated they were satisfied with their solar experience.

The in-depth telephone discussions conducted were designed to probe and seek various pieces of information that would enable us to draw experience profiles of Satisfactory, Unsatisfactory, and Mixed solar users. In our categorization, we attempted to determine whether the owner had a significant problem. The findings are attached as Appendix E to this report.

We defined a significant problem as one which:

- a. Cost more than 5 percent of the initial system cost to repair, or
- b. Took more than 15 days to correct, or
- c. Was greater than that experienced with equivalent systems using traditional energy sources.

We have been able to obtain the following profiles:

Typically,

an owner reporting his experience as Satisfactory has not had significant problems;
 an owner reporting his experience as Unsatisfactory has had significant problems;
50% of the owners reporting their experience as Mixed have had significant problems.

Although there are exceptions to these profiles, they are relatively few, and our sample size was large enough to justify these profiles within reasonable errors.

To define the consumer problem, we need to assess both its magnitude and also the nature and causes of the problems. The data in Appendix C indicates that 12% of the owners have assessed their experience to be Unsatisfactory, and 21% assessed their experience to be Mixed. Using this data and the above profiles, we estimate that about 22% of solar users have had significant problems. This represents the magnitude of the consumer problem.

To understand the nature and causes of the consumer problem, reference is again made to Appendices D and E, which deal with the hot line data and the in-depth telephone discussions, respectively. To date, we have been able to identify 5 major problem areas. These are:

- Installation Problems
- Inadequate System Performance
- Inadequate or Unsatisfactory Repair Service
- Unsatisfactory Information Provided By Vendor
- Unsatisfactory Redress Action

For each of these problem areas we have identified some typical problems encountered and suggested some causes. These are shown in Appendix F to this report. Our data suggests that if the owner's description of his problem and experience is correct, it is relatively easy to identify the nature of the problem; it is extremely difficult, however, to determine the cause of the problem. The difficulty is compounded by the fact that the discussions and probings have taken place over the telephone, and thus personal assessment of the solar system, the installation, and the information provided by the vendor has not been made. It is evident from Appendix F that an identified problem can stem from a number of deficiencies. Component failure, for example, may be a result of inadequate operating or maintenance instructions, or may result from poor system or component design. An assessment of the adequacy of instructions would require either personal inspection or more extensive questioning of the owner. Thus, without additional information, there remains uncertainty as to the exact cause of problems identified by our solar experience information.

We have determined that in order to gain certainty about the nature and causes of the consumer problem, we need to expand our 5 problem areas to include more specific ones and accurately assign a cause, or causes, to each. To accomplish this, an in-depth structured survey of the 1,000-plus owners identified needs to be performed, with possible field visits to establish confidence in the survey results. Unfortunately, the detailed survey and field visits are beyond the scope of this project.

Consumer Problems In Other Industries:

For comparative purposes, a search was initiated for information on studies and surveys in the heating, ventilation, and air conditioning industries which could yield consumer satisfaction levels with technologies analogous to solar, problems encountered with these technologies, and indicate industry interface with consumer protection mechanisms and systems. Industry associations, trade associations, manufacturing firms, research institutes, and other organizations were contacted for this information. This search proved disappointing for all industries except the heat pump industry. Relevant data concerning the heat pump experience is attached as Appendix G. On the whole, we have determined that there is a critical shortage of data available to the public pertaining to consumer experiences in other fields. Information surveys conducted by private firms on product performance and acceptance are treated as proprietary by the firms involved.

Solar System Contact Groups:

We have prepared a final draft of the task report identifying the contact groups for the solar consumer. The original scope of the work statement has been expanded here to include not only the industry contact groups (manufacturers, distributors, dealer/installers, architects/engineers, builder/developers, etc.), but also informational contact groups, such as industry advertisements, press reports, periodical and government information sources. These must be considered as part of the solar industry infrastructure in that they contribute to the consumer's decision, his expectations, and his ultimate satisfaction or dissatisfaction with solar energy systems. Additional details are provided in the task report—Appendix H. DOE is requested to carefully review Appendix H and return their comments within 10 days of receipt of this document.

Workshop:

Approximately 360 individuals were invited to the Solar Energy Consumer Protection Workshop in Atlanta, Georgia. After mailing of the Preliminary Announcement to these invitees, numerous telephone calls were made to specific individuals

in an attempt to get a balanced attendance, geographically and with respect to consumer organizations, industry representatives, government offices, state energy offices, public utilities, etc. There were 113 participants who attended the May 3-6 Workshop. The Preliminary Announcement, Final Agenda, and Guidelines for Workshop Chairmen and Discussion Leaders are attached as Appendices I, J, and K, respectively. Additionally, to provide the participants with the relevant background information on solar heating and cooling technology, a brief summary on the status of solar heating and cooling was also prepared. This is attached as Appendix L to this report.

We are presently awaiting receipt of the transcript of the proceedings of the Workshop. Further detailed analyses of the recommendations will be made after reviewing the transcripts. It was evident, however, from the final plenary session, that the participants were almost unanimous in their conclusion that new and alternative consumer protection mechanisms are not needed, but that existing consumer protection mechanisms should be utilized and made more effective. This may require enforcement and, where necessary, provision of adequate budgets to support such enforcement.

Consumer Protection Mechanisms:

For purposes of the Workshop discussion, we identified the 8 most important existing consumer protection mechanisms. These are: (1) Standards, Testing, Certification and Labeling; (2) Trade Licensing Laws and Training Programs; (3) Building Codes; (4) Consumer Education/Information; (5) Federal, State and Local Consumer Protection Laws; (6) Warranties; (7) Utility Regulation; and (8) Self-Regulation by Trade, Industry and Business Groups. Detailed descriptions of each of the 8 mechanisms were prepared, along with suggested criteria for evaluating the effectiveness of these mechanisms. (The Descriptions and Evaluation Criteria are attached as Appendix M.)

In addition, a brief description was prepared for each of the following consumer protection mechanisms: (1) Disclosure Statements; (2) Bonding; (3) Common Law Remedies; (4) Better Business Bureaus; (5) Consumer Action Panels; (6) Mediation-Arbitration; and (7) Information Dispute Settlement Mechanisms. (This is attached as Appendix N to this report.)

Progress With Respect to Work Plan and Upcoming Plans

We have completed a final draft for your review (attached as Appendix H) of the section on industry infrastructure and solar system contact groups.

We have gathered significant information on the magnitude of the consumer problem. Our data reflects owner assessments of the nature of the consumer problem, and from our knowledge and experience with solar systems and solar users, we have identified a range of possible causes associated with the problems identified. We have categorized those problems most frequently occurring and identified mechanisms which will address these problems.

We have held a nationally-attended, and successful, Consumer Protection Workshop in Atlanta and explored the mechanisms and issues involved in consumer protection and evaluated the effectiveness of existing consumer protection mechanisms. The transcripts of the Workshop will be available within 30 days and will be summarized in a future Letter Progress Report. Detailed proceedings of the Workshop are also planned.

In verbal discussions with the Technical Project Officer we have agreed that the strong consensus of the Workshop participants was that new consumer protection mechanisms are not required, or necessary. The project staff will therefore not attempt to develop new mechanisms. We agreed that present mechanisms which address different facets of the consumer problems experienced, in aggregate, constitute a consumer protection system. The system itself thus consists of mechanisms which may be integrated into the system, but which often are effective as a consumer protection mechanism independent of their application within a system. By putting together existing mechanisms in alternate structures, new or alternate consumer protection systems can be examined.

We will now examine the application and integration of existing mechanisms into consumer protection systems. We will determine if there appears to be gains made through systems of consumer protection over application of existing independent consumer protection mechanisms.

We will attempt to determine improved strategies for implementation of existing mechanisms and systems, and determine the costs and legal and administrative barriers to program implementation.

Potential Problems

We anticipate serious difficulty in assessing the true costs of implementing the strategies for more effective application of consumer protection mechanisms and systems. Such costs should include not only direct administrative costs of such programs, but also costs reflected in industry as a result of the programs and how such programs affect solar equipment costs. We must also assess the impact on both solar market and solar industry development.

(FOR REVIEW ONLY)

APPENDIX D

FSEC Toll-Free Telephone Line

Results to Date

Steven R. Sim

Present date: April 21, 1978

Beginning date: January 11, 1978

(The total number of days the phone has been in operation is 73. The phone operates from 9 a.m. to 6 p.m., Monday through Friday.)

Results to Date

(A) Number of Calls Received and Owners Located:

Total number of calls received:	910
Total number of solar owners identified:	522
Percentage of total calls which come from owners:	57%

Comment:

All efforts to publicize the toll-free line have stressed that the line is for the sole purpose of allowing solar owners to call the Center and inform us of their experiences with their solar equipment. This type of publicity has greatly increased FSEC's ability to attract only solar unit owners to use the line. By comparison, the National Solar Heating and Cooling Information Center's (NSHCIC) toll-free phone line is advertised as an informational line. The NSHCIC estimates that only 10% of their calls come from solar equipment owners.

(B) System Application (by the total number and percentage):

Residential:	506	(97%)
Commercial:	16	(3%)
Domestic Hot Water (DHW)	:	420 (80%)
Pool Heating (PH)	:	49 (9%)
DHW & PH	:	25 (5%)
Space heating (& DHW)	:	13 (2%)
Space cooling (& space heating & DHW)	:	14 (3%)
Other	:	1 (less than 1%)

Comments:

(1) The residential sector accounted for approximately 97% of the units as was expected. However, the domestic water heating application produced a smaller percentage than expected with only 85% (80% DHW only and 5% DHW and PH) reporting that their primary system application was domestic hot water.

(2) A result hidden in the above figures is that 99 of the owners contacting the Center via the toll-free line indicated that they had either built and/or installed their units themselves. This means that 19%, or approximately 1 out of every 5 owners who phoned us, were not involved in a "basic" market transaction in which the owner purchases an already-constructed unit and has it installed by persons other than himself.

(3) In the residential sector, all but 8 units were installed in houses. Six of these eight installed not in houses were installed for individual apartments, condominiums, or townhouses. One was in a mobile home and one was in a park service outpost.

(4) In the pooling heating application, all but three were residential installation.

(C) Date of System Installation (by total number and percentage):

1977-1978	:	271 (52%)
1976	:	80 (15%)
1975	:	53 (10%)
1974	:	20 (4%)
1970-1974	:	9 (2%)
1960's	:	9 (2%)
1950's	:	16 (3%)
1940's	:	33 (6%)
1930's	:	26 (5%)
1920's	:	4 (less than 1%)
prior to 1920's	:	1 (less than 1%)

Comments:

(1) As expected the vast majority, 81%, of the units were installed from 1974 to the present.

(2) An unexpected result is the relatively large number of units predating 1960. Approximately 15%, or every 6th or 7th unit reported, was installed prior to 1960.

(D) Perceived Experience (by total number and percentage):

No problems and Satisfied	:	283 (54%)
Problems but Satisfied	:	115 (22%)
(Total Satisfied)	:	398 (76%)
Problems and Mixed	:	56 (11%)
Problems and Unsatisfied	:	68 (13%)
(Total Reporting Problems):	:	239 (46%)

Comments:

(1) A higher percentage of owners contacting the Center via the Hot Line indicate satisfaction than does the entire sample of owner experiences collected by the Center through all sources: Hot Line, letter, warranty cards, etc.

(2) The total number of owners indicating problems, major and minor,

is 239 or 46% of all reporting owners.

(3) Of the 98 units installed from 1900-1974, 64 reported no problems and 25 reported problems but satisfied for a total of 89 out of 98 or 91% satisfied. (With the older units the most common, reported problem was rusting of tanks necessitating tank replacement. In general this rusting did not become serious enough to warrant replacement until 15 years or more after installation.)

(4) Of the 99 owners reporting that they had built and/or installed their units themselves, 29 reported problems but only 13 would admit that they were unsatisfied or mixed with their units.

(5) In the "Problems but Satisfied" category, the following specific problems were most frequently mentioned:

<u>Problem</u>	<u>No. of Cases</u>
*Freeze-ups	28
*Sensor	10
Leaking	9

Thus out of 52 total freeze-up cases reported (see Section G), 28 of these owners (or 54%) indicated that even though their units had experienced a freeze-up, they were still completely satisfied with the unit!

* Note: Some owners reported both sensor failure and a freeze-up in this same category.

Also interesting is that of 16 owners who either built and/or installed their units themselves (and who were thus probably much more aware of the internal workings of the system than the average owner would be) and who also reported a freeze-up, 7 reported they were completely satisfied with their units.

(6) In the "Problems and Unsatisfied" category, the following breakdown of unsatisfied cases by system application is possible:

<u>System Application</u>	<u>No. Unsatisfied</u>	<u>Percent of Total Application</u>
DHW	29	7%
PH	23	47%
Space Heating	4	31%
Space Cooling	12	86%

(7) In the "Problems and Mixed" category, the following breakdown of mixed cases by system application is possible:

<u>System Application</u>	<u>No. Mixed **</u>	<u>Percent of Total Application</u>
DHW	40	10%
PH	5	10%
Space Heating	2	15%
Space Cooling	2	14%

** Note: 7 cases in this category fell into the DHW and PH classification and are not included in this tally.

In this category the specific problems most frequently mentioned were:

<u>Problem</u>	<u>No. of Cases</u>
Freeze-ups	11
Poor installation	5
Not heating to expectations	5

Note: Thus out of 52 total freeze-up cases, 39 owners experiencing this problem report that they are not satisfied with their unit because this problem has arisen.

(8) The final breakdown by application and experience is as follows:

<u>Application</u>	<u>% Satisfied</u>	<u>% Unsatisfied</u>	<u>% Mixed</u>
DH ^w	83	7	10
PH	43	47	10
*** Space Heating	54	31	15
*** Space Cooling	0	86	14

*** Note: With only 13 space heating and 14 space cooling cases reported, these figures are too low to present enough data to make the percentages for these two applications meaningful in a statistical sense. The important point to be gleaned here is that not one solar space cooling unit owner reports satisfaction.

(E) Time After Installation Until Problem Occurred:

Out of the 239 cases indicating problems, many owners were unsure of the exact length of time after installation when the problem surfaced. Many owners would not even hazard a guess as to this time period. The following information was obtained from those 213 owners indicating a reasonable certainty of the length of time involved.

<u>Length of Time After Purchase That Problem Occurred</u>	<u>Total No. of Cases Reporting Reasonable Certainty of Time Period (%)</u>
Within one year	169 (79%)
1-2 years	14 (7%)
2-3 "	6 (3%)
3-10 "	3 (1%)
10-20 "	9 (4%)
20-30 "	6 (3%)
30-40 "	5 (2%)
40- "	1 (less than 1%)

Comment:

Most of the cases reporting problems within one year reported that the problems occurred immediately after installation.

(F) Time After Problem Arose Before Corrected

Out of the 239 cases indicating problems, many owners were unsure of the exact length of time after the problems arose before the problem was corrected. Many owners would not even hazard a guess as to this

time period. The following information was obtained from 216 owners indicating a reasonable certainty of this length of time. These owners are not the identical group reported in the previous section.

<u>Length of Time After Problem Arose Before Corrected</u>	<u>Total No. of Cases Reporting Reasonable Certainty of Time Period (%)</u>
1 week or less	59 (27%)
1 week-1 month	30 (14%)
1 month-6 months	13 (6%)
6 months-1 year	3 (1%)
Still not corrected	111 (51%)

Comment:

Although the owners of units whose problems have not been corrected will be able to answer with total certainty the question of "when their units' problems were corrected," and thus might have a slightly higher percentage in this category because of this certainty, the number of uncorrected cases is unexpected. This number is 46% of the total number of problem cases reported.

(G) Types of Problems Most Often Reported:

(Total number of cases reporting problems:

239, some of which reported more than one problem.)

<u>Problem Type</u>	<u>No. of Times Reported</u>	<u>Percent of Total Problem Cases</u>
Freeze-ups	52	22%
Water not heated to expectations	33	14%
Water Leakage	28	12%
Poor Installation	27	11%
Unit Never Worked	23	10%
Controller	16	7%
Sensor	15	6%
Service	15	6%
	209	88%

(H) Number of Problems in 7 Problem Category Areas (and percentages):

<u>7 Main Categories</u>	<u>No. of Times Reported</u>	<u>Percent of Total Problem Cases ****</u>
(1) Inadequate System Performance	57	24%
(2) Component or System Design Flaw	151	63%
(3) Installation Problem	27	11%
(4) Inadequate or Unreliable Info.	3	1%
(5) Inadequate information for O&M and Warranty	0	0%
(6) Inadequate or unsatisfactory Repair Service	15	6%
(7) Legal, administrative, and institutional barriers	12	5%

**** Note: Some cases reported more than one problem and thus may fall into more than one problem category.

EXHIBIT 3

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 COUNSEL TO THE CHAIRMAN

BERNARD J. WINKER
 MINORITY COUNSEL

MEMORANDUM

DATE: September 18, 1978
 TO: John E. Moss, Chairman
 FROM: Subcommittee Staff
 SUBJECT: Summary of Problems in DOE-Funded
 Solar Energy Systems

Introduction

Forty operating solar systems funded by the Department of Energy were reviewed from a performance basis. Preliminary results indicate a high percentage of operating problems. The review includes residential and commercial installations covering active air and water systems.

Results

<u>Problem</u>	<u>Number of Systems</u>	<u>Number of Problems</u>
Freezing	37	11 (29.7)
Collector to Manifold Leak	40	15 (37.5)
Controller Malfunction	40	11 (27.5)
Collector Malfunction	40	22 (55.0)
a. Flat Plate Type	36	20 (55.5)
b. Concentrating Type	4	2 (50.0)

EXHIBIT 4

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MEMORANDUM

DATE: September 20, 1978
TO: John E. Moss, Chairman
FROM: Subcommittee Staff
SUBJECT: Preliminary Results of Subcommittee Questionnaire

Introduction

As you know, the Subcommittee, in cooperation with the Florida Solar Energy Center, the FTC, the DOE, and the California State Energy Commission, has surveyed solar owners in California, Michigan, and Wisconsin. 781 questionnaires were sent out, and 336 usable responses were received. The Subcommittee staff is now in the process of analyzing the returns. Some initial results seem significant, however.

Preliminary Results1. Owner Level of Satisfaction with Solar System Operation.

A high percentage of owners were generally satisfied with the operation of their systems.

<u>Very Satisfied</u>	<u>Satisfied</u>	<u>Unsatisfied</u>	<u>Very Unsatisfied</u>	<u>Can't Say</u>
52.1%	34%	4.3%	2.1%	6.7%

2. Reported Problems. Despite the high level of owner satisfaction, a significant number of problems were experienced. Of those who answered the question, the following numbers of problems and percentages were reported:

	<u>Number of Cases</u>	<u>Percentage of Those Who Answered This Question</u>
Water or other fluid leak	108	47.6%
Controller operates inefficiently	43	18.9
Controller has been repaired	39	17.2
Controller has been replaced	30	13.2
Water condensed inside collector	66	29.1
Pipes or collector loosely mounted	38	16.7
Collector glass or cover has separated from the collector box	21	9.3
House damaged during installation	19	8.4
Pump or fan operates all the time	20	8.8
Pump or fan noisy	27	11.9

3. Cost of system. The average purchaser of the solar system is fairly well off. 64.4 percent of those that answered this question paid cash for their system and about 70 percent of the systems are installed in houses where the combined income is \$20,000 a year or more. The following system costs were reported:

<u>System Type</u>	<u>Average Cost</u>
Hot water	\$2,160
Space heat	4,236
Pool heat	2,253
Water and space heat	5,245
Water, heat and cool	5,167

4. Energy Savings. The following monthly utility bill savings were attributed to the solar system. While it is not clear from the questionnaire, the savings figures probably represent months during which the system is working properly.

<u>System Type</u>	<u>Average Reported Monthly Savings</u>
Hot water	33.3%
Space heat	33.9
Pool heat	37.0
Water and space heat	47.1
Water, heat and cool	54.2

5. Warranties. Written warranties were given in less than two-thirds of the reported cases:

	<u>Written Warranties</u>
Yes	61.3%
No	31.3
Don't know	7.4

Conclusions

The high level of satisfaction probably derives in part from the significant number of do-it-yourselfers in the sample, who are likely to be more appreciative of their own work than of someone else's. In addition, the bulk of the systems are less than two years old, so the problems reported are likely to reflect system design and installation experience more than system or component disability.

Mr. SIMS. Mr. Meeker, if you would, please direct your attention to the memorandum dated September 18, 1978, to Chairman Moss from the subcommittee staff, the subject of which is "Summary of New England Electric Solar Water Heating Experiment."

You have briefly described to us an experiment that your company participated in. As I understand it, New England Electric System purchased approximately 100 solar hot-water heaters and installed them in single-family residences. Is that correct?

Mr. MEEKER. What we did was contract for 100 to be installed. We allowed the main supplier to choose the contractor because they would be the experts, not us, at the time. We allowed them to install equipment.

Mr. SIMS. Thank you.

In the first year of operation I understand that the following findings resulted. The 15 most successful systems functioned rather well. They saved on the average 37 percent of the energy that would have gone to hot water; is that correct?

Mr. MEEKER. Yes, sir.

Mr. SIMS. I understand that the 15 worst systems functioned very poorly indeed. They attained an average energy savings of about 5 percent; is that correct?

Mr. MEEKER. Yes, sir.

Mr. SIMS. I understand that of the 100 systems, approximately 77 of these systems had at least one major stoppage of a nature that required a technician to come and repair; is that correct?

Mr. MEEKER. That is also correct.

I think it is important that you look at the time frame, though. Those systems were installed in late 1975. The majority of them were installed in 1976. It could be expected that problems would occur like that. There has been a significant turnabout in the second year, however.

Mr. SIMS. Let us discuss that.

I understand that the second year technically ends about the first of October. Is that correct?

Mr. MEEKER. Yes, sir.

Mr. SIMS. But do you have some preliminary results that you can show with the understanding they may be subject to modification one way or the other?

Mr. MEEKER. Sure, I would be glad to.

If you go on the same basis as you would defining the savings in the first year, the 15 best systems, the second year I think would average somewhere in the neighborhood of 55 percent.

Mr. SIMS. Fifty-five percent savings?

Mr. MEEKER. Yes, on the consumer's hot water heating bill as opposed to the overall energy savings of the home.

The worst 15 will average a little bit better than 20 percent. However, I must clarify and say that all the modifications were not made prior to the beginning of the first year. Well, 5 of those 15 are no longer in there and have been replaced. They should perform better next year.

On the whole, for the second year, I would anticipate an average energy savings for all 100 of above 40 percent.

I would like to take the time to tell you what we did, if you do not mind.

Mr. SIMS. If I could get to that in a moment, please.

What is the average cost of each of these systems?

Mr. MEEKER. Initially it was \$2,200. It is up to about \$2,500 now, installed.

Mr. SIMS. Given that range, is that 40-percent energy savings generally a good economic return for the consumer?

Mr. MEEKER. For the average person, probably not. However, how I would identify the solar market, if somebody had the \$2,500 and had already insulated his home and was putting in solar, yes, I think a 40 to 50 percent savings could be significant, particularly if he used more than the average amount of hot water.

For the average family of three or four, I would say perhaps it would not be competitive with standard fuels in the New England area. However, if you had six or seven people in your family—let us say, a wife, a husband, and four children—they would use a lot more hot water than normal people and, yes, they could save dollars.

Mr. SIMS. So this level of energy saving is moving into the range where it may or may not be economically attractive?

Mr. MEEKER. I do not think it will be economically attractive in our service area. More Government subsidies would be required for solar to become competitive.

Mr. SIMS. Please explain the things that you were going to explain before.

Mr. MEEKER. What we did after identifying the problems was to sit down with the manufacturers and contractors to see if we could work something out to correct the problems that existed.

By and large the majority of the manufacturers were very cooperative. Forty-two systems were almost completely replaced and manufacturers made major modifications to approximately 30 others. That basically would give you 72 systems that were completely different in the second year than in the first year of the experiment.

Mr. SIMS. Seventy-two out of 100 systems were virtually or completely different in the second year?

Mr. MEEKER. Right.

Mr. SIMS. That is essentially the basis of the increased energy savings?

Mr. MEEKER. Well, that and also more dialog with the consumer. What we did in conjunction with SEIA is to publish a little solar water heating guide. The Brookhaven National Laboratory, ourselves, and Mr. Butt's organization sat down and went through that.

What we attempted to do with our customers was to sit down with them and explain how to use the hot water. For example, if you have a solar system—and say Mrs. Murphy gets up at 7 a.m. and sends the kid off to school and does her wash and her dishes at 8 a.m. before the Sun can get up there and have a major input into your hot water tank, you are not going to save too much.

However, if she waits until 1 o'clock in the afternoon when the sun is up and uses that hot water and lets the sun replenish the tank, you are going to maximize whatever savings you could get.

Mr. SIMS. Obviously for the average consumer it is not really feasible for such a person to think in terms of replacing or making major modification to his system if it does not function as it should or if it is improperly installed.

Mr. MEEKER. Given the time frame of 1975 and 1976, you are right. But the equipment that is out on the market now far exceeds that which was there in 1975 and 1976 and even in 1977. Some manufacturers have replaced systems this year. There has been a marked improvement of what they did in both 1976 and 1977.

Mr. SIMS. Do you think that back in 1975 when you embarked on this experiment the consumer, and indeed, the New England Electric System, may have suffered from some high expectations as to what solar energy savings might result?

Mr. MEEKER. I think to a degree, yes. I think people thought—and I am sure we were one of the organizations that thought this. Our consultant had told us you could install a system for roughly \$1,300. As it turned out, it was \$2,200.

The impression that I get in talking with customers is that they see the sun there. They expect to get energy from the sun. They do not realize the overall cost of installing equipment. As fuel costs rise and as electricity rises, certainly that will equal out.

Mr. SIMS. I just would like to read to you the summary from an Arthur D. Little report prepared for your utility on the initial experiences. I quote:

The issue of high expectations is particularly relevant because of the Government grant and incentive programs currently being established. Consumer frustrations could impede the development of the solar market unless particular efforts are made to insure that systems installed with Government or industry support address many of the difficulties encountered in this program.

In addition, consumers must be cautioned in advance about the operating problems associated with these early installations.

Mr. Meeker, do you think that general charge remains true today?

Mr. MEEKER. Yes, I certainly do.

Mr. SIMS. Thank you.

Mr. Yarosh, would you please refer to exhibit No. 2, which is a memorandum dated September 19, to the Honorable John E. Moss, from subcommittee staff entitled: "Summary of Florida Solar Energy Center Survey of Solar Consumer Problems."

Do you have that before you?

Mr. YAROSH. Yes.

Mr. SIMS. I would ask you to turn to the top two pages and find a May 18, 1978 letter. This is a letter sent by you to the Governmental Technical Representative in the Department of Energy with whom you are working. The following documents, I believe, are a part of this progress report.

I would like you to turn to a document entitled, "Florida Solar Energy Center Toll-Free Telephone Line, Results to Date by Steven R. Sim." I believe he is an employee of the Florida Solar Energy Center; is that correct?

Mr. YAROSH. That is correct.

Mr. SIMS. As I understand it, this report summarizes the experiences of approximately 522 solar users in the State of Florida; is that correct?

Mr. YAROSH. That is correct.

Mr. SIMS. As you mentioned, these experiences were collected in a variety of fashions: Through a toll-free hot line, through post cards, telephone calls, and a variety of other ways.

So, the experiences are indicative of what is happening in the solar area in Florida. But I do not think one would want to place proba-

bility numbers on this or say that these data are terribly precise. Is that a fair cautionary note?

Mr. YAROSH. The data represents an assessment or perception of owners. To that extent there may be errors in it. To the extent that we are depending on the owners in many cases to discern and give us their ideas on problems and perceptions.

Mr. SIMS. Nonetheless, you would expect the results to be directional as to what is actually happening in the solar energy area in Florida?

Mr. YAROSH. I think they reflect the perceptions of the owners. I think they do offer a very useful direction as to potential problem areas.

Mr. SIMS. I have summarized some of the results in this short two-page document. The first finding was that solar owners are very satisfied generally with the operation of the systems. Those that are satisfied are 67 percent; mixed, 21 percent; and unsatisfied, 12 percent.

But when you look at the number of problems experienced by these owners in system operations, we found that 239 owners reported either major or minor problems, which is approximately 46 percent; is that correct?

Mr. YAROSH. That is what the data says.

Mr. SIMS. I understand that you estimated that the number of owners in this survey with major problems was approximately 22 percent; is that correct?

Mr. YAROSH. Yes. In many cases, we had mixed reactions. In order to determine the true experience of the owners who responded that they had mixed reactions to the system, we did an in-depth telephone interview and determined that the total fraction of people with what was defined as a significant problem was about 20 percent.

Mr. SIMS. I would like to turn now to exhibit 3, which is a one-page memorandum dated September 18, the subject of which is: "Summary of Problems in DOE-Funded Solar Energy Systems."

The Department of Energy, in a preliminary survey, looked at the operation of 40 operating solar systems that they had funded. They found four particular problems, the results of which are identified on the sheet.

For example, 37 systems were susceptible to freezing or could possibly freeze. Of that number, 11 systems had freezing problems, which is nearly 30 percent. For example, in 40 of the systems, 11 of the controllers malfunctioned.

Mr. Meeker, I think you explained to us that this is like a chain. If any link in the chain fails to operate, or operates inefficiently, the operation of the entire system is affected; is that correct?

Mr. MEEKER. Basically that is correct.

Mr. SIMS. So, if the controller malfunctions, would you expect that the system did not operate as efficiently as it should have?

Mr. MEEKER. Most certainly.

Mr. SIMS. I would like to turn now to exhibit 4, which is also a preliminary collection of numbers. This particular collection of numbers was generated by the subcommittee in a survey that the subcommittee has recently completed of solar consumers in California, Wisconsin, and Michigan.

I would like to acknowledge now the great help that we have received from Dr. Yarosh's people and from a number of other persons,

including the Federal Trade Commission, elements in the Department of Energy, and the California State Energy Commission.

Unfortunately we have not been able to get the final results of the questionnaires. But we do have some preliminary data that I would like to put in the record now. (See exhibit 4, p. 128, this hearing.)

Mr. Yarosh, as you can see from item No. 1, the solar owners, like in Florida, are very satisfied with the operation of their system. These appear to be very hearty pioneers, indeed.

Again, I want to emphasize that these are preliminary numbers and could change. Of the respondents who answered these questions, we find a number of problems that have a very high incidence. To the question of water, or other fluid leak, 108 people responded that they had experienced this. That came out to be almost 48 percent of those who had responded to the questionnaire.

Mr. Yarosh, what does it mean to the operation of a system if there is a water or fluid leak? Could you briefly describe how little or how much that means to the operation of a solar system?

Mr. YAROSH. Well, of course, it depends on what kind of system you are talking about. For example, in Florida we have a very simple system. They are often called open systems.

A small leak in such a system where potable water actually goes through the collector might not be serious. In other systems where, for example, a fluid leak in the collector system where the fluid is not water and is not easily replaceable as in an open system, could not continue for very long before the system would effectively be inoperative.

In other cases, the leak, depending on where it is, could present a serious hazard.

So, it is difficult to answer a question quite that broad. But certainly if there is a leak in the system, it ought to be repaired. Systems should not leak.

Mr. SIMS. Mr. Butt, you emphasized the need for consumer credibility if the solar energy industry is to continue to grow. Accepting the fact that these reports of problems are from the owner's point of view and have not been verified by a technical inspection, do you think the solar industry has very high credibility now with the consumer or do you think there is an awful lot of work that might profitably be done?

Mr. BUTT. I think there is a great deal of work to be done, unquestionably so. We have a great deal of interest, certainly, by the general public in solar. We need to protect that interest.

This, of course, is the reason why we are so very interested in doing everything that can be done to expedite the further development of standards and codes and rating, labeling, and certification programs in order to reduce the number of problems that occur and to be sure that when and if they occur they get corrected promptly.

Mr. SIMS. Thank you, Mr. Chairman.

I have no further questions.

Mr. MOSS. Mr. Gore?

Mr. GORE. Thank you, Mr. Chairman.

I would like to thank the witnesses for being with us today. I think this is a most timely hearing. Echoing the sentiments that the chair-

man expressed earlier, I think the importance of this hearing is to insure that purchasers of solar equipment do not experience a high level of disappointment.

The results of the various surveys that the staff has introduced into the record and that Mr. Sims has introduced into the record thus far, show there is a very high level of consumer satisfaction with solar equipment purchased today.

Moreover, there is a very impressive savings on utility bills. But the point should be made that the kind of person by and large who has purchased solar equipment today is enthusiastic about it from the beginning and is more likely to live with some problems with the solar equipment.

As we seek to stimulate with Government incentives the wider purchase of solar equipment, the kinds of problems these initial purchasers have experienced may become more serious in the minds of the average consumer who is expected to purchase solar equipment in the coming years.

Therefore, it is important to try to anticipate some of those problems and to try to explore ways to avoid those problems.

Mr. Butt, I know from my experience with you in other subcommittees that you are very interested in developing industry standards without Government participation or with Government participation.

But your primary focus is on the industry doing it themselves. Is that realistic? Can it be done?

Mr. BUTT. Yes, it can be, and is being done. There are a number of standards in preparation in ASTM that should be beginning to issue in the immediate future.

The labeling and certification program that was referred to earlier to be in place. We hope to be able to put it in place before the end of this year.

The advantage, as we see it, of developing standards—and I think maybe industry standards is a misnomer because what we are really talking about are consensus standards in which there is input, not only from industry, but from the consumer, from Government, from the design professions, and from various user groups.

So, we are looking for consensus standards in which all the interested parties will participate. I think this gives you a better standard albeit often somewhat more slowly than you get if any one group wrote it all themselves.

Mr. GORE. What about the test methods upon which industry standards would be based? We have studies indicating that some of these test methods make it impossible to compare test results from different locations or from the same location during different times of the year.

An example is the ASHRAE 93-77 collector test. It was assessed and evaluated by Mr. Lumsdaine at the New Mexico Solar Energy Institute. He concluded, and I quote:

The magnitude of the errors can be quite large. It is thus unfair to both manufacturers and consumers to have a collector labeled with a lower performance rating simply because of errors introduced by the test method.

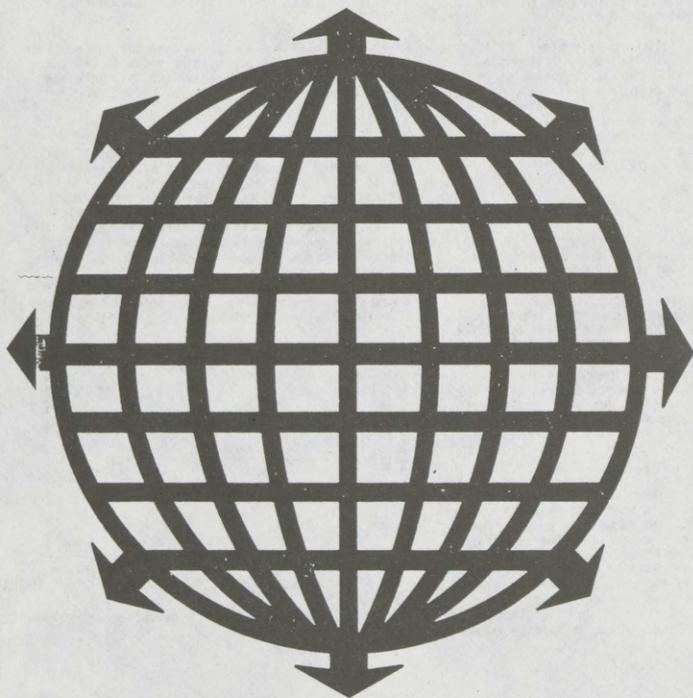
Are you familiar with this evaluation? How can we get test methods that are reliable?

[The report referred to follows:]

PROCEEDINGS OF THE 1978 ANNUAL MEETING

Denver, Colorado

**American Section of the
International Solar Energy Society, Inc.**



Volume 2.1

**Agriculture
Bio-chemistry
Engineering**

ON THE TESTING OF SOLAR COLLECTORS
TO DETERMINE THERMAL PERFORMANCE

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ABSTRACT

Recently, ASHRAE proposed Standard 93-77, "Methods of Testing to Determine the Thermal Performance of Solar Collectors", which includes a test procedure for both liquid and air solar collectors. This procedure represents an attempt to provide uniform standards by which collectors can be evaluated and compared according to their thermal performance. The purpose of this paper is to provide some experimental data and to discuss some of the potential sources of errors encountered either inherent in the test method or when applying test results to actual installations. The following parameters are sources of potential errors: 1. Collector tilt angle, 2. wind velocity, 3. spectral distribution of radiation (percent of diffuse and direct), 4. incident angle modifier, 5. differences between test fluid and in-situ fluid, and 6. single collectors and collectors in series. Methods of normalization of experimental data for comparison are presented for some of these parameters.

1. INTRODUCTION

The recently proposed test procedure, ASHRAE Standard 93-77, is a proposed method to determine the thermal performance and to rate solar collectors for heating and cooling applications. This consensus standard test procedure was prepared based on an earlier testing procedure proposed by the National Bureau of Standards (NBSIR 74-636). The objective of the test procedure was to provide a uniform standard by which collectors can be evaluated and compared according to their thermal performance. Collectors can be tested indoors or outdoors. The test procedure also provides means to determine the time constant and variation of collector efficiency with change of angle of incidence (incident angle modifier).

The purpose of this paper is to present some experimental data on the problems arising from this test procedure as well as to discuss the possible corrections or changes that can be made in order to minimize the serious errors that can be introduced by strictly following the ASHRAE 93-77 test procedure. This paper is also intended to caution those using the test results: if two collectors are tested in different facilities and/or under dissimilar environmental conditions, a comparison of collector thermal performance based on the efficiency versus

$\Delta T/I$ curves can be invalid because thermal efficiency is influenced by such factors as collector tilt angle, wind velocity, spectral distribution of radiation (percent of diffuse and direct) and the incident angle modifier as well as differences in the test fluid in the case of liquid collectors.

2. DISCUSSION OF EXPERIMENTAL AND THEORETICAL RESULTS

A description of the equations used for the computations that follow is given in Appendix A, and the description of the experimental facility is given in Appendix B.

2.1. Tilt Angle

Figures 1 and 2 are examples of experimental results obtained with the same set of collectors tested at two different times of the year. Analytical calculations (see Fig. 3) using the collector parameters confirm the same discrepancies for the two tilt angles. The difference in efficiency is almost five percent at the higher fluid temperatures. The collectors are from the same manufacturer, with the same model number.

A means to correct for the tilt angle is simply to normalize the results with respect to a 45-degree tilt.

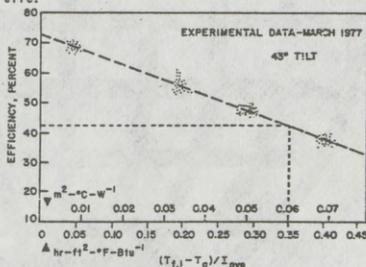


Fig. 1 Experimental efficiency of collectors tilted normal to the sun in March 1977.

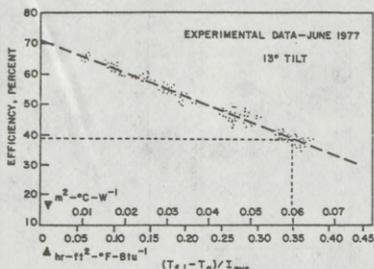


Fig. 2. Experimental efficiency of collectors tilted normal to the sun in June 1977.

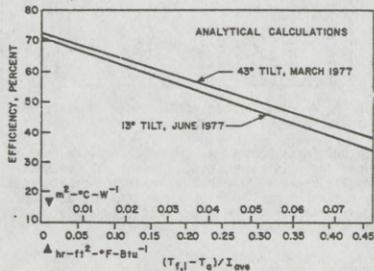


Fig. 3. Influence of tilt angle on collector performance.

Figure 4 gives the relationship between the ratio of top loss to tilt angle (from [1]). The empirical relationship used to calculate the curves in Figure 4 is

$$U_t(45^\circ)/U_t(\theta) = [1 - (\theta - 45^\circ)(0.00259 - 0.00144\epsilon_p)]^{-1} \quad (1)$$

Comparisons between this equation and other methods [2,3] showed very little difference. It was also found by using several empirical methods that both aspect ratio and length/gap ratio had only a small influence on this relationship for typical ranges of collector size.

For the graph in Figure 1, the approximate equation is

$$\eta(43^\circ) = 0.73 - 4.90 \Delta T/I \quad (2)$$

and for the graph in Figure 2,

$$\eta(13^\circ) = 0.71 - 5.50 \Delta T/I \quad (3)$$

Equation (3), when corrected by using eqn. (1) and eqns. (A-1) through (A-7), yields

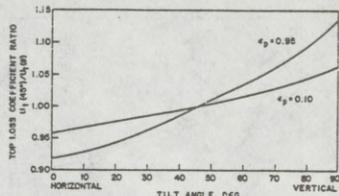


Fig. 4. Influence of collector tilt angle on top loss coefficient.

$$\eta(45^\circ) = 0.73 - 4.85 \Delta T/I \quad (4)$$

which is quite close to eqn. (2) and could be used for comparative purposes. Thus normalizing the result with respect to a tilt angle of 45° does reduce the margin of error.

2.2. Wind Velocity

The influence of wind velocity on collector efficiency is discussed briefly in [3]. The relative influence of wind on the collector efficiency depends on the number of covers. Thus Figures 5 and 6 show the two extremes of the influence of wind speed on collector efficiency: one for a bare collector and the other for a collector with two covers.

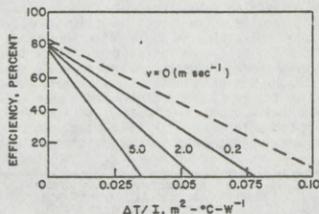


Fig. 5. Influence of wind speed on collector efficiency (no covers).

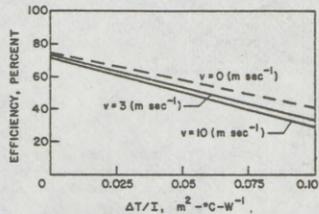


Fig. 6. Influence of wind speed on collector efficiency (two covers).

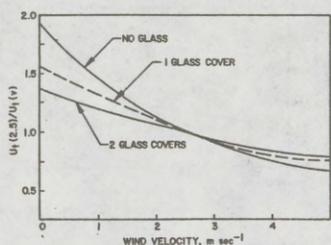


Fig. 7 Influence of wind velocity on top loss coefficient.

A method for normalizing the integrated wind speed is given in Figure 7. These curves are derived empirically using the method given in Appendix A. This normalization is the same as that for the tilt and corrects the slope (F_{RU}) and intercept (F_R) of the efficiency curve.

2.3. Spectral Distribution

Figure 8 gives the test results for three identical collectors that were tested together. The test results of 9 May show a great deal of scatter, and all three collectors gave efficiency values that were higher than normal on that day. A thorough check showed that the single parameter that differed greatly on 9 May from the other days was the ratio of scattered to direct radiation as shown on Figure 9. Retesting of these collectors on 23 May when the scattered radiation was about the same as during the early tests reduced the data scatter and brought the efficiency values back to those shown in Figure 10. Additional tests have confirmed that a change in the ratio of scattered to direct radiation of only a few percent can produce substantial differences in the efficiency curve.

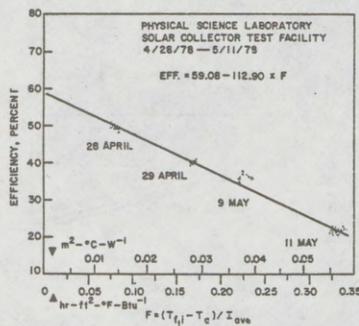


Fig. 8 Influence of scattered radiation on collector performance.

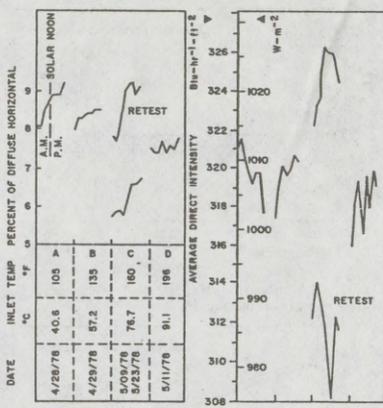


Fig. 9 Percent of scattered and direct radiation for five days (3 collectors).

Further investigation is needed to provide corrections for this phenomenon. However, the present results clearly show that a comparison of efficiency curves is not valid when the data was obtained under test conditions where scattered radiation differed by more than five percent.

2.4. Incident Angle Modifier

Numerous tests conducted with different collectors simply do not substantiate the symmetric nature of the incident angle modifier equation

$$K_{\tau a} = 1 + b_0 \left[\frac{1}{\cos \theta} - 1 \right]$$

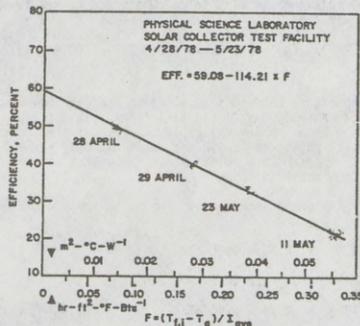


Fig. 10 Influence of scattered radiation on collector performance.

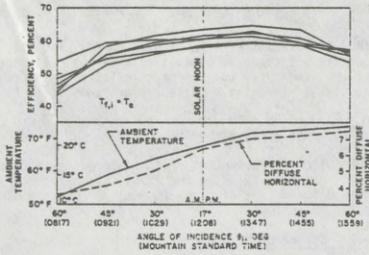


Fig. 11. Incidence angle modifier test results for six collectors.

Figure 11 shows the results for six collectors tested under the same conditions. These curves show that the efficiency about solar noon is definitely non-symmetric. Other tests substantiate these results. Note that the percent of diffuse radiation is steadily rising. If the collectors were aimed normal to the sun, the increase in diffuse radiation will result in a drop in efficiency. The reason for this, as mentioned earlier, is the fact that the transmission-absorption product decreases for the direct beam at higher incidence angles but not noticeably so for the diffuse component.

It is important to note here that tests conducted with tracking collectors to increase the amount of testing time available should take this phenomenon into account. The same collector tested in the afternoon could produce higher efficiencies than if tested before noon.

2.5. Correction for Differences in Collector Fluids

Tests are normally conducted using water as the cooling fluid for liquid collectors. Frequently, when the collectors are installed at the site, other types of fluids are used to prevent freezing. Figure 12 gives the efficiency curves for pure water, water mixed with 50 percent ethylene glycol and a 100-percent ethylene glycol solution. Because changes in fluid properties influence the heat capacity, conductivity and thus the overall loss coefficient, the results show that this change affects the intercept as well as the slope (F_R and U_L) of the efficiency curve.

Figure 13 shows the influence of Reynolds number and Prandtl number on collector efficiency. Note that changing the viscosity of the fluid changes the efficiency by only a small amount. However, there is a sizeable difference in efficiency if the fluid is under laminar or turbulent flow conditions. The Prandtl number has a large influence on efficiency for laminar flow but not for turbulent flow. Thus the large difference in efficiency shown in Figure 12 is due to the change from turbulent flow (for water at low viscosity) to laminar flow (for more

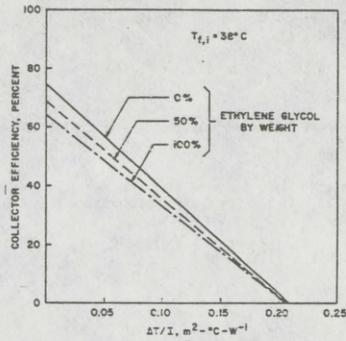


Fig. 12. Collector performance for different cooling fluids.

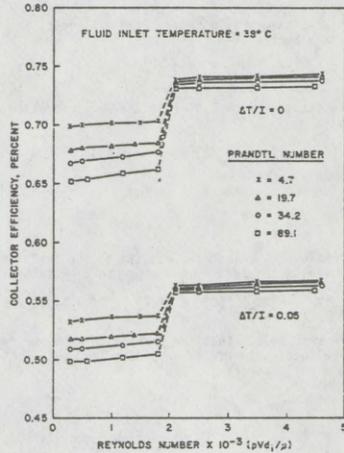


Fig. 13. Influence of Reynolds and Prantl number on collector efficiency.

highly viscous solutions).

2.6. Collector Performance in Series

This problem was brought to the attention of the author by Dennis Jones of the National Bureau of Standards [4]. The analysis by Jones has been extended here for the general case of N collectors.

The efficiency of the collector is given by (see Appendix A).

$$\eta = F_R [(\tau_c \alpha_p) - U_L (T_{f,i} - T_a)] / I$$

Also,

η = Heat Collected/Heat Incident on Collector

$$= MC_p (T_{f,1} - T_{f,i}) / I$$

where $M = \dot{m}/A$, the mass flow rate per unit area, and $T_{f,i}$ is the fluid exit temperature from the first collector. Therefore,

$$F_R (\tau_c \alpha_p) - U_L F_R (T_{f,i} - T_a) / I - MC_p (T_{f,1} - T_{f,i}) / I$$

or

$$C_1 I - C_2 (T_{f,1} - T_a) = MC_p (T_{f,1} - T_{f,i})$$

$$T_{f,1} = T_{f,i} + (MC_p)^{-1} [C_1 I - C_2 (T_{f,1} - T_a)]$$

where $C_1 = F_R (\tau_c \alpha_p)$, $C_2 = U_L F_R$.

For two collectors in series, the efficiency of the pair becomes

$$\eta = \frac{1}{2} [C_1 - C_2 (T_{f,i} - T_a) / I] + \frac{1}{2} [C_1 - C_2 (T_{f,1} - T_a) / I]$$

The substitution of $T_{f,1}$ into the above equation results in

$$\eta = [C_1 - C_2 (T_{f,i} - T_a) / I] [1 - \frac{1}{2} C_2 / (MC_p)]$$

Now for two collectors in series,

$$\eta = MC_p (T_{f,2} - T_{f,i}) / I$$

By combining the last two equations, the exit temperature at the second collector can be obtained:

$$T_{f,2} = T_{f,i} + (MC_p)^{-1} [C_1 - C_2 (T_{f,i} - T_a) / I] [1 - \frac{1}{2} C_2 / (MC_p)]$$

It is easy to see that the correction required for two collectors in series when data from only a single collector is available is

$$CF_2 = 1 - \frac{1}{2} C_2 / (MC_p)$$

For N collectors, the correction factor is

$$CF_N = 1/N + [(N-1)/N] CF_{N-1} - 1/N [C_2 (MC_p)^{-1} CF_{N-1}]$$

$$= 1/N + CF_{N-1} / N [(N-1) - C_2 / (MC_p)]$$

with $CF_1 = 1$.

Let $x = C_2 / (MC_p)$; then the first three correction factors are:

$$CF_1 = 1$$

$$CF_2 = 1 - \frac{1}{2} x$$

$$CF_3 = 1/3 - (1 - \frac{1}{2} x) [2 - x] / 3 = 1 - 2/3 x + 1/6 x^2$$

Thus the overall efficiency of a series of collectors is not the same as that of a single collector of the same type, but can be calculated if the test results of the single collector are known.

3. SUMMARY OF FINDINGS

The following parameters can influence the test results obtained by using the ASHRAE Standard 93-77 method for determining the thermal performance of solar collectors.

3.1. Collector Tilt Angle

Collectors are tested normal to the sun; however, due to different solar altitudes during winter and summer, the collector tilt changes the convective coefficient within the collector (and thus the cover losses), affecting the efficiency of the collector.

3.2. Wind Velocity

Collectors can be tested if the wind velocity is below 4.5 meters per second (10 miles per hour). However, even for the case of collectors with double glazing, a relatively calm day and a day when the wind averages 3 meters per second will produce different results. This error increases for the case of one cover and is very substantial for bare collectors.

3.3. Percent of Direct and Diffuse Radiation

Collector efficiency is plotted against $\Delta T/I$ with no regard given to the percent of diffuse and direct radiation that constitutes I . Experimental results show that when the percentage of direct radiation increases the collector efficiency increases also. In tests with four collectors, a 3 to 5 percent change in scatter radiation produced several percentage points of change in the efficiency.

3.4. Incident Angle Modifier

It is assumed in the test procedure that the incident angle modifier is symmetric about solar noon. The present experimental data indicates that the incident angle modifier tests produce non-symmetric efficiencies about solar noon. In fact, between the hours of 9 a.m. and 4 p.m. the efficiency steadily increases. This can be due to the fact that the diffuse component of the radiation steadily increases. This may at first seem to contradict the findings discussed in the paragraph above. However, a moment of reflection will show that this is quite consistent. In the test conditions above, the collector is always nearly normal to the direct radiation, thus the diffuse component is, relatively speaking, less effective. In the incident angle modifier test, except near solar noon, the effective transmission-absorption product decreases for the direct beam at higher incidence angles but not for the diffuse component.

The following two items concern the efficiency of collectors when installed at a given site.

3.5. Differences Between Test Fluid and Site Fluid

A single fluid should be specified for all tests. As shown in the present calculations, differences in the fluids used during these tests can produce sizeable differences in efficiency.

3.6. Single Collectors and Collectors in Series

When collectors are tested singly, the results cannot be applied directly to applications where they are connected in series; a correction factor is available to compensate for the change.

4. CONCLUSION

This paper has shown that the testing of solar collectors for thermal performance according to ASHRAE 93-77 standards poses many problems which make it impossible to compare test results from different sites or from the same site during different times of the year without qualifications. The magnitude of the errors can be quite large, and it is thus unfair to both manufacturers and consumers to have a collector labeled with a lower performance rating simply because of errors introduced by the test method. For example, higher efficiencies for a given collector can be obtained by testing it in the winter (higher tile angle), at a location with more direct than diffuse radiation (but the same total I), or at a lower average wind velocity.

Methods of normalizing some of the data are also presented in order to make fair comparison possible. More work is certainly necessary, and corrections must be made in the present method of obtaining and presenting the data. It also appears that continued indoor/outdoor testing could eliminate some of the problems presented in this paper. A combination of determining the intercept of the efficiency curve outdoors and slope indoors could alleviate some of the problems described here. In fact, a recent report [5] showed that the combined indoor/outdoor tests cost about the same as outdoor testing, and substantial reductions in cost are projected for the indoor/outdoor test in the future.

5. ACKNOWLEDGEMENT

Mr. Harold Connell and Mr. Bill Stevens of the Physical Science Laboratory at New Mexico State University supplied most of the experimental data presented in this paper. Their questions concerning some of the experimental results were responsible for the author's detailed investigation into the collector test problems.

6. NOMENCLATURE

- A collector area, m^2
b bond length, m

- b_0 constant
C empirical constant
 C_b bond conductance, $W (m^\circ C)^{-1}$
 C_h, C_v horizontal, vertical values of empirical constant C
 C_p liquid heat capacity, $W-hr(kg^\circ C)^{-1}$
D tube external diameter, m
 d_i tube internal diameter, m
 F_R heat removal factor
 Gr_D Grashof number
 $h_{f,i}$ internal film coefficient of liquid
 h_{p-c} convective coefficient between plate and cover, $W m^{-2}^\circ C^{-1}$
 $h_{r,c-s}$ radiation coefficient from cover to sky, $W m^{-2}^\circ C^{-1}$
 $h_{r,p-c}$ radiation coefficient from plate to glass cover, $W m^{-2}^\circ C^{-1}$
 h_w wind heat transfer coefficient, $W m^{-2}^\circ C^{-1}$
I radiation intensity, $W m^{-2}$
 $K_{\tau a}$ incident angle modifier
 K_a air conductivity, $W (m^\circ C)^{-1}$
 K_b bond conductivity, $W (m^\circ C)^{-1}$
 K_f liquid conductivity, $W (m^\circ C)^{-1}$
 K_i conductivity of insulation, $W (m^\circ C)^{-1}$
 K_p plate conductivity, $W (m^\circ C)^{-1}$
L collector length, m
 l thickness of insulation, m
M liquid mass flow rate per unit area, $kg hr^{-1} m^{-2}$
 \dot{m} liquid mass flow rate, $kg hr^{-1}$
N number of collectors in series
Nu Nusselt number
Pr Prandtl number
 Q_c heat collected, W
 Q_I heat incident on collectors, W
 Re Reynolds number
 T_c mean cover temperature, $^\circ K$
 $T_{f,0}$ liquid exit temperature of collector, $^\circ K$
 $T_{f,1}$ liquid exit temperature of first collector, $^\circ K$
 $T_{f,2}$ liquid exit temperature of second collector, $^\circ K$
 $T_{f,i}$ liquid inlet temperature, $^\circ K$
 T_p mean plate temperature, $^\circ K$
 T_a ambient temperature, $^\circ K$
t plate thickness, m
 u_b bottom loss coefficient, $W m^{-2}^\circ C^{-1}$
 U_e edge loss coefficient, $W m^{-2}^\circ C^{-1}$
 U_L overall loss coefficient, $W m^{-2}^\circ C^{-1}$
 U_t cover loss coefficient, $W m^{-2}^\circ C^{-1}$
V fluid velocity, $m sec^{-1}$
v wind velocity, $m sec^{-1}$
W plate-tube distance, m
 α_p plate absorptivity

- γ bond average thickness, m
 δ plate-to-cover spacing, m
 ϵ_c cover emissivity
 ϵ_p plate emissivity
 η collector efficiency
 θ tilt angle, deg
 θ_i incidence angle, deg
 λ length of riser, m
 ρ density, kg m⁻³
 σ Stefan-Boltzman constant, $5.67 \times 10^{-8} \text{ W m}^{-2} \text{ }^\circ\text{K}^{-4}$
 τ_c cover transmissivity

7. REFERENCES

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 [3] E. R. Streed, "The Results of a Round-Robin Flat-Plate Collector Test Program", Proceedings of the 1977 Flat-Plate Solar Collector Conference, February 28-March 2, 1977, Orlando, Florida, pp. 267-280.
 [4] Dennis Jones, personal communications, National Bureau of Standards, 2 May 1978.
 [5] L. H. Usher, "Cost Effective Solar Collector Performance Testing Under Continued Indoor and Outdoor Conditions," Solar Seminar on Testing Solar Energy Materials and Systems, National Bureau of Standards, Gaithersburg, Maryland, May 22-24, 1978.

8. APPENDIX

8.1. Appendix A - Theoretical Analysis

If the inlet and exit temperatures and the mass flow rate are known, the equation for efficiency is

$$\eta = Q_c / Q_i = \dot{m} C_p (T_{f,o} - T_{f,i}) / IA$$

Frequently, however, $T_{f,o}$ is not known. In particular, this is the case when collector performance is to be predicted. The efficiency of the collector is given by the equation

$$\eta = F_R [(\tau_c \alpha_p) - U_L (T_{f,i} - T_A)] / I \quad (\text{A-1})$$

where the heat removal factor is

$$F_R = MC_p [1 - \exp(-U_L F' / MC_p)] / U_L \quad (\text{A-2})$$

and where the collector efficiency factor F' is given by

$$F' = 1 / (U_L W) \left[\frac{1}{U_{L,D} + (W-D)F} + \frac{1}{C_b} + \frac{1}{\pi d_i h_{f,i}} \right]^{-1} \quad (\text{A-3})$$

$$C_b = k_b b / \gamma$$

$$F = [\tanh(U_L / k_p \delta)^{1/2} (W-D) / 2] [(U_L / k_p \delta)^{1/2} (W-D) / 2]^{-1}$$

$$h_{f,i} = (k_f / d_i) \left\{ 3.66 + \frac{0.067 [(d_i / \lambda) R_e Pr]}{1 + 0.04 [(d_i / \lambda) Pr R_e]^{1/3}} \right\}$$

The total loss coefficient is composed of the top loss U_t , the back loss U_b , and the edge loss U_e :

$$U_L = U_t + U_b + U_e \quad (\text{A-4})$$

where

$$U_t = \left\{ \frac{1}{h_{p+c} + h_{r,p+c}} + \frac{1}{h_w + h_{r,c+s}} \right\}^{-1}$$

and

$$h_{r,p+c} = \sigma (T_p^2 + T_c^2) (T_p + T_c) / [\epsilon_p^{-1} + \epsilon_c^{-1} - 1] \quad (\text{A-5})$$

$$h_{r,c+s} = \epsilon_c \sigma (T_c^2 + T_s^2) (T_c + T_s) \quad (\text{A-6})$$

$$h_w = 5.7 + 3.8 v \quad (\text{A-7})$$

$$U_b = K_f / \lambda$$

The edge conductivity can be computed similar to U_b ; however, this value is usually small and frequently neglected. In order to compute the loss coefficient U_e , it is necessary to first assume a cover temperature. This assumption can then be checked with the heat balance equation

$$T_c = T_p - U_L (T_p - T_A) / [h_{p+c} + h_{r,p+c}] \quad (\text{A-8})$$

The difficulty is in computing h_{p+c} (and thus U_t) which is dependent on the tilt angle. Some approximations are available to relate h_{p+c} to the tilt angle. Dropkins and Somerscales (P. B. [1]) presented a relationship using liquids between parallel plates. For air, the relationship is

$$Nu = [0.060 - 0.017(\theta/90) Gr_\delta^{1/3}] \quad (\text{A-9})$$

for $Gr_\delta < 2 \times 10^5$.

For a multi-cover collector, it is more convenient to use the relationship

$$U_t (\theta = 45^\circ) = \left\{ \frac{N}{(344/T_p) [(T_p - T_A) / (N+f)]^{0.31} + \frac{1}{h_w}} \right\}^{-1} + \frac{\sigma (T_p + T_s) (T_p^2 + T_s^2)}{[\epsilon_p + 0.0425N(1-\epsilon_p)]^{-1} + [(2N+f-1)/\epsilon_c]^{-1}} \quad (\text{A-10})$$

where

$$f = (1.0 - 0.04 h_w + 5 \times 10^{-5} h_w^2)(1 + 0.058 N)$$

and the influence of tilt can be approximated by

$$U_c(e)/U_c(45^\circ) = 1 - (e-45^\circ)(0.00259 - 0.00144\epsilon_p) \quad (A-11)$$

Eqn. (A-11) does not account for the variation in L/δ . To account for L/δ , Holman [2] gives the relationship

$$h_{p+c} = (Ck_a/\delta)[Gr_\delta Pr]^n [L/\delta]^m$$

$$\text{for } 11 < L/\delta < 42 \quad (A-12)$$

and where for $6,000 < Gr_\delta Pr < 200,000$:

Vertical Plate: $C = 0.197$ $n = 1/4$ $m = -1/4$

Horizontal Plate: $C_h = 0.212$ $n = 1/4$ $m = 0$

For $Gr_\delta Pr < 200,000$, eqn. (A-12) takes on a different form:

Vertical Plate: $C = 0.073$ $n = 1/3$ $m = -1/4$

Horizontal Plate: $C_h = 0.061$ $n = 1/3$ $m = 0$

The ratio of the convective coefficients depends on L/δ , or

$$\frac{h_{p+c}(\text{horizontal})}{h_{p+c}(\text{vertical})} = [C_h/C_v][L/\delta]^{-m}$$

which is, for $Gr_\delta Pr < 200,000 = 1.08 [L/\delta]^{-m}$

and for $Gr_\delta Pr > 200,000 = 0.84 [L/\delta]^{-m}$

For other angles, a linear interpolation is sufficiently accurate.

Typical parameters used are:

$$\alpha_p = 0.87, \quad t = 0.125 \text{ cm}, \quad W = 11.43 \text{ cm},$$

$$d_i = 1.52 \text{ cm}, \quad D = 1.70 \text{ cm}, \quad \delta = 4 \text{ cm}, \quad L = 2.25 \text{ m},$$

$$A = 2.25 \text{ m}^2, \quad \epsilon_c = 0.90, \quad \epsilon_p = \text{varied},$$

$$k_p = 45 \text{ W(m } ^\circ\text{C)}^{-1}, \quad C_p = 0.92 \text{ W-hr(kg } ^\circ\text{C)}^{-1},$$

$$k_f = 0.65 \text{ W(M } ^\circ\text{C)}^{-1}, \quad \tau_c = 0.91, \quad Pr(\text{air}) = 0.7,$$

$$\sigma = 5.67 \times 10^{-8} \text{ W m}^{-2} \text{ } ^\circ\text{K}^{-4}, \quad k_a = 0.032 \text{ W(m } ^\circ\text{C)}^{-1},$$

$$M = 75 \text{ kg hr}^{-1} \text{ m}^{-2}.$$

Figure A-1 shows a comparison between the empirical

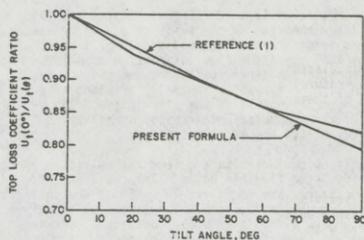


Fig. A-1. Comparison of top cover loss ratio calculations by different methods.

formula given in [1] and eqn. (A-12) with a length over gap ratio of approximately 40. After numerous computer runs with several length/gap ratios typical of present-day collectors, the results show that the loss coefficient is fairly insensitive to this parameter.

8.2. Appendix B - Test Facility

The Solar Collector Test Facility is located on the second story roof of the Physical Science Laboratory building on the campus of New Mexico State University in Las Cruces, New Mexico, at 106.75° W longitude, 32.28° N latitude and an elevation of 1200 m (3935 feet) above mean sea level.

The facility shown schematically in Figure B-1 consists of six test stands, a liquid conditioning system and an instrumentation system. The test stands all face true south and are adjustable for tilt. The collector support frames can support varying sizes of collectors up to 1.2 x 3 meters (4 x 10 feet). Larger size collectors may be accommodated by special jiggling and/or use of two stands. The liquid conditioning system consists of a hot and a cold loop, each supplying a port of a three-way thermostatically controlled mixing valve. Collected heat is dissipated to the atmosphere through a liquid-to-air heat exchanger, and the liquid is then stored in a 300 l (80 gal.) tank for the cold supply side. A standard 500 l (80 gal.) electric water heater and a 9 kW preheater supply the hot side. The mixing valve is a Powers pneumatically controlled valve which maintains the temperature in the supply manifold well within the required $\pm 0.5^\circ\text{C}$ (0.9°F) during a test period. Liquid is metered from the supply manifold to each individual collector under test through a venturi flowmeter which is individually calibrated in place using the weigh-tank method. The differential pressure across the venturi is read on a U-tube manometer operating with mercury or an organic fluid depending on the flow rate. Mass flow measurements are $\pm 1\%$ or better over the calibrated range of the venturi. During a test, the required test flow rate is maintained at a nominal level by adjusting the venturi differential pressure as measured with a U-tube manometer, to a value computed from the flow calibration equation using a nominal value of inlet fluid temperature and a manometer fluid

temperature of 15.6 °C (60 °F). Actual mass flow is later computed on the basis of actual collector inlet temperature and actual manometer temperature (ambient) using the flow calibration equation. Flow calibration is periodically checked using a precision turbine flowmeter installed in place of a collector. Because of the simplicity of the venturi flowmeter/manometer combination, stability and repeatability are excellent.

Liquid is conducted to and from the collector ports by insulated flexible hoses. Inlet and outlet temperatures are monitored in wells at the collector end of these hoses, with the intervening couplings and pressure taps thoroughly insulated. The temperature measuring wells are located as near as possible to the collector inlet and outlet fittings and are filled with a thermally conductive material (Wakefield 120) to insure good heat transfer between the sensors and the copper well. Differential pressure between collector inlet and outlet is monitored with either an inclined or a U-tube manometer depending on pressure level.

Temperatures are measured at the collector inlet and outlet by two different types of sensors. Differential fluid temperature between collector inlet and outlet is measured with six-junction thermopiles manufactured from type T (copper-constantan) thermocouple wire in accordance with ANSI Standard C96.1-1964 (R1969). Absolute inlet and outlet temperatures are measured in the same temperature wells using National Semiconductor Type LM570DH solid state temperature sensors. These sensors are very linear but each has slight differences in slope and offset; therefore, each is individually calibrated and correction factors are programmed into the computer. Temperature sensors are calibrated in place against a Hewlett Packard Model 2801A Quartz Thermometer which has a guaranteed accuracy of 0.02 °C traceable to the National Bureau of Standards. Temperature sensor leads are routed along the hoses under the hose insulation to insure against false readings caused by thermal conduction through the leads.

Total solar radiation is measured with Eppley Precision Spectral Pyranometers which have a temperature sensitivity of $\pm 1\%$ or less from -20 to +40 °C, linearity of $\pm 0.5\%$, cosine error of $\pm 1\%$ or less from 0 to 70 ° zenith angle and response time of 1 second. One pyranometer is mounted on a horizontal surface and one on the center collector frame so that it always assumes the collector tilt angle. An Eppley Normal Incidence Pyrheliometer on a tracking mount tracks the sun to provide direct beam radiation measurements. The diffuse component of solar radiation is computed from the total and direct measurements and sun angles at any given instant.

A complete weather station monitors ambient temperature, humidity, wind speed, wind direction and barometric pressure. One of two wind speed sensors measures wind velocity at a point two meters in front of the collectors and at mid-collector height. This is the wind speed recorded with the test data. This sensor is a six-cup anemometer with an optical chopper transducer. Starting threshold is less than 1.2 km per hour (0.75 mph) and accuracy is ± 1.6 km hr⁻¹ (± 1 mph).

All sensors are sampled at one-minute intervals by a programmable data acquisition system. This system digitizes the data, prints it on a paper tape and records it on magnetic tape for subsequent computer reduction. Pyranometer and wind speed data is also recorded on continuous strip chart records. The pyranometer recorder incorporates a ball and disc integrator that integrates the incoming solar radiation for each test period. A numerical integration is also performed in the computer and agrees very well with the ball and disc integrator as long as there are not transient effects such as cloud passages. Overall system accuracy and precision for absolute temperature measurements exceed the ASHRAE 93-77 requirement of ± 0.5 °C and ± 0.2 °C respectively and meets the requirement of ± 0.1 °C accuracy and precision for differential temperature measurements.

Mr. BUTT. I am not familiar with the specific report that you cite, Mr. Gore, but the general discussion I certainly am familiar with. The problem as far as ASHRAE 93-77 is concerned is not the method. The problem has been with the lack of adequate or adequately calibrated instrumentation in the test laboratories.

In the past few months the situation has been very largely and pretty nearly corrected. That is, major test laboratories have now had their equipment and their installations calibrated. There is no reason why they will not get reproducible results that will make it possible to compare the results properly of the collectors tested.

Mr. Yarosh's facility was one tested. The results can be compared to, let us say, one in California, or one tested in Alabama, Arizona, or any of the other places where test laboratories are presently testing collectors. This is one problem that I certainly think we have now solved.

Mr. GORE. Well, I do not think that is the problem that Mr. Lumsdaine is focusing on. You say you have not seen this particular report.

But let me just tell you that he used the same equipment to test the different collectors.

Mr. BUTT. Collectors are not all the same, Mr. Gore.

Mr. GORE. He got different results testing the same collector with the same equipment. He identified six sources of test error, only some of which he successfully was able to correct.

These were: Collector tilt angle, wind velocity, spectral distribution of radiation, incident angle modifier, differences between test fluid and in situ fluid, and single collectors versus collectors in series.

Let me ask a question regarding another kind of test. There are reports of significant variations in thermal and economic performance data derived from computer simulations, such as sol-cost. Are you familiar with sol-cost?

Mr. BUTT. Yes.

Mr. GORE. Are you familiar with the F-chart, a derivative of a computer simulation?

Mr. BUTT. Yes.

Mr. GORE. Are you aware of the magnitude of the errors in these methodologies? If so, what kind of cautionary statements should a company make of such analyses before the studies are given out to consumers?

Mr. BUTT. First of all, a computer simulation is basically that: It is a simulation. I realize real-life experience is always going to be different. Consumer habits will not be the same as were assumed. The average climate which was assumed will be different from the actual climate.

So, there are these kinds of uncertainties which we certainly cannot do anything about.

As far as the basic way in which simulation programs operate, within reasonable limits, I think both programs will produce results which will properly represent what the consumer can expect to get from a system.

I think Jack Meeker pointed out that how much hot water you get out of a solar heater depends on how you use it. You cannot introduce those differences such as when you plan to do your washing into a computer simulation very well.

Both F-chart and sol-cost seem to be reasonably well representative of what indeed does happen. In the range of operating conditions that would be represented by a space heating system, or by a water heater, the two computational methods will give results which are fairly close to one another; that is, within a rather few percent. At the extreme end of the types of applications that one would encounter, particularly in air-conditioning, the spread is probably unacceptably large between what you get with sol-cost and what you get with the F-chart. They are pretty good methods.

Mr. GORE. Do you think they are pretty good test methods?

Mr. BUTT. Well, simulation methods. Neither sol-cost nor F-chart are test methods.

Mr. GORE. Are they sufficiently reliable to tell the consumer that this is a sound basis on which to judge the quality of the equipment that is being offered for sale?

Mr. BUTT. They do not speak to the question of quality of equipment. They speak to the question of how many Btu's can you expect this equipment to produce, given load characteristics, climate information, and data which identifies and represents the installation itself and its components.

Mr. GORE. If you compare test results on different equipment and match that against the dollar, the price, then it is a means for evaluating the quality. What other means does the consumer have?

Mr. BUTT. When you use the word "quality," I interpret that to mean things that would relate to the durability and reliability of the equipment. Sol-cost and F-chart tell you how many Btu's it will produce, but it does not say anything about whether it will last a month or 10 years or 100 years.

Mr. GORE. Well, one of the sources of information consumers use in deciding what kind of automobile to purchase is the EPA mileage results. It is not very accurate, but as a comparison between automobiles, it has some value.

The errors in each of these tests appear to me to be of a magnitude that they are not useful for that purpose. Am I drawing the wrong conclusion there?

Mr. BUTT. I believe you are, sir.

The rating labeling and certification program that we are about ready to implement is based on performance tests run in accordance with 93-77. It will, in effect, give the consumer something that corresponds to the EPA mileage rating.

It will be somewhat more complicated than that because the rating will vary—that is, the rating for a collector will not be the same in Florida as it is in Minnesota even though the mileage for an automobile may be the same in both places.

So, our system necessarily is going to be somewhat more complicated.

Mr. GORE. Mr. Yarosh, do either you or Mr. Meeker have enough information to agree or disagree with Mr. Butt's assessment?

Mr. YAROSH. I can amplify a little bit on it. An analog might be, for instance, suppose you tested the engine of a car and you tested the engine—just the engine. You obtained a certain efficiency for that engine. How far you would drive a car would depend on the kind of car you are putting that engine in.

I could take that same engine and put it in a very small light car and get one mileage rating. I could put that engine in a very large heavy car and get a very different rating. The mileage I get also depends on the kind of driving that I do, whether in the city or country or whether I drive at a steady rate, and so forth.

In the field of solar, it is even more complex. But let me draw that analogy. We have, so far, tested only collectors which might be similar to the engine of a car. But we cannot just use a collector. That is only one component of a system. We put that collector into a system. How well it does in that system depends on many other components in that system. Like the engine in the car.

What the consumer sees is the efficiency of the whole system. He does not see the efficiency of that one collector, which is the only thing so far that we test.

For example, if I put a very efficient collector into a system, but I do not put a large enough storage tank for water, the efficiency of the system can be very poor, indeed. The efficiency also, as Sheldon Butt mentioned, varies with where I use that system, whether in Minnesota, Florida, or wherever.

The efficiency of that system also varies—in the way that I drew the analog with whether I drive in the city or country—on how I use the water in that system. As Jack Meeker mentioned, whether I use the water at certain times of the day or other times.

I wish it were not so complex, but unfortunately it is. We do not have a real easy convenient index yet to be able to tell the consumer how a given system will work and that after all, is really what he is most interested in. I think more can be done.

I do not see our way out of the woods yet, frankly, in that area. But I believe the directions that we are moving in will contribute.

Mr. GORE. Let us take an average consumer today who wants to buy a solar hot water and space heating system for his or her home. What steps can that consumer take to make sure that he or she gets the best available system for his home and that he avoids the kinds of problems that have turned up in the surveys introduced into the record?

Mr. YAROSH. The first thing I would do, of course, would be to contact the vendors of solar systems, identify a number of them. I would certainly advise that consumer to ask for the names of individuals so he can identify where that solar vendor or installer has already put systems in.

Mr. GORE. Names of prior customers?

Mr. YAROSH. Names of prior customers. Obviously he is likely to get happy, smiling, satisfied customers from the system vendor. But nevertheless I would talk with those people and find out what they think about their system.

I would ask to see the kind of warranty he offers, whether it is a full or limited warranty, and read it extremely carefully.

I would admonish the potential consumer to ask and see the operating and maintenance instructions on the system.

In some cases, depending on the kind of system, there does exist information on systems which have undergone evaluation. For instance, as part of the solar water heater initiative HUD program, the 11 States

that have participated in that program have had to carry out evaluations on the quality and the performance of that system.

Regardless, if I were seeking a solar water heater, I would ask whether those are among the approved systems under the HUD program, whether they had been evaluated and have been certified to participate in the HUD program.

All of these things I would suggest that he do. I would suggest that he get some of the many pamphlets on consumer protection.

Incidentally, one of the things that occurred to me a long time ago is that we have many thousands of libraries around the country. These ought to be centers for information on solar energy.

I again recognize that it is difficult to get information to the public. But I think we can do a better job. These are some of the steps that I certainly would suggest.

Mr. GORE. Thank you for that response.

I notice your emphasis on the importance of warranties. I would call your attention to material previously inserted into the record.

The subcommittee's questionnaire shows that as many as one-third of solar purchasers did not get a written warranty.

Your advice would be to demand a written warranty or else not purchase the system; is that correct?

Mr. YAROSH. I think we have proceeded to the point where I would insist on a warranty; yes. I would have not said that 2 years ago, perhaps.

Mr. GORE. You would not have said that 2 years ago, but you believe that now?

Mr. YAROSH. Yes.

Mr. GORE. Well, Mr. Meeker, what should a consumer do?

Mr. MEEKER. I think you have to proceed today and get some type of warranty.

Without taking the time to read all of this, in the consumer guide that we do publish, it says: "Selecting a Solar Contractor." There are nine steps. There are two or three that have not been mentioned.

One, the contractor should be able to demonstrate support from the manufacturer. In other words, if he is going to be a franchise agency or installer of a particular piece of equipment, he must demonstrate that he has been trained by that manufacturer to install that equipment to demonstrate that he knows what he is doing.

Two, if something goes wrong with the equipment, he is not left holding the bag and the manufacturer is not going to leave town. Most manufacturers are reputable. There is no doubt about that. But there are a few that unfortunately are not.

The one thing that I think is very critical is this. The consumer should have something in the agreement with the contractor that he will come back probably within a week of the initial startup of the system. Most of the problems that occurred in our first year occurred within the first month and first week.

If a control is going to malfunction, specifically it is going to malfunction during the first cycle. In other words, when the sun goes down and comes up again the next morning, if a sensing device has been improperly installed or actually the wires have been twisted or some-

thing like that, the system will not turn on again. You can spot that within a week.

Mr. GORE. Mr. Chairman, I would request unanimous consent to put the text of that consumer guide pamphlet into the record.

Mr. Moss. Without objection, it will be placed in the record at this point.

The Chair would also ask unanimous consent that all material referred in these hearings be placed in the record.

Is there objection?

Hearing none, it will be inserted.

[The solar consumer guide referred to follows:]

BUYING A SOLAR WATER HEATING SYSTEM

PURPOSE

Solar energy provides several major benefits: (1) reduction of national dependence on imported oil, which is subject to supply interruptions and rapid price increases, (2) minimal environmental damage, and (3) reduction of the drain on our limited oil and natural gas supplies. The means of using solar energy to supply heat and hot water are presently available, but the rapid expansion of solar technology has created a new industry whose members vary widely in technical and business competence.

The following recommendations are given by a task force concerned with improving solar hot water systems. They are based on a review of experience with installation and operation of 100 systems, sponsored by the New England Electric System companies, and on the members' knowledge of the solar industry.

Because no condensed statement can replace public education on solar energy's potential and problems, users are advised to consult the many reference books available before buying, particularly, "Buying Solar", (National Technical Information Service PB-282 134); or call the National Solar Heating and Cooling Information Center's toll free hot line at 1-800-523-2929.

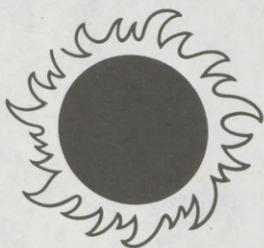
This booklet has been prepared in part with funding from the U.S. Department of Energy through the Solar Technology Transfer Program at Brookhaven National Laboratory.

It may be reproduced without further permission. Acknowledgment is made of the special contribution made by the New England Electric System companies in permitting a review by Robert O. Smith, P. E., of the data obtained over many months of experience with systems from a number of solar manufacturers and contractors. Other contributors include: the

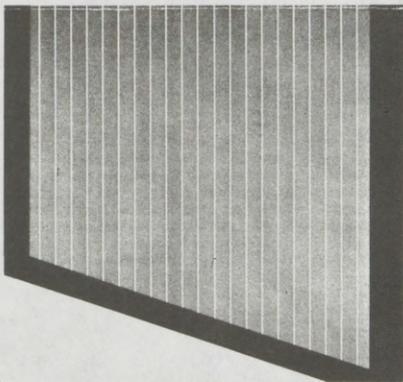
Massachusetts Solar Action Office, the Solar Energy Industries Association, Oak Ridge National Laboratory, the Franklin Institute, and the U.S. Department of Energy. Individuals working on the consumer committee were Messrs. Ryc Loope of Sunworks Inc., Jack Meeker of New England Electric System companies, William Osborn of the Massachusetts Solar Action Office, Gordon Pressa a consultant to Brookhaven National Laboratory, Burt Swerdlow of Grumman Sunstream Division, Ms. Roberta Walsh, Chairperson of the U.S. Department of Energy.

The material herein presented does not represent a consensus or the disparate viewpoints of the contributors. It summarizes useful suggestions from each. Suggestions for its improvement are solicited.

BNL
W. L. Graves
Brookhaven National Laboratory
Upton, NY 11973



SOLAR WATER HEATING CONSUMER GUIDE



Courtesy of

New England Electric
20 Turnpike Road
Westborough, Massachusetts 01581

SELECTING A SOLAR WATER HEATING SYSTEM

- 1 Estimate the total installed cost including materials, labor, permits and fees, and service contract charges based on the contractor's written commitment.
- 2 Obtain in writing an estimate of the system's performance, giving the total solar energy supplied for the year. Two widely used methods of calculating this yield are "The F-chart Computer Program" of the University of Wisconsin and "Solcost" of the U.S. Department of Energy. This figure should be considered with the price quoted by the contractor in selecting a system. Family and house size should be factored into the decision. The system's performance should be calculated and preferably tested by an independent, recognized laboratory in accordance with HUD minimum property standards. The calculations should allow for your location and family size.
- 3 Be sure the collector's face is near true south as possible and are unshaded from 9:00 a.m. to 3:00 p.m.
- 4 Select a system with well-insulated pipes (R-4 or better) and tanks (R-11 or better).

SELECTING A SOLAR CONTRACTOR

- 5 Select a system with adequate protection against freezing. If antifreeze is used, note that toxic materials must be separated from the domestic hot water by a double wall design. If freeze protection depends on the electric operation of a valve, require firm assurance of the reliability and service life of the valve. If the system drains to avoid freezing, check the pitch of all piping exposed to low temperatures to avoid low pockets of water which may freeze and burst.
- 6 Select a system whose proper operation can be monitored. An elapsed time meter on the pump and thermometers in the storage tank and in the pipes to and from the collector are desirable. The meter should read under 80 hours per week. The thermometers should show a sizeable temperature increase while the pump is running. On a bright, sunny day, an increase of 15 to 25 is normal.
- 7 Require the contractor to pressure-test the system for leaks. Very little loss of pressure should be observed in tests of one hour at 125 psig, or of 24 hours at 25 psig.
- 8 Specify in the contract that final payment is to be made after the system has operated satisfactorily for seven days and has then been inspected by the contractor.
- 9 Check your state energy office regarding federal, state, and local tax relief and subsidies for your system.
- 1 Consult several solar contractors before making a selection. While time-consuming, it is essential in obtaining quality work at a fair price.
- 2 Obtain a written quote on the complete job. Consider the cost along with the other factors given below.
- 3 Consider the contractor's location. A local office is important in providing a prompt response to service calls and also will be interested in protecting its local reputation.
- 4 Determine the contractor's qualifications. Experience in installing solar hot water systems as well as in such closely related fields as plumbing and heating is desirable. His support from the manufacturer of the solar equipment is also important and should be verified by a certificate of training or by supervision or inspection of the job by a representative of the manufacturer.
- 5 Establish the contractor's local reputation. Request references and check them regarding satisfaction with the installation, the amount of service that has been required, and the promptness of response to requests for service. Inspect some installations if possible.
- 6 Require a written warranty. Read carefully and consider the provisions of the warranty. Disregard unwritten assurances. Prefer a full to a limited warranty; on a limited warranty find out exactly what is covered (federal law requires that all conditions be stated clearly). Require a warranty on parts and labor of at least one year. Try to obtain a warranty on the collectors, heat exchanger (if any) and tank of five years. Determine the obligations of the manufacturer and the contractor. Seek a warranty that is transferable to a new owner of the property. Obtain a commitment for a response to warranty calls within 15 days.
- 7 Consider the availability, terms and cost of a full system service contract.
- 8 Require an Owner's Manual. The manufacturer should provide a clear and complete manual which the contractor should review with the homeowner.
- 9 Obtain written agreement that final payment will not be made until after the system has operated normally for seven days and then been inspected by the contractor.

Mr. GORE. I would like to thank you gentlemen for responding to my questions. I would like to close by saying that in spite of these problems that we are focusing on this morning, we did find a very high level of consumer satisfaction.

I would just note again that the average monthly savings on the utility bills that we found in our survey ranged from 33.3 percent to 54.2 percent. So, I think that in spite of some of these problems, solar energy is creating a lot of satisfied customers as well as some who are not.

Thank you, Mr. Chairman.

Mr. MOSS. Mr. Greene?

Mr. GREENE. Thank you, Mr. Chairman.

Mr. Butt, as I understand it, the principal, perhaps, if not the only Federal standard that relates to solar systems at this point is HUD's intermediate minimum property standards. Would that be a correct understanding?

Mr. BUTT. Yes, I think so. I do not know of any other major Federal standard other than that intermediate minimum property standard.

Mr. GREENE. To whom does this standard apply? What classes of consumers are covered by this standard?

Mr. BUTT. Specifically, it applies to any consumer who uses VA or FHA financing or who participates in the Government funded or assisted demonstration programs and, I believe, also to the consumers who are participating in the hot water heating initiative. It applies in a mandatory fashion to all of these.

Mr. GREENE. Since most hot water installations are retrofit installations, does the VA and FHA coverage have any significant impact? Are there a number of consumers in that category? Or are most consumers other than consumers under the HUD initiatives excluded from this standard?

Mr. BUTT. Well, most consumers outside of those whom I listed—and these would represent the majority of the consumers—are not covered in a mandatory fashion by the HUD intermediate minimum property standards.

Mr. GREENE. So then a majority are not covered by this Federal standard?

Mr. BUTT. I would suggest to you that probably 80 percent of the total water heater installations are not in a mandatory fashion covered by that standard.

Mr. GREENE. Generally, what does this standard provide for?

Mr. BUTT. It provides, I think, a checklist, a series of statements of what things should be done, what things should not be done. It mandates certain construction or installation procedures. It is a good document. It is in need of revision because more knowledge is available now in some of the areas that are covered, let us say, by statements of intent or guidelines can now be more definitely covered.

Mr. GREENE. Are there particular areas where that greater definition can be provided now?

Mr. BUTT. Yes.

Mr. GREENE. What would those be?

Mr. BUTT. I think in the area of thermal performance testing; we now are much better off there than we used to be. In the area of specifying some of the elements of the reliability and durability; we are better off in many of those areas. The Department of Energy has some programs underway which, within a few months, will give us much more information still in those areas. So, it is an evolutionary proposition. Those are some of the areas, though, that I think HUD would agree a next issue of those standards can address much more effectively.

Mr. GREENE. Thank you—

Mr. MOSS. We are going to have to suspend in order that the roll-call in progress on the floor can be responded to. We will try to be back by 11:30. The committee will stand in recess.

[Brief recess.]

Mr. MOSS. The committee will resume.

Mr. GREENE?

Mr. GREENE. Thank you, Mr. Chairman.

Mr. MEEKER, have you had any experience with the HUD "Intermediate Minimum Property Standards," or were your consumers part of the 80 percent not covered by this?

Mr. MEEKER. We are part of the 80 percent. We began our test before that was published.

Mr. GREENE. I see.

Have you had an opportunity to review the document? Do you regard it as useful to consumers?

Mr. MEEKER. I think it is useful. I have not reviewed it, perhaps, the way I should in an indepth analysis.

Mr. GREENE. Mr. Yarosh, have you had any direct experience with HUD's standards as they relate to solar heating and domestic hot water systems?

Mr. YAROSH. Our center has. I personally have not in detail reviewed those.

We have reviewed the "Intermediate Minimum Property Standards" and have just issued a draft report on our review of those standards. So, I think perhaps a copy of the draft might be made available as a matter of fact.

Mr. GREENE. Mr. Chairman, if the record could be kept open at this point.

Mr. MOSS. We will hold the record at this point to receive that.

[Testimony resumes on p. 181.]

[The draft report referred to follows:]

**Evaluation of
Intermediate
Standards
for Solar Domestic
Hot Water Systems**

**HUD Initiative
(NBSIR 77-1272)
Interim Report**

Prepared For:
National Bureau of Standards
Purchase Order 810880

From:
Florida Solar Energy Center
300 State Road 401
Cape Canaveral, Florida 32920

By:
S. M. Gleman
W. R. McCluney

Date:
September 8, 1978
FSEC RD-78-4



Evaluation of Intermediate Standards for Solar Domestic
Hot Water Systems - HUD Initiative (NBSIR 77-1272)

INTRODUCTION

This report constitutes a preliminary analysis and a set of recommended changes to the "Intermediate Standards for Solar Domestic Hot Water Systems - HUD Initiative, NBSIR 77-1272". It is based on the eleven months experience of the technical staff of the Florida Solar Energy Center (FSEC) in the use of the document (NBSIR 77-1272) in evaluating more than 250 commercial systems presented to the FSEC for acceptance in the HUD/Fla. Solar Hot Water Initiative. Interaction between the industry, installers, homeowners, and the FSEC staff in this process was intense, pressured, often heated, but always productive.

I. What should be the purpose of such a document?

The ultimate purpose of the document should be to define a solar system as acceptable for a tax credit or government subsidy program. In many localities, the document will also be used as a model for building codes; perhaps some states will use it as a model for statewide solar standards. It is therefore very important that the MPS document be so presented (phrased, organized) as to be conveniently accessible to the people in the field who will have to use it. This includes building inspectors and other persons not customarily engaged or expert in solar domestic hot water work. As much as possible, the document should be self-contained, without multitudinous references to other Standards, which may be difficult (in regard to both time and money) to obtain.

A primary motivation of the standard should be to protect the health

and safety of the public, without placing unnecessarily onerous restrictions on the manufacturers and vendors. Of secondary concern for many standards is the protection of the consumer from fraud or hidden defects in quality. However, these matters are increasingly being handled by local, state, and federal regulatory bodies, and therefore do not require detailed attention in this document.

It is especially important that the buyer not be restricted by this document from purchasing low quality merchandise when he is aware of the quality he is purchasing and is willing to accept it in return for a lower price.

II. What was the degree of willingness and/or inferred ability of solar vendors to conform to the Standard?

Most vendors applied a double standard to the Standard. It was fine as long as it kept the "junk systems" (competitors's systems) off the market; however, it became "government bureaucratic interference" when it required a second collector or a tempering valve for their own system.

Most vendors/installers did not have the time or the technical background to read the Standard (copies were supplied free, and instantly, upon request - about 50 copies given out in the course of the program) and apply it to their own systems. The process the vendors used was one of presenting their standard systems to the FSEC, and then perhaps modifying the systems to conform to the Standard after more or less altercation and/or discussion.

It would be very useful to produce a pictorial guide to the Standard, either as an appendix or a companion document in booklet form, which

would show careful illustrations of typical good (compliant) systems alongside bad systems (not acceptable or improper practice); and would outline what would be necessary to upgrade the deficient system. As an example - one of the better companies in the Florida program attempted to shave nickles in the initial installations, by not installing a P-T valve in the collector loop. "System works fine without extra PT valve." They also used a plastic air vent valve at the high point. One bright morning at a particular installation, they isolated the collector to work on another part of the system. Shortly thereafter, they discovered why that section exists in the Standard, when the threads in their plastic air vent yielded and it took off like a rocket amid clouds of steam from the collector. (For at least a while after that they installed P-T valves in the collector loop.) However, if they had seen an illustration of the problem (for example, Fig. 2 of the present report) they would have known of the problem before experiencing it (and may or may not have modified their design appropriately).

III. To what extent is a site visit to a specific installation valuable or even necessary to determine strict compliance with the Standard?

It really depends on how well you know the installer. Some installers bore the inspector with identical, perfect installations. Others do everything but fill the tank with rattlesnakes. Each installer should be examined several times initially, and spot-checked thereafter. In the event that the installer is unknown, and particularly for the do-it-yourself installer, a site visit and careful inspection is an absolute necessity.

Once again, a picture-book of good versus bad installations would save

a lot of trouble. Many fledgling solar installers make many mistakes the first few systems they install, and subsequently learn proper practice from these mistakes. The problem, one of visualization, is best treated by illustration, rather than verbiage.

IV. Which portions of the Standard exhibit the following problems?

a) Ambiguity or lack of clarity in language.

The most difficult sections of the Standard are those on Manuals, S-600-3 et seq. Section S-600-3 makes sense initially, being a listing of identifiable objects, until one reads the commentary and subsequent sections. What is the difference between a simplified owner's manual, and maintenance and operation instructions? And if there is a difference, why should there be?

In particular, we would like to meet the person who claims to understand section S-600-3.2. (We have a stack of real-world manuals for him to evaluate. After his evaluation, he can explain it to the irate vendors.)

In the Florida HUD program, we discarded these manuals sections after much frustrating labor, and produced a simple, fourteen-point checklist for manuals. An annotated version of this is provided as Appendix II. It will be noted that any point can be instantly recognized as existing or not existing in a manual - for example - either it tells you how to drain the collector or it doesn't. We thus didn't have to worry about such puzzling questions as whether this maintenance procedure was "cross-referenced for all subsystems and organized into a maintenance cycle".

Suggestion: rewrite these sections.

b) Requirements overly subjective

All sections on site and building design are considered subjective, impossible to determine compliance, and impossible to enforce, particularly in a limited program such as the HUD Solar Hot Water Initiative.

Recommendation: Delete these sections.

c) Method of determining compliance is inadequate, too expensive, or too difficult.

Examples of problems in determining compliance are provided by each and every section of the Standard for which compliance cannot be determined from a simple schematic diagram (submitted by a vendor). Pipe hangers (S-615.3.1) and their use in a particular system could occupy considerable evaluation time, for a single specific site. Vibration and sound isolation (S-615-6) produce a similar problem. Protection from heated components, (S-600-6.3) connection of collector frames and/or other support structures (S-601-11) and waterproofing of tanks, pipes and ducts (S-607-2.1) are other examples. For all of these, site visits by trained personnel are required to determine compliance. In the Florida HUD program, we required the vendor, as part of his application, to sign a certification that the plumbing and collector mounting would meet the 77-1272 Standard. Our enforcement, however, was necessarily lax.

d) Information to determine compliance is not available.

How in the world is one to evaluate whether a system employs "special design considerations" to avoid the growth of mold, fungus, or mildew on the "shaded membrane area"? (S-501-3.1) How in the world is one

to explain this to a struggling vendor who asks, "do you want me to mount them flat, or leave a space, or put them on a rack?". The Standard should be more specific or else delete this section.

e) Document too detailed for the purpose intended.

This depends on the purpose. If for use of bureaucrats, lawyers, engineers, and major companies, it is nowhere too detailed, since such users thrive on detail. But if it is at all to be used as a guide for small solar entrepreneurs, it is presently unreadable. See section II, paragraph 2 of this report, and also the conclusions and recommendations section.

V. What problems were actually encountered by the FSEC staff in using the Standard, and how were these problems actually handled?

The following certainly is not a complete list, just a spectrum of typical examples (that actually occurred). Other examples are given elsewhere in this report.

Case I

Problem: Large, very well-known solar firm with one of the best collectors in the world drops out of program because it cannot or will not produce a complete test sequence as specified by the Standard.

Action: We expressed our regrets.

Case II

Problem: Very small, inexpensive, low-technology solar firm uses snap-switch thermostat at the collector for control. (Violates S-615-14.4)

Action: The company drives across the State to FSEC, sits down with

engineers. Addition of a second snap switch reduces the total number of Btu's collected by the system, but stops the possibility of losing Btu's in the evening, thereby meeting this section of the Standard. System accepted.

Case III

Problem: Various well-known companies present system using collectors that will not drain by gravity in any position. (Does this violate S-615-10.5? If you have an air compressor, it doesn't take long to blow them out.)

Action: Systems accepted - however - a warning is put on the acceptance certificate as a flag to the consumer that he will have real problems with these systems in the event of simultaneous power failure and freezing conditions.

It should be noted that in no instance was the vendor package approved as submitted. Each vendor ran into a problem somewhere in the evaluation process used at the FSEC for the HUD program, as summarized in Appendix I.

IV. What problems not actually encountered might be anticipated in the use of the Standard for purposes other than those of FSEC?

There is no discussion of low-cost approaches. The Standard if interpreted rigorously, is really limited to drain-down and antifreeze systems. (See sections S-615.14.1 and S-615-14.1) We ignored these sections in order to permit the acceptance of single-tank, direct systems, which in Florida comprised the bulk of the HUD systems presented for evaluation.

A question that arises in meetings with Community Action Agencies and

similar groups is, "How are you going to get solar to the poor people with a Standard that is aimed at, devoted to, high technology expensive systems?" (There's not even a proper picture of a bread-box hot water system in the whole Standard!)

There will be future problems with:

- 1) Aluminum collectors using aqueous or ethylene glycol transfer fluids - just let the pH get out of spec for a day and the collector goes into solution.
- 2) Thermosyphon systems and heat exchangers - someday, someone will have to figure out how to size them properly.
- 3) Collector isolation and drain (for direct systems) without draining the tank, too. The section on draining, S-615-10.5, is too weak. We had to invoke S-615.1.2 on back-up, in order to require this very necessary feature.
- 4) It will be difficult to get building officials and much of the solar industry to read the document. We once again recommend a condensed and profusely illustrated appendix or companion volume to interpret or at least exemplify the full Standard.

VII. What additional safeguards are needed but not presently provided in the Standard?

An explicit statement that the collector (in systems using water as a heat exchange fluid) can be isolated and drained, without interrupting DHW service more than momentarily (say, one to ten minutes).

A better manuals section must be produced. (The present one is almost useless.)

Details of collector mounting requirements should be spelled out.

A useable sizing procedure for single-tank-direct systems.

A useable sizing procedure for thermosyphon direct systems.

A useable sizing procedure for thermosyphon with heat exchangers.

A useable sizing procedure for bread-box collector-tanks.

Specific guidelines on controllers, and control mechanisms, if any.

A single, coherent section on outlet temperature requirements.

VIII. Conclusions and Recommendations

There are two very important problems associated with the development and use of minimum property standards in areas where the technology is developing rapidly.

The first problem is that what is intended as a "minimum" standard actually becomes a "maximum" standard which, for reasons of cost competition, the design engineer strives to meet and not exceed (except in special circumstances). There is no generally acceptable solution to this problem.

One might set the minimum level of quality and/or performance quite high, in recognition of the problem, and thereby force the industry into a high standard of excellence. However, this can be unfair to both the consumer (who has to pay higher prices and buy a higher level of quality than he wants) and to the vendor who is forced to design costly systems that are more difficult to sell. The other extreme has obvious difficulties of its own.

It is recommended that the document contain a prominently displayed statement of general intent at the beginning. The present document

suffers from this problem in several locations. (For example, the wording of section S-615-14.4 places some strong constraints on the nature of the control system that can serve to prevent acceptance of adequate, but substantially cost-cutting approaches to design of this subsystem.)

It is recommended that the wording of several sections (identified in Section IV of this report) be ameliorated to permit a wider range of design approaches.

A very serious problem with the present document is the difficulty with which it is read and understood by the people (such as local building inspectors, plumbing contractors, small solar equipment manufacturers and vendors, etc.) most likely to have to use it. This difficulty stems from the following problems:

- 1) Its length. The "meat" of the document is buried in a long series of sections that are of lessor or no importance to the reader. Although there may be good legal reason for inclusion of extensive requirements in a large number of areas, to do so greatly reduces the effectiveness of the document.
- 2) Its sentence structure. Many of the more important sections contain excessively lengthy sentences couched in legalistic-sounding phrases that are difficult for the average reader to follow.
- 3) Its overly technical nature. The document is written in the language of scientists, engineers, attorneys, and academicians, and as such is not very accessible to the

people (including the consumers) that might wish (or be forced) to use it. Presently, these people are forced to consult with technically trained and fairly well-educated individuals to interpret the document (i.e., to tell them what they can't do). In a more readable form, they could perform this interpretation themselves more easily and probably with greater compliance to the intent of the standard.

- 4) Its reliance on other Standards. Many users will not have ready access to referenced Standards.

The document serves (attempts) to define, limit, or control the practices of a number of people in an industry. But in practice it will not be sufficient to simply write a complicated document and expect its requirements to be carried out.

We have, then, a dilemma. For a standard to accomplish its primary function of protecting the public, it must cover every contingency, every situation, and must not leave any area of potential hazard overlooked. In short, it must be truly encyclopedic. However, its content must be accessible to the people who will use it, or who must live by it.

It is tempting to suggest the publication of two documents, one a legal and technical standard; and the other, a popularized, simplified version. However, this would amount to having two separate standards.

Probably the best solution would be to illustrate the Standard throughout. Examples, such as Fig. 1 & 2 should be included, as well as

expanded, simplified commentary text.

Failing this, a companion volume or appendix to the Standard could be issued, containing the illustrations and supporting commentary on the level of a high-school or vocational school shop text. It should be explicitly stated that the purpose of such a volume would be supportive and illustrative, and that the text of the actual Standard is the final authority.

As a first step in identifying the minimum necessary content of the supplementary material, we offer Table 1, Common Compliance Problems. This table lists sections of the standard which were referenced most frequently by the HUD Solar Water Heating Initiative Project staff in evaluating systems for compliance. These are the sections which need first attention, and would most immediately lend themselves to modification for accessibility to actual, real-world users of the Standard.

IX. Addendum

A paper closely related to the content of this report was presented at the 1978 Denver meeting of the American Section of the International Solar Energy Society. This paper is attached as Attachment 1.

TABLE 1

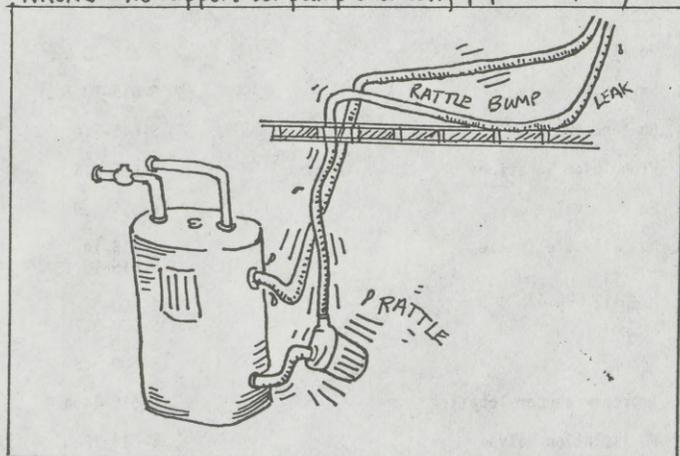
COMMON 77-1272 COMPLIANCE PROBLEMS

<u>Problem</u>	<u>77-1272 Section</u>
No mixing valve	S-615-10.6
No shutoff valve	S-615-10.7.1
No tank drain	S-615-7.4
Wrong pipe locations	S-615-7.6
No P.T. valve	S-615-7.9
No fail-safe freeze	S-615-14.1 S-615-10.15
Manuals	S-600-3 S-600-3.1 S-600-3.2 S-600-3.3
Improper sensor location	S-615-14.4
No isolation valves	S-615-10.5
Requirement for isolation	S-615-1.2
Efficient operation	S-615-14.4

Figure 1

S-615-3.1 Pipe Hangers and Supports

WRONG - No support for pump and long pipe runs.



Right - Pump and Pipe runs well supported - no vibration or leaks.

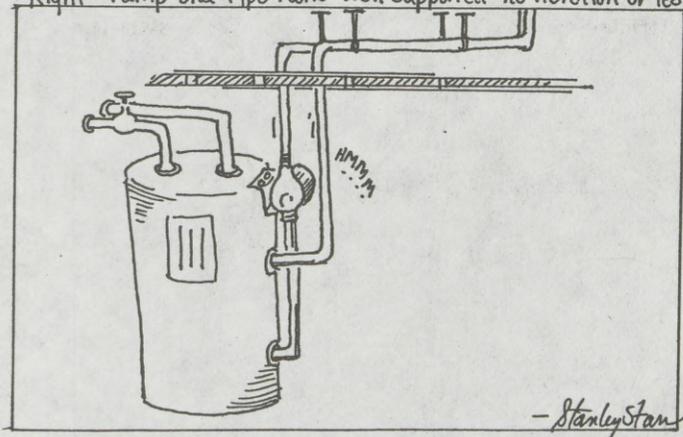
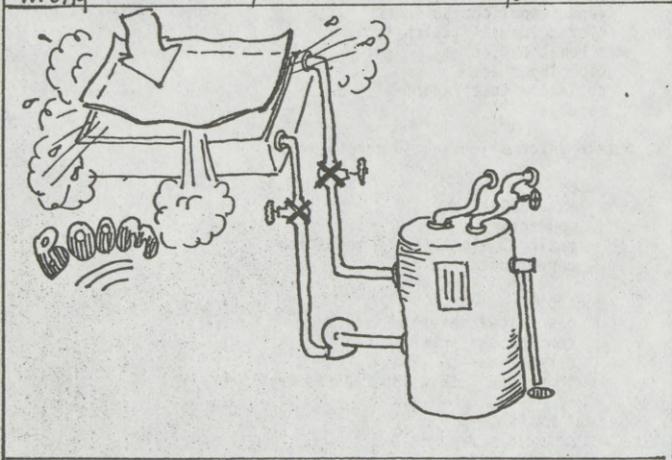


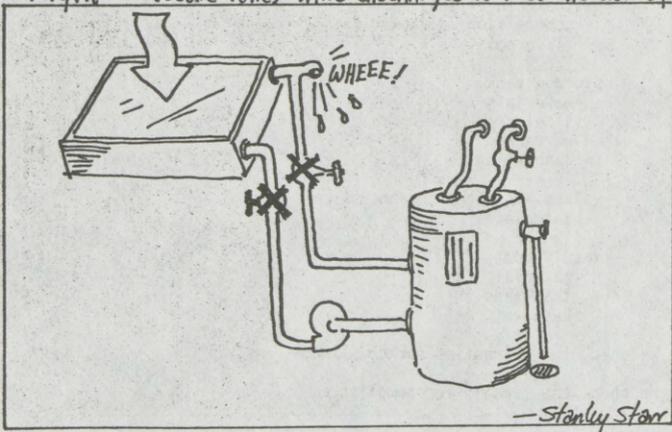
Figure 2

S-615-14.1.1 Automatic Pressure Relief Devices

Wrong - Excessive pressure CAUSES damage to isolated components!



Right - Pressure relief valve discharges to roof - no damage



- Stanley Starr

Appendix I

Brief Report of System Evaluation Procedure

1. We check that all items of information are present, including:

- vendor application sheet
- system identification forms
- schematic diagram
- plumbing sheet
- collector test report
- manuals

2. We obtain information on all components:

- pumps
 - materials
 - warranties
 - ratings, electrical & mechanical
 - recommended fluids
- controllers
 - electrical characteristics
 - control characteristics
 - warranties
 - independent test lab reports or UL approval
- heat exchangers
 - materials
 - construction
- heat exchange fluid
 - composition and toxicity
 - flash point
- storage tank
 - materials
 - size
 - warranty
 - insulation
- valves and other components
 - material
- insulation
 - material
 - thickness
 - R-value

3. We check the warranties for compliance
4. We check the manuals for compliance.

5. We check the system for compliance.
6. We size the system for compliance.
7. We check the collector reports for compliance.
8. We certify the system.

Appendix II

FLORIDA HUD PROGRAM MANUALS CHECKLIST

✓ Acceptable
 X Unacceptable
 ? Questionable

I. INSTALLATION

Aimed at knowledgeable installer

1. Schematic Diagram
One-to-one correspondence with HUD system _____
2. Description of plumbing and electrical
connections in reasonable detail _____
3. Description of collector mounting
including method of anchoring to
roof or rafters _____
4. Description of roof penetrations -
needs a good (typical) diagram (for
plumbing and electrical penetrations
in particular) _____
5. Start-up procedure
(first-time) _____
6. Parts list (Vendor supplied)
Reasonably complete list of parts/
materials required for installation _____
7. Parts list (Non-vendor supplied)
Reasonably complete list of parts/
materials required for installation _____

II. OWNERS

Simplified operation and maintenance - aimed
at average homeowner

1. Schematic Diagram -
as above _____
2. Description of operation including
normal and freeze modes. Tell the
homeowner how it works, not how great
it is. _____
3. List of major components with manufacturers
names and addresses. Pumps, controller, panel,
tank. If you relabel, you can list yourself
as manufacturer. _____

4. Drain and fill procedures to isolate and drain collector loop without more than momentary interruption of DHW service. _____
5. Other maintenance procedures, if any. _____
6. Adequate information to determine if system is working properly. Give a procedure for the homeowner to see if his system is working properly. What should it do? What should it not do? _____
7. Emergency procedures
A brief section on emergency (example: a leak in attic piping - what should owner do?) and safety (example: don't burn yourself on piping or scald yourself when operating P.T. valve.) _____

Attachment I

USE OF THE HUD MINIMUM PROPERTY STANDARDS IN EVALUATING
SOLAR DOMESTIC HOT WATER SYSTEMS FOR THE
HUD/FLORIDA SOLAR HOT WATER HEATING INITIATIVE

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ABSTRACT

We describe the application of the HUD Minimum Property Standards (MPS 4930.2 or NBSIR 77-1272) for evaluation of solar hot water systems proposed by vendors during the Florida Residential Solar Water Heating Initiative Program. Problems arising in the system evaluations (including materials compatibility, toxicity of heat transfer fluids, system sizing, collector testing, manuals, control systems and freeze protection) will be examined, leading to a discussion of practical strengths and weaknesses in the implementation of the MPS document. Industry attitudes and acceptance of the document will be treated. Suggestions are offered for the future improvement of the MPS and for the use of the MPS by government agencies and private concerns.

1. INTRODUCTION

As an encouragement to the solar industry, and a stimulant to public awareness of commercially-available solar domestic hot water (DHW) systems for new and retrofit installation the U.S. Department of Housing and Urban Development (HUD) created 1,650 grants of \$400.00 each to single family residence owners and builders in Florida. This HUD/Florida Solar Water Heating Initiative (HUD Program) is administered by the Florida Solar Energy Center (FSEC). Similar HUD hot water initiatives are currently underway in ten northeastern states.

An important part of the HUD Program involved FSEC certification that the proposed commercial systems would meet the HUD Minimum Property Standards for Solar Heating and Domestic Hot Water (or equivalently, the NBS Intermediate Standards for Solar Domestic Hot Water Systems/HUD Initiative, NBSIR 77-1272, Hereinafter called "the Standard"). The Standard was used to evaluate the more than 250 systems presented by 54 manufacturers for the Florida HUD Program.

To date 151 systems presented by 40 vendors have been certified as in compliance with the standard. The actual use of the Standard, its interpretation, observation, observed effects on industry, and some suggestions for improvement are discussed.

2. SCOPE, INTENT, AND ORGANIZATION OF THE STANDARD

The Standard applies only to the solar energy system, and to immediately associated design and planning. Apparently, the major intent of the Standard is to insure certain minimum levels of quality in DHW systems installed under the HUD Program. "Quality" can be taken to mean operating effectiveness, structural soundness, durability, economy of operation, economy of maintenance, utility, and safety. The Standard first addresses site and building design, then proceeds to materials, system design and construction, and finally considers the problem of sizing or predicting the thermal performance of solar DHW heaters.

3. USE OF THE STANDARD BY THE FSEC

It was impossible, due to staff, budget, and time limitations, to apply the Standard rigorously. Instead, we developed a hierarchy of application for the various sections of the Standard. Some sections were enforced to the letter, and some to the intent, of the Standard. Many sections were ignored or replaced with more specific guidelines.

3.1 Definition of Solar DHW System

The first step in the evaluation process was to determine what constitutes a solar DHW system and what changes to the system would constitute a system model change. It was determined that a solar water heating system consists of the following:

1. Major Components (i.e. collector(s), storage tank(s), pump, controls, heat exchanger and transfer fluid).
2. Plumbing (i.e. piping) tubing, pipe insulation, valves, fittings, hoses, etc.)
3. Collector Mounting Structure

The following guidelines were established for determining what constitutes a new system model:

1. Change in collector model number.
2. Change in the number of collectors.
3. Change in the number of storage tanks (i.e. single tank system versus dual tank system).
4. Addition or deletion of a major component (i.e. direct versus indirect system, pumped versus thermosiphon system).

These guidelines several equivalent pumps, tanks, storage tanks, transfer fluids or heat exchangers could be specified for a given system.

Definition of System Vendor

A second step in the evaluation process was to define the level in the industry infrastructure which would be responsible for applying for system certification. Due to site specific areas of the yard, the installer would have been a likely candidate. However, this would have resulted in massive paper flow and duplication of effort due to the large number of installers around the state. To minimize duplication of effort, application for system certification was required from the system vendor. The system vendor was defined as the entity which packages and/or specifies the various components that form a solar DHW system. In most cases the vendor was the collector manufacturer. When a vendor's system was certified, that system would be installed by anyone provided the vendor's installation instructions were followed. This resulted in minimizing the number of systems for review; however, forced us to ignore several site specific areas of the standard.

Overall Procedure

Vendors who wished to participate in the HUD program were required to submit extensive information and substantiating documentation for their proposed system. We required a complete set of identification forms required from a vendor for each model of solar DHW system. The vendor certified not only each major component of his system by manufacturer and model number or other designation, but also the materials and component maximum ratings of all plumbing components. The vendor was required to furnish an accurate schematic diagram, labelled by the HUD system designation, which showed all components and the manner of interconnection. In addition, each was required to submit a signed certification that the collector mounting and system plumbing for all HUD installations would meet the HUD Standard and local codes. This package was the starting point for system evaluation.

Proposed system descriptions were submitted to us as assembled files of information collectors, pumps, controllers, heat exchangers, storage tanks, transfer fluids, and plumbing components. This information was obtained primarily by directly contacting the manufacturers of the components. Cooperation of the various manufacturers was excellent, except in the case of certain proprietary transfer fluids. (This non-disclosure is quite understandable.) When we had sufficient information, we conditionally accepted a component for certain types of solar systems. This acceptance was usually hedged with necessary restrictions, such as "check materials compatibility with other system components", or "check pump power requirements".

The technical review of a system was a process involving several steps. First, the schematics and identification forms were given a preliminary review for compliance. Such problems as installation pumps in open systems, improper control

systems, single-wall heat exchangers with toxic transfer fluids, incapacity of collector loop to drain, improper valves and so on, were usually evident at this stage of the process. In addition, the installation and owner's manuals were reviewed at this time. Vendors were notified of problems. As collector test reports became available, we sized the systems, using standard analytical techniques such as f-chart, or inventing non-standard techniques as required. Vendors were notified if their systems required more collector area to meet the Standard.

When vendors had responded with adequate information and completed any required changes in their system (usually a process requiring several iterations), the system was put before a final review board, which could either accept the system or send it back for further refinement by the vendor. When a system was finally accepted, certificates (see Figure 1) were issued to the vendor. These certificates served primarily as a signal to the grant recipients that they could obtain their grants if they installed the system called out on the certificate. In addition, any special restrictions or warnings pertaining to a particular system were called out on its certificate.

3.4 Application of the Standard

For a given vendor application package, we first asked the question of utility - "is this a solar DHW system" - and then carefully examined the package with regard to the following:

1. Safety
2. Utility
3. Economy of maintenance and operation
4. Durability
5. Structural soundness
6. Effectiveness (sizing)

(The reason sizing is last is not because it was considered least important, but because for most systems, test reports on the collectors were not available until late in the evaluation process.)

In the evaluation process, Site and Building Design were almost completely ignored (we did refuse to accept one system proposing a series connected pair of collectors, one east - and one west-facing - but this was as much due to sizing as design) although we did collect some data (a sketch of the proposed site) from each recipient application. A complete examination of each site and proposed system would have required the expenditure of substantially more time and funds than were available for the administration of the program. Moreover most homeowners had strong opinions regarding the location of their systems. It would have been futile and injurious to the HUD program to enforce contrary arrangements.

We reviewed the Materials and Compatibility chapter of the Standard and decided to treat it as a specification that the solar DHW systems shouldn't fall apart, blow away, hurt, electrocute, or poison people, catch fire easily, dissolve spontaneously, or deteriorate rapidly. This should be true not only for the individual components, but for the entire system when assembled together. This chapter was applied as strictly as possible.

We viewed the Construction chapter as a specification of good design and construction for the various parts of the system, and for the entire system taken together. Numbers were brought into the document where possible (e.g., "the outlet temperature shall not exceed 140°F"). Some room was left for innovation in approaching any of the desired functions of a solar DHW system, such as heating water, not freezing or exploding, and so forth. However, this chapter was occasionally too restrictive.

3.5 Problems Arising in Application of the Standard

The problems we encountered can be put into two broad categories: those due to reluctance of the vendors, grant recipients, or building officials to accept Standard, and those due to poor or non-specific wording in the Standard. Some examples are given below. (Note - a comprehensive study and evaluation of the MPS is in progress at the FSEC. This will entail a complete listing of specific Standard-related problems encountered in the HUD program.)

Materials compatibility was a frequently-recurring trouble. The Standard is specific on this subject, but public and industrial acceptance of the Standard's requirements is mixed. Consider the question, "can aluminum and copper appear in the same collector?" This, of course, depends on the nature of their use. Nevertheless, at least one local building department in Florida has a specific prohibition against these materials appearing in the program prohibited on this basis.

We dealt with the common occurrence of aluminum absorber plate with copper flow passages by accepting the combination only when the collector enclosure was sufficiently sealed to prevent the intrusion of moisture.

A similar recurring problem was the use of cast-iron pumps in open systems. Even after some of the vendors involved changed their specifications to a compatible material, they installed cast-iron pumps anyway, and subsequently had to change them.

The subject of toxicity of transfer fluids was a difficult one. The original requirement for double-wall heat exchangers for non-potable transfer media was relaxed to a requirement for double-wall heat exchangers only in the case of toxic fluids. What, then, constitutes a toxic fluid? Is propylene glycol toxic? (We thought not.) Is ethylene glycol toxic? (We thought so.) What about decidedly toxic, but low-concentration inhibitors? What about proprietary substances? Certain toxic fluid problems were resolved by the vendor's re-specification of transfer fluid; others have not yet been resolved. It is predicted that toxicity will be a continuing problem.

System sizing was initially a severe problem. In Florida, most systems presented were single-tank direct systems. This precludes the use of f-chart for sizing. Arthur Litka, of the FSEC, developed a program for sizing based on an energy-balance technique (the "Litka method"), which showed a

good correlation with the f-chart solar fraction, for those systems amenable to f-chart. We used this method for all single-tank, direct systems, including thermosyphon systems.

Collector testing was perhaps the most severe and lingering problem. Most test facilities had backlogs, which delayed testing of collectors and thus our receipt of test reports, until late in the program. It is worth noting that some collectors delivered to testing centers before the start of the HUD program had still not completed a test sequence at the final deadline for system approval.

In some cases the test reports and/or facilities were of dubious merit, or in borderline cases, had to be substantially by the FSEC to represent properly the collectors in question.

Manuals are a very important part of a solar DHW system, and were examined very closely in the Florida HUD program. We discarded (after considerable study) the manuals section of the Standard. We felt that these sections were too vague to be implemented.

The question, "does this specific manual meet the requirements of the Standard?" could not be answered in any instance. However, manuals are the only assurance that the vendor's knowledge regarding his particular system would be given to the installer and consumer.

We therefore developed a checklist for manuals which included the following items: (for the installation sections - aimed at knowledgeable installers); schematic diagram, description of plumbing and electrical connections, description of collector mounting, description of roof penetrations, startup procedure, list of parts supplied by the vendor and those to be supplied by the installer; (and for the owners section - aimed at the average homeowner); schematic diagram, description of operation including both normal and freeze-protect modes, list of major components with manufacturer's name and address, collector loop isolation, drain and fill procedure, any other necessary maintenance procedures, adequate information to determine if the system is operating properly, emergency procedures, and safety information.

4. CRITIQUE OF THE STANDARD

The following discussion of the utility of the Standard is based on practical application of the document, and is given in very general terms for brevity.

4.1 Strengths

- 1) The document is usually not overly restrictive.
- 2) The document speaks in terms of currently accepted design, but does not limit innovative design or provides a mechanism for review of novel design.
- 3) At least in regard to standard systems, the Standard usually admits a simple yes or no answer to the question, "does this

*...the same collector, and wanted one of the best collectors in the program...

*"reworked"

particular system meet this criterion of the Standard."

6. Weaknesses

- 1) Even the document is vague, it is unintelligible. (See, for example, the sections of the Standard on manuals.)
- 2) Certain sections are too site specific or too subjective to be implemented (e.g., Site and Building Design) in such programs as the HUD Initiative.
- 3) The document is occasionally too restrictive. (For example, the fail safe controls paragraph, 5-615-14.1, as stated, requires either automatic draindown or antifreeze systems - which would disallow most Florida-type recirculation systems. Also, the efficient operation paragraph, 5-615-14.4, does not permit certain innovative control schemes, such as those involving use of a timer on the pump and stratification of the storage tank.)

7. INDUSTRY ATTITUDES AND ACCEPTANCE

The response of the Solar Industry to the Standard has been varied and interesting. The range of response ran from submittal of elaborate and exhaustive compliance documents on one extreme to the vendor's leaving the program on the other. Industry was unanimously unenthusiastic about the Standard. The prevailing attitude was that the Standard was great as long as it kept "junk systems" off the market. However, when requirements were applied to their own systems, the process was called "necessary interference and red tape". In many cases, the vendor realized an improved system as a result of meeting the requirements of the Standard and eventually expressed satisfaction. On the other hand, some vendors used such requirements as opening valves to gouge the recipients. They would vociferously deplore "bureaucratic interference," and then charge the recipients \$70.00 or \$100.00 to install a tempering valve with the system. Needless to say, this is not a reasonable charge for a \$7.50 item with straightforward installation.

The Manuals Requirements were a particular sore spot with most of the vendors. However, most were eventually pleased with the manuals they produced as a result of the HUD Program.

It is worth mentioning that all of the grumbling about the Standard was small in comparison to the concern over the warranty requirements in the Program.

8. POSSIBLE FUTURE IMPROVEMENTS

The following are offered for consideration as possibilities for improvement of the Standard in terms of practicality and utility of implementation.

1. As a general rule, make sure that an answer or solution for any requirement in a paragraph or section of the Standard. A simple answer should be sufficient for any question raised. It is easy to see, for example, that

aluminum and copper can be used in the flow passages if silicone transfer fluid is specified; however, one cannot look at a manual and say whether its "maintenance procedures are cross referenced for all subsystems". In short, delete subjective matters, and strive for clarity.

2. As a general rule, make sure that important items are treated directly. Consider the requirement for isolation of the collector loop in a direct, open system. The paragraph on System Drainage (5-615-10-5) does not specify valves for isolation. It specifically avoids this. To require valves, one must invoke 5-615-1.1 on Back-up! Succinctly stated, don't leave loopholes.
3. Make sure that several sample systems, complete with manuals, are used to test the Standard before it goes out. These can be obtained from industry, or from the FSEC.
4. Obtain industry comment from at least six vendors. Better yet, get a consensus opinion from an organization such as SEIA.

9. CONCLUSIONS AND RECOMMENDATIONS

It is anticipated that the scope and content of the Standard will dwindle with revision; the various local, state, and federal agencies will increasingly utilize the Standard as a consequence.

We recommend that government agencies, building departments, and so forth, use only the sections of the Standard that they can reasonably apply and enforce. These may presently be limited to very simple, straightforward, and objective matters (e.g. ability of the collector loop to drain in the event of simultaneous freeze and power failure), but can be expanded as the need becomes apparent.

It is recommended that Industry become increasingly aware of, take an interest in, and incorporate the Standard's reasonable requirements into designs. In the event of conflicts due to innovation, the sooner input to NBS is made, the sooner the Standard can be modified to admit them.

As a recommendation for use of the Standard; when in doubt, move in favor of the proposed system, not the Standard. The marketplace should provide the ultimate decision.

Mr. GREENE. Mr. Butt, in your prepared statement, you indicated that a number of voluntary consensus standards were being developed by the industry in conjunction with Government and others. Could you comment initially on how consumer input and new technologies are assured participation in the process of developing those new standards?

Mr. BUTT. Let me address the first question concerning consumer input. In the work which has been carried out by SEREF, which operates through a number of committees—four technical committees and a steering and oversight committee—we have consumer representation on each of the committees. The consumers' representatives in turn, since many of them are not technically trained, are encouraged to bring technical consultants with them.

The key thing, I think, that makes it possible to get meaningful input in this manner is that, because of the DOE funding for this program, we are able to pay their expenses and a modest honorarium so that they are indeed in a position to be there and be heard and make their inputs known. From our point of view in preparing this particular standard—which is a labeling and certification procedure for collectors—we have definitely found that we are better off for having had them there. We will have a better product when we get through. And I think that is important.

Mr. GREENE. The SEREF proposal, of course, is only one of many that relates to the various parts of a typical solar system or solar systems in the broad. Do you know if such similar requirements are imposed upon ASHRAE, ASTM, and various others that are developing those standards?

Mr. BUTT. In general, all of those organizations do, in their committee structure, have consumer representation. The effectiveness of it varies somewhat. I must say, in my judgment, it is probably not as generally effective as it has been in the SEREF program because of the difficulty which the consumers' representatives experience in being able to get to the meetings. Often this is simply a financial difficulty.

Mr. GREENE. The key, from your perspective, would be that the consumer should have, one, the opportunity to participate and, two, they should have access to or themselves be experts.

Mr. BUTT. Yes, sir. Those two plus, since their organizations are generally very short on funds, some funding assistance, I think, is indicated.

Mr. GREENE. The standards process is one which few of us understand very well. Could you describe generally the process by which standards are developed, generally how they are incorporated into model codes, and then how model codes are relied upon by local and State building code officials?

Mr. BUTT. The first step, of course, is to perceive a need for a standard. In the case of the solar standards, this has been done through the American National Standards Institute's Steering Committee on Solar Standards, which, with a great deal of input from the National Bureau of Standards, has developed a matrix of all of the standards which we feel ultimately will be required in the solar business.

Let's use ASTM as an example. Generally speaking, a specific committee of ASTM will accept responsibility for preparation of the standard. It will in turn delegate the actual work to either a subcom-

mittee or a task force of a subcommittee who will meet, discuss the various aspects of the standards. One or more members of that committee will prepare a draft or portions of a draft for assembly together. These drafts will be circulated, debated, modified, and generally hammered out into something that is a consensus. Although not required by ASTM's rules or procedures, very often very close to a 100-percent consensus agrees, yes, this is a good document; it protects me and it protects the other fellow, because the other fellow has been heard, too.

That document will go to balloting by a subcommittee usually, as a first step. An attempt will be made to resolve negatives, to make changes to satisfy people who voted negatively. The standard will then go as a next step to ballot by the entire committee, and the same things happens again. Then, finally, it will go to balloting by the entire association.

Code authorities—in most jurisdictions what is used is a model code or a slightly modified model code, and there are four major model code organizations. They will then reference those standards and in effect say in their code that this piece of equipment has to meet ASTM standard number thus and such. Usually, they will add to that “or equivalent” so as to permit some latitude and flexibility.

That, in general, is the process. One always has a problem, however, in writing a standard, of trying to strike some sort of balance between a very definitive standard and still permitting some latitude for innovation. In a rapidly-evolving industry such as the solar industry, this is a significant problem: Just how you do it so you accomplish what you want to do in terms of protection of the users and assurance of quality or assurance of performance but yet not at the same time make it too difficult for something new to gain acceptance. It is just a problem that you have to face.

Mr. GREENE. Recognizing the delicacy of the standards development process, it would be correct, however, to say that development of a standard is an intermediate step in the process of providing some protection to consumers. That is, there is development of the standard. It is recognized by a code authority. Then it is incorporated into the provisions of law administered by particular States and localities. So, as a consequence, the standards development process is only sort of one-third of the way down the road. Would that be a correct statement?

Mr. BUTT. Absolutely.

Mr. GREENE. How long does it take generally from the time a standard is agreed upon until the time it has the force and effect of law?

Mr. BUTT. In other words, is incorporated in a building code.

I do not think I can give you an accurate answer to that. My primary activity has been in the standards area rather than in the code area.

Mr. GREENE. I see.

Generally, could you give us some broad estimates or ranges of how long that takes? Does it take months? Or does it take years?

Mr. BUTT. In the case of solar, it seems that it happens rather quickly, in a matter of months.

Mr. GREENE. Putting the development of standards in the context of today's hearing what standards have been developed to date dealing with solar devices or solar systems?

Mr. BUTT. The HUD "Intermediate Minimum Property Standards," of course. The Sheet Metal and Air-Conditioning Contractors National Association's installation standards. The two ASHRAE performance measurement standards. The Air Conditioning and Refrigeration Institute's number 910, which is a form of rating, labeling, and certification standard. The SEREF rating, labeling, and certification program, which is substantially more extensive than the ARI program, is very close to being finished, but is not finished. It will be substantively finished in another 30 to 60 days.

There have been some standards developed in Florida, which are being applied in Florida. There is a body of standards that exist in California to determine eligibility for the California income tax credit. There is one model code that incorporates solar provisions—unfortunately, not very well. And there may be some others that I am not aware of. But those, I think, pretty much catalog what is finished as of today.

Mr. GREENE. Other than the HUD standard and the standards you have mentioned in California and Florida, which relate to those States only, how many standards of those that you have mentioned have the force and effect of law? Any?

Mr. BUTT. Compliance with standards is generally, insofar as the standard itself is concerned, voluntary. The force and effect of law comes into play when these standards are referenced in a building code which then, by adoption by local jurisdictions, becomes a regulatory requirement within that jurisdiction.

There is a code in Los Angeles. A number of jurisdictions have adopted the code which I referred to. I do not know how many.

Mr. GREENE. Would it be fair to say that coverage by these codes or recognition by code authorities and by States and localities of these particular standards is spotty?

Mr. BUTT. Yes, that certainly would be fair.

Mr. GREENE. Congressman Gore discussed earlier ASHRAE 93-77, the test standard for collectors and also asked you some questions about the adequacy of labeling and matters related to that.

There are, however, from the consumer protection perspective, questions about durability and reliability, both with respect to collectors and, as Mr. Meeker indicated before, various components and also for systems. When can we expect standards to be developed by the voluntary process for durability and reliability for individual components of systems and then for systems themselves?

Mr. BUTT. The last status report I saw on that subject indicated that some of the ASTM standards in this area should be forthcoming in the next 6 to 12 months. There are a series of these involved.

There is some very important work in this area being done as a part of the Department of Energy's collector test program, which is currently underway, that will give us a great deal more data to use in this standardization process and in developing new standards and modifications to existing standards. I believe, perhaps, the DOE people can respond to some detailed questions regarding their program better than I can.

Mr. GREENE. But would it be fair to say that the consumer cannot immediately expect standards to be available for recognition by code

authorities, et cetera, immediately, dealing with durability and reliability?

Mr. BUTT. That is correct, yes, because we are probably 6 months away from being able to address that broadly.

Now, a few aspects of it can be dealt with at this point of time. But, to address it broadly, we are perhaps 6 months away from being able to do that.

Mr. GREENE. One of the matters which has been brought to our attention is the difference between the effectiveness and efficiency of components as they are tested by themselves and the effectiveness and efficiency of components as they operate inside a system. It has been argued that, for some components, it is unfair to the consumer to have a component-labeling standard or a component-testing standard because they are never operated by a consumer-individually.

Could you comment on that?

Mr. BUTT. Well, yes. ASHRAE is developing, at the present time, a thermal performance measurement standard for measuring the thermal performance of complete residential hot water systems. As soon as that standard is available, I anticipate that a rating, labeling, and certification program to use it will immediately begin to be developed.

It is of help and assistance to the consumer, I think, to be able to compare the characteristics of collectors. True enough, a good collector may not operate in a poor system to its full efficiency. But, given that there are substantial similarities between systems and some general rules of thumb, for example, which are followed rather widely as to gallons of storage per square foot of collector. I think labels that will be available shortly that identify relative performance of collectors should be quite useful to the consumer. But, obviously, it will be still more useful in the future when he is able to have a rating on the entire hot water heater.

Mr. GREENE. When can the consumer expect to see a system rating program generally available in the country for hot water heaters and then for space heating systems?

Mr. BUTT. The ASHRAE standard is presently in draft form being circulated for comment. It would be my estimate, let us say, that we should be able to get our hands on that standard as a finished document to begin an implementation procedure, probably this coming spring. This is my estimate of when ASHRAE might be completed with it.

Mr. GREENE. And implementation might require how much time?

Mr. BUTT. Development of rating, labeling, and certification procedures based on that standard depends a little bit on how the standard ends up looking. But I would hope that we would be able to do it within 6 months.

Mr. GREENE. Would it be fair to say then that, other than for HUD's intermediate minimum property standards, which covers, as you suggest, perhaps 20 percent of the installation out there, that the consumer is pretty much on his own right now?

Mr. BUTT. Well, not entirely so, sir. Most of the water heater system manufacturers, for example, do have data available which identifies performance of their product under standard conditions.

A problem, of course, is the manner in which this is calculated. It is not uniform. So, there may be some lack of total comparability.

Most of the manufacturers of water heater systems do provide information concerning the types of materials used in the system. So, there is a good deal of information available. It is of a sort, however, at this point in time that I think requires that the consumer spend some time studying it and evaluating it and following the guide, for example, in Mr. Meeker's pamphlet.

It is something that requires more effort on the part of the consumer than consumers normally make in purchasing a product. And that is part of our problem, of course. It is a major part of our problem.

Mr. GREENE. Recognizing a general lack of standards but recognizing that manufacturers are providing some information to consumers, what would your advice be beyond what has already been suggested to the individual consumer who wishes to buy a safe, reliable and effective system?

Mr. BUTT. About the only thing I would add to what is in Mr. Meeker's booklet and was explained by him previously and the things that Dr. Yarosh mentioned—in choosing the contractor, choose one that has been in the community for some length of time. Preferably it would be a father and son business in that community, one that you think is going to be there for the next couple of generations; that is very important. Of course, whether it is a solar installation contractor or an automobile dealer, for that matter, that to me is most important.

Mr. GREENE. Would you suggest that consumers look toward, for example, the durability and reliability certifications that are provided under California law for individual systems or individual collectors?

Mr. BUTT. Yes, I think so. This reinforces the consumer's own judgment. It helps him greatly. He may not be able to locate a contractor who has been around for a generation or two. There may not be one available. And this would help particularly in those cases.

Mr. GREENE. Let me take you through standards from perhaps a more industry-oriented perspective.

There have been some who suggest that standards can be overburdensome and that the HUD intermediate minimum property standards have been possibly overburdensome. What is your perspective on that?

Mr. BUTT. There are some individual areas in which the HUD intermediate minimum property standards are excessively demanding. These are some of the things that need to be changed. There are some things in there that unnecessarily add to cost.

Mr. GREENE. Could you identify specific things which add cost without adding consumer benefit or consumer protection?

Mr. BUTT. I will think back a little while because it has been a while since I reviewed them.

In one place they required that, in the case of nonaqueous heat transfer fluids, the flash point had to be, I think it was, at least 100 degrees above the maximum no-flow temperature of the system. The flash point is a technical term. And it is not the temperature at which a self-supporting fire will occur; that is another thing which generally is a higher temperature for the same material.

That particular requirement which, for some purposes, HUD subsequently waived would limit the use of nonaqueous fluids to relatively few fluids, most of which are characteristically fairly expensive.

That is one example that I can remember. That was one that I personally got mixed up in.

Mr. GREENE. Mr. Yarosh, in your presentation to the Second National Conference on Standards for Solar Energy Use, you are noted as having suggested that design suggestions, as opposed to absolute standards, would be a more appropriate way of going forward. Could you comment on that?

Mr. YAROSH. Yes. I am not sure—for instance, you asked when will thermal performance standards be established—I am not sure we want to establish pass-fail thermal performance standards.

I worry about the fact that, if we do in fact require minimum thermal performance, are we removing, as an option, from the potential purchaser the decision to optimize, for example, on the maximum number of Btu's per dollar. In other words, we have to be extremely careful when we establish standards that we do not decide we want all Cadillacs constructed in order to insure reliability. It may be cheaper, depending on the particular circumstances that exist, to buy, if you will, a less reliable system, a system that may not last quite as long but may be significantly cheaper.

We have in fact evidence of that in the solar field already. Certain kinds of systems would not meet some of the tentative standards, but they are very inexpensive systems.

I am not sure we want to remove those options.

Mr. GREENE. Let me interject there, if I might.

Does that suggest then that one of our potential options would be to require testing for durability and testing for thermal performance and labeling in accordance with such tests but not establish that a minimum cutoff be provided?

Mr. YAROSH. Not establish pass-fail standards, for instance, to meet different kinds of requirements.

Mr. GREENE. Just tell the customer what he is getting.

Mr. YAROSH. Yes, it is particularly difficult when you are going to offer tax credits or incentives of certain kinds to require minimum performance without considering economics.

Mr. GREENE. Let me stop you for just a second.

Mr. Butt, would you agree with that as being an appropriate way of going forward?

Mr. BUTT. I think you have to look at different aspects on a case-by-case basis. In terms of thermal performance, a mandatory minimum rating, I think, would be unquestionably a mistake. In terms of some other factors that relate very specifically to durability or even to safety, certainly, I think there are going to have to be pass-fail standards.

So, I think we have to be careful. But I think that we should look for a system that has both in it.

Mr. GREENE. Thank you.

Mr. Yarosh, would you continue.

Mr. YAROSH. Let me give you an example of some of the difficulties we have run into and were brought out in the New York meeting.

The ASHRAE 90-75 was a standard that was developed with respect to energy efficiency in buildings. We since have determined that we can do much, much better than the standards in ASHRAE 90-75.

That was adopted as a part of many codes. I think there are at least 25 States that have that in their code.

One of the problems with our efforts to accelerate the development of standards and move them in the codes is that they tend, when they get adopted into codes, to become hardened, to get set in concrete; and you cannot change them easily. Twenty-five States still have ASHRAE 90-75 as part of their codes, even though we know we can do much better. That is important nowadays, when we are trying to encourage improved energy utilization.

What I am concerned with is the fact that we are trying to accelerate a process that normally has taken, in the engineering field, many, many years. We are trying to compress that down to terms of almost months. In doing that, we are likely to make decisions which, upon reflection, will not have been very wise. They may damage the industry, conceivably, more than they help.

I agree with Mr. Butt that certain kinds of standards on reliability probably can be instituted. But I would look very carefully about those to see how they impact the industry and public. Standards might impact seriously on costs. You do not want to build a system of very high standards which will, essentially, require significant subsidization because of the competitive position of solar with respect to alternative energy. That is another danger that we have to be alert to.

In Florida we do have some standards above and beyond the 93-77. For example, we run exposure tests for a minimum of 30 days on every collector that we test. Then we retest the collector to see if its performance has held up. If it falls 10 percent below the previous test performance, we will not certify that collector. We also examine for other things which are stipulated. Those are in the documents I submitted for the record of this committee.

I think that it is important that we recognize that we might be expecting too much, too soon, from what I call an infant and fragile industry.

I also concurrently recognize that, with the Government being the main driving force through incentives that we expect soon, that they certainly incur an obligation to be sure that they do not encourage the use of poor systems. They must also recognize that they do not want to devise a program whereby they impact on costs and on the designs of systems to the point where they build Government subsidies into the whole process for a very long time. Those are some of the concerns.

Mr. GREENE. Mr. Butt, in your prepared text, you noted that the industry does not "disagree with the concept of a minimum guarantee." What minimum guarantees would the industry not oppose?

Mr. BUTT. What I am referring to there is, in the event that as a condition for eligibility for Federal tax credits—as is true in the case of California as a condition for eligibility for their tax credit—a minimum warranty or guarantee is required. As a matter of principle we would not object to that as being one of the things that was required for eligibility for the tax credit.

Mr. GREENE. Mr. Yarosh, you mentioned in your earlier comments that the Department of Energy demonstration program was not producing data that was especially relevant to the field. Would you specify what you were talking about there?

Mr. YAROSH. What I have suggested in the past is this. We are suspicious that some of the kinds of information that we see in the normal private market sector transaction you may not see in the demonstration programs. The primary reason for that is the difference in the degree of expert oversight that the systems and installations see.

For instance, in a normal private market sector transaction, Joe Doe is interested in a solar system, and he may look in the phone book. He goes around and visits a few dealers. He does not hire an energy or solar consultant. He has no expert body to go to. He makes a decision pretty much on his own and probably mostly through information that he gathers from the system vendors he has talked to or others who have systems.

In the demonstration programs, even in the HUD solar water heater initiative, there is expert oversight. For example, our engineers and scientists have pored over systems and evaluated them and put them on a list before we permitted someone to select a system for the \$400 grant. It is the same way in the demonstration programs that are funded by DOE. There is normally a significant amount of technical oversight.

So, some of the kind of problems that would surface in a private market sector transaction will not be seen in Government programs because you have people looking this thing over.

That is why I have made the appeal that in addition to gathering data from our demonstrations, we go out and find out what the guy on the street is running into who purchased a solar system. What are his problems? And what have his experiences been?

Mr. GREENE. Thank you.

Mr. Chairman, I have no further questions.

Mr. MOSS. Mr. WUNDER?

Mr. WUNDER. Thank you, Mr. Chairman.

Mr. MEEKER, in testimony earlier, you indicated that the second year average for savings for hot water was 40 percent.

Mr. MEEKER. Approximately 40 percent, yes.

Mr. WUNDER. During the break, I asked you what that meant in dollars. You indicated to me that it was roughly \$130 a year.

Mr. MEEKER. That would be 50 percent, but it is close enough.

Mr. WUNDER. I took that and increased it by 10 percent a year, assuming that the utility costs would go up 10 percent a year. It took me 12 years to amortize what you indicated earlier was your \$2,500 average cost. That is a long time before any economic benefits are derived.

Would you not agree that, in order to implement these solar systems on a wide scale basis, it is going to take quite a bit of Government subsidy to reach the average homeowner and even the above-average homeowner?

Mr. MEEKER. Much more than it is now; correct. Keep in mind that the figures that I gave you were predicated roughly on the average family of four at approximately \$260 a year cost of hot water heated with electricity in our service area.

The difficulty that I have when you look at it that way is that it is not attractive for the average family of four right now. I think I

indicated earlier, if you have more people in the family, six or eight people, while your percentage of savings might be somewhat lower than, say, 50 percent, your overall dollar savings is much greater. Therefore, the payback is a little bit quicker.

You have to identify the market. Again, I think the solar industry—I do not want to say were trapped, but that is the only word that comes to me right now. People thought that all they had to do was put a solar collector on their home and save all kinds of money.

Mr. WUNDER. Immediately.

Mr. MEEKER. That simply is not true.

You have to identify the market. The market is there, the people who use more than the average amount of hot water. Unfortunately, right now it is the family who is making more than the average income. But the market is there.

Mr. WUNDER. Can a solar system of the sort that you install break down, malfunction, and the homeowner, the consumer, not know about it?

Mr. MEEKER. Unfortunately, yes.

Some manufacturers now do offer an option where you can spot it.

Mr. WUNDER. How?

Mr. MEEKER. Right now I still think the control is the biggest problem. If the control malfunctions, either the pump will not turn on or it will not shut off. If the pump does not shut off in the North, and you have got freezing temperatures out there, you are taking all the hot water that you built up during the day, and you are throwing it out to the low temperature at night. So, you are losing a significant amount of energy.

You might be able to hear that if you go down to the basement and listen for the pump. However, most pumps are rather quiet today; you almost have to go over and put your hand on it to get a vibration to feel if it is running. But, if a control breaks down and it does not operate the pump, in most cases the homeowner—unless he really wants to go out there and really is enthused with solar and checks it out every day, will not notice it.

To answer your question how—what we did is put an elapsed time meter on the control. So, when we monitor it weekly, our technicians go out there. You can tell how many hours during the week that pump has operated.

Probably a little bit cheaper method of doing this would be to install a light indicator in the kitchen or upstairs so the housewife, or whoever, could look at it and see, if it is a sunny day, that light is not on then the pump is not working.

The same thing would be true if, at 11 o'clock at night, the light was on and the pump was running. If it is 20 degrees out there, then you know you have a problem.

Mr. WUNDER. What you are describing now is what Mr. Yarosh talked about earlier; the level of sophistication that you have in your demonstration project is far greater than the type of person in a private transaction that he was talking about.

Mr. MEEKER. No doubt about it.

Mr. WUNDER. In your experiment, were the systems that you put in exclusively solar hot water?

Mr. MEEKER. They were all hot water with electric backup and all retrofit systems.

Mr. WUNDER. In terms of the sophistication of the system, is space heating more sophisticated than hot water alone?

Let me go up the ladder. Space heating plus hot water; and then space heating with air-conditioning and hot water.

Does it go up in terms of level of sophistication of the system?

Mr. MEEKER. I think you have to identify the region of the country you are talking about, for one. Certainly in New England it would not do you any good to retrofit a solar heating system, in my opinion; because you have to insulate the heck out of a home. It would be rather costly, also. However, in the South you have a different story.

In New England, I would think right now, on a retrofit basis, the best type of system to install would be solar hot water—then solar water and space heating.

Mr. WUNDER. To get back to the thrust of my question. Let me ask Mr. Butt this question.

Are solar hot water systems the least sophisticated in terms of the hardware, let us say?

Mr. BUTT. There is not much difference in sophistication between a hot water heater and a space heating system, just primarily a difference in size. When you go from that to a solar-driven air-conditioner, then you do make a great change in the degree of sophistication.

Mr. WUNDER. The types of problems that Mr. Meeker and his company found with the least sophisticated solar system could therefore be considerably greater when you go to this more sophisticated system because of the fact that it is more sophisticated, and it may have this greater propensity, if you will, to have a problem. Is that a fair statement?

Mr. BUTT. The difference in the case of a space heating system is, as I mentioned, not very great. You do not really have many more different kinds of things to go wrong. When you get to the air-conditioning, then indeed there are a whole additional list of things that can go wrong.

Mr. WUNDER. Thank you, Mr. Chairman.

Mr. MOSS. Are there further questions? Mr. Gore?

Mr. GORE. I have a couple of questions following up on counsel's questions.

Mr. Meeker, you said that solar space heating would not be viable in New England. I am not sure that is completely accurate. I have seen a number of houses that use solar space heating in New England.

We had hearings earlier on passive solar heating. Some of those systems work extremely well in any climate in the United States. And there are some active solar space heating units in New England and climates similar to New England that do work.

You mentioned the importance of insulation. I think that most people would agree that insulation is a prerequisite for solar heating through the United States.

Mr. MEEKER. I thought I said—I am incorrect if I did not—on a retrofit market. In other words, if you were going to install a solar space heating system on an existing home—and in New England most of your homes are of an older nature and are not insulated the way they should be—then you would have an awful problem.

Mr. GORE. Yes, insulation is the first step that a consumer should take before getting very interested in solar energy. Would you agree with that, Mr. Butt?

Mr. BUTT. Absolutely; no question at all.

There are difficulties associated with retrofitting something as large as a space heating system to most existing homes. There are difficulties with retrofitting an existing home so as to make insulation adequate. You can usually do that, of course, in the attic. It is often rather difficult, to the point of being impractical, to do it in the walls.

Our own view is that, in the space heating area, for a number of years to come, what we will mostly see are applications to new residences and water heaters. Since there are so many more existing residences than there are new ones built every year, the bulk of the water heater market, I think, will continue to be retrofits.

Mr. GORE. I wanted to make one final point on this notion of sophistication and see if you agree with my information about this.

When you get to cooling, then you really increase not only the sophistication but the availability—all kinds of problems enormously. Solar cooling is in a completely different ball park than solar heating or water heating. Is that correct?

Mr. BUTT. Absolutely.

Mr. GORE. As for the difference between space heating and water heating, it is really not one of sophistication; it is one of size and capacity. The differences in sophistication come between air systems and water systems, between systems where you drain the fluid during the winter, systems where you use antifreeze-type compounds, systems where you mix the hot water or where you have the heat transfer. But between space and water heating, there is not that much difference.

Mr. BUTT. That is correct.

Mr. GORE. Thank you, Mr. Chairman.

Mr. MOSS. Gentlemen, we want to thank you for your appearance here. It is helpful to the committee in the furtherance of its work. At this time you are excused.

Mr. BUTT. Thank you, Mr. Chairman.

Mr. MOSS. Our next witnesses will be a panel composed of Mr. Joseph Sherman, Mr. Carl Conner, Mr. Mike Power, and Mr. Dave Engel. The witnesses have no statements.

Mr. Gore?

Mr. GORE. Mr. Engel, in your August 25 status report on solar energy, which has been circulated for public review and comment, the consumer protection actions of the Federal Government are treated in a single paragraph.

On page IV-19, the report observes, "Widespread public confidence is a critical factor for increasing solar energy use." I would presume that the reverse is also true, that a widespread lack of confidence would quickly reduce solar energy use, as happened with heat pumps, as the chairman referred to. Is that a fair assumption?

STATEMENTS OF JOSEPH SHERMAN, DIRECTOR, DIVISION OF ENERGY BUILDING, TECHNOLOGY AND STANDARDS, DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT; DAVE ENGEL, CO-CHAIRMAN, INSTITUTIONAL INCENTIVES AND BARRIERS PANEL, DOMESTIC POLICY REVIEW OF SOLAR ENERGY INTEGRATION GROUP, HUD; CARL CONNER, PROGRAM MANAGER FOR STANDARDS, CODES, TESTING AND CERTIFICATION, DEMONSTRATION BRANCH OFFICE OF SOLAR APPLICATIONS, DEPARTMENT OF ENERGY; AND MIKE POWER, Ph. D., COCHAIRMAN, INSTITUTIONAL INCENTIVES AND BARRIERS PANEL, DOMESTIC POLICY REVIEW OF SOLAR ENERGY, DOE

Mr. ENGEL. Yes, sir.

Mr. GORE. In part six, Opportunities for Federal Action, there is another discussion of the need for consumer information and protection. It is also quite brief. It states, "Since many such services are the responsibility of State governments, the Federal Government may choose to work largely through the States."

Four options are listed. I would like to examine each one of them.

The first is support of diverse solar information and education programs including the use of neighborhood and community groups.

Does either DOE or HUD have a coherent and comprehensive policy regarding the categories and quantity of information that will be presented to potential solar consumers and which defines the medium and the means of information transmission?

Mr. ENGEL. One of the key elements of the HUD-DOE solar program is the National Solar Heating and Cooling Information Center, which is funded jointly by HUD and the Department of Energy. That is probably at the point the major vehicle for the outreach of information to consumers and to the building industry, which in some ways are consumers themselves.

Some of the publications are broadly disseminated. One in particular, "Solar Energy and Your Home," has been distributed to over 3 million households in the past 2 years.

I think probably Mr. Sherman could talk in more detail about the nature of that information program.

Mr. GORE. Mr. Sherman?

Mr. SHERMAN. You have seen most of the material in prior committees. We do, through the National Solar Heating and Cooling Information Center, distribute consumer information ranging from consumer tips on solar energy through what it is like to have domestic hot water in your home, as well as solar heating in your home, what to look for, and what not to do—including things like Mr. Meeker's book. So, we do do information dissemination to the general public as well as individual constituencies that we are trying to reach, such as the builders, the manufacturers, and what have you.

As far as the longer term role, there is a role for that information center as well as the regional Solar Energy Research Institutes, and the national SERI. There are groups out there with information that had not been out there just as short as 2 or 3 years ago.

As far as working with neighborhoods, we do have a group within HUD that works with neighborhood consumer groups. We are getting information out through that path as well.

Mr. GORE. Do you think you have focused enough on consumer protection and giving people information they need to avoid some of the problems that our survey showed up?

Mr. SHERMAN. Without literally taking each one in hand and walking them through the process, I think we probably have gone quite far.

With the standards that we have—again, it is only a certain percentage of the market because there is no mandate for national standards—with the FHA mortgage insurance, with the work that we are doing in reviews of solar systems, and, more importantly, with the fact that, when a system manufacturer meets a set of standards, the chances of him changing that product to market to an outside group is unlikely. So, as a result, once he has met the standard, once he has been reviewed by the Solar Energy Center or others, the chances of him coming out with a different product to market outside that limited market is unlikely.

As a result, those standards, even though they only address some 20 percent of the market, actually impact a very much larger percentage of the market.

Mr. GORE. You rely on the toll-free number; right?

Mr. SHERMAN. As a passive means of information. We also go out to conferences, State fairs, and all kinds of other things. We have a mobile solar van that travels all around the country to all kinds of major exhibits. We have a whole active program as well as the toll-free number.

Mr. GORE. Suppose somebody comes to one of your programs. Or suppose somebody calls the toll-free number—incidentally, what is that number?

Mr. SHERMAN. From anywhere but Pennsylvania, it is (800) 523-2929, from Pennsylvania it is (800) 462-4983.

Mr. GORE. I always wondered why that is. All these 800 numbers always have a subtitle “except in Texas” or “except in New Hampshire.”

Mr. SHERMAN. The State that the center is located in has a different number.

Mr. GORE. I see.

Suppose I call that number and say I want to buy a solar hot water heater. What brand should I get?

Mr. SHERMAN. We will not tell you what brand you should get. But we will send you two documents. One is Consumer Tips on Solar Energy, which talks about the supplier-installer, what you can expect in costs and repairs, what kind of warranties you need, design and sizing, zoning and taxes, testing. These are just headlines of the document I am reading. I would like to submit it for the record here at this point.

[The document referred to follows:]



NATIONAL SOLAR HEATING AND COOLING INFORMATION CENTER

P. O. BOX 1607
ROCKVILLE, MD 20850

CALL TOLL FREE (800) 523-2929
IN PENNSYLVANIA CALL (800) 462-4983

SOLAR ENERGY SYSTEM CONSUMER TIPS

Solar heating and cooling is a growing business, with over 3,000 U.S. suppliers and installers selling solar systems. This paper gives some guidelines to help you select the best solar system for your needs.

Exercise care in your decisions just as you would for any important purchase. Consider your solar investment in the same way you would regard buying a car or any major appliance. Your first job is to acquaint yourself with how solar space heating or hot water systems work. Then shop around, checking with several suppliers or installers before making the final decision.

SUPPLIER/INSTALLER

When contracting the supplier or installer, find out his track record. How many systems has the firm installed? Do any members of the firm have heating, plumbing, or engineering experience? Did anyone receive formal training from the manufacturer on how to install the system? If not, will the manufacturer have any control over the installation process?

COSTS/REPAIRS

Make sure to obtain a cost estimate in writing. Find out how much of the cost is for the system itself, and how much is estimated for installation. Also, inquire whether any regular maintenance will be required, and if so, how much it will add to the initial cost. See if the installer will offer you a service contract. If the installer does not perform repairs, find out who will, and check whether the manufacturer offers a complete supply of parts.

When shopping for a solar system, try to find out about the past performances of both the product itself and the installer. Try to obtain a list of previous buyers of the system you are considering. Has it lived up to its advertising?

WARRANTIES

When examining the warranty be sure to find out:

- A. Is it a full or limited warranty? If it is limited, find out what is covered and what is not.
- B. What responsibilities will you have to keep the warranty current? What must you do to file a warranty claim?
- C. How long will the warranty last? Long-term warranties are appealing, but some may be misleading. Be wary of extended guarantees or promises which appear unrealistic; make sure the company you are dealing with is financially able to back them up.

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THE NATIONAL CENTER AND THE ABOVE ORGANIZATIONS DO NOT ENDORSE, RECOMMEND OR ATTEST TO THE QUALITY OR CAPABILITY OF ANY PRODUCTS OR SERVICES OF COMPANIES OR INDIVIDUALS.

DESIGN AND SIZING

While there are basic "rules of thumb" which can be applied to sizing solar systems, they ignore many complex factors which are involved in the proper design of a space heating or hot water system. Therefore, the responsibility of sizing a solar system should rest with the solar engineer (or qualified building sub-contractor) in cooperation with the supplier.

If you are shopping for a domestic hot water system, it is helpful if you know your family's hot water consumption rate. It has been estimated that each family member will use an average of 20 gallons of hot water each day, but this figure will vary depending on the number and size of your hot water-consuming appliances. If you are shopping for a space heating system, it is important to know your home's heating requirement. There are some computerized services for sizing solar energy systems which may be helpful in the design process.

Like any conventional heating system, your solar system will be economical only as long as your home is energy-efficient. For existing homes, this may dictate upgrading your insulation if it is currently inadequate. For new homes, the natural factors of the building site should also be considered. These factors include local climate and topography, along with the building's site orientation and construction type. Remember, by designing with nature, you will be able to reduce your home's energy consumption.

RETROFITTING

If you are considering adding solar to an existing building (retrofitting), make sure to ask yourself the following questions:

- A. Does your roof have enough southern exposure to accommodate the collectors? Does that area have any existing or potential shading problems?
- B. Is the roof strong enough to hold the collectors? This factor is critical with solar space heating systems which require large collector arrays. The small number of panels required for solar domestic hot water systems should not affect most roofs.
- C. If you are considering adding a solar space heating system, is your present heating system compatible? For example, forced-air heating systems are good mates for solar systems because they operate at similar temperatures. However, hot water and steam heating systems are less suitable because they operate at temperatures higher than those produced by most solar flat-plate collectors.
- D. How much will it cost to remodel the building for solar? The cost of necessary remodeling is a vital factor when determining whether a solar retrofit will be economical.

ZONING AND TAXES

Before your solar system is installed, be sure your installer checks local building and zoning regulations. Also, find out whether you will gain any tax advantages from owning a solar system; many states and communities have already passed laws which grant a reduction or exemption on sales, income, or property taxes. Finally, make sure your solar system is covered by your home insurance policy.

SYSTEM TESTING

Once the system has been installed in your home, be sure the installer thoroughly tests it out. For instance, the system should be pressure-tested in order to detect leaks. Thermometers should be placed on pipes or ducts going to and from the collectors to monitor the system's heat gain; another thermometer should be placed in the storage area to measure how much heat is being retained. All switches and moving parts should function quietly, and elapsed-time meters should be used to find out whether these parts (i.e., pumps or fans) are working more than they have to. It is important that some simple monitoring equipment (such as thermometers or pressure gauges) is a part of your system, so you can check its performance from time to time. Finally, be sure that the installer leaves you an operating manual for your system.

As with any major purchase, you'll be more satisfied with your solar system if you exercise care while selecting it.

Additional Sources of Consumer Information

THE BUY WISE GUIDE TO SOLAR HEAT...Floyd Hickok, editor; Hour House, PO Box 40082, St. Petersburg, FL 33743, 1976, 121 pp, \$9.00.

BUYING SOLAR...Federal Energy Administration. Available from: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Stock No. 041-081-00120-4, 1976, 71 pp, \$1.85.

HOMEOWNER'S GUIDE TO SOLAR HEATING AND COOLING...W.M. Foster; Tab Books, Blue Ridge Summit, PA 17214, 1976, 196 pp, \$4.95.

SOLAR HOT WATER HEATING AND YOUR HOME...Available from: National Solar Heating and Cooling Information Center.

DC105
1st Edition
Oct. 1977

Mr. SHERMAN. In addition you will get a document such as this, which explains what domestic hot water is and additionally gives you consumer tips. But, more important, it gives the names of manufacturers that we have identified through the National Solar Heating and Cooling Information Center that are located in your area that serve your geographic area without rating them in any way, so that they can go out and contact these manufacturers. At least they have a starting point.

That is about all you will get. You will not get a recommendation at all as to what system to use.

Mr. ENGEL. I might add that both those publications are being substantially expanded and updated right now. New versions of both those publications will be available in the next couple of weeks probably.

Mr. SHERMAN. I have copies which I cannot even leave with you because these are the only two available right now; they are in my office for review. I will give you the titles: "Solar Hot Water in Your Home, the Basics." It is a major expansion of "Solar Hot Water in Your Home." It is an update of "Solar Hot Water in Your Home" and there is a companion publication, an economic workbook. It covers the basics of solar domestic hot water technology and consumer considerations, some introductory economics; but most are left for the next document.

Mr. MOSS. We will ask that you have that copied and supply us with a copy. We will hold the record open for it.

Mr. ENGEL. I shall.

The next document, which is the actual economic document that the consumer will get, this is also under review. I will just read the title: "Solar Hot Water in Your Home, Economics Workbook for Homeowners."

Mr. MOSS. I make a similar request on that with a similar reservation.

Mr. SHERMAN. Yes, sir.

[Testimony resumes on p. 294.]

[The publications referred to follow :]

SOLAR PUBLICATIONS

DATE: September 12, 1978TITLE: SOLAR HOT WATER AND YOUR HOME: THE BASICSNUMBER: SD-142 (Also see SD-118)RESPONSIBLE ORGANIZATION / INDIVIDUAL: FIRL/B. SchultzWHO IS IT FOR? (intended audience): Consumers

Give user needs justification if applicable. _____

Quantity to be printed. _____

WHAT IS IT ABOUT? (topic): Update of Solar Hot Water & Your Home and companion to SD-118: Economics Workbook. Covers the basics of solar DHW technology, and consumer considerations. Some intro economics but most are left for SD-118

WHY DO WE NEED IT?

WHY WILL THE INTENDED AUDIENCE WANT TO READ IT?

HOW DOES IT FURTHER THE GOALS OF THE SOLAR INFORMATION PROGRAM?

Most consumers ask for easy-to-understand info on solar DHW. The old SHW&YH is a bit out dated and limited. The revised version will fit nicely into the Solar DHW economics workbook.

NOTE: Text on WANG #0538A, Tape 39A

WHO SUGGESTED THIS TOPIC? A. ReigerWHO APPROVED THIS CONCEPT? A. Reiger

* This article will be sent to F. Weinstein on 9/13/78, then to A. Reiger (HUD)

SOLAR HOT WATER AND YOUR HOME: THE BASICS

August 23, 1978

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INTRODUCTION

Solar Energy has been around for centuries. Its uses have been as varied as the needs of humanity -- heating buildings, drying grain, generating industrial heat, brewing beer. Today, of all the things that can be done with solar energy, heating household water is one of the most practical.

Although solar domestic water heaters have gained widespread acceptance over the last few years, they have been used in this country since the 1890's. More than a hundred manufacturers now produce solar water heating equipment, and tens of thousands of American households are using this hardware to put the sun to work.

Most consumers who are shopping for solar water heating systems are talking with distributors or manufacturers of solar systems. This booklet tells what to look for and suggests points to consider about systems, costs, guarantees and reliability. It explains how solar domestic systems operate, and what the financial considerations of installing a system are. It tells you what you should know to become an informed solar energy consumer. You will find a glossary of solar energy terms and a bibliography of books and pamphlets about solar energy.

A companion volume, *Solar Hot Water and Your Home: Economics Workbook for Homeowners* is also available for free from the National Solar Heating and Cooling Information Center. It will show how to estimate the costs and savings you can expect if you install a solar domestic hot water system in your home.

HOW DOES IT WORK?

The basic function of any solar hot water system is the conversion of solar radiation ^{or} (sunlight) into thermal energy ^{or} (heat) that can be used to heat water for home use. The sunlight must be collected, changed into heat, stored for future use, and moved into the household water supply.

Solar energy systems are not usually designed to provide 100% of a home's hot water. When there is enough sunlight, the solar system itself can make the water as hot as you need. At other times, it does some of the work for your conventional water heater by pre-heating the incoming cold water. If you have used up all the solar heated water, your conventional system can do the whole job.

Because it uses an automatic control system, a solar hot water system is no more complicated to use than any conventionally fueled heater.

Let's look at the components that make up the system and see what they do.

COMPONENTSThe Collector

The solar collector converts sunlight into usable heat. Of all the different types of collectors available, the flat-plate collector is the one most often used in solar domestic hot water systems.

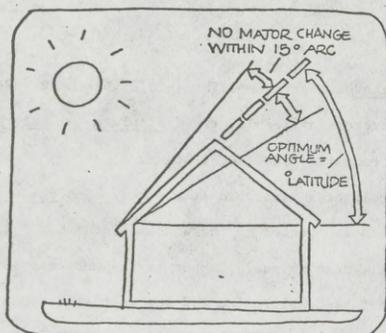
The flat-plate collector is shaped like a box. The absorber plate turns sunlight into heat and is located on the bottom of the box. It is usually made of copper, steel, or aluminum. Copper is the most expensive material, but it offers the best heat absorption and the most resistance to corrosion. The surface is painted black, so it absorbs light well. Instead of paint, some absorber plates are covered with a special selective coating that increases their absorption of sunlight. Insulation is placed behind the absorber plate to keep heat from escaping through the back of the collector.

A transfer medium, usually water or air, is passed through the absorber plate and heated. It carries this heat out of the collector, to the storage tank.

The top of the collector is made of one or more layers of glazing (glass or plastic) that keeps heat that has accumulated on the absorber plate from escaping to the air. These cover plates are fitted into the weather-resistant sides and back of the box.

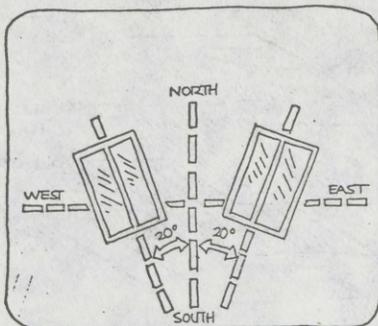
Flat-plate collectors are designed to accept sunlight from many different angles, so they don't have to move to track the sun. They should be permanently mounted at an angle equal to the latitude, but a variation of fifteen degrees either way is acceptable. Flat-plate collectors should face true south, but a difference of up to twenty degrees either way is acceptable.

If the pitch of your roof corresponds to this alignment, the collectors can be mounted directly onto the roof. If the pitch isn't right, mounting



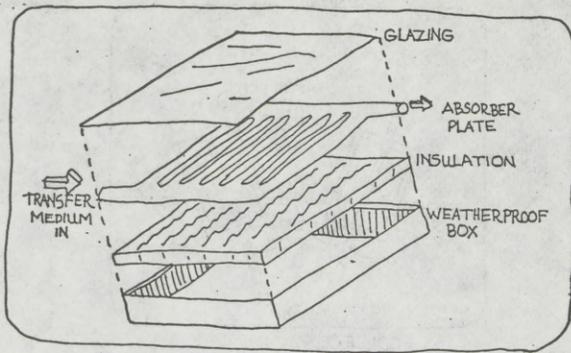
COLLECTOR TILT FOR DOMESTIC HOT WATER

Collectors should be permanently mounted at an angle equal to the latitude, but a variation of fifteen degrees either way is acceptable.



COLLECTOR ORIENTATION

Flat-plate collectors should face true south, but a difference of up to twenty degrees either way is acceptable.



FLAT-PLATE COLLECTOR

Flat-plate collector is the most often used solar collector in domestic hot water systems. (The absorber plate turns sunlight into heat and is located on the bottom of the box.)

racks can be used to correct the alignment. If it is impossible to mount collectors on your roof, they can be mounted on racks on the ground.

(illustrate)

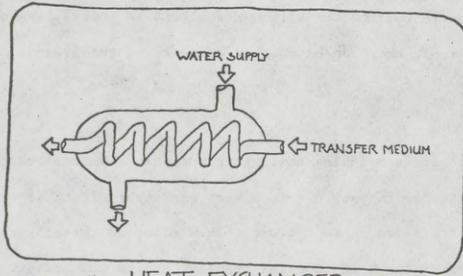
Heat Exchangers

A heat exchanger is a device that transfers heat from one substance to another. The radiator in your car is a heat exchanger; it takes the heat from the coolant and transfers it to the air. In a solar hot water system, the heat exchanger takes the heat from the transfer medium and puts it in your household water. Systems that use household water as the transfer medium don't use a heat exchanger, but all other systems do. Sometimes ^{non-drinkable} poisonous additives must be used in the transfer medium; then, a double wall heat exchanger must be used. This gives added protection against contamination of the drinking water.

Storage Tank

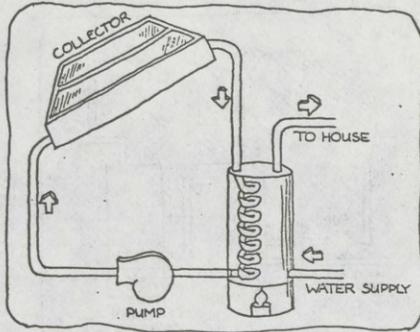
A storage tank is used to keep a supply of solar heated water for times when no solar energy is being collected. This tank is heavily insulated and is made of steel, fiberglass, or concrete. The heat exchanger transfers its heat to the water in the storage tank. The water is then ready for household use.

In some systems, the solar storage tank is also the conventional water heater tank. Whenever the sun is shining, the water in the tank is heated. If enough solar energy is collected, the water can be used without further heating. Should the temperature in the tank drop below the desired degree, a thermostat automatically turns on the conventional water heater to provide supplementary heat.



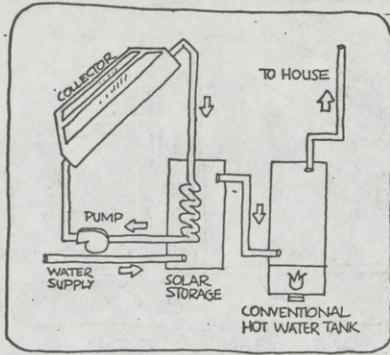
HEAT EXCHANGER

In a solar hot water system, the heat exchanger takes the heat from the transfer medium and puts it in your household water.



A ONE TANK SYSTEM

A storage tank is used to keep a supply of solar heated water for times when no solar energy is being collected.



TWO TANK SYSTEM

Besides the obvious advantage of greater capacity, the two tank system operates at a higher overall efficiency than the one tank system.

In most systems, the solar heated water is kept in a separate tank from the conventional water heater. Cold water enters the solar storage tank, is warmed by circulation from the solar collectors, then drawn off to the conventional water heater. Besides the obvious advantage of greater storage capacity, the two tank system maintains a lower temperature in the solar storage tank than in the conventional water heater. Since the storage is cooler, the transfer medium will also remain cooler. The cooler the transfer medium, the more easily it can pick up heat from the solar collector. Because of this, the two tank system operates at a higher overall efficiency than the one tank system. Of course, the price of the second tank adds to the initial cost of the system.

Water is always drawn from the top of the storage tank, because that's where the hottest water is. This tendency of water to separate into layers of different temperature is called heat stratification.

Pumps and Plumbing Fixtures

In most domestic hot water systems, a pump is used to force the transfer medium through the collector, to the storage tank, and back to the collector. The pump and the pipes which connect the other components and control the flow of the transfer medium are standard plumbing materials, installed using standard techniques.

Shut off valves are used to isolate any component from the rest of the system; this makes checkups and repairs easier. Drains should be provided that allow for the fast emptying of the system in case of emergency. The mixing valve draws in cold water when the solar heated water gets too hot. Because heated water expands, an expansion tank should be used to take up the

extra volume and prevent the system from becoming overpressurized. Relief valves allow excess pressure to escape.

Fans and Ducts

Some systems use air as the transfer medium. Instead of a pump, they rely on a fan for circulation. Standard heating, ventilation, and air conditioning (HVAC) ductwork is used to carry the transfer medium through these systems.

Control System

The control system automatically operates the pump or fan. When the collector becomes hot enough to add heat to the water in storage, the pump or fan is turned on. This forces the transfer medium from the collector to the storage tank and back. When the collector cools down, the pump or fan is turned off. Temperature sensors located in the collector and in the storage tank allow the control unit to monitor the temperature in these places and operate the pump or fan at the correct times.

SYSTEMS

Let's see how these components fit together to make a complete solar hot water system.

Active Systems. Most solar hot water systems on the market today are active systems. That is, the transfer medium is forced through the components by electric pump or fan. The use of these devices allows flexibility in the layout of the system. All active systems use the same basic components which can be combined in a variety of ways to meet individual needs.

Because water freezes, some sort of protection must be built into systems

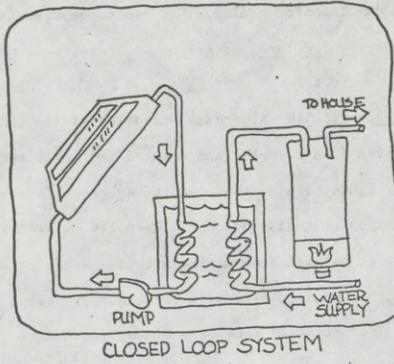
that use water as the transfer medium. The two categories of active water circulation systems, closed loop and draindown, solve this problem in different ways:

Closed loop systems. The water-based transfer medium contains antifreeze to protect the system from freezing and a corrosion inhibitor to protect the system from rust. Since both of these additives are poisonous, the transfer medium circulates through a closed loop between the collector and heat exchanger, so that it is kept from mixing with the drinking water. A double wall heat exchanger is used to make sure the transfer medium can't leak into the storage tank. Some systems provide a window for checking the storage tank: since antifreeze and corrosion inhibitors are ^{colored} dyed, any leak is easily detectable.

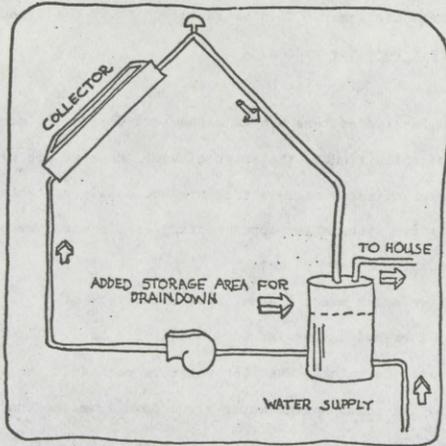
Draindown systems. These systems don't need antifreeze because they are designed to empty the collector when its temperature approaches freezing. A thermostat on the collector turns off the pump when the temperature falls to around 35° F. When the pump isn't working, the transfer medium drains down into the storage tank. This also protects the system during power outages. Obviously, the tank must be large enough to accommodate this extra volume of transfer medium.

Because the transfer medium isn't poisonous, a more efficient single wall heat exchanger can be used. In some of these systems, no heat exchanger is used, and the drinking water is used as the transfer medium.

Active Air Systems. Besides systems that use water as a transfer medium, there are others that use air to transfer heat to the water supply. Air-to-water heat exchange is theoretically less efficient than water-to-water. However, some water-to-water systems lose efficiency because they must use a cum-



Antifreeze and corrosion inhibitors are kept from mixing with drinking water in a closed loop system.



DRAINDOWN SYSTEM

Draindown systems don't need antifreeze because they are designed to empty the collector when its temperature approaches freezing.

bersome double wall heat exchanger. This could reduce their efficiency to below that of a good air-to-water system.

Passive Systems. Passive systems use no mechanical devices to ^{move} the heat from the point of collection to the point of use. Passive hot water systems are limited to warm climates because they are not easily protected against freezing. Passive systems for space heating are in more common use because they can be adapted to any climate. ✓

The simplest passive solar water heating system consists of a black tank which is filled with water and is located on a building's roof. The tank absorbs sunlight and heats the water. When hot water is needed in the building, a faucet is opened and the solar heated water flows down from the roof. Supply water flows up to the tank and replaces the water drawn out. *illust from Fardone.*

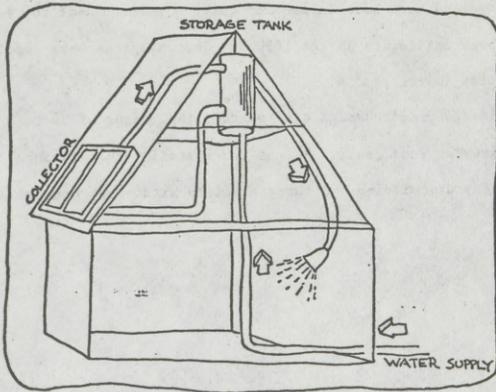
This type of system doesn't cost much and can be installed by any do-it-yourselfer. But its usefulness is limited by its inability to store heated water when the sun isn't shining.

The thermosyphon system is a more useful passive device. It works on the principle that warmer water is lighter than cooler water and tends to rise. A common system uses a conventional solar collector which is mounted on the roof. Water enters the bottom of the collector, becomes heated, and rises to the top. This hot water flows up a pipe that goes to the top of a storage tank placed above the collector. This draws cooler water from the bottom of the storage tank to the bottom of the collector.

Hot water for home use is also drawn from the top of the storage tank. This flow of water into the home pulls more supply water up to the bottom of the storage tank.

Passive systems have been in use for quite a while. Roof top tanks were used in Southern California in the 1890's. Thermosyphons were popular in Southern Florida in the 1930's.

Most buildings aren't designed to sustain the weight of up to a hundred gallons of water at roof level. Before you install a thermosyphon system, you must make sure your building can carry the load without structural damage.



THERMOSYPHON WITH CONVENTIONAL
COLLECTOR + STORAGE TANK

The thermosyphon system is a useful passive device which doesn't require the use of pumps but instead works on the principle that warmer water is lighter than cooler water and tends to rise.

HOW BIG SHOULD YOUR SYSTEM BE?

You could put enough collectors on your roof to heat all the water you'll ever use. You could put a tank in your basement big enough to supply you with hot water even after several sunless days.

Such a system would cost much more than it would ever save on fuel bills. Most solar hot water systems are smaller: they are designed to provide 50-75% of a home's hot water; a system this size can save you money over the life of the system.

But how many collectors and what size tank do you need to provide this percentage of your hot water? Considering the cost of a solar system, you shouldn't rely on guesswork. You can estimate a reasonable collector size by using *Solar Hot Water And Your Home: Economics Workbook for Homeowners*. You may also wish to talk with a solar professional who will evaluate many variables, such as these:

How much hot water does your household use?

Each member of an average household uses between 15 and 20 gallons of hot water per day. How much water does each member of your household use? It depends on your personal habits and how many appliances you have that use hot water; dishwashers and washing machines both use a lot.

What is your climate like?

Different parts of the country receive different amounts of sunlight. The number of collectors you need depends on the amount of sunlight your area gets. The scientific name for usable sunlight is insolation; it is measured either in BTU's per square foot per day or, in the metric system, as Langley's per day. necessary

The temperature of the water supply varies from city to city. For example, Salt Lake City's water is around 42°F, while Miami's is about 70°F. The more your system has to raise the temperature of the water, the larger the collector area you need.

How hot do you want your water?

Most conventional home water heaters are thermostatically set to supply water at 140°F. If you reset the thermostat to 125°F, you'll use less energy, but your water will still be hot enough for showers, clothes washing, and other hot water uses. It will also stretch the contribution made by your solar hot water system.

How efficient are the collectors you plan to use?

Different brands of collectors deliver different amounts of heat from the same amount of sunlight. Collectors with less than average efficiency require more area to collect the same amount of heat than collectors with more than average efficiency. 7

You should buy collectors that give you the most energy per dollar. Remember, though, the system must work for quite a few years to pay for itself. A cheaper system might cost you less to buy but may break down before your initial investment can be recovered.

Here are some rules-of-thumb for estimating the size system you need. Remember, they can't replace the careful calculations of a solar professional. Any system that departs radically from these ranges should be investigated quite closely.

Collector Area: 15 - 20 square feet of collector area per person in the household.

Storage Area: 1.5 - 2 gallons of storage per square foot of collector used.

Heat Exchange Area: 5 - 10 square feet of heat exchange surface per person.

SOLAR HOT WATER ECONOMICS

Although a solar hot water system saves you money every time it supplies energy to heat your home's water, it costs money to buy and install. This booklet will tell you what information you need to estimate the costs and savings of any proposed domestic hot water system. We'll point out some costs you may not have considered; explain what you need to know to figure out your savings, and show you how to find the unit cost of your conventional fuel and how the fuel price escalation rate will affect it.

Solar Hot Water and Your Home: Economics Workbook for Homeowners shows you how to use this information to make an estimate of costs and savings.

SYSTEM COST

When you are shopping for a system, be sure to get a cost estimate that includes labor charges. Installed systems usually cost from \$1,500 to \$3,000. The cost varies according to the size of the system and the cost of labor.

Home Remodeling. If you are adding a solar hot water system to an existing home, it is likely that you'll need to do some remodeling to accommodate the equipment. For instance, the pipes from the collector to the storage tank will have to be set inside the walls. The cost of this remodeling will probably not be included in the estimate of installer's charges.

Financing Costs. If you finance your system with a home improvement loan or as part of a mortgage, be sure to include the interest charges as part of the total system cost.

System Maintenance. Like all HVAC equipment, solar energy systems require maintenance. Since most systems now in use are new, it's hard to predict what

the upkeep will be. It is estimated that the yearly maintenance cost will be about one percent of the capital cost of an uninstalled system. *ext the hardware alone, at \$15*

Taxes. Although a solar hot water system may increase your property tax assessment, it could actually decrease the taxes you must pay. Many state and local governments have enacted laws which reduce property, sales, and income tax for those who install a solar energy system. *Reference*

Insurance. You should make sure that your system is covered by your homeowner's insurance. Your premiums shouldn't go up by much, if at all. You should include any increase in your premiums as part of your system cost.

SYSTEM SAVINGS

The amount you save with a solar hot water system depends on how much water is heated by your system and what you pay for the conventional fuel that heats the rest. Conventional fuel prices are expected to increase dramatically during the operating life of your system. Your savings over the next twenty years could be substantial.

Unit Cost. To figure out your fuel savings with a solar hot water system, you first need to find out the unit cost of your conventional fuel. Unit cost is the amount you pay for a particular amount of energy. For example, your unit cost for electricity is measured in cents per kilowatt hour. Natural gas is measured in cents per thousand cubic feet or in cents per therm.

Block rate structure. You can divide your most recent fuel bill by the number of units consumed, and this will give you your average unit cost. This method isn't always accurate because some utilities rely on block rate structures. That is, you pay different unit costs for different numbers of units you consume. Generally, unit costs decrease as your consumption increases.

The best way to find out your unit cost is to ask your utility or fuel supplier for the unit cost, including all fuel adjustment factors and taxes for the last unit of fuel you bought that billing period.

Increases in the fuel unit cost. Although no one can say for sure what fuel will cost in the future, it is certain that the price will keep going up. Remember, the greater this increase, the more money a solar energy system will save you.

Just to get an idea of how fuel costs can increase, consider the chart below.

It assumes an 8% annual increase which is less than many energy experts are predicting.

FUTURE UNIT COSTS, ASSUMING AN 8% ANNUAL INCREASE

Unit Cost In Year	Multiply 1978 Unit Cost By		New Unit Cost
1978	_____ x 1.00	=	_____
1979	_____ x 1.08	=	_____
1980	_____ x 1.17	=	_____
1981	_____ x 1.26	=	_____
1982	_____ x 1.36	=	_____
1983	_____ x 1.47	=	_____
1984	_____ x 1.59	=	_____
1985	_____ x 1.71	=	_____
1986	_____ x 1.85	=	_____
1987	_____ x 2.00	=	_____
1988	_____ x 2.16	=	_____
1989	_____ x 2.33	=	_____
1990	_____ x 2.52	=	_____
1991	_____ x 2.72	=	_____
1992	_____ x 2.94	=	_____
1993	_____ x 3.17	=	_____
1994	_____ x 3.43	=	_____
1995	_____ x 3.70	=	_____
1996	_____ x 4.00	=	_____
1997	_____ x 4.32	=	_____

If you are currently paying 4¢ per kilowatt hour for electricity to heat you water, by 1984 it will cost 1.59 times as much, or nearly 6½¢ per kwh, and over 12¢ per kwh in 1993 (only 15 years from now).

This is all assuming that you think conventional fuel costs are going to rise at 8% a year. If you believe that fuel costs will rise at an even higher rate, such as 10% per year, your savings from your solar hot water system will be larger yet!

SOLAR COSTS VS. SOLAR SAVINGS

There are a number of ways to compare solar costs and savings:

Monthly cash flow analysis. What will your solar energy system save you every month? This method shows you.

When you talk about the cost of owning a home, you usually mean your monthly mortgage payments, plus the cost of taxes and insurance. In the last several years, you've also had to figure in the cost of energy for heating and cooling.

If you include a solar hot water system in a new home, the cost will probably be added to your mortgage. Your monthly mortgage payment will go up. But your monthly energy cost will go down. And things are better! As fuel prices go up, your non-solar neighbors will be spending more and more for energy. You'll be getting most of yours for free, with no escalation in your mortgage payments. Before too long, your savings each month will be more than the solar segment of your mortgage payment! This is called positive cash flow -- your energy savings minus your monthly costs for mortgage payments, taxes, and insurance -- is now on the plus side. Each month your solar hot water system will save you money on your fuel bill.

Instructions for calculating your cash flow are given in *Solar Hot Water and Your Home: Economics Workbook for Homeowners*.

Life cycle analysis. This method is used to estimate the savings over the life of the system. Lifetime cost of the system is calculated, including the cost of the conventional fuel used for backup heating. A fuel escalation rate is used to predict future fuel costs. The cost of operating a complete conventional system over the same period is calculated, using the same fuel escalation rate.

The difference in the two figures is the projected amount saved by installing a solar system. If this figure is divided by the number of years in the life cycle, you get the average yearly savings.

Payback period. Your solar hot water system will save you money from the first day you use it. The payback period is the number of years it takes for your fuel savings to equal the cost of the system. For a solar domestic hot water system installed to supplement an electric water heater, the payback period would be around ten years in most of the country. In areas where electric rates are substantially higher than the national average, the payback period is much shorter.

Resale value. Chances are that you won't live in your present house for the entire payback period. However, as fuel prices increase, your solar energy system should increase the resale value of your property.

CONSUMER CONSIDERATIONS

When you buy a solar hot water system, you are making a sizable expenditure, with the expectation of reliable performance and savings over a number of years. The following suggestions can help you to spend your money wisely. You should become familiar with the manufacturer's literature. In the bibliography at the back of this booklet you will find listed other pamphlets and books that can help you answer any questions you still have. Of course, you can always call us, The National Solar Heating and Cooling Information Center, for the answer to any solar heating question. Call 800-523-2929. If you are in Pennsylvania, call 800-462-4983. Ask for our pamphlet, "Solar Consumer Tips."

You need to know more than just the mechanical aspects of the system you are considering. Here are some specific things to look into when you are shopping for a solar hot water system:

Proof that the components will perform as advertised

The American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) has developed a procedure to test the thermal performance of solar equipment. The U.S. Department of Housing and Urban Development has issued Intermediate Minimum Property Standards that specify the performance of solar equipment. Has the equipment you intend to buy been tested by an independent laboratory according to these standards? Ask to see the report itself, not what the solar equipment manufacturer claims the report says.

The Installer

Quality workmanship is just as important as quality equipment; a poorly installed solar hot water system will not perform up to its full potential. Try to find an installer with a good track record. Does he have heating or plumbing experience? Has he ever done solar work before? How many solar energy systems has he installed, and are they working satisfactorily?

If your system has not been custom designed by a solar professional, then the installer is even more responsible for the correct functioning of your system. He should keep the total pipe length as short as possible; you'll save money on piping, but more importantly, it will make the system more efficient. The installer must insulate the pipes and the tanks, even the pipes inside your house. Unless you live in a climate where it freezes only once or twice a year, he shouldn't install electric heat tapes as freeze-up protection. They could cost you more to run than the amount of money you could save by using the solar system.

All components should be installed so that they can be removed for servicing and repair. Controls should operate quietly. Valves should be corrosion resistant. So the system uses no more electricity than it has to, pumps and fans should be no larger than needed.

has specific

Zoning

Before your solar hot water system is installed, make sure it won't violate local building and zoning regulations.

Warranty

One important protection for the customer is the ability and willingness of the manufacturer and installer to stand behind their product and its installation. This willingness is often expressed as a warranty. Every consumer product warranty must meet the Federal requirements established by the Magnuson-Moss Act. This act spells out what disclosures the seller must make and what limitations may be included in the warranty. However, there is no requirement that a product provide a warranty, nor that a warranty provide a specific level of protection. You should read the warranty carefully to see just what you are being promised.

Warranties on equipment may state that they are only in effect if certain installation standards are followed; make sure your installer follows these standards. Installers may guarantee their work only as long as certain maintenance procedures are followed; this is up to you.

There are two kinds of warranties, limited and full. Here are some examples of both:

Full Warranty. "This product is unconditionally guaranteed. The manufacturer will provide both labor and parts to correct any problem, at no cost to you."

Full Warranty. "This product is guaranteed against all defects in construction for a period of five (5) years. The manufacturer will pay for all labor and parts needed to correct any defect."

Limited Warranty. "This product is guaranteed to be one of the finest solar systems ever manufactured. The manufacturer will pay for any parts

needed to correct any problem, as long as all installation and maintenance work has been done by manufacturer approved personnel."

Limited Warranty. "This solar hot water system has been installed in accordance with the local building codes. The installer will repair any damage to the system resulting from defects in workmanship, for a period of (3) years. Warranty is void if the proper maintenance schedule is not followed."

Service and Maintenance

Be sure you know specifically who will service the solar energy system if anything goes wrong. Your solar installer may be in the business of servicing systems. If not, find someone with the skills needed to do whatever repair is needed. Don't settle for any handyman who says he can do the job.

Many maintenance companies offer service contracts. If yours does not, find out what they charge for the routine service your system needs.

Testing the system

The system should be taken through a complete operating test by the installer before acceptance by the homeowner. The operation of the system as well as steps to take in an emergency, should be explained. Any installation or manufacturing defects should be corrected. And there should be confirmation that the system does increase the temperature of the water in storage.

Owners' Instructions

Be sure you get an owners' manual or at least written instructions that give the information that you should have about your system. It should tell you what parts are used in your system and where to get replacements; how to turn your system off and on; what you can do to help maintain the system; and what to do if something goes wrong.

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HOT WATER: SOLAR WATER HEATERS AND STACK COIL HEATING SYSTEMS...S. Morgan et al; Hot Water, 350 East Mountain Dr., Santa Barbara, CA, 1975, 31 pp, \$2.00 (Available from International Compendium, 10762 Tucker St., Beltsville, MD 20705, 301-937-0040.)

Basic instructions for building and installing various types of solar water heaters.

SOLAR WATER HEATING FOR THE HANDYMAN...S. Paige; Edmund Scientific Company, 101 E. Gloucester Pike, Barrington, NJ 08007, 1974, 32 pp, \$4.00.

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BASICS OF SOLAR HEATING AND HOT WATER SYSTEMS...American Institute of Archi-

tects/Research Corporation, 1735 New York Ave., N.W., Washington, DC 20006, 1977, 48 pp, \$5.00.

Passive and active systems which can be used in residential heating and domestic hot water systems.

DESIGN MANUAL FOR SOLAR WATER HEATERS...Horizon Industries, 12606 Burton St., North Hollywood, CA 91605, 1977, 40 pp, \$5.00.

Definitive manual that introduces the engineer to the various systems used to heat domestic water.

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THE BUY WISE GUIDE TO SOLAR HEAT...F. Hickok; Hour House, P.O. Box 40082, St. Petersburg, FL 33743, 1976, 121 pp, \$9.00.

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How to purchase, install, and maintain solar heating and cooling and hot water systems.

HOW TO BUY SOLAR HEATING..WITHOUT GETTING BURNT!...M. Wells and I. Spetgang, Rodale Press, Emmaus, PA, 1978, 62 pp, \$12.95.

Although it focuses mainly on solar space heating systems, it still serves as a useful consumer guide for water heating systems; especially useful section on dealing with contractors.

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TX 75247. Rates: \$15.00/year or \$1.50/back issue.

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NJ 07960. Published bi-monthly \$1.00 per copy.

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COMPUTER PROGRAMS FOR SOLAR SYSTEM PERFORMANCE AND SIZING...(source sheet)

HEAT TRANSFER FLUIDS FOR SOLAR HEATING AND COOLING...(fact sheet and bibliog-
raphy)

PRACTICAL AND DO-IT-YOURSELF PROJECTS FOR SOLAR UTILIZATION...(bibliography)

READING LIST FOR SOLAR ENERGY...(bibliography)

SOLAR DIRECTORIES...(bibliography)

SOLAR ENERGY SYSTEM CONSUMER TIPS...(fact sheet and bibliography)

GLOSSARY

ABSORBER PLATE - the part of a flat-plate collector that turns sunlight into heat. It is usually a sheet of metal painted black.

BLOCK RATE STRUCTURE - pricing system used by some utilities. They charge one price rate up to a particular amount of fuel used, and a different rate for additional amounts of fuel.

CASH FLOW ANALYSIS - method for evaluating costs and savings of solar systems on a month-by-month basis.

CLOSED LOOP - a type of solar energy system that recirculates the same transfer medium. To protect the system from freezing and corrosion, toxic anti-freeze and anticorrosives are added to the transfer medium.

CONTROL SYSTEM - the part that automatically turns the system on and off. It includes the sensors placed on the absorber plate and the storage tank that measure when there is enough heat to run the system.

CONTROL UNIT - see control system

COVER PLATE - the glass or plastic that covers the top of the flat-plate collector. It keeps the heat generated in the collector from escaping.

DOUBLE WALL HEAT EXCHANGER - a type of heat exchanger that provides double separation between the transfer medium and the potable water. It is required to be used when the transfer medium contains toxic substances.

DRAINDOWN - a type of solar energy system that allows for the transfer medium to be removed from the collector when the collector temperature drops to freezing.

EXPANSION TANK - a tank containing air that takes up the increased volume produced when water is heated. It prevents the solar system from becoming over-pressurized.

FLAT-PLATE COLLECTOR - the most common type of solar collector. Built with standard construction materials and techniques, it turns non-concentrated sunlight into usable low-grade heat.

HEAT EXCHANGER - a device that transfers heat from one substance to another. An automobile radiator is a heat exchanger.

INSOLATION - the amount of solar energy striking an area over a specific period of time. It can be measured in British Thermal Units (BTU's) per square foot per day, or in the metric system as Langleys per day. A Langley is a calorie per square centimeter.

KILOWATT HOUR - unit in which electricity is sold; abbreviated kwh.

LIFE CYCLE ANALYSIS - method for evaluating total costs and savings of solar equipment over the lifetime of the system.

PAYBACK PERIOD - the amount of time it takes for a solar hot water system to pay for itself in fuel savings.

MIXING VALVE - draws in cold water when solar heated water gets too hot.

PRE-HEATING - using a solar energy system to raise the temperature of water before it enters a conventional water heater.

RELIEF VALVE - allows excess pressure to escape.

RETROFIT - installation of a solar energy system in an existing house.

SHUT OFF VALVE - used to isolate a solar component from the rest of the system.

SINGLE WALL HEAT EXCHANGER - a heat exchanger in which the two heated substances are kept apart by only one structure. This type of heat exchanger may be used in solar energy systems that use non-toxic additives in the transfer medium.

SOLAR COLLECTOR - a device that turns sunlight into usable heat.

STORAGE TANK - a container used to hold water heated by the sun.

THERM - unit in which natural gas is sold.

THERMOSYPHON - a type of solar energy system that circulates the transfer medium without a pump, relying on the tendency of heated water to rise.

TRANSFER MEDIUM - the substance that takes the heat off the absorber plate and transfers the heat to the storage tank. It is usually water or air.

UNIT COST - the amount you pay for a particular amount of energy. For example, your unit cost of electricity may be 4¢ per kilowatt hour.

SOLAR PUBLICATIONS

DATE: September 12, 1978TITLE: SOLAR HOT WATER AND YOUR HOME: ECONOMICS WORKBOOK FOR HOMEOWNERSNUMBER: SD-118 (also see SD-142)RESPONSIBLE ORGANIZATION / INDIVIDUAL: FIRL/F. WeinsteinWHO IS IT FOR? (intended audience): Consumers

Give user needs justification if applicable. _____

Quantity to be printed. _____

WHAT IS IT ABOUT? (topic): This is a companion to Solar Hot Water and Your Home: The Basics. It is formatted as a workbook estimator which permits the user/reader to figure out how much solar DHW might cost and how much they can save. Based on simplified RSVP.

WHY DO WE NEED IT?

WHY WILL THE INTENDED AUDIENCE WANT TO READ IT?

HOW DOES IT FURTHER THE GOALS OF THE SOLAR INFORMATION PROGRAM?

The most common consumer question remains, "What does it cost?" This booklet allows the reader/user to figure it out for himself. The reader should have familiarized himself with solar DHW basics and be ready to ask the real question-- "Does the economic picture support my decision to go solar?"

NOTE: Text on WANG #0532A on Tape 39WHO SUGGESTED THIS TOPIC? A. Reiger (HUD) / Frank Weinstein (FIRL)WHO APPROVED THIS CONCEPT? A. Reiger

* This article will be sent to F. Weinstein on 9/13/78, then to A. Reiger (HUD).

SOLAR HOT WATER AND YOUR HOME:

Economics Workbook for Homeowners

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The calculations used in this workbook were developed by Booz-Allen & Hamilton, Incorporated, under a contract with the U.S. Department of Housing and Urban Development (HUD). All assumptions represent the state-of-the-art in solar economic modeling. HUD, Booz-Allen & Hamilton, and the National Solar Heating and Cooling Information Center have developed this booklet to be a guideline which will help answer economic questions about solar energy systems.

PART I

INTRODUCTION

We are told that energy from the sun is abundant and inexhaustible--that it is a renewable natural resource we can use without energy consuming conversion techniques.

How much of that abundance can be put to work for you and how much it will cost are your major concerns. This book will help you answer some economic questions--but these will only be a guideline to the economic feasibility of solar energy. You will then have to pursue the notion with solar installers in your area.

Radiation falls freely but to collect, store, and distribute it costs money. The costs can vary depending on the complexity of the system, the experience of your manufacturer and installer, and the expectations you have of the systems.

It has been said that "domestic hot water heating offers the best opportunities for cost effective application of solar energy" in the home. Since hot water usage represents 20-45% of the average home heating bill and typical solar systems provide about 50-75% of this energy, you can expect to save about 15% of your total fuel costs using solar hot water.

We have prepared this workbook to help you estimate these costs and savings and to determine whether solar hot water is a worthwhile addition to your home.

Before working through this booklet, we recommend you read the companion booklet, *Solar Hot Water and Your Home: The Basics*. It contains basic information which will help you choose reasonable values for some of the items used here.

HOW TO USE THIS WORKBOOK

The following pages of instructions and worksheets contain a series of steps which start with simple calculations (showing basic estimates of savings) and lead to more complicated procedures (such as economic payback periods).

By following these easy steps you can determine whether solar energy makes sense for you. Or if you're already sold on solar, these calculations can help you to evaluate the performance of various systems.

YOU DON'T HAVE TO DO EVERY STEP. Decide how much you need to know and go just that far. At a later date, after more investigation into the possibility of solar, you may wish to go further.

Steps 1, 2, and 3 cover the amount of energy and fuel bill savings possible with a solar hot water system. These steps will be useful for anyone who is considering the purchase of a system for his home.

Steps 4 and 5 will help you estimate the cost of a solar hot water system (including installation) and predict its payback period.

Steps 6, 7, and 8 will only apply to cases where the solar hot water system will be financed.

In each step, a sample case is given to help you follow the directions correctly. Space is provided for you to write down your answers, and if you'd like to compare results between several different solar hot water systems, make copies of the worksheets located in the back of this booklet. These worksheets show what you need to know and what you have to do.

If you'd like to find out more about the assumptions made in developing this workbook, turn to Part III. It will also give you an idea of how the actual results you'll obtain with a solar hot water system on your home could vary from what you've figured out here.

Look at the diagram below. It will show you which steps to do.

IF YOU WANT TO :

ESTIMATE ANNUAL ENERGY SAVINGS

ESTIMATE FIRST YEAR FUEL BILL SAVINGS

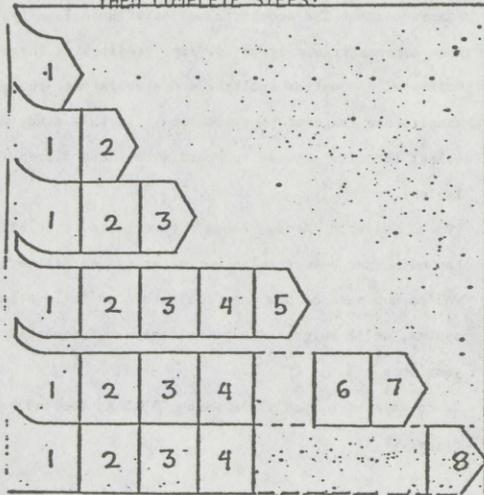
ESTIMATE LONGER TERM FUEL BILL SAVINGS

ESTIMATE SYSTEM COST AND PAYBACK PERIOD

SHORT-TERM LOANS ONLY
ESTIMATE OVERALL SYSTEM COST AND PAYBACK PERIOD

MORTGAGES ONLY
ESTIMATE WHEN SYSTEM RETURNS FAVORABLE CASH FLOW

THEN COMPLETE STEPS.



PART II

STEP I

ESTIMATE ANNUAL ENERGY SAVINGS

How much electricity, natural gas, or fuel oil could a solar hot water system save you each year? This depends on:

**Consumption.* The amount of hot water used in a typical home depends primarily on how many people live there.

**Climate.* Amount of sunlight and average year-round temperature range at your location. In this step, you'll select the city closest to yours from those listed in Table 1.

**Total Collector Area.* Along with climate, this affects how much energy your solar hot water system delivers. If you're not sure of how many collectors to include in your system, we'll suggest a size we consider reasonable for your home.

To do this step, you'll be using TABLE A, located on pages 40.

YOUR HOME

SAMPLE CASE

1a. Fill in the Type of Fuel

used by your conventional water heater (electricity, gas, or oil)..... _____

(Minneapolis)
electricity

Now, turn to TABLE A-1 if you filled in electricity, A-2 for gas, and A-3 for oil.

YOUR HOME

SAMPLE CASE

1b. Fill in your Family

Size.....

4

Then locate the column in TABLE A which lists your family size.

1c. IF YOU DON'T KNOW HOW MUCH COLLECTOR TO INCLUDE IN YOUR SYSTEM, SKIP AHEAD TO LINE 1e.

IF YOU KNOW THE SIZE, find the column in TABLE A marked "Collector Size". It is located under the "Family Size" column. Fill in the Collector Size (in square feet) which comes closest to the size you're planning on.....

1d. From TABLE A, fill in the Amount of Annual Energy Savings.*

It is in the column corresponding to your family size, collector size, and city.....

You have now finished Step 1. Skip ahead to the middle of the next page.

1e. IF YOUR LEFT LINES C AND D BLANK, fill in the Amount of Annual Energy Savings from TABLE A*. It is in bold type, corresponding to your family size and city.....

3700

YOUR HOME

SAMPLE CASE

1f. Fill in Collector Size. It is the figure at the top of the column where you located your Annual Energy Savings figure.....

sq. ft.60 sq. ft.

This is the collector size we consider reasonable for a family of your size, in your climate region.

You've just estimated how much energy a solar hot water system could save you each year. You also have an idea of how much collector to include in the system.

To find out how these energy savings could affect your fuel bills, go on to Step 2.

*The Annual Energy Savings figure you obtained is based on a draindown solar hot water system, one which does not include a heat exchanger (that is, does not use antifreeze in the collectors).

Your system may include a heat exchanger or may differ from our average one in other ways. Check Part III, page 27 which tells you how to work these differences into the computations.

STEP 2

ESTIMATE FIRST YEAR FUEL BILL SAVINGS

YOUR HOME

SAMPLE CASE

If you were to buy a solar hot water system now, how much could you save in fuel bills during the first year? This step will help you get an idea. To do this step, you'll need to know what the current *Unit Price of Fuel* is in your area. Refer to *The Basics*, p. 23, for assistance in determining the *Unit Price of Fuels*.

2a. Fill in your *Annual Energy*

Savings with the solar hot water system (from Step 1,

Line d or Line e).....

_____ 3700

2b. Fill in the current *Unit Price of Fuel* used in your conventional hot water heater.....

_____ 4¢ = \$.04

2c. MULTIPLY: *Line 2a X Line 2b*

You've just estimated your *First Year Fuel Bill Savings* with a solar hot water system.....

\$ _____ \$ 148

If you want to find out what your total fuel bill savings could be over a longer period, go on to Step 3.

STEP 3 ESTIMATE LONGER TERM FUEL BILL SAVINGS

How much could a solar hot water system save you in the years to come?

To find out, you'll need to know what the Fuel Escalation Rate is for your hot water system fuel.

You'll also select a factor from TABLE B. Refer to *The Basics* p. 25 for assistance in determining the Fuel Escalation Rate.

	YOUR HOME	SAMPLE CASE
3a. Fill in your <i>First Year Fuel Bill Savings</i> (from Line 2c).....	\$ _____	\$ <u>148</u>
3b. Fill in your <i>Fuel Escalation Rate</i>	_____ %	<u>8</u> %
3c. Choose the <i>Time Period</i> (in years) that you wish to consider.....	_____ yrs	<u>5</u> yrs
3d. Look at TABLE B, select the number corresponding to Lines 3b and 3c.....	_____	<u>5.9</u>
3e. MULTIPLY: <i>Line 3a X Line 3c</i>		
You've just predicted what your <i>Cumulative Fuel Bill Savings</i> could be (for the period you chose) with a solar hot water system..	\$ _____	<u>\$873.20</u>

TABLE B. Cumulative Savings Factors

Time Period (Year)	Fuel Price Escalation Rate (% per year)									
	4	6	8	10	12	14	16	18	20	
1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
2	2.0	2.1	2.1	2.1	2.1	2.1	2.1	2.2	2.2	2.2
3	3.1	3.2	3.2	3.3	3.4	3.4	3.4	3.5	3.6	3.6
4	4.3	4.4	4.5	4.6	4.8	4.9	5.1	5.2	5.4	5.4
5	5.4	5.6	5.9	6.1	6.4	6.6	6.9	7.2	7.4	7.4
10	12.0	13.2	14.5	15.9	17.5	19.3	21.3	23.5	26.0	26.0
15	20.0	23.3	27.2	31.8	37.3	43.8	51.7	61.0	72.0	72.0
20	29.8	36.8	45.6	57.3	72.1	91.0	115.4	146.6	186.7	186.7

This is the last step you need to do in order to get an idea of your possible solar hot water savings. If this is all you want to find out, stop here. If you'd like to get an estimate of your solar hot water costs, go on to step 4.

STEP 4

ESTIMATE SYSTEM COST AND PAYBACK PERIOD

This section will help you to estimate the installed cost of your solar hot water system.

YOUR HOME

SAMPLE CASE

4a. If you already know how much your solar hot water system will cost (including installation), fill it in here.....

\$ _____

\$ _____

Then if you want to learn more about the economic value of the solar system, read the bottom section of this page.

4b. If you don't know the system cost, we've included a table below which will help you estimate it.

DIRECTIONS: Look at TABLE C. Select either the column marked "New Homes" or "Existing Homes." Then, go down the column you've chosen until you reach a line corresponding to the Collector Size of your system.

The number you've located is an estimate of the Installed Cost of an average solar hot water system for your home.....

\$ _____

\$2000 (NEW HOME)

The economics of your solar system will vary depending on how you plan to pay for it.

TABLE C. Estimated Solar System Cost

COLLECTOR SIZE (Sq.ft.)	SYSTEM COST FOR NEW HOMES \$	SYSTEM COST FOR EXISTING HOMES \$
20	1000	1140
40	1500	1680
60	2000	2220
80	2500	2760
100	3000	3300
120	3500	3840

If you're paying cash
for your system..... GO TO STEP 5

If you plan to finance your
system with a short-term or
home improvement-type Loan.....GO TO STEP 6

If your system is to be
financed as part of the
mortgage on your new home.....GO TO STEP 8

STEP 5 ESTIMATE PAYBACK PERIOD (FOR CASH-PURCHASED SYSTEMS ONLY)

How long will it take for a solar hot water system on your home to pay itself back in fuel savings? In this step, we'll help you estimate the *Payback Period* for the system. If you plan to finance your system, we suggest you skip ahead to Step 6 or 8.

	YOUR HOME	SAMPLE CASE
5a. Fill in your <i>First Year Fuel Bill Savings</i> (from Line 2c)...	\$ _____	\$ <u>148</u>
5b. Fill in the <i>Fuel Escalation Rate</i> (from Line 3b).....	_____ %	_____ %
5c. Fill in the <i>Installed System Cost</i> (from Line 4a. or b).....	\$ _____	\$ <u>2000</u>
5d. DIVIDE: <i>Line 5c ÷ Line 5a.</i>	_____	<u>13.5</u>
5e. Look at TABLE D. Select the number corresponding to <i>Lines 5b and 5d.</i>		
The number you've found in the table is a prediction of the <i>Payback Period</i> for your solar hot water system.....	_____ yrs	<i>ESTIMATED</i> <u>10 yrs</u>

If you're going to pay cash for your solar hot water system, you have finished the workbook. We suggest you turn to Part III to get an idea of what your estimates are based on.

TABLE b. Payback Period, Years

Cost/1st yr. Savings Ratio	Fuel Escalation Rate (% per year)								
	4	6	8	10	12	14	16	18	20
1.	1	1	1	1	1	1	1	1	1
2.	2	2	2	2	2	2	2	2	2
3.	3	3	3	3	3	3	3	3	3
4.	4	4	4	4	4	4	4	4	4
5.	5	5	5	5	5	5	4	4	4
6.	6	6	6	5	5	5	5	5	5
7.	7	7	6	6	6	6	6	5	5
8.	8	7	7	7	6	6	6	6	6
9.	8	8	8	7	7	7	7	6	6
10.	9	9	8	8	7	7	7	7	7
15.	12	12	11	10	10	9	9	8	8
20.	15	14	13	12	11	11	10	10	9
25.	18	16	15	14	13	12	11	11	10
30.	21	18	16	15	14	13	12	12	11
35.	23	20	18	16	15	14	13	13	12
40.	25	11	19	17	16	15	14	13	13
45.	27	23	20	18	17	16	15	14	13
50.	29	24	21	19	18	16	15	14	14
55.	30	26	22	20	18	17	16	15	14
60.	**	27	23	21	19	18	16	15	15

** More than 30 years.

STEP 6 ESTIMATE OVERALL SYSTEM COST (SHORT-TERM LOANS ONLY)

If you are planning to finance a solar hot water system home improvement loan, you should get an idea of what the system will cost, including all finance charges.

In this step, we'll show you a way to estimate this overall cost. To complete this step, you'll need to know what the *Interest Rate* and the *Length of the Loan* will be.

	YOUR HOME	SAMPLE CASE (most new homes will use step 8 instead)
6a. Fill in the <i>Installed System Cost</i> (from Line 4a or b)....	\$ _____	\$ <u>2000</u>
6b. Fill in the <i>Amount of Solar Loan</i> (if different from Line 6a).....	\$ _____	\$ <u>1500</u>
NOTE: Home improvement loans usually cover the full cost, with no down payment. Only fill in Line 6b if you are putting down some cash and taking out a loan on the remainder of the cost.		
6c. Fill in the <i>Length of the Loan</i> (in years)	_____ yrs	_____ <u>6</u> yrs
6d. Fill in the <i>Interest Rate</i>	_____ %	_____ <u>11</u> %
6e. Look at TABLE E. Select the number corresponding to the <i>Length of the Loan</i> and <i>Interest rate</i> (from Lines 6c and 6d).....	_____	_____ <u>1.37</u>

IF YOU ARE MAKING A DOWN PAYMENT GO ON TO LINE 6g.

YOUR HOME

SAMPLE CASE

6f. MULTIPLY: *Line 6a X Line*

6e. This is your Overall

Financed System Cost (100%

financing only).....

\$ _____

\$ _____

You have now finished Step 6. Go on to Step 7 on
page 201.

6g. MULTIPLY: *Line 6b X Line*

6e.

This is the Overall Cost

of Financed Portion of

System.....

\$ _____

\$ 20556h. SUBTRACT: *Line 6a - Line 6b.*

This is the Amount of

Solar Downpayment.....

\$ _____

\$ 5006i. ADD: *Line 6e + 6h.*

You've just estimated

your Overall Financed

System Cost.....

\$ _____

\$ 2555

Go on to Step 7.

TABLE E . Short-Term Loan Factors

Term of Loan (Years)	Interest Rate							
	8	9	10	11	12	13	14	15
1	1.04	1.05	1.06	1.06	1.07	1.07	1.08	1.08
2	1.09	1.10	1.11	1.12	1.13	1.14	1.15	1.16
3	1.14	1.14	1.16	1.18	1.20	1.21	1.23	1.25
4	1.17	1.19	1.22	1.24	1.26	1.29	1.31	1.34
5	1.22	1.25	1.28	1.31	1.34	1.37	1.40	1.43
6	1.26	1.30	1.33	1.37	1.41	1.45	1.48	1.52
7	1.31	1.35	1.39	1.44	1.48	1.53	1.57	1.62
8	1.36	1.41	1.46	1.51	1.56	1.61	1.67	1.72
9	1.41	1.46	1.52	1.58	1.64	1.70	1.76	1.83
10	1.46	1.52	1.59	1.65	1.72	1.79	1.86	1.94
11	1.51	1.58	1.65	1.73	1.81	1.88	1.96	2.05
12	1.56	1.64	1.72	1.80	1.89	1.98	2.07	2.16
13	1.61	1.70	1.79	1.88	1.98	2.08	2.18	2.28
14	1.67	1.76	1.86	1.96	2.07	2.18	2.29	2.40
15	1.72	1.83	1.94	2.05	2.16	2.28	2.40	2.52

STEP 7 ESTIMATE PAYBACK PERIOD FOR FINANCED SYSTEMS
(SHORT-TERM LOANS ONLY)

What will the payback period be for a solar hot water system financed with a home improvement loan? This step will help you predict how many years this will take.

In this step, we'll help you estimate the Payback Period for the solar hot water system, including the costs of financing it.

	YOUR HOME	SAMPLE CASE
7a. Fill in the Overall Financed System Cost (from Line 6f or i).....	\$ _____	\$ <u>2555</u>
7b. Fill in your First Year Fuel Bill Savings (from Line 2c).....	\$ _____	\$ <u>148</u>
7c. Fill in your Fuel Escalation Rate (from Line 3b)...	_____ %	<u>8</u> %
7d. DIVIDE: Line 7a ÷ 7b...	_____	<u>17.2</u>
7e. Look at TABLE D (located on page 16). Select the number which corresponds to what you filled in on Lines 7c and 7d.		
The number you've found in the table is an estimate (in years) of the Payback Period for a solar hot water system financed with a short-term loan.....	_____ yrs	(ESTIMATE) <u>12</u> yrs

TABLE F . Annual Loan Payment Factors for Mortgage Loans .

Length of Mortgage (Years)	Interest Rate (%)								
	8	8-1/4	8-1/2	8-3/4	9	9-1/4	9-1/2	9-3/4	10
20	.100	.102	.104	.106	.108	.110	.112	.114	.116
25	.093	.095	.097	.099	.101	.103	.105	.107	.109
30	.088	.090	.092	.094	.097	.099	.101	.103	.105

Now that you've estimated the payback period for a solar hot water system financed with a short-term loan, you have finished the workbook. We suggest you turn to Part III to get an idea of what your estimates are based on.

STEP 8 ESTIMATE WHEN SYSTEM RETURNS FAVORABLE CASH FLOW
(MORTGAGES ONLY)

If you're financing a solar hot water system as part of the home mortgage, one way of determining if the system is a good investment is to find out when your annual fuel savings will exceed the annual costs of the solar energy system.

This relationship between costs and savings is known as a *Cash Flow*. In this step, we'll show you a way to estimate when the cash flow from your solar hot water system could turn favorable.

To find this out, we'll take your first year fuel savings figure, along with the fuel escalation rate you chose (from Steps 1 and 3), and compare them with the amount you'll be paying each year for the solar portion of the mortgage. To do this step, you'll need to know what the *Interest Rate* and *Length (in years)* of the mortgage will be.

To simplify this step, we've assumed that annual maintenance costs from the system will be offset by deductions you can claim on federal taxes for interest payments on the mortgage. We've also assumed that the entire cost of the solar hot water system will be covered by the mortgage.

YOUR HOME

SAMPLE CASE

8a. Fill in *First Year Fuel**Bill Savings* (from Line

2c).....

\$ 148

	YOUR HOME	SAMPLE CASE
8b. Fill in your Fuel Escalation Rate (from Line 3b)	_____ %	_____ 8 %
8c. Fill in the Installed System Cost (from Line 4a or b)	\$ _____	\$ 2000 _____
8d. Fill in the Length of the Mortgage (in years)	_____ yrs	_____ 30 yrs
8e. Fill in the Interest Rate	_____ %	_____ 9 %
8f. Look at TABLE F. Select the number corresponding to the Length of the Mortgage and Interest Rate (from Line 8d and 8e).....	_____	_____ .097
8g. MULTIPLY: Line 8c X Line 8f This is the Annual Solar Portion of Your Mortgage Payment	\$ _____	\$ 194 _____
8h. DIVIDE: Line 8g ÷ 8a....	_____	_____ 1.3
8i. Look at TABLE G. Select the number corresponding to your Fuel Escalation Rate (line 8b) and what you filled in on line 8h. The number you've found in the table is an estimate of how many years it will take until a solar hot water system on your home returns a favorable cash flow.	_____ yrs	_____ 5 yrs

TABLE G. Year in Which Savings Exceed Costs

Cost/1st yr. Savings Ratio	Fuel Escalation Rate (% per year)								
	4	6	8	10	12	14	16	18	20
1.0	1	1	1	1	1	1	1	1	1
1.1	4	3	3	2	2	2	2	2	2
1.2	6	5	4	3	3	3	3	3	2
1.3	8	6	5	4	4	4	3	3	3
1.4	10	7	6	5	4	4	4	4	3
1.5	12	8	7	6	5	5	4	4	4
1.6	13	10	8	6	6	5	5	4	4
1.7	15	11	8	7	6	6	5	5	5
1.8	16	12	9	8	7	6	5	5	5
1.9	18	13	10	8	7	6	6	5	5
2.0	19	13	11	9	8	7	6	6	5
2.1	20	14	11	9	8	7	6	6	6
2.2	22	15	12	10	8	8	7	6	6
2.3	23	16	12	10	9	8	7	7	6
2.4	24	17	13	11	9	8	7	7	6
2.5	25	17	13	11	10	8	8	7	7
2.6	26	18	14	12	10	9	8	7	7
2.7	27	19	14	12	10	9	8	8	7
2.8	28	19	15	12	11	9	8	8	7
2.9	29	20	15	13	11	10	9	8	7
3.0	30	20	16	13	11	10	9	8	8

Refer to *The Basics*, page 27,
for a discussion of cash flow.

You now have an idea of how many years it will take for the annual savings of your solar hot water system to exceed its annual costs. We suggest you read Part III to get an idea of what your estimates are based on.

PART III

ASSUMPTIONS AND METHODS USED IN THE
WORKBOOK

A. GENERAL

This workbook is based on data furnished by RSVP, the solar economics computer program developed by HUD. The workbook uses *average data* for:

- *Weather conditions for a city near you.
- *Performance of common types of solar flat-plate collectors and hot water systems. However, provision has been made for you to substitute your own collector performance data, if you can obtain it. (See sect. E below)
- *Amount of hot water used in a household of your size.
- *Temperature of your home's hot water supply.

Naturally, since this workbook is based on average data, the actual results you get from a solar hot water system will vary from what you're about to estimate on the following pages. The most likely factors to affect your estimates include:

- *Climate conditions and amount of shading in your location.
- *Size and number of appliances in your household which use hot water.
- *Type of solar hot water system you choose for your home.

To simplify this workbook, we've assumed that the amount you'll pay each year for maintenance on your solar hot water system will be offset by deductions you'll be able to claim on federal taxes for interest payments on solar loans.

Cost effective solar hot water systems usually provide 50-75% of your home's hot water needs. Therefore, we've assumed that your home will also include a conventional hot water heater to serve as backup.

B. TECHNICAL ASSUMPTIONS

Solar Hot Water System Type. We assumed your solar hot water system will include two tanks: one for solar pre-heating (or storage), and the other for your conventional water heater. For more information on how a "two-tank" system works, see *Solar Hot Water and Your Home: The Basics* page 11.

Solar Energy Storage. We assumed the solar preheating tank in your system will have a capacity to store 1.8 gallons of water for each square foot of installed collector. A good range for the storage capacity is between 1.5 to 2 gallons for each square foot of collector.

Protection Against Freezing. As mentioned earlier, the Annual Energy Savings figures in Table A of Step 1 are based on a system using the "draindown" approach to prevent collector pipe freezeups. If your system uses a heat exchanger, its performance will be slightly less efficient. Refer to sect. D for more information.

Solar Collector Performance. We assumed your system will include flat-plate collectors similar to those now on the market. Output data was compiled by averaging the performance curves of a number of commercially available flat-plate collectors. While the data does not apply to any single collector on the market, it resembles the performance of a collector using:

- *Steel Absorber Plates
- *Selective Black Coating
- *One layer of Glazing

The "averaged" collector performance data used could lead to an error of as much as $\pm 20\%$ in estimating fuel savings. If you can obtain specific performance data on the collectors you're planning to include in your system, your estimates from this workbook may be done more accurately. Refer to sect. E for more details.

Climate Data. Table A (on page 40) is based on weather data for a typical year at each of the cities listed. Weather conditions vary from location to location and from year to year and will affect the fuel you actually save with your solar hot water system.

Shading. We assumed your collectors will be unshaded.

Collector Tilt. This refers to the angle your collectors are mounted off horizontal. We assumed your collectors would be mounted at an angle equivalent to your latitude (which is generally considered the preferred tilt angle for solar hot water systems). However, you can still obtain satisfactory results as long as your collectors are mounted within $\pm 15^\circ$ of the latitude of your location.

Collector Orientation. This refers to how close to true south your collectors face. We assumed your collectors would face true south. However, you'll still obtain good results as long as your collectors face within 20° of true south.

Recommended Collector Size. In Step 1, we determined this by choosing the size which could offer the lowest cost for each unit energy delivered by a solar hot water system, for a family of your size, in your climate region, subject to providing at least 50% of your hot water needs.

Temperature of Incoming Water Supply (Inlet Temperature). We assumed the average temperature of water entering your home would be equivalent to the average year-round outside temperature of the city you chose in Step 1.

Temperature of Hot Water Supply (Outlet Temperature). We assumed your home's hot water would be heated to 140°F , a standard operating temperature for most residential hot water heaters. However, you'll conserve fuel by turning the hot water thermostat down to $125\text{--}130^\circ\text{F}$.

Conventional Hot Water System Operating Efficiency. In Step 1, your annual energy savings was based on an assumed *average efficiency rating* for your conventional water heater. The efficiency rating used depends on your type of fuel:

- (1) Systems using Fuel Oil: 50% efficiency.
- (2) Systems using Natural Gas: 60% efficiency.
- (3) Systems using Electricity: 100% efficiency.

C. ECONOMIC ASSUMPTIONS

System Installed Cost. In Step 4, we estimated that the *installed cost* of hot water systems for new homes would be \$500, plus an additional cost of \$25 for each square foot of collector. These estimates are based on the costs of solar hot water systems funded during the first three cycles of the HUD Solar Demonstration Program.

The difference in costs for systems installed on new or existing homes is based on engineering estimates of how much extra it will cost to remodel existing homes to accommodate solar hot water systems.

If you are considering a solar hot water system for an existing home, keep in mind that the actual cost of remodeling will depend on how much work is needed to get the system installed. Your actual cost could vary considerably from our estimates. (Refer to *The Basics*, page 22, for additional information.)

System Maintenance. We assumed that maintenance for solar hot water systems will average \$25 each year. However, this figure may vary for your system; you can estimate that 1% of the capital cost of an uninstalled system will be required each year for maintenance. As mentioned earlier, we expect that this cost can be offset by deductions on federal taxes for interest payments on solar loans.

Property Taxes and Insurance. We assumed that any additional costs for these items would also be offset by deductions on federal taxes for interest payments.

SOLAR TAX INCENTIVES. Many states and communities have already passed solar tax incentives. While this booklet was being written, Congress was considering legislation which would grant federal income tax credits for solar hot water and space heating systems.

Many communities have reduced or eliminated property taxes for solar hot water systems; in other areas, solar energy systems aren't being assessed.

Therefore, the effect of property tax relief on your solar hot water system will be relatively small and gradual. Homeowners who are financing their systems as part of a mortgage will be most affected by solar property tax incentives.

Unlike property tax reductions, sales tax exemptions and income tax credits are usually one-time benefits (though some states may allow you to carry over a credit for several consecutive years). The major difference between these two kinds of tax incentives is that you'll probably save more money with an income tax credit. In a few states, you can deduct a portion of the amount you paid for a solar hot water system from your net taxable income.

Tax incentives are designed to improve the economics of solar hot water systems. The state of the law is constantly changing. Therefore, if you're considering solar hot water for your home, we suggest that you contact the National Solar Heating and Cooling Information Center for up-to-date information on solar tax incentives in your area.

D.

ADJUST ANNUAL ENERGY SAVINGS -
SYSTEMS WITH HEAT EXCHANGERS

This technically oriented section is intended for those readers who wish to make corrections for losses due to heat exchangers.

As was explained in *The Basics*, pp. 7, Heat Exchangers are used whenever the collector fluid must be kept separate from your drinking water. Your heat exchanger may have one or two walls, depending on whether or not the collector fluid you're using is toxic. Systems with heat exchangers sacrifice operating efficiency because some heat is lost during the transfer process. In this section, we'll show you how to adjust the *Annual Energy Savings* figure you obtained in Step 1 to account for the heat exchanger.

YOUR HOME

SAMPLE CASE

D1. Fill in your Heat Exchanger

Reference Factor.

If your system includes a
Single Wall heat exchanger
(nontoxic collector fluids
only), fill in .98

If your system include a *Double
Wall* heat exchanger (for toxic
collector fluids), fill in .90

.90

D2. Fill in your Annual Energy

Savings Adjustment Factor.

Turn to TABLE H, located on page 39.

TABLE H: ANNUAL ENERGY SAVINGS ADJUSTMENT FACTORS
FOR HEAT EXCHANGERS

Persons in Household Collector Size	2 persons			4 persons			6 or more		
	20 sq. ft.	40 sq. ft.	60 sq. ft.	40 sq. ft.	60 sq. ft.	80 sq. ft.	60 sq. ft.	80 sq. ft.	100 sq. ft.
.90	.89	.91	.93	.89	.90	.91	.89	.90	.91
.98	.99	.99	.99	.99	.99	.99	.99	.99	.99

YOUR HOME

SAMPLE CASE

This table is arranged like
Table A. Locate the factor
by selecting the number cor-
responding to your *Heat Ex-*
changer Reference Factor

(from Line D1), your *Family*
Size and Collector Size
(from Lines 1b, and 1c or 1f)

D3. MULTIPLY: *Line D2 X Line 1d*
or 1e.

RESULT: *Your Annual Energy*
Savings adjusted for a system
using a heat exchanger.....

.90

3330
(not used in
Steps 2-8)

Use this figure instead of the original *Annual Energy*
Savings in steps 2 through 8.

However, if you intend to use your own collector
performance data in this workbook, turn the page to
Section E. You'll carry over the figure you obtained on
Line D3 to the following page.

E. ADJUST ANNUAL ENERGY SAVINGS -
USING YOUR OWN COLLECTOR DATA

This technically oriented section is intended for
those readers who can obtain specific performance data
from the collector manufacturer and would like to use it
instead of our data

The data used in Table A of Step 1 is based on an average of the collector performance graphs of a number of commercially available flat-plate collectors. This data was obtained through testing procedures specified in HUD's *Intermediate Minimum Property Standards for Solar Hot Water and Space Heating Systems*, 1977 edition.*

The collector performance graph for the "average" collector we used in this booklet is shown in figure 1. When reading the graph, keep in mind that collector efficiency goes down as temperatures inside the collector get hotter than the outside air.

The horizontal axis of the graph indicates the ratio:

$$\frac{\text{Collector Inlet Temperature} - \text{Outside Air Temperature}}{\text{Incoming Solar Radiation}}$$

The vertical axis shows percentages for the collector's operating efficiency.

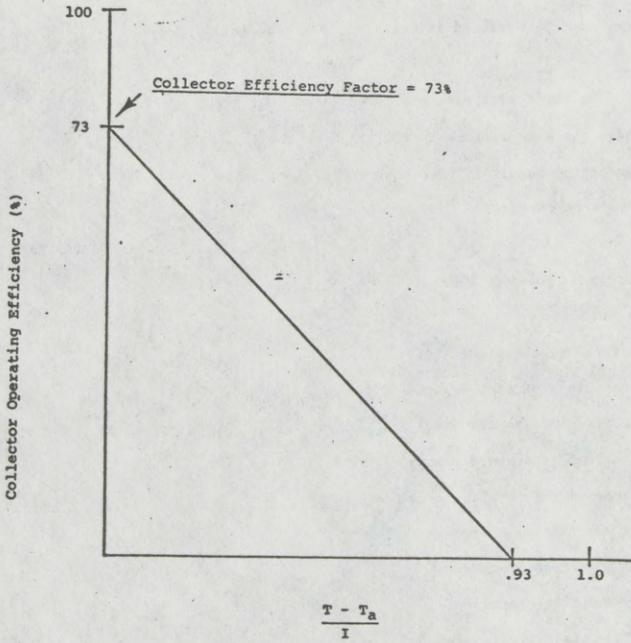
A useful reference point in comparing the efficiency of different collectors is to find the place where the curve crosses the vertical axis. This is the collector's operating efficiency whenever the average temperature inside the collector is the same as that of the outside air. While there are several technical names for this reference point, in this workbook we'll refer to it as the *Collector Efficiency Factor*.

If you can obtain a collector performance graph from your manufacturer, you can substitute it in place of our "average" data. Keep in mind that your collector must also be tested in accordance with procedures mentioned in HUD's *Intermediate Minimum Property Standards*, in order to get results consistent with the remainder of this workbook.

*The procedures for testing solar collector efficiency specified in HUD's *Intermediate Minimum Property Standards* are based on ASHRAE Document #93-77: *Method of Testing for Rating Solar Collectors Based on Thermal Performance*.

Figure 1

PERFORMANCE GRAPH FOR THE "AVERAGE"
FLAT-PLATE COLLECTOR USED IN THIS WORKBOOK



where T is the Collector Inlet Temperature in °F

T_a is the Outside Air Temperature in °F

I is the Incoming Solar Radiation in BTU/hour/sq. ft.

TABLE 1. ANNUAL ENERGY SAVINGS ADJUSTMENT FACTORS
FOR COLLECTOR PERFORMANCE DATA

Persons in Household Collector Size Efficiency Factor	2 Persons		4 Persons		6 or More Persons	
	20 Sq Ft	40 Sq Ft	40 Sq Ft	80 Sq Ft	60 Sq Ft	100 Sq Ft
0.65	0.88	0.90	0.88	0.89	0.88	0.89
0.67	0.91	0.92	0.91	0.92	0.91	0.92
0.69	0.94	0.95	0.94	0.95	0.94	0.95
0.71	0.97	0.98	0.97	0.97	0.97	0.98
0.73	1.00	1.00	1.00	1.00	1.00	1.00
0.75	1.03	1.02	1.03	1.02	1.03	1.02
0.77	1.06	1.04	1.06	1.05	1.06	1.04
0.79	1.09	1.06	1.09	1.07	1.06	1.06
0.81	1.12	1.09	1.11	1.10	1.11	1.09
0.83	1.15	1.11	1.14	1.12	1.14	1.11
0.85	1.18	1.13	1.17	1.15	1.17	1.13

YOUR HOME

SAMPLE CASE

factor by selecting the number corresponding to your Collector Efficiency Factor (from Sect. E, Line E3), your Family Size and Collector Size (from lines 1b and 1c or 1f).....

1.05

E5. IF YOU USED SECTION D: (your

system has a heat exchanger)

MULTIPLY: Line E4 x Line D3

RESULT: Your Annual Energy Savings adjusted for a system using a heat exchanger, based on your own Collector Performance Graph.....

E6. IF YOU DID NOT USE SECTION D:

(your system does not include a heat exchanger)

MULTIPLY: Sect. E, Line 4 X Line 1d or 1e.

RESULT: Your Annual Energy Savings, based on your own Collector Performance Graph..

Use the figure you obtained on either Line 5 or 6 in place of Annual Energy Savings in the rest of the steps in this workbook.

PART IV TABLE A-1. Kilowatt-Hours of Electricity Saved Per Year

Number of Occupants Collector Area (Sq. Ft.)	2			4				6 (or more)				
	40	60	80	40	60	80	100	40	60	80	100	120
Location												
ALABAMA												
BIRMINGHAM	(2100)	2500	2600	(2600)	3400	3900	4300	2800	(3900)	4700	5300	5800
ALASKA												
ELI FRANKS	(2200)	2900	3100	2500	3400	4200	4000	2600	3700	4600	(5400)	6200
ARIZONA												
TUCSON	(2500)	2600	2600	(3500)	4700	4500	4500	(3900)	5100	5900	6300	6400
ARKANSAS												
LITTLE ROCK	(2100)	2500	2600	(2600)	3400	4000	4300	2900	(3800)	4700	5300	5800
CALIFORNIA												
LOS ANGELES	(2500)	2700	2800	(3100)	4100	4500	4700	3400	(4600)	5500	6100	6500
SACRAMENTO	(2300)	2500	2600	3000	3500	4200	4400	3200	(4400)	5200	5900	6100
SAN FRANCISCO	(2300)	2700	2800	(2800)	3700	4300	4700	3000	(4200)	5100	5700	6300
COLORADO												
DENVER	(2900)	3100	3200	(3500)	4400	5200	5400	3900	(5200)	6300	7100	7500
GRAND JUNCTION	(2900)	3000	3100	(3500)	4500	5000	5200	3800	(5200)	6200	6900	7300
CONNECTICUT												
HARTFORD	(2200)	2700	2900	2400	(3500)	4100	4600	2700	3800	(4700)	5500	6100
DISTRICT OF COLUMBIA												
WASHINGTON	(2000)	2400	2600	2400	(3200)	3700	4200	2500	3500	(4300)	5000	5500
FLORIDA												
JACKSONVILLE	(2000)	2400	2500	2400	3300	3800	4100	2900	(3800)	4600	5100	5500
MIAMI	(2100)	2300	2300	(2700)	3400	3800	3900	(3100)	4000	4700	5200	5500
TALLAHASSEE	(2200)	2500	2600	(2800)	3500	4000	4300	3000	(4100)	4900	5500	5800
TAMPA	(2200)	2400	2500	(2900)	3600	4000	4200	(3200)	4200	5000	5500	5800
GEORGIA												
ATLANTA	(2200)	2500	2700	(2700)	3500	4000	4400	2900	(3900)	4800	5400	5900
SAVANNAH	(2100)	2400	2500	(2600)	3400	3900	4200	2900	(3900)	4700	5300	5700
HAWAII												
HILO	(1900)	2200	2300	(2400)	3000	3500	3700	2600	(3500)	4200	4700	5000
HONOLULU	(2200)	2300	2300	(3000)	3700	3900	4000	3400	4400	5000	5500	5600
IDAHO												
BOISE	(2400)	2800	2900	(3100)	3900	4500	4800	3200	(4400)	5400	6100	6500
POCATELLO	(2700)	3000	3100	(3200)	4300	4900	5200	3500	(4800)	5800	6600	7100
ILLINOIS												
CHICAGO	(2100)	2600	2800	2500	(3400)	4000	4500	2700	3700	(4600)	5300	5900
SPRINGFIELD	(2200)	2600	2800	2600	(3500)	4200	4600	2800	3900	(4800)	5500	6100
INDIANA												
INDIANAPOLIS	(2000)	2500	2700	2400	(3200)	3800	4300	2600	3600	(4400)	5100	5600
IOWA												
DES MOINES	(2300)	2700	2900	2700	(3600)	4300	4700	2900	4000	(5000)	5700	6300
KANSAS												
KANSAS CITY	(2300)	2700	2800	(2700)	3600	4300	4600	3000	(4100)	5000	5700	6200
WICHITA	(2400)	2700	2800	2900	3800	4500	4700	3200	(4300)	5300	6000	6500
KENTUCKY												
LEXINGTON	(2400)	2700	2800	(2900)	3800	4400	4600	3000	(4300)	5200	5900	6400
LOUISIANA												
LOUISVILLE	(2100)	2500	2700	2500	(3300)	3900	4300	2700	3700	(4500)	5200	5700
MARYLAND												
BALTIMORE	(2100)	2500	2700	2500	(3100)	4000	4400	2700	3700	(4600)	5300	5800
MASSACHUSETTS												
AMHERST	(1900)	2400	2700	2200	(3400)	3800	4100	2300	3200	4100	(4700)	5300
BOSTON	(1900)	2400	2600	2200	(3400)	3800	4000	2300	3200	(4600)	4700	5300
MICHIGAN												
LANSING	(2100)	2500	2700	2400	(3200)	3900	4400	2400	3600	(4400)	5100	5700
SAYLOR ST. MOORE	(2300)	2700	3000	2600	(3600)	4300	4800	2800	3900	(4900)	5700	6200
MINNESOTA												
MINN-ST. PAUL	(2200)	2700	3000	2600	(3500)	4200	4700	2700	3800	(4700)	5500	6200
MISSISSIPPI												
JACKSON	(2100)	2400	2500	2500	3300	3800	4100	2400	(3800)	4500	5100	5600
MISSOURI												
KANSAS CITY	(2300)	2700	2800	(2700)	3600	4300	4600	3100	(4100)	5000	5700	6200
ST. LOUIS	(2200)	2600	2700	(2500)	3500	4100	4400	2500	(3900)	4700	5400	5900
MONTANA												
BILLINGS	(2400)	3000	3100	(3100)	4100	4800	5100	3300	(4600)	5600	6400	7000
GREAT FALLS	(2500)	3000	3100	(3000)	4100	4700	5100	3200	(4500)	5500	6300	6900

TABLE A-1 (Continued)

Number of Occupants Collector Area (Sq. Ft.)	2			4			6 (or more)					
	40	60	80	40	60	80	100	40	60	80	100	120
Location												
EPASKA												
LINCOLN	2300	2800	2900	2800	3700	4400	4800	3000	4200	5100	5900	6500
EVADA	2600	2600	2700	3600	4400	4500	4600	4000	5200	6100	6400	6500
LAS VEGAS	3000	3700	3200	3800	4400	5300	5500	4100	5600	6700	7400	7700
NEW YORK												
EV JERSEY												
ATLANTIC CITY	2200	2700	2800	2700	3500	4200	4600	2900	4000	4800	5600	6100
EV MEXICO												
ALBUQUERQUE	2900	3000	3100	3900	4900	5200	5300	4300	5700	6700	7300	7400
EV YORK												
ALBANY	2100	2600	2800	2500	3300	4000	4500	2600	3700	4500	5300	5900
NEW YORK	1700	2200	2400	2000	2700	3300	3700	2100	2900	3700	4300	4800
ROCHESTER	2100	2600	2800	2500	3300	4000	4400	2600	3700	4500	5200	5800
SYRACUSE	2000	2400	2700	2300	3100	3700	4200	2400	3400	4200	4900	5500
ORTH CAROLINA												
CAPE MATEPAS	2400	2700	2700	3100	4100	4500	4500	3400	4600	5400	6100	6400
RALEIGH	2200	2600	2700	2700	3500	4100	4600	2900	4000	4800	5500	6000
ORTH DAKOTA												
RISWARCK	2600	3100	3300	3100	4200	5000	5400	3400	4700	5700	6600	7300
MO												
CLEVELAND	2000	2400	2600	2300	3100	3700	4100	2500	3400	4200	4900	5500
COLUMBUS	2000	2500	2700	2400	3200	3800	4200	2500	3500	4400	5000	5600
OKLAHOMA												
OKLAHOMA CITY	2500	2700	2800	3100	4000	4500	4700	3400	4600	5500	6200	6500
TULSA	2200	2500	2700	2700	3500	4100	4400	2900	4000	4800	5500	6000
RECON												
NEEDFORD	2200	2500	2600	2700	3500	4000	4300	2900	4000	4800	5400	5800
PORTLAND	1700	2100	2400	1900	2600	3200	3600	2100	2900	3600	4200	4700
PENNSYLVANIA												
PHILADELPHIA	2100	2600	2800	2500	3400	4000	4500	2700	3800	4600	5300	5900
PITTSBURGH	2100	2500	2700	2500	3300	4000	4400	2700	3700	4600	5200	5800
STATE COLLEGE	2000	2400	2700	2300	3100	3700	4200	2400	3400	4200	4900	5500
HOE ISLAND												
NEWPORT	2100	2600	2800	2500	3400	4000	4500	2700	3700	4600	5300	5900
SOUTH CAROLINA												
CHARLESTON	2100	2500	2600	2700	3400	4000	4300	2900	3900	4700	5300	5800
SOUTH DAKOTA												
RAPID CITY	2700	3100	3200	3300	4300	5000	5400	3500	4800	5900	6700	7300
TENNESSEE												
MARSHVILLE	2000	2400	2600	2500	3300	3800	4200	2700	3700	4500	5100	5600
TEXAS												
AMARILLO	2700	2900	2900	3400	4400	4900	5000	3800	5100	6000	6700	7000
DALLAS	2100	2400	2500	2700	3400	3900	4100	2900	3900	4700	5300	5700
EL PASO	2600	2700	2700	3700	4400	4700	4800	4100	5400	6300	6800	6700
HOUSTON	2000	2300	2400	2600	3300	3800	4000	2800	3800	4600	5100	5500
UTAH												
SALT LAKE CITY	2400	2700	2900	2900	3900	4500	4800	3100	4300	5200	6000	6500
VIRGINIA												
MT WASHINGTON	2200	2700	2800	2400	3400	4100	4400	2700	3800	4700	5400	6000
RODFOLK	2200	2600	2700	2600	3500	4100	4500	2900	3900	4800	5500	6000
RICHMOND	2100	2500	2700	2600	3400	4000	4400	2800	3800	4700	5300	5800
WASHINGTON												
SEATTLE	1700	2100	2300	2000	2700	3200	3600	2100	3000	3700	4300	4800
SPOKANE	2300	2700	2900	2800	3700	4300	4600	3000	4100	5000	5700	6200
WEST VIRGINIA												
PARKERSBURG	1900	2400	2600	2300	3100	3600	4100	2400	3400	4200	4800	5300
WISCONSIN												
MADISON	2300	2800	3000	2600	3600	4300	4800	2800	3900	4800	5600	6300
WYOMING												
LANDER	3000	3300	3400	3700	4400	5600	5800	4100	5500	6700	7600	8000
LARAMIE	2900	3100	3400	3400	4400	5300	5700	3400	5000	6100	7000	7700

TABLE A-2. Therms of Natural Gas Saved Per Year

Location	2			4				6 (or more)				
	40	60	80	40	60	80	100	40	60	80	100	120
ALABAMA												
BIRMINGHAM	(120)	140	150	(150)	190	220	240	160	(220)	270	300	330
MOBILE	(120)	160	140	140	190	(240)	270	150	210	260	(310)	350
FLORIDA												
MIAMI	(140)	150	150	(200)	240	250	260	(220)	290	340	360	360
TUCSON	(120)	140	140	(150)	190	230	240	160	(220)	260	300	330
KANSAS												
LITTLE ROCK	(140)	150	160	(180)	230	260	270	190	(260)	310	350	370
CALIFORNIA												
LOS ANGELES	(130)	140	150	(170)	220	240	250	180	(250)	300	330	350
SACRAMENTO	(130)	150	160	(160)	210	240	270	170	(240)	290	330	360
SAN FRANCISCO	(140)	180	140	(200)	260	300	310	220	(300)	360	400	430
KENTUCKY												
GRAND JUNCTION	(160)	170	140	(200)	260	290	300	220	(290)	350	390	410
CONNECTICUT												
HARTFORD	(120)	150	170	150	(200)	240	260	160	220	(270)	310	350
DISTRICT OF COLUMBIA												
WASHINGTON	(110)	140	150	130	(180)	210	240	140	200	(240)	280	310
LOUISIANA												
JACKSONVILLE	(120)	130	140	(150)	190	220	230	160	(220)	260	290	310
MIAMI	(120)	130	130	(160)	190	210	220	170	230	270	290	310
TALLAHASSEE	(120)	140	150	(160)	200	230	240	170	(230)	280	310	330
FLORIDA												
TAMPA	(120)	140	140	(160)	200	230	240	180	240	280	310	330
GEORGIA												
ATLANTA	(120)	140	150	(150)	200	230	250	160	(220)	270	310	340
SAVANNAH	(120)	140	140	(150)	190	220	240	160	(220)	270	300	320
HAWAII												
HONOLOULU	(110)	120	130	(130)	170	200	210	150	(200)	240	270	290
IDAHO												
BOISE	(140)	160	160	(170)	220	260	270	180	(250)	310	350	370
POCATELLO	(150)	170	140	(180)	240	280	300	200	(270)	330	380	400
ILLINOIS												
CHICAGO	(120)	150	160	140	(190)	230	250	150	210	(260)	300	340
SPRINGFIELD	(120)	150	160	150	(200)	240	260	160	220	(270)	310	350
INDIANA												
INDIANAPOLIS	(120)	140	150	140	(180)	220	240	150	200	(250)	290	320
IOWA												
DES MOINES	(130)	160	170	150	(210)	250	270	160	230	(280)	330	360
KANSAS												
KANSAS CITY	(140)	150	160	(160)	210	240	260	170	(230)	280	320	350
WICHITA	(140)	160	160	(170)	220	250	270	180	(250)	300	340	370
KENTUCKY												
LEXINGTON	(130)	150	160	(170)	220	250	260	180	(250)	300	340	360
LOUISVILLE	(120)	140	150	140	(190)	220	250	150	210	(260)	300	330
LOUISIANA												
NEW ORLEANS	(100)	120	130	120	(160)	190	210	130	180	(220)	250	280
SHREVEPORT	(120)	130	140	(150)	190	220	230	160	(210)	260	290	320
MAINE												
CARROLL	(120)	140	140	150	(200)	240	260	160	220	(270)	320	360
PORTLAND	(130)	140	170	160	(210)	250	280	170	230	(290)	330	370
MARYLAND												
BALTIMORE	(120)	140	150	140	(190)	230	250	150	210	(260)	300	330
MASSACHUSETTS												
AMHERST	(110)	140	150	120	(170)	210	230	130	180	230	(270)	300
ROSTON	(110)	130	150	120	(170)	200	230	130	180	(230)	270	300
MICHIGAN												
LANSING	(120)	140	160	140	(180)	220	250	150	200	(250)	290	330
SAULT ST. MARIE	(130)	140	170	150	(200)	250	260	160	220	(280)	320	350
MINNESOTA												
MINN-ST. PAUL	(120)	160	170	150	(200)	240	270	160	220	(270)	310	350
MISSISSIPPI												
JACKSON	(120)	140	140	(140)	190	220	230	160	(210)	260	290	320
MISSOURI												
KANSAS CITY	(130)	150	160	(160)	210	240	260	170	(230)	280	320	350
ST. LOUIS	(120)	150	150	(150)	200	230	250	160	(220)	270	310	340
MONTANA												
BILLINGS	(150)	170	140	(180)	230	270	290	190	(260)	320	360	400
GREAT FALLS	(140)	170	140	(170)	230	270	290	180	(250)	310	360	390

TABLE A-2 (Continued)

Collector Area (Sq. Ft.)	2			4				6 (or more)				
	40	60	80	40	60	80	100	40	60	80	100	120
Location												
NEBRASKA												
LINCOLN	(140)	160	170	(160)	210	250	270	170	(240)	290	330	370
NEVADA												
LAS VEGAS	(150)	150	150	(200)	250	260	260	(230)	300	350	360	370
RENO	(170)	180	140	(210)	280	300	310	(230)	(320)	380	420	440
NEW JERSEY												
ATLANTIC CITY	(130)	150	160	(150)	200	240	260	160	(220)	240	320	350
NEW MEXICO												
ALBUQUERQUE	(170)	170	170	(220)	280	290	300	(240)	320	380	410	420
NEW YORK												
ALBANY	(120)	150	160	140	(190)	230	250	150	210	(240)	300	330
NEW YORK	(160)	120	140	110	(150)	180	210	120	170	(210)	(240)	270
ROCHESTER	(170)	150	160	140	(190)	230	250	150	210	(260)	300	330
SYRACUSE	(110)	140	150	130	(180)	210	240	140	190	(240)	280	310
NORTH CAROLINA												
CAPE HATTERAS	(140)	150	160	(180)	220	250	260	190	(260)	310	350	370
RALEIGH	(130)	150	160	(150)	200	230	260	170	(230)	280	310	340
NORTH DAKOTA												
BISMARCK	(180)	140	190	180	(240)	280	310	190	(260)	330	380	420
OHIO												
CLEVELAND	(110)	140	150	130	(180)	210	240	140	190	(240)	280	310
COLUMBUS	(110)	140	150	140	(180)	220	240	140	200	(250)	290	320
OKLAHOMA												
OKLAHOMA CITY	(140)	160	160	(140)	230	260	270	190	(260)	310	350	370
TULSA	(170)	140	150	(150)	200	230	250	170	(230)	270	310	340
OREGON												
MEDFORD	(120)	140	150	150	(200)	230	240	170	(230)	270	310	330
PORTLAND	(100)	120	130	110	(150)	(180)	200	120	160	200	(240)	270
PENNSYLVANIA												
PHILADELPHIA	(120)	150	160	140	(190)	230	250	150	210	(260)	300	340
PITTSBURGH	(170)	140	150	140	(190)	230	250	150	210	(260)	300	330
STATE COLLEGE	(110)	140	150	130	(180)	210	240	140	190	(240)	280	310
RHODE ISLAND												
NEWPORT	(120)	150	160	140	(190)	230	260	150	210	(260)	300	340
SOUTH CAROLINA												
CHARLESTON	(120)	140	150	(150)	200	230	240	160	(220)	270	300	330
SOUTH DAKOTA												
RAPID CITY	(150)	180	190	(190)	250	290	310	200	(280)	340	380	420
TENNESSEE												
NASHVILLE	(120)	140	150	140	(190)	220	240	150	(210)	250	290	320
TEXAS												
AMARILLO	(150)	160	170	(200)	250	260	290	210	(290)	340	380	400
DALLAS	(120)	140	140	(150)	200	220	240	170	(220)	270	300	320
EL PASO	(160)	160	160	(210)	260	270	270	(330)	310	340	380	380
HOUSTON	(170)	130	140	(150)	190	210	230	160	(220)	240	290	310
UTAH												
SALT LAKE CITY	(140)	160	160	(170)	220	250	270	180	(240)	300	340	370
VIRGINIA												
MT HEATHER	(190)	150	160	150	(200)	230	260	160	220	(270)	310	340
NORFOLK	(170)	150	150	(150)	200	210	250	160	(220)	270	310	340
RICHMOND	(190)	140	140	(150)	190	210	250	160	(220)	270	300	330
WASHINGTON												
SEATTLE	(180)	120	130	110	(150)	(180)	210	120	170	210	(240)	270
SPOKANE	(130)	150	160	140	(210)	240	260	170	230	(280)	330	350
WEST VIRGINIA												
DEWEESBURG	(110)	130	150	170	(170)	210	230	140	190	(240)	270	300
WISCONSIN												
MADISON	(130)	140	170	150	(200)	240	270	160	220	(280)	320	360
WYOMING												
LANDRO	(170)	190	190	(210)	240	320	330	230	(310)	340	430	440
LARAMIE	(140)	190	190	(190)	250	300	330	210	(240)	350	400	440

TABLE A-3. Gallons of Oil Saved Per Year

Occupants or Area (Sq. Ft.)	2			4				6 (or more)				
	40	60	80	40	60	80	100	40	60	80	100	120
Location												
ALABAMA												
BIRMINGHAM	180	120	170	130	170	190	210	140	190	230	260	280
ALASKA												
FAIRBANKS	110	140	150	120	170	200	230	130	180	220	270	300
ARIZONA												
TUCSON	170	130	130	170	210	220	220	190	250	290	310	310
ARKANSAS												
LITTLE ROCK	180	120	130	130	170	190	210	140	190	230	260	280
CALIFORNIA												
LOS ANGELES	120	130	140	150	190	220	230	170	220	270	300	320
SACRAMENTO	110	120	170	140	180	210	210	160	210	250	280	300
SAN FRANCISCO	110	130	140	140	180	210	230	150	200	250	280	310
COLORADO												
DENVER	140	150	150	170	220	250	270	190	260	310	350	370
GRAND JUNCTION	160	150	150	170	220	250	260	190	250	300	340	360
CONNECTICUT												
HARTFORD	110	130	140	130	170	200	230	130	190	230	270	300
DISTRICT OF COLUMBIA												
WASHINGTON	180	120	130	110	150	180	200	120	170	210	240	270
FLORIDA												
JACKSONVILLE	180	120	120	130	160	180	200	160	180	220	250	270
MIAMI	180	110	110	130	170	180	190	150	200	230	250	270
TALLAHASSEE	110	120	130	140	170	200	210	150	200	240	270	290
TAMPA	110	120	120	140	170	190	200	150	210	240	270	280
GEORGIA												
ATLANTA	110	120	130	130	170	200	210	140	190	230	260	290
SAVANNAH	180	170	120	130	170	190	200	140	190	230	260	280
HAWAII												
HONOLOULU	60	110	110	120	150	170	180	130	170	200	230	250
INDIA	110	110	110	150	180	190	200	170	220	250	270	280
INDONESIA												
RATISF	120	130	140	150	190	220	230	160	220	260	300	320
PRCATELLA	130	150	150	160	210	240	250	170	230	290	320	350
ILLINOIS												
CHICAGO	180	130	140	120	160	200	220	130	180	220	260	290
SPRINGFIELD	110	130	140	130	170	200	220	140	190	230	270	300
INDIANA												
INDIANAPOLIS	160	120	130	170	160	190	210	120	170	210	250	270
IOWA												
DES MOINES	110	130	140	130	180	210	230	140	200	240	280	310
KANSAS												
KANSAS CITY	110	170	140	130	180	210	220	140	200	240	280	300
WICHITA	120	130	140	140	190	220	240	160	210	260	290	320
KENTUCKY												
LEXINGTON	120	170	140	140	190	210	230	150	210	250	290	310
LOUISIANA												
LOUISVILLE	180	120	130	120	160	190	210	130	180	220	250	280
LOUISIANA												
NEW ORLEANS	90	100	110	100	140	160	180	110	150	190	220	240
SHREVEPORT	180	120	140	120	160	190	200	130	180	220	250	270
MAINE												
CARROLL	110	140	150	130	170	210	240	130	190	230	270	310
PORTLAND	110	140	150	130	150	220	240	140	200	250	280	320
MARYLAND												
BALTIMORE	180	120	130	120	160	190	210	130	180	220	260	280
MASSACHUSETTS												
AMHERST	90	120	170	110	150	180	200	110	160	200	230	260
BOSTON	90	120	140	110	140	170	200	110	160	200	230	260
MICHIGAN												
LANSING	180	120	170	120	160	190	210	120	170	220	250	280
SAULT ST. MARIE	110	140	140	130	170	210	240	140	190	240	280	310
MINNESOTA												
MINN-ST. PAUL	110	170	140	130	170	200	230	130	190	230	270	300
MISSISSIPPI												
JACKSON	180	170	170	170	160	190	200	140	180	220	250	270
MISSOURI												
KANSAS CITY	110	170	140	130	180	210	220	140	200	240	280	300
ST. LOUIS	110	170	140	130	170	200	220	140	190	230	260	290
ONTARIO												
HILLTOPS	120	150	140	150	200	230	250	160	220	270	310	340
SHREVEPORT	120	140	140	150	200	230	250	160	220	270	310	340

TABLE A-3 (Continued)

Collector Area (Sq. Ft.)	2			4				6 (or more)				
	40	60	80	40	60	80	100	40	60	80	100	120
Location												
NEBRASKA												
LINCOLN	(110)	140	140	(140)	180	210	240	150	(200)	250	290	310
NEVADA												
LAS VEGAS	(120)	130	130	(170)	210	220	220	(200)	260	300	310	320
RENO	(140)	150	160	(160)	240	260	270	200	(270)	320	360	370
NEW JERSEY												
ATLANTIC CITY	(110)	130	140	(130)	170	200	220	140	(190)	240	270	300
NEW MEXICO												
ALBUQUERQUE	(140)	150	150	(190)	240	250	260	(210)	280	330	350	360
NEW YORK												
ALBANY	(120)	130	140	120	(150)	200	220	130	180	(220)	260	290
NEW YORK	(200)	110	120	100	(130)	160	180	100	140	180	(210)	230
ROCHESTER	(140)	130	130	120	(160)	190	220	130	180	(220)	260	280
SYRACUSE	(160)	120	130	110	(150)	180	200	120	170	(210)	240	270
NORTH CAROLINA												
CAPE HATTERAS	(120)	130	130	(150)	190	220	230	170	(220)	270	300	310
RALEIGH	(110)	130	130	(130)	170	200	220	140	(190)	240	270	290
NORTH DAKOTA												
BISMARCK	(130)	150	160	150	(210)	240	270	160	(230)	280	320	360
OHIO												
CLEVELAND	(120)	120	130	110	(150)	180	200	120	170	(210)	240	270
COLUMBUS	(100)	120	130	120	(160)	190	210	120	170	(210)	250	270
OKLAHOMA												
OKLAHOMA CITY	(120)	130	140	(150)	190	220	230	170	(220)	270	300	320
TULSA	(110)	120	130	(130)	170	200	210	140	(190)	240	270	290
OREGON												
MEDFORD	(110)	120	130	130	(170)	200	210	140	(190)	240	270	280
PORTLAND	(80)	100	110	90	130	(160)	180	100	140	170	(200)	230
PENNSYLVANIA												
PHILADELPHIA	(120)	130	130	120	(170)	200	220	130	180	(230)	260	290
PITTSBURGH	(150)	120	130	120	(160)	190	210	130	180	(220)	260	280
STATE COLLEGE	(120)	120	130	110	(150)	180	200	120	160	(200)	240	270
PHONE ISLAND												
NEWPORT	(120)	130	140	120	(160)	200	220	130	180	(220)	260	290
SOUTH CAROLINA												
CHARLESTON	(120)	120	130	(130)	170	190	210	140	(190)	230	260	280
SOUTH DAKOTA												
RAPID CITY	(120)	150	160	(160)	210	250	260	170	(240)	290	330	360
TENNESSEE												
MEMPHIS	(120)	120	130	120	(160)	190	200	130	(180)	220	250	270
TEXAS												
AMARILLO	(120)	140	160	(170)	210	240	240	180	(250)	290	330	360
DALLAS	(120)	120	130	(130)	170	190	200	140	(190)	230	260	280
EL PASO	(130)	130	130	180	220	230	230	(200)	260	310	320	330
HOUSTON	(160)	110	140	(130)	160	180	190	140	(190)	220	250	270
UTAH												
SALT LAKE CITY	(120)	130	140	(140)	190	220	240	150	(210)	260	290	320
VIRGINIA												
MT VEAHER	(110)	130	140	120	(170)	200	220	130	190	(230)	260	290
NORFOLK	(110)	130	130	(130)	170	200	220	140	(190)	230	270	290
RICHMOND	(120)	120	140	(130)	170	200	210	140	(190)	230	260	290
WASHINGTON												
SEATTLE	(80)	100	110	100	130	(160)	180	100	150	180	(210)	230
SPokane	(110)	130	140	130	(180)	210	220	140	200	(240)	280	300
WEST VIRGINIA												
PARKERSBURG	(90)	120	120	110	(150)	180	200	120	160	(200)	240	260
WISCONSIN												
MADISON	(110)	140	150	130	(170)	210	230	140	190	(240)	270	310
WYOMING												
LANDER	(150)	160	160	(180)	240	270	280	200	(270)	330	370	390
LARAMIE	(160)	160	170	(160)	220	260	280	180	(240)	300	340	380

Here is an extra worksheet you can use to compare the economics of three solar hot water systems side-by-side. We suggest you make photocopies so you can use it several times. If you need more detailed instructions, refer to the steps on the inside pages of this workbook.

STEP 1 ESTIMATE ANNUAL ENERGY SAVINGS

1a. Fill in *Type of Fuel* used by your conventional water heater..... _____

1b. Fill in your *Family Size*..... _____

If you don't know the collector size, skip ahead to Line 1e.

1c. Turn to TABLE A. Fill in the *Collector Size* which is closest..... _____

1d. From TABLE A, Fill in the *Annual Energy Savings* corresponding to your family size, collector size, and city..... _____

Then go on to Step 2.

1e. From TABLE A, fill in the *Annual Energy Savings* indicated in **bold type**..... _____

1f. From TABLE A. Fill in the *Collector Size* corresponding to your annual energy savings (*Line 1e*), family size, and city..... sq. ft. sq. ft. sq. ft.

STEP 2 ESTIMATE SHORT-TERM FUEL BILL SAVINGS

2a. Fill in Annual Energy Savings (from Line 1d or 1e).....

2b. Fill in Unit Price of Fuel used by your conventional water heater.....

2c. MULTIPLY: Line 2a X Line 2b

You've just estimated your First Year Fuel Bill Savings..... \$ \$ \$

STEP 3 ESTIMATE LONG-TERM FUEL BILL SAVINGS

3a. Fill in First Year Fuel Bill Savings (from Line 2c).....

3b. Fill in Fuel Escalation Rate..... % % %

3c. Fill in Time Period..... yrs. yrs. yrs.

3d. Turn to TABLE B. Select the number corresponding to what you filled in on Lines 3b and 3c. This is your Energy Savings Factor.....

3e. MULTIPLY: Line 3a X Line 3c

You have estimated your cumulative Long-Term Fuel Bill Savings for the period you chose..... \$ \$ \$

STEP 4 INSTALLED SYSTEM COST

4a. If you already know the cost, fill it in here \$ \$ \$

4b. If you don't know the cost, turn to TABLE C. Choose the column marked *New* or *Existing Home*, and then go down to the line corresponding to the system's Collector Size. The number you've found is an estimate of the Installed Cost..... \$ \$ \$

STEP 5 PREDICT SIMPLE PAYBACK PERIOD (CASH ONLY)

5a. Fill in <i>First Year Fuel Bill Savings</i>	\$	\$	\$
5b. Fill in <i>Fuel Escalation Rate</i>	%	%	%
5c. Fill in <i>Installed System Cost</i>	\$	\$	\$
5d. DIVIDE: <i>Line 5c ÷ Line 5a</i>	_____	_____	_____
5e. Turn to TABLE D. Select the number corresponding to what you filled in on <i>Lines 5b and 5d</i> .			
The number you've found is an estimate of your system's			
<i>Payback Period</i>	_____	_____	_____
	yrs.	yrs.	yrs.

STEP 6 ESTIMATE OVERALL FINANCED SYSTEM COST

(SHORT TERM LOANS)

6a. Fill in <i>Installed System Cost</i> (from <i>Line 4a or 4b</i>).....	\$	\$	\$
6b. Fill in <i>Amount of Solar Loan</i> (if different from <i>Line 6a</i>).....	\$	\$	\$
6c. Fill in <i>Length of the Loan</i>	yrs.	yrs.	yrs.
6d. Fill in the <i>Interest Rate</i>	%	%	%
6e. Turn to TABLE E. Select the number corresponding to what you filled in on <i>Lines 6c and 6d</i>			
If you are making a down payment, go on to <i>Line 6g</i> .			
6f. MULTIPLY: <i>Line 6a X Line 6c</i>			
This is your <i>Overall Financed System Cost</i> ...	\$	\$	\$

Since you're financing the entire cost of the system, you have finished Step 6. Go on to Step 7.

6g. MULTIPLY: *Line 6b X Line 6e*

This is the Overall Cost of Financed Portion
of System..... \$ _____ \$ _____ \$ _____

6h. SUBTRACT: *Line 6a - Line 6b*

This is your Solar Downpayment..... \$ _____ \$ _____ \$ _____

6i. ADD: *Line 6g + Line 6h*

You've just estimated your Overall Financed
System Cost..... \$ _____ \$ _____ \$ _____

STEP 7 PREDICT PAYBACK PERIOD FOR FINANCED SYSTEM

(SHORT-TERMS LOANS ONLY)

7a. Fill in Overall Financed System Cost (from
line 6d or g)..... \$ _____ \$ _____ \$ _____

7b. Fill in First Year Fuel Bill Savings (from
Line 2c)..... \$ _____ \$ _____ \$ _____

7c. Fill in Fuel Escalation Rate (from Line 3b)
_____ % _____ % _____ %

7d. DIVIDE: *Line 7a ÷ 7b*..... _____ _____ _____

7e. Turn to TABLE D. Select the number corres-
ponding to what you filled in on Lines 7c and 7d.

The number you've found is an estimate of Payback
Period for a Financed System..... yrs. yrs. yrs.

STEP 8 PREDICT WHEN SYSTEM RETURNS FAVORABLE

CASH FLOW (MORTGAGES ONLY)

8a. Fill in First Year Fuel Bill Savings (from
Line 2c)..... \$ _____ \$ _____ \$ _____

8b. Fill in Fuel Escalation Rate (from Line 3b)
_____ % _____ % _____ %

8c. Fill in <i>Installed System Cost</i> (from <i>Line 4a</i> or <i>4b</i>).....	\$	\$	\$
8d. Fill in the <i>Length of the Mortgage</i>	<u>yrs.</u>	<u>yrs.</u>	<u>yrs.</u>
8e. Fill in the <i>Interest Rate</i>	<u>%</u>	<u>%</u>	<u>%</u>
8f. Turn to TABLE F. Select the number corres- ponding to what you filled in on <i>Line 8d</i> and <i>8e</i>	_____	_____	_____
8g. MULTIPLY: <i>Line 8c X Line 8f</i>			
This is the <i>Annual Solar Portion of Mortgage</i> <i>Payment</i>	\$	\$	\$
8h. DIVIDE: <i>Line 8e ÷ 8a</i>	_____	_____	_____
8i. Turn to TABLE G. Select the number corres- ponding to what you filled in on <i>Line 8b</i> and <i>8h</i> . You've just predicted how many years it will take for your system to return a <i>favorable cash flow</i> .	<u>yrs.</u>	<u>yrs.</u>	<u>yrs.</u>

Mr. SHERMAN. This is a companion to the "Solar Hot Water in Your Home, the Basics." It is formatted as a workbook estimator, which permits the reader to figure out how much solar domestic hot water might cost and how much they might save. Again, might. It is based on a simplified version of a model that we have prepared called RSVP.

This is a model that we now have available for homebuilders and consumers; and we are working with lending institutions. It is a model by which you can actually go in and press in your house type, where you are located, the solar system type, and it will tell you your economics on that particular system. It is a very simple approach. It costs anywhere from 50 cents to \$1 to run the model.

Mr. GORE. We heard from the last panel that the very first thing that a consumer ought to do is to make sure that the home is well insulated, that savings from solar energy may depend upon good insulation. I do not see anything about insulation.

Mr. ENGEL. For domestic hot water; that is less crucial. For space heating, absolutely.

Mr. GORE. It says solar heating and cooling. Is this just domestic hot water?

Mr. SHERMAN. This is basically more hot water.

Mr. GORE. It does not say that.

Mr. SHERMAN. No, it does not.

Mr. GORE. What do you send somebody if they call up for solar space heating? The same thing?

Mr. SHERMAN. No. We have a whole other package on that one. This is "Solar Energy in Your Home," which goes into more detail about what solar energy is. This first one that you saw was "Solar Hot Water in Your Home." This one is "Solar Energy" and goes into more detail on exactly the energy systems in your house.

There are many additional publications that I have; I cannot even count the numbers of them. They deal with all these subjects.

These are little flyers that go out on a periodic basis.

What we do in the National Solar Heating and Cooling Information Center is that, when we get a significant number of requests or questions being asked along a very similar set of lines, we will prepare a little brochure answering all those questions. When people call, in the future the Center will just send them a publication. So, as questions come in, we prepare various documents like a reading list for solar energy, for one.

I have literally hundreds of titles for individual publications: Sources of information on alternate energy sources, solar retrofit bibliography. In these you will see that there is an awful lot here on how to build solar energy in your house and how to retrofit and also on energy conservation.

Mr. GORE. Let me backtrack on my earlier question. I see here in the pamphlet that "Like any conventional heating system, your solar system will be economical only as long as your home is energy-efficient. For existing homes, this may dictate upgrading your insulation, if it is currently inadequate."

Mr. SHERMAN. We have a book, by the way, that is entitled "In the Bank or Up the Chimney," a book that was prepared by the Department of Housing and Urban Development.

Mr. GORE. It is a very clever title.

Mr. SHERMAN. The cover is even more clever. It shows the dollars going right out the chimney.

It is a homeowner's guide to insulating their own home: How to do it yourself or contract for it. An important point is that we have had dissemination through the Government Printing Office as well as active dissemination of that document through HUD. Over 2 million have been sold by HUD through the Government Printing Office. It is now available unedited through the Sears catalog. So, it has really gotten out to the general public.

Mr. GORE. When does this go out?

Mr. SHERMAN. Things like this go out to just about anybody and everybody on our mailing list.

Mr. GORE. How many of these have gone out? Do you have any idea?

Mr. SHERMAN. No, but we are talking in the hundreds of thousands to millions of most of these publications.

Mr. GORE. What if a consumer calls you and says the manufacturer of the equipment I am considering purchasing has made the following claims? Can I believe him?

Mr. SHERMAN. I do not know that we have gotten any phone calls like that. Typically, we would not answer a direct question like that. It is very difficult.

What we recommend is that they get a competent engineer or architect to assist them. Remember, if we are talking about solar heating on a house, we are talking about an investment that is anywhere between \$5,000 to \$11,000.

Mr. GORE. Front-end cost.

Mr. SHERMAN. That is not something you want to do on your own by yourself. We recommend strongly that he get some professional who is knowledgeable in the area to assist him and not do it by themselves.

That is the only recommendation. As to whether particular claims are accurate—it is very hard to evaluate a set of claims over the phone not knowing more about the situation.

Mr. GORE. To what extent do you rely on ASHRAE 93-77? Isn't that the current standard for collector testing?

Mr. SHERMAN. Pretty much exclusively.

Mr. GORE. We have heard that this test has produced inconsistent results, even when the same collectors are tested on the same equipment. We have also heard evidence that the computer simulations of a system's performance contain unacceptable variations. Do you think that it is useful to disseminate information to consumers that may contain economic or thermal performance errors of this magnitude?

Mr. SHERMAN. First, I am not sure about the magnitude. But let me give you the alternative. And I think it was discussed quite well by Mr. Yarosh.

We have an amazing problem with standards in this country. If we are to get a standard of any kind that is totally available to everybody to meet—in other words, everybody can be tested on the exact same basis—then we have to test the thing we are testing in an ideal location. In other words, we have to make it back into a laboratory under absolutely controlled conditions. That happens with the EPA standards for mileage.

Then, translating that into what really happens in real life becomes an impossible task. So, what do you do? Maybe, if you test it in real life—although you would not get everything perfectly together—at least you might get something a little bit closer to what real life really is.

For instance, we test the building materials in the laboratory for fire. A wall may get a 1-hour fire rating. People ask me how long will it last in a fire. It may last 5 hours. It may last 10. It may last 10 minutes. But, according to the standard laboratory test, where a fire so large hits that wall, it will last 1 hour.

It is just a relative level of confidence that you can have. It is not an absolute.

Mr. GORE. Do you have programs underway to improve these standards?

Mr. SHERMAN. We are working, hopefully, closely with SEIA and other industry consensus standards groups, if you will, to get a set of nationally recognized standards that the Government just can adopt rather than promulgate themselves.

Mr. GORE. Mr. Sherman, you are with the Division of Energy Building Technology and Standards. You are the director of it. Who in your division is responsible for consumer protection?

Mr. SHERMAN. We do not have a division that large that we can have somebody. We have about five people in solar energy in the division. We are right now running the National Solar Heating and Cooling Information Center and the demonstration program. That is 7,000 housing units plus all the other stuff in the Information Center. So, it is a relatively small, tightly run thing,

We work very closely with an office of consumer affairs in HUD. We also have a tremendous field network.

An example of consumer protection came up just recently, and I would like to share it with you without sharing the name, if I may. An installer of solar equipment was putting out an ad that said HUD approved solar systems—we do not approve solar systems. This was not caught by us here in Washington but by our field staff. A letter was written to us saying that this is happening.

We wrote the manufacturer immediately, saying that this is not correct and what you are doing is actually wrong. However, we said it is important, for the development of the solar industry, that the public have confidence in the industry and in its products. But honest advertising and aggressive marketing of your products and refraining from misleading advertising, which could lead to inappropriate installations, will build public confidence much better.

Then we had a legal opinion from our general counsel, who wrote a letter to this person saying that whoever falsely advertises or falsely represents any device whatsoever, et cetera; and it gives all the penalties of the Justice Department.

So, we are constantly watching for any kind of misleading advertising that relates to any of the HUD programs. However, we also put in another caveat at the end of it where we say, "Please do not let this letter deter you from honestly advertising your products and its qualification for the hot water program. If that is true, an example of an appropriate language would be 'qualified for the hot water initiative' in a given State, as opposed to 'HUD-approved'."

So, we are trying to work with manufacturers and installers to come up with the right language as opposed to prosecuting them for using the wrong language.

Mr. GORE. You told them, don't do it again.

Mr. SHERMAN. Right, or else.

Mr. MOSS. How do you determine that they qualify for the HUD program?

Mr. SHERMAN. This is done by the individual States. It was alluded to earlier today, where we had the 11 State hot water initiative. Each State worked themselves to process and evaluate through their technical offices each solar system that was to ultimately be built in that State under the hot water initiative program. Florida used the Florida Energy Center. Connecticut used the University of Connecticut. The other 9 States used PINY, the Polytechnical Institute of New York, for the certification program.

But they are not HUD-approved. They are accepted for use—it is a small difference but an important one—under the demonstration program.

Mr. GORE. Dr. Power, you are cochairman of the Institutional Incentives and Barriers Panel, Domestic Policy Review of Solar Energy. Do you know whether DOE has a consumer protection person for solar energy?

Dr. POWER. Yes. We are fortunate to have just gotten a new employee, Polly Craighill, who is going to be Director for the Consumer Impacts Branch under Tina Hobson, who is Director for Consumer Affairs. She has a background in solar and just came from the State of Florida. We are delighted to have her with us.

Mr. GORE. Is anyone in the commercialization program responsible for consumer protection?

Dr. POWER. Perhaps I do not understand the question; there is a commercialization effort which is a task force type of operation. There is no formal organization to that effect.

Consumer protection is, however, a major concern in all of our programs.

Mr. GORE. Mr. Chairman, I would like to hold the record open so that we might have supplied to the subcommittee the names of individuals at DOE who are responsible for consumer protection in solar and the offices in which they work.

Do you think consumer protection is getting enough emphasis?

Dr. POWER. It is a major concern in our programs.

[The following information was received for the record:]

LIST OF DOE INDIVIDUALS WITH SIGNIFICANT RESPONSIBILITY FOR CONSUMER PROTECTION IN SOLAR

Name	Title or office affiliation	Phone
Ms. Omi Walden	Assistant Secretary, Conservation and Solar Applications	376-4943
Mr. Ron Scott	Director, Solar Applications and Commercialization	376-9610
Ms. Tina Hobson	Director of Consumer Affairs/IR	252-5141
Ms. Polly Craighill	Director of Consumer Impacts/IR	252-5871
Mr. Carl Conner	Program Manager, Standard, Codes Testing and Certification/CS	376-9623
Ms. Lynda Conner	Program Manager, Barriers and Incentives Branch/CS	566-6192
Mr. Bill Lane	Office of Competition/PE	376-9712
Mr. John Bell	Office of the General Counsel	566-9171
Mr. Rhett Turnipseed	Office of Program Director, Solar, Geothermal, Electric and Storage Systems/ET	376-4745
Dr. Howard Walton	Director, Office of Energy Use Analysis/EIA	566-7493

Mr. GORE. We are finding a pretty high-level of complaints, people who, while they are overall satisfied with their systems, have experienced severe problems. As a different kind of purchaser enters the market, we anticipate this to be an even more serious problem.

I am not sure that I see enough being done about it by DOE or HUD. Maybe I am wrong. It just does not seem like enough is being done.

Dr. POWER. I would say that our concerns are very strong about doing the right thing. I agree that, as we move into a situation where we have a tax credit, perhaps, for solar energy, that we will have to be even more alert. We will have to do more.

One of the things that we found was that——

Mr. GORE. That may be next week, you know, or 2 weeks from now.

Dr. POWER. I agree.

One of the things that we found was that the components of consumer protection are, as identified so clearly in the earlier session: the widespread dissemination of reliable information, the establishment of standards, the provision of sound warranties, and so forth. We have determined that in a number of cases Federal preemption, if you will, of the ordinary processes has been counterproductive. We are trying to balance the——

Mr. MOSS. Will you yield, Mr. Gore?

Mr. GORE. I would be glad to.

Mr. MOSS. Dr. Power, I have concern about a great many things. Some of them I am doing something about; some of them I am doing absolutely nothing about. My concern is not diminished because I am either doing something or nothing.

I think what Mr. Gore wants, and what we want on the record here, is what you are actually doing. Your concerns are interesting, but they are not informative to the committee as to what you are doing to resolve the problems.

Dr. POWER. Perhaps, if I could ask Mr. Conner from the Solar Division to just address a few of the things that we are doing in our solar development.

Mr. MOSS. I think the question that Mr. Gore had asked you was one directed to you, specifically, because it was felt that you should be able to answer that. If you cannot, just say you cannot.

Dr. POWER. I would prefer for Mr. Conner to answer if that is all right.

Mr. GORE. I will take an answer from Mr. Conner, Mr. Chairman. He is the program manager for standards——

Mr. MOSS. It is perfectly all right, but you want the record to show that you cannot answer it. Is that right?

Dr. POWER. I would prefer, if possible, to come back to the question after——

Mr. MOSS. Dr. Power, I would prefer that you answer the question either definitively or merely by stating that you cannot answer the question.

Dr. POWER. I cannot answer the question fully.

Mr. GORE. You are cochairman, Mr. Engel, of the Institutional Incentives and Barriers Panel. The concern which motivated us to hold this hearing was that consumer dissatisfaction may become the most significant barrier to the wider use of solar energy in the United States.

Mr. ENGEL. In terms of the DPR itself, I think it very clear that consumer concerns were very strongly addressed. Fully one-half of the Institutional Barriers Panel's work dealt exclusively with consumer affairs. The one-half—

Mr. GORE. Well, it does not show in the draft report—it is two paragraphs.

Mr. ENGEL. In terms of the recommendations in chapter 6, listed there is one whole initiative of the whole series. And everything there is listed in terms of bullets.

Mr. GORE. All you say is "work with appropriate organizations," "expanded equipment labeling," "assisting in the development of consensus standards," "support of diverse solar information and education programs"—we covered that earlier.

Mr. MOSS. Mr. Conner, are you able to address yourself to this point?

Mr. CONNER. Yes, sir. I would like to talk about the DOE program in general and how we have considered consumer concerns in every aspect of our program. For instance, we have a very aggressive research and development program to try to bring lower cost, more cost-effective products and systems to the marketplace. Of course, this is aimed at providing better, more efficient equipment for the consumer.

In our demonstration program we have also considered consumer interests very heavily. We have worked very closely with each of our contractors in each demonstration project to try to assure that they get a good system and that the system operates properly.

We have a very aggressive program in the development of standards and testing of solar collectors and for certification of solar equipment. Here again, everything in this program does consider the consumer interest. We try to assure that we get consumer input on each phase of the program.

Mr. GORE. Let me follow up on that. The introduction of the report notes that 12 public forums were held and over 2,000 people submitted data or comments. Representatives from over 30 Federal agencies participated in the review.

Yet, we just have a couple of paragraphs here. I am concerned that the public and the Congress may have some difficulty in commenting meaningfully on how we can attack this problem successfully.

Mr. CONNER. I was not personally at these public forums nor was I involved in the preparation of that portion of the DPR reports. So, I really cannot comment on that.

Mr. GORE. You are program manager for standards, codes, testing and certification with the Demonstration Branch in the Office of Solar Applications and Commercialization.

Mr. CONNER. That is correct.

Mr. GORE. Did you want to comment on the question that I addressed earlier to Dr. Power about consumer protection?

Mr. CONNER. As far as consumer representation in the Department of Energy? Was that the question?

Mr. GORE. Yes. Who is responsible in your division?

Mr. CONNER. In the past, I have been responsible for consumer protection.

Mr. GORE. In addition to being the program manager for the entire standards program?

Mr. CONNER. That is correct.

Mr. GORE. How many hours a week do you think you spend on consumer protection concerns?

Mr. CONNER. Let me follow through on that. More recently, Lynda Connor in our office has been taking the responsibility for consumer protection. I have been spending more time in the codes and standards area and on some other responsibilities.

As far as direct interaction with consumers, we have had a number of meetings with consumers and consumer organizations related to every aspect of our program to try to get their input in our program.

We get a number of calls from private individuals who are interested in doing solar installations. Most of these are inquiries on where do they find information on solar and how can they get funding. I personally have had very few complaints from consumers on installations. Most of them are requests for information.

Mr. GORE. As we pointed out earlier, I think part of the reason for that is the nature of the purchaser in the early stage of the solar industry. Maybe I am wrong about that, but I think that that is an important factor.

Mr. CONNER. I might also comment that, since HUD is handling the demonstrations in the residential program, I would imagine most of the residential consumers who have problems would tend to call HUD rather than calling the Department of Energy.

Mr. GORE. Mr. Sherman, you wanted to comment?

Mr. SHERMAN. Yes. I think that I would like to brag a little bit. We in the program in HUD have done quite a bit in consumer protection as it relates directly to the consumer. DOE does most of its demonstrations in the commercial center; we do it in the residential, which more closely impacts the consumer.

We do have the standards. They are real. They are in effect. Those standards are consumer protection standards. They talk about durability, testing, prediction of life. That is the purpose of that standard.

Mr. GORE. What are your standards?

Mr. SHERMAN. The HUD Intermediate Minimum Property Standards.

Congress, when they passed Public Law 93-409, gave us 120 days to develop standards. We developed an initial set of standards within that time frame. We saw a lack of ability to enforce those standards because of their general nature. As a result, we then developed these Intermediate Minimum Property Standards, which are now part of all our housing programs.

In addition to that, we found what we considered a major—

Mr. Moss. Mr. Sherman, when we talk of the application of standards developed by HUD, are we talking of standards that would be applicable to construction of homes under the various programs administered by HUD rather than general applicability?

Mr. SHERMAN. Yes, sir, we are; but we are talking a little bit broader.

Mr. Moss. As we look at the pattern of home construction around the country today outside of the urban centers, about what percentage of new housing is built under HUD-administered programs?

Mr. SHERMAN. I think that is a very fair question. The answer is going to astound you. In one- and two-family housing, the ultimate insurance that we provide is somewhere in the vicinity of 3 percent of

the total market. Also, though, many builders and developers who build housing in this country today have no idea what the ultimate takeout insurance is going to be on that house, whether it is going to be sold FHA, VA, Farmers Home, or conventional.

As a result, to be a smart marketing person, a builder goes ahead and builds for all contingencies to the extent that he can, so that he can market to the broadest sector. Therefore, he would most likely build under the FHA standards so that, when a buyer comes, if he qualifies for FHA, VA, or Farmers Home, that person can buy the house under any of those programs.

So, how many are actually using it in building, I would say would be significantly more, without having the specific details, than are actually taking out insurance.

Mr. MOSS. Do you have those details?

Mr. SHERMAN. I am sorry. I do not, sir.

Mr. MOSS. Thank you.

Mr. SHERMAN. In addition though, the HUD standards that are in effect are in effect for not only the HUD-insured units but, as I mentioned, all Farmers Home units as well as VA, as well as all the demonstration units, of which thus far you have at least 7,000; and we will be announcing another 5,000 or so in the next few days. So, we are talking about an additional 11,000 or 12,000 units, not including the 10,000 additional units under the hot water initiative program.

So, it does have fairly good market penetration.

Mr. MOSS. It became meaningful only when one relates it to the whole. And you would have to know that portion which is affected.

Mr. SHERMAN. Yes, sir.

In addition, we found a major consumer problem in the demonstration program in reviewing the applications for grant awards. What we found was a tremendous inadequacy of warranties to the consumer, a very mixed bag of warranties.

It ranged from no warranty to warranties that, in order to meet the warranty, you had to clean up the air in the city to meet EPA guidelines before the warranty was even in effect. Some warranties said if there was any dust on your collector it will not be acceptable. Some warranties said also that, if there is a leak in the collector, the homeowner must take the collector off the roof, ship it back to the factory for the factory to determine if there is a problem.

Mr. MOSS. I believe those are unlawful warranties.

Mr. SHERMAN. Well, none of them met Moss-Magnusson.

Mr. MOSS. I think I can tell you that they are unlawful warranties.

Mr. SHERMAN. We noticed.

In cycle four, which was the first time we really focused on this issue, we said, wait a minute. No homeowner in his right mind is going to spend \$5,000 or \$6,000 to put a solar system on his house and then have to take the thing off if it leaks and send it back to the factory for \$8,000. So, we had better straighten this out.

What we did was to say that we are going to set some warranty requirements because there is a general lack of warranty requirements. The No. 1 provision was, meet Magnusson-Moss. That is law. That we have to do.

But, more important, start providing a 5-year warranty against defects in parts and labor for the collector, the only new part of a

solar system for heating and hot water. Storage tanks we know. Pipes we know. Pumps we know.

For corrosion of the collector plate, which seems to be a problem, provide a 1-year parts and labor replacement at the site plus 4 years additional parts only.

That is to the manufacturer of the equipment.

The installer of the equipment we asked to provide a typical HVAC system warranty that he provides. That is a 1-year warranty on parts and labor.

Now an awful lot of the manufacturers in the——

Mr. MOSS. What kind of system have you required be adopted by the individual installers to insure that, when a problem develops, they will be around to honor their warranty?

Mr. SHERMAN. That is another level of problem, sir, that we are working on with the DPR. One of the recommendations for study in the DPR is the possibility of some kind of warranty reinsurance or some kind of program.

Mr. MOSS. Something comparable to the National Association of Homebuilders warranty program?

Mr. SHERMAN. Something in this document to deal with that issue so that we can take the fledgling industry, as Mr. Butt said, and help it along in case there is some catastrophic failure—help the consumer get his rights and not necessarily wipe out the solar manufacturer, by some kind of Federal reinsurance or something.

But the spinoff is interesting. Here is an announcement by a manufacturer now giving a 5-year warranty. So these things that we do sometimes spin off into the larger marketplace. That is not for the HUD program. That is generally in the marketplace appearing in major magazines. So, these things start catching on. I think that is consumer protection.

Mr. GORE. What does the warranty provide as regards the controller problem we heard so much about from the first panel? Have you focused in on that?

Mr. SHERMAN. Yes. It is 1 year on parts and labor and installation.

The thing that is most critical that we have found as being the single largest new thing that we do not know anything about is the collector. That is the new piece of equipment on the block. Everything else is pretty much stuff that we have all seen before, the hot water tanks, the storage tanks, the rockbeds. There is nothing new. The collector is the new thing.

The controllers have been used. They have been used, be they only thermostats or something more sophisticated. Those kinds of things we have a 1-year parts and labor warranty on defects in materials and workmanship.

Mr. GORE. What do you think about a federally insured warranty program—reinsurance?

Mr. SHERMAN. I think that we put it in this document as a consideration to see exactly where it would go. This is one of the things that are under consideration. I was involved with that, as was Mr. Engel.

Mr. GORE. What is your opinion of it?

Mr. SHERMAN. It is hard to say.

Mr. ENGEL. There are a lot of pluses and minuses.

Mr. SHERMAN. Right; there are both.

Do you just say, well, any manufacturer can do it? Or do you set additional sets of standards?

There are a lot of items in there that are not clear yet. These things have to be worked out.

The idea is good. Now, the details can kill it or make it. That is what we want to see. When we develop the full details of what can the industry do, what can we do, how much is the impact, what is the cost, then we will know more about whether it is great or just good or no good at all.

Mr. GORE. I wonder if you could provide to this subcommittee a somewhat more detailed statement on what you think the pluses and minuses are of that kind of program. Is that too much to ask?

Mr. SHERMAN. I do not think that I am the one who is studying it as much as the DPR is because of the recommendations made, and it is now in there for study. I would defer to Dr. Power on that one.

Dr. POWER. We will be happy to provide that information.

Mr. GORE. Thank you.

Mr. MOSS. Without objection, we will hold the record open to receive it.

[Testimony resumes on p. 337.]

[The following document was received for the record:]

CONSUMER PROTECTION WARRANTY
ASSURANCE PROTECTION OPTIONS

Solar Energy Domestic Policy Review
Institutional Incentives and Barriers Panel

September 21, 1978

Statement of the Problem

Growth and evolution of the solar industry has been marked by certain peculiarities. The nature of these peculiarities is such that attention is needed in the area of consumer protection and the resultant relationship between manufacturers and consumers, an interaction frequently defined by the terms of warranty protection plans manufacturers provide. There are several cogent reasons justifying government attention to this aspect of the solar market place.

First, solar is one of the few consumer product markets which has been actively developed and encouraged with the full participation of the Federal Government. As a result of this intervention, individuals have been encouraged to purchase and install solar, for purposes of public as well as private benefit. This federal encouragement/intervention carries with it the attendant responsibility of helping to protect the public from potential industry abuses.

Second, due to governmental involvement, the normal time span for growth and development of the solar industry has been compressed, and the usual process of product improvement has been altered. In some cases, it has been advanced, but in others impeded. Thus, early purchasers may be subject to a greater number of imperfectly designed systems than would otherwise have been the case.

Third, the very nature of solar leaves room for potential problems. For example, it is difficult for even a sophisticated consumer to evaluate a typical system's mechanical operation.

Proposals are usually designed to address two major issues:

- a) manufacturer reluctance to offer warranties judged to be comprehensive enough to adequately protect consumers, and
- b) manufacturers' ability to honor their warranties.

By providing this dual protection, warranty assurance programs would help mitigate consumer reluctance to the extent that current and future homeowners will buy solar systems knowing that they will have meaningful recourse should problems, which are related to manufactured components, arise. Having removed this reluctance, the domestic solar industry should enjoy greater growth than might otherwise be the case.

The purpose of warranty assurance for solar manufacturers is therefore two-fold: 1) to help manufacturers bear the cost of securing insurance to cover liabilities they incur as a result of offering more comprehensive warranties, and 2) to provide consumers with added protection in those cases where manufacturers do not or can no longer, honor their warranty commitments.

Why Warranty Assurance Protection is Needed

The Real Estate Research Corp. recently surveyed a group of individuals who had recently purchased homes with solar systems-- 40 percent had concerns regarding the presence of the solar system, of which 59 percent were related to possible breakdowns and 17 percent routine maintenance. This concern is further supported by the fact that the absolute number of solar collector manufacturers has declined by roughly 12 percent in the last year.

(This is a net number which takes into account new entrants as well as dropouts. As such, the 12 percent figure belies the true number of firms that have either gone bankrupt or have discontinued this line of production.) Moreover, the fact that many solar installers are still learning the trade, and many installation-related mistakes have been documented, has also contributed to both consumer reluctance to buy and a slower rate of industry growth.

Another element of concern exists where warranties are offered, but review judged them to be seriously inadequate when it came to meeting real or perceived risk levels. One such review of "5-year" solar warranties indicated that, in many cases, the homeowners would be required to: a) remove the collector from the roof at owner's expense (leaving roof exposed); b) ship the collector to the factory also at owner's expense; c) leave to the manufacturer's discretion if a warrantable defect existed; d) pay return shipping costs; and e) assume all responsibility for reinstallation. In addition, installers' warranties appeared to be vague or non-existent.

Definitions/Precedents

Before a formal discussion of the options is undertaken, a review of key insurance definitions is warranted. We feel that this brief digression will avoid confusion in the usage of terms.

Assurance	Assurance programs are primarily designed to encourage consumer confidence in a particular product, often through guarantees regarding performance over some period of time, that is through warranties.
Insurance	Insurance is basically a contract binding a company to indemnify an insured party against specified loss in return for premiums paid.

Co-insurance	Co-insurance is a form of insurance in which the insured accepts a share of the risk. For example, deductible automobile insurance policy options are a form of co-insurance since the owner can choose to pay for the loss on some portion of the risk.
Reinsurance	Reinsurance means essentially insuring by contracting to transfer in whole or in part a risk or contingent liability already covered under an existing contract. For example, insurance companies with large liability exposure will find other insurers to cover their ability to adequately handle the policy.

Federal intervention into the insurance marketplace is not new. Major precedents exist for government assistance in insuring against certain types of risks/accidents. Examples include protection from nuclear accidents (Price - Anderson Act), damage from civil disturbances (FIA Riot Insurance), danger that investment property will be damaged or expropriated (War Risk Assurance), or destroyed by natural causes (Federal Crop Insurance).

Proposed Options

A series of basic assumptions were identified as having important bearing on examination of the various options available to the solar industry. These basic assumptions are as follows:

- Option should protect both the consumers and manufacturers.
- General subsidization should be avoided.
- Any subsidies which are given should be of a short duration, for example, until a performance data base is developed.
- Program design must provide for early phase out.
- Program should maximize private sector participation.

- Program should avoid the creation of a new federal, permanent bureaucracy.
 - Program should not inhibit competition among manufacturers.
- 1) A Non-Profit Assurance Corporation

One such option proposed to assist solar energy equipment manufacturing companies in providing more comprehensive warranty protection for consumers would be the creation of a private, non-profit corporation to act as an intermediary between private insurance carriers and the solar companies. Such a corporation would function to secure two types of "insurance" covering solar energy equipment and consumers:

- 1) A reasonably priced policy for companies that covers the liability level incurred by the warranties the companies issue.
- 2) Insolvency coverage for consumers who find that equipment they bought is no longer covered because the manufacturer either refused to honor the warranty, but should have, or went bankrupt.

As a pre-requisite for membership in the corporation, solar companies would have to demonstrate that their equipment and warranty coverage meet existing solar industry standards that are acceptable to the corporation. The solar energy companies would also have to offer specified minimum warranty terms for the equipment covered.

This option calls for voluntary participation by solar manufacturers. The Panel feels that this approach has several advantages. First, it "softens" the argument that the Federal Government is once again intruding into the workings of the private

sector, and that the solar industry is being singled out from among the various producers of energy. Second, the decision of whether or not to join would lie with the individual manufacturer; they would have to decide if they wanted or needed the protection provided by the warranty assurance program. Third, the voluntary program would give the manufacturers the option of either joining or dropping out at a later date.

The corporation would cover its costs of operation through membership insurance fees and federal funding. For the corporation to effectively operate, the Federal Government would have to bear the cost of administrative "start-up" and for a limited time subsidize the insurance premium payment program.

The Solar Warranty Assurance Corporation would determine a "reasonably priced" premium for the coverage desired. This premium would be based on a prudently optimistic, rather than worst case, assessment of anticipated equipment failures. The formulas devised to determine the premiums would also try to account for the expected costs of covering warranty liability, and solar company bankruptcy rates. It is anticipated that the limited knowledge about such factors as durability and cost of repair would make the initial premium rate selected subject to considerable error.

In the final analysis, the goal would be to attempt to make these calculations with the objective of keeping costs as low as possible for the participating solar companies. Because of the newness of the technology and insurance industry caution, the

initial premium levels for the risk demanded by the carriers could well be higher than the premium level a warranty corporation would set for its members. In this case, the Federal Government would ultimately pay the difference, thereby providing an initial subsidy to the solar equipment manufacturing industry. For the Federal Government, the greatest risk occurs if too much optimism governs assessments of what is a reasonable premium.

Under this plan, actual data would be used to readjust, every two years, the premiums charged. If the premium levels need to be increased, industry would be charged more. At the same time, the Federal Government subsidy of the difference between the actual premium industry pays and what is paid for the private carrier insurance will decrease. After more adjustments over the next four years, the Federal Government subsidy of the insurance premiums would be ended, and industry would bear the full cost of the insurance program.

The Warranty Assurance Program may be criticized for having competent solar energy companies supporting "weaker" companies with poorer quality components or inadequate quality control. At the outset, this situation may be unavoidable. As the corporation evaluates its members' performance, however, premiums can be adjusted to reflect demonstrated performance shortcomings. As a result, certain companies would pay more for their membership.

The existence of a warranty assurance corporation should raise consumer confidence in the solar energy industry in view of the proposed guarantee to honor any warranty obligation

should a manufacturer become insolvent.

This particular guarantee, however, again raises a concern about "good" companies subsidizing weak ones, since part of the corporation's financial responsibility would be to cover valid warranty claims made against insolvent solar companies. If bankruptcy rates are high, the remaining solar companies in the corporation would be paying higher premiums and the Federal Government might have to intervene to relieve the burden placed on those companies.

The assurance corporation will also benefit the relatively smaller but reputable manufacturers because they will be in the position to offer the consumer a better warranty and therefore be able to compete with the larger manufacturers on an equal footing.

The above benefits notwithstanding, it is crucial that any program explicitly limits Federal Government financial participation to a short period of time, and incorporates a method for that participation to be phased out as the industry matures. In fact, this concept leaves open an option for the corporation itself to disappear if the industry matures to the point where it can secure desired insurance without need for an intermediary: or, like many other industries, it finds that warranty insurance is not desirable.

Before discussing other options considered in the course of this review, the Panel wishes to comment on one particular problem

area, installation or system performance warranties.

By not including system performance warranties or installation warranties, the option previously described fails to address some important issues. This is crucial since many consumer complaints may be related to how well a system is functioning and not to specific component failures.

The panel's hesitancy about a national program dealing with performance and installation warranties was influenced by certain of the guiding assumptions listed on page 4, and some other technical considerations related to system performance. A system's performance is a function of four distinct components: 1) design, 2) quality of fabricated components, 3) quality of installation, and 4) use and maintenance. Problems with any one of these affect the others and can severely impact the system's overall performance, which may give rise to a consumer complaint. Another problem exists regarding performance calculations. To date, industry has no widely accepted standard or measure of what constitutes acceptable "performance" of a solar system. Clearly, there could be as many measures of performance as there are generic types of solar energy heating and cooling systems.

The current distribution/marketing system presents additional complications. Solar energy systems reach consumers in a number of ways. Some manufacturers sell them directly to installers, and have created their own dealer/installer network. Others use dealers, but also work through distributors who wholesale to installers and builders, or retail directly to the public.

When the manufacturer has created his own dealer network, he has the potential to control how his product is installed. Where a middleman such as a wholesaler is involved, this opportunity is usually lost.

Another key consideration for the panel was a pronounced unwillingness to see the Federal Government create a situation where thousands of independent HVAC contractors, plumbers, and solar specialists felt they had to belong to a national non-profit corporation to be in the solar energy business.

Finally, some positive considerations about other programs in the installation area helped convince the Panel to reject an installers warranty protection program for any nationally oriented program. Private institutions, associations and government have been funding programs to assist the training of solar installers. Industry's certification of equipment should also assist installers select better components and help solve some of these problems. Some states have already developed installer certification and/or licensing programs of their own. These and other similar programs should upgrade the general quality of solar installations. Together they could obviate the need for a nationally organized solar warranty assurance program which extends down to the independent dealer/installer.

Finally the panel feels it will be difficult to determine in many cases whether a performance or installation warranty has been violated, and for what reason. Trying to deal with these kinds of installer-related concerns with a nationally organized corporation just does not appear to be a sound approach.

Accepting the panel's view does not preclude the Federal Government from approaching the installer-related problem in

different ways. To start, the Panel feels the warranty assurance corporation can have a positive effect if it is seen as a single part of a supporting foundation being constructed for the solar heating and cooling industry. It helps by giving consumers and installers better warranties to work with, and a guarantee of an available follow-up mechanism. As such, this initiative could be accompanied by, (or have substituted for it) broad-based support for general programs aimed at increasing installer competency and requiring better warranties. The broader approach would have the Federal Government continue to encourage manufacturers to increase their warranty coverage using other mechanisms.

These alternative choices include:

- Continued pressure through federal procurement or subsidy programs, with the Federal Government insisting on a desired minimum warranty.
- Consumer education programs that emphasize warranty coverage.
- Support for state programs designed to increase installer competency which may also include installer warranties.
- Support for private industry initiatives, which could include funding for educational and technical assistance on warranties for manufacturers and identification of marketing advantages inherent in more comprehensive coverage.

The remainder of this section presents more information and discussion of these and other options. Some were rejected, others are just listed for the reader's information. The Panel organized these into federal, state, and private industry categories.

2) Federal Government Options

a) The Federal Government would reimburse, in full, solar manufacturers for insurance premiums on policies which would be written by private insurance firms. The major drawback to such a plan would be temptation by the insurance industry to inflate rates knowing the Federal Government would cover the premium payments.

b) The Federal Government would act as the reinsuring agent for policies written by private carriers covering manufacturers' warranties.

This option may not be feasible if the insurance industry would prefer to deal with an entity which represented all participating solar manufacturers rather than individual firms themselves. Moreover, the very nature of reinsurance dictates that the insured item be of a large dollar magnitude in the terms of cash value, e.g., a supertanker. While the aggregate of solar warranties may be large by company standards, they would be too small to be of any interest to firms who are in the reinsuring business. Finally, there is no demonstrated insurance industry activity for the Federal Government to reinsure.

c) The Federal Government would set up a federal agency to directly insure warranties of the solar manufacturers. Due to public disdain towards the creation of yet another bureaucratic "watchdog" and the panel's objective to include private sector participation, this proposal would not be a viable option for the solar industry.

3) State Level Options

Warranty assurance programs available on the state level may be vitally important because they allow more attention to be paid to installation warranties through establishment of local programs. Two such plans have been proposed in California, one at the instigation of the California Energy Commission in the form of legislation submitted to the State Assembly, and another proposed by the California Solar Energy Industry Association. Both of these programs involved specific warranty assurance programs.

a) California Solar Energy Consumer Warranty Insurance Authority

During the 1977-78 session of the California legislature, a bill (AB 2982) was introduced to enact the Solar Energy Consumer Warranty Authority Act and establish the Solar Energy Consumer Warranty Insurance Association. The proposal provided for the following:

- a non-profit corporation;
- required membership for firms whose equipment meets state standards and qualifies for state tax credits;
- a membership fee of 2% of sales to capitalize the fund;
- payment to consumers for repairs;
- reporting on member performance.

(See Appendix C for a more detailed description of this plan.)

b) CAL-SEAL Warranty Assurance Program

Under the CAL-SEAL Warranty Assurance Program, qualified solar systems bearing the CAL-SEAL label would be assured of industry and state backing if necessary to uphold the fundamental warranty requirements of the "guidelines and criteria" set in the California Solar Energy Tax Credit Bill (AB 1558).

Funds would only be expended as a last resort and if spent would require that the warrantor responsible be dropped from the CAL-SEAL labeling program and his installations or components would no longer qualify for the Sales Tax Credit nor for the Warranty Assurance.

The warranty assurance program will be administered by the CAL-SEAL Program Director through the CAL-SEAL Program, utilizing CAL-SEAL resources, facilities and personnel.

Eligibility of warranty assurance is limited to:

1. Installations for solar systems (as defined by the Guidelines) that bear the CAL-SEAL Label and are installed by a licensed contractor who is registered with and participating in the CAL-SEAL program.
2. Solar components manufactured for resale to the general public and are within the purview of the Guidelines and subject to certification.

Both of these programs have the distinct advantage of including installations warranties. The California State Assembly Bill designated a period of time for installer responsibility followed by a manufacturer's obligation.

c) Florida Certification Program

In Florida, a more general approach to resolve the same problems has been proposed. Working together, the Florida Solar Energy Center and the Florida Solar Energy Industries Association (SEIA) plan to require that beginning in 1980, all solar energy heating and cooling equipment installed in Florida will have to be certified.

To support compliance with this requirement, the state, again working with the Florida SEIA, plans to establish minimum competency guidelines and a testing program for installers. Two additional support mechanisms are also envisioned, a public awareness program so that consumers know they should look for the state certificate seal, and a program to train and certify system inspectors.

No warranty assurance program is apparently contemplated in Florida at the present. An industry association spokesman feels the program outlined above is going to upgrade the quality of installations and that reputable firms will not require an insurance program to provide warranty backup for consumers.

d) State Warranty Option

In addition to those state level options described above, a program might be created involving a warranty/inspection system where consumers and installers (or either), could request a technical inspection of an installation to certify that it meets existing installation standards. When an inspection finds the solar system acceptable, the installer would offer a full warranty for a

specified period of time. This program could be completely voluntary, or might be included as part of a state program mandating certain requirements for solar energy businesses.

Federal Government subsidy (along with state funding) could be limited to the training of inspectors. The inspection could be handled by existing building code officials. Department of Energy regional Solar Energy Research Centers could provide technical and educational support, which is probably necessary since building code inspections have traditionally been health and safety oriented. Installers would pay a fee for the inspections, the cost of which could then be passed on to the consumer.

This program addresses the installation problem on the state level, but has the same drawbacks relative to a bureaucratic "watch-dog" agency. Although the program described above does not address the issue of insolvency, provisions for establishing such coverage could also be an added feature of the program.

At this stage in the development of the solar industry, the creation of a pilot manufacturer warranty assurance program on the state level may only be counter-productive. It would delay any nationally-oriented program. If every state was encouraged to set minimum manufacturer warranties, solar companies would be faced by the monumental task of complying with numerous and varying state standards. Finally, it would be difficult to properly generalize locally obtained data for the larger national program.

4) Private Sector Options

In the event private insurance carriers do become interested in providing coverage for solar heating and cooling components, warranties, or service contracts, the Federal Government could assist

by commissioning research projects designed to answer major insurance industry concerns and make technical know-how available through its solar energy laboratories.

The Solar Energy Industry Association and Solar Energy Research and Education Foundation are attempting to advance collector standards and certification programs. Additional Federal Government support for such efforts which would help industry self-regulate and improve product quality should alleviate certain technical problems in the market and encourage companies to offer more comprehensive warranties. The Federal Government may also want to consider supporting an association for solar installers which deals with installation technology and directly addresses problems with training and education aids.

Implementation Issues

A wide spectrum of issues surround implementation of the various options was examined by the Panel. Problems concerning the "state of art" development for standards, assessment of manufacturer warranty versus installer problems, the role of private insurance companies and federal involvement in this sector, and the effect on the competitive atmosphere for solar energy companies will be reviewed.

For purposes of this report the implementation issues are grouped under four main headings:

- Insurance Industry Issues
- Consumer Issues
- Solar Energy Industry Issues
- Government Intervention Issues

Insurance Industry Issues

- The insurance industry does not write much warranty assurance coverage; it is considered a surplus line.

Discussion: Insurance representatives contacted said that there had been some experiments in the past with regard to warranty insurance, but difficulties involving overlap between manufacturing and installation prompted the companies to back away from such policies. Moreover, manufacturing companies offering warranties seem to generally be operating in a "self-insurance" mode. They usually make a contingent liability entry in their accounting records similar to a bad debt entry. These liabilities are then cleared through cash payments, labor and materials allocations, or lack of claims. In some cases, companies set aside amounts in interest accounts to cover warranty obligations, and hence, are self-insured. These observations indicate therefore that the creation of warranty assurance programs may run counter to general practices in both the insurance and manufacturing industries and would be likely to run into firm opposition from many solar energy companies.

- The private insurance carriers may have a difficult time deciding on proper premium levels, and will want to adopt a "worst case" posture in most cases.

Discussion: Rates do not generally depend on the type of business involved, or the length of time a business has been in existence. The range of cost premiums depend primarily on the business and consumer climate in various regions of the country, where, for example, a state may be considered claim conscious by the insurance industry.

Moreover, because the insurance industry already underwrite policies covering manufactured items that are subsequently assembled into a larger item, difficulty in developing a similar line for manufacturers of those component parts which go into solar collectors may not even arise.

- At present, solar heating and cooling systems are covered by the Magnuson-Moss--Federal Trade Commission Improvement Act.

The Act provides minimum disclosure standards for written consumer product warranties and defines federal content standards for such warranties. Moreover, the Act contains "redress" provisions to aid consumers in bringing suit for failure to honor warranties or service contracts.

For the purposes of discussion, a warranty is generally part of the sales contract for a particular product. Therefore, the consumer, as buyer, is primarily concerned that the seller of this product honor such a warranty should the product fail to perform. Although the Magnuson-Moss Act focuses on legal redress when the seller fails to honor his contractual agreement to "replace, repair, or refund", it also addresses the issue of tort liability when personal or economic injury is incurred by

the consumer because of product failures. Thus, when a seller "breaches" his duty to honor a warranty, it is not only a violation of a sales contract, but can also be a tortious wrong, suable by the consumer against the seller, distributor, or manufacturer, regardless of any contractual agreement among the parties.

Therefore, estimating the cost of warranty insurance coverage should not be limited to "repair and replace" cost figure, but also to what reserves may be needed to cover the losses when personal and or economic injury is incurred by the consumer. Bearing in mind the FTC provision for legal redress under "failure to honor warranty" theory and recent reports of solar system malfunctions resulting in minor property damage, a review of the availability and extent of product liability insurance coverage should also be made before steps are taken to estimate the cost of creating a separate warranty insurance program. (see Appendix A for a more complete discussion of the Magnuson-Moss Act, warranty coverage and consumer rights to bring suit)

Consumer Issues

- Warranty assurance programs could actually delay consumer acceptance of solar energy because the consumer might feel the solar industry needs special insurance programs because it is not technically ready.
- Unscrupulous firms could use membership in an association to disarm consumer wariness.
- Solar companies may raise prices to cover costs of the insurance.

Discussion: Those companies participating in a warranty assurance program could avoid an outlay of funds by self-insuring. If they

join an assurance corporation, however, they would probably pass on added costs to the consumer. There is a possibility consumers might find added costs coming from a completely different set of circumstances if costs for warranty liability coverage are quite low, but manufacturers could pass on the cost to them of an expensive national program that anticipated high costs. This situation raises serious questions about the general premise, that solar manufacturers do not offer more extensive warranty coverage because they cannot afford to. It may be a case where the companies do not know they can afford to offer more warranty coverage. If they did so, they might actually increase business turnover to more than offset the added costs. This argument should be extensively examined.

- The creation of warranty assurance programs for solar manufacturers may not resolve the problems inherent in the marketing of solar products, namely consumer confidence in system performance and installation warranties (See discussion pp. _____).
- This program may depend heavily on the existence of accepted standards, which will have to be used to govern membership in the program. These standards do not exist industry-wide at present, and they may vary regionally for a certain period of time.
- The weeding-out process could be delayed.

Discussion: Any government supported warranty/risk assurance program could be a detriment to the consumer over the long-run, because it may hinder the normal sorting out process which occurs when new industries are in a nascent stage of development. Firms that would have disappeared in a normally evolving competitive atmosphere may survive and continue to sell products which are of lesser quality than might otherwise be the case. In the long-run,

the consumer ultimately suffers when the marginal products are allowed to remain on the market. Thus, even though such a program helps the consumer in the short-term, the long-term implications are not so favorable.

Before resolving this issue, another short-term benefit should be weighed against longer term disadvantages, namely the consumer might benefit from a delay in the weeding-out process since small companies with high quality products could be assisted by the existence of a warranty assurance SWAC program. In this case, government sharing of warranty liability would reduce near-term costs and help the smaller quality companies compete.

- Anti-competitive problems may be created because of the purpose behind these warranty assurance options.

Discussion: The various options examined are specifically designed to provide meaningful benefits to manufacturers of medium temperature flat plate liquid or air type collectors, or special liquid collectors, due to the nature of the problems addressed. Low temperature, low technology, or passive design technology manufacturers may not materially benefit from a warranty assurance program. This may result in providing an unfair competitive advantage to a certain segment of the solar manufacturing industry. The extent to which this may distort the market should be carefully considered.

Solar Energy Industry Issues

- Solar companies dispute necessary warranty levels.
- Very little data is known about the many factors that will determine the cost to solar companies for warranty coverage.

Discussion: Some company representatives feel that the cost of covering their warranty liability to date has been "meaningless". This impression is only based on a few years of experience. Other companies have been complaining vociferously about government mandated warranty requirements governing participation in federal programs. They have cited these warranty requirements as the main reason behind significant price increases. This whole area needs close attention.

- The solar market is quite price competitive, and companies may object strongly to added costs (i.e., the insurance premium, however small) when they are demonstrably cash short.
- "Good" solar companies may legitimately object to the fact that they are subsidizing companies with poor equipment.

Discussion: Industry leaders that have built sales on existence of a strong warranty may be concerned that smaller weaker companies are able to offer the same coverage because the Federal Government may be willing to subsidize a warranty assurance program. (see pp. 10) These and other anti-competitive aspects, as noted above, need to be carefully reviewed.

Federal Issues

- Establishing warranty assurance programs may be considered a government giveaway to industry and could lead to requests from other alternative energy industries for similar plans.

- The Federal Government would be paying risk insurance for private companies which, in many cases, is a normal business expense.
- The Government would be in a position where it can mandate, through its participation in these warranty assurance programs, minimum warranties for the solar industry.
- Government intervention in the industry at this stage for this reason may retard natural maturation of mechanisms that alleviate the problem. The Government may inadvertently create a new bureaucracy which would sustain itself, assume long-term market power, and adopt a regulatory role.
- Potential exists for unanticipated costs to the Government over the short-term, and there is a danger that it will be difficult to terminate a subsidy program after the designated phase-out period.
- Government places itself in a liability situation where it has little direct bargaining power with the private insurers.
- With the Government sharing liability, there may be no incentive for solar companies to try harder to improve their products.

APPENDIX AMAGNUSON-MOSS ACT CONSIDERATIONS AND HUD WARRANTYConsumer Protection Warranty Assurance Protection Options

The following terms are defined within the Magnuson-Moss Act:

Consumer - means a buyer (other than for purposes of resale) of any consumer product who is entitled by the terms of such warranty (or service contract) to enforce against the warrantor (or service contractor) the obligation of the warranty (or service contract).

Supplier - means any person engaged in the business of making a product directly or indirectly available to consumers.

Warrantor - means any supplier or other person who gives or offers to give a written warranty or who is or may be obligated under an implied warranty.

Written Warranty - (a) any written affirmation of fact made in connection with the sale of a consumer product by a supplier to a buyer which relates to the nature of the material or workmanship and affirms or promises that such material or workmanship is defect-free or will meet a specified level of performance over a specified period of time, or (b) any undertaking in writing in connection with the sale by a supplier of a consumer product to refund, repair, replace or take other remedial action with respect to such product in the event that such product fails to meet the specifications set forth in the undertaking.

Service Contract - means a contract in writing to perform over a fixed period of time or for a specified duration, services relating to the maintenance or repair (or both of a consumer product).

"Remedy" - means whichever of the following actions the warrantor elects:

- a) repair
- b) replacement, or
- c) refund

except that the warrantor may not elect refund unless (i) the warrantor is unable to provide replacement and repair is not commercially practicable or cannot be timely made, or (ii) the consumer is willing to accept such refund.

Private Consumer Remedies Under the Act

A consumer can sue for personal or economic injury due to:

- 1) failure to honor a written warranty;
- 2) failure to honor a service contract agreement;
- 3) failure to honor any implied warranty created by state law (e.g., warranties of merchantability or fitness for a particular use under the U.C.C.);
- 4) violation or failure to comply with a requirement of the Act.

Under the Act, the following persons (or companies) can be sued:

- 1) Under a written warranty only the person (or company) "actually making" the written warranty. (Consider those circumstances where one company is deemed to have "adopted" a warranty of another company as its own).
- 2) Under an implied warranty, anyone who is liable under state law.
- 3) Under a service contract, anyone who is obligated, under the contract (as determined by state law).

- 3) For violation or failure to comply with the requirements of the ACT (warrantor, service contractor and seller--under presale contract--are covered under this rule.)

Nevertheless, before bringing suit under the Act for breach of warranty or service contract, a consumer must give the person obligated a reasonable opportunity to perform (cure the breach). If the person does not meet this obligation within a reasonable amount of time, a number of remedies are generally available to the consumer (e.g., recovery of purchase price, market price of a replacement, or loss in value due to the problem). Moreover, the Act contains a "lemon" clause applicable only to "full" warranties. This provision entitles the consumer to a choice of a full refund or a new replacement producer if the warrantor fails to remedy defects after a reasonable number of attempts.

4. Minimum Solar System Warranty Requirements

Include in the Application copies of the warranties which the builder/ developer, solar system and/or collector manufacturer and installer will extend to the owners of existing buildings or to purchasers of new buildings. These warranties must be reasonable and, at a minimum:

- a. Comply with all applicable provisions of the Magnuson-Moss Warranty Act of 1975 (12 U.S.C. 2301 et. seq.) which establishes Federal disclosure terms and substantive and enforcement provisions for written warranties on consumer products;
- b. Include a one year warranty from the installer against failure of the solar system, any component, or assembly where such failure is caused by a defect in materials, manufacture or installation. The warranty shall cover the full costs of parts and labor required to remedy the defect, including, if necessary, replacement at the site, and shall run from the date of installation completion. The warranty shall also include provision for field inspection at no charge to the consumer, to verify failure, establish probable cause, and determine corrective action required. NOTE: The installer's warranty may include pass-through warranties provided by his supplier or the manufacturer.
- c. Include a five (5) year collector manufacturer's warranty which shall include:
 - (1) A five (5) year warranty against defects in materials or manufacture. The warranty shall cover the full costs of parts and labor required to remedy the defect, including, if necessary, replacement at the site, and shall run from the date of installation completion.
 - (2) A five (5) year warranty against corrosion of the absorber plate and other coolant passages. This corrosion warranty shall cover, for the first year, full costs of parts and labor required to remedy the defect including, if necessary, replacement at the site. For the remainder of the warranty period, the corrosion warranty shall cover the cost of all parts, delivered to the site, necessary to remedy the corrosion defect, including the cost of furnishing new collectors, if necessary. The corrosion warranty shall run from the date of installation completion.
- d. The manufacturer's warranty shall also include provision for a field inspection at no charge to the consumer to verify failure, establish probable cause, and determine corrective action required. NOTE: The manufacturer is not required to warrant against system failure caused by defective or faulty installation.
- e. All warranties may specify reasonable installation and maintenance procedures for the warranty to be effective. However, no warranty shall be voided or in any way reduced by conditions that may occur in normal operation of the system.
- f. HUD also expects the manufacturers of other major system components such as heat exchangers and storage tanks to reasonably warrant their products in accordance with established industry standards.

APPENDIX B

Consumer Protection Warranty Assurance Protection OptionsSample Insurance Programs

1. Federal Disaster Assistance Administration

Yearly appropriations \$200,000,000 of which \$6,000,000 (or 3%) overhead. 168 personnel (75% professional; 25% clerical). This program is somewhat difficult to budget for as it is based solely on historical experience and if in any given year, more disasters occur, the program merely receives supplemental funding.

2. Federal Insurance Administration

This administration is divided into a number of insurance sectors: crime insurance, flood insurance, etc. Difficulty with using this program's cost figures is that there is no reliance on appropriations (as of now) but rather on profits made in another sector. Using the flood insurance program as an example, one finds 1.3 million policies in force with a cost of administering these policies at \$15 million or approximately \$10.00 per policy. Approximately 400 persons work exclusively in the flood insurance sector (under the \$15 million budget).

3. California Warranty Assurance Corporation and Cal-Seal

The start up costs for proposed creation of a Solar Energy Consumer Warranty Insurance Association in California were estimated to be \$250,000. For the California SEIA Cal-Seal Program costs were estimated at \$125,000. (see the main text and Appendix C for description of these programs)

4. Homeowners Warranty Corporation

The Homeowners Warranty Corporation is the first 10 year nationally-insured protection plan for home buyers. The Corp-

ration is a wholly-owned subsidiary of the National Association of Home Builders and is seen as a viable alternative to federally-supported warranty programs. The program applies only to new homes where the builder gives a 1-2 year warranty: one year warranty against defects in workmanship and material; a two year warranty against certain limited defects in plumbing, heating, etc. and a two year warranty against major structural defects. From years 3-10, a major insurance company will provide direct insurance protection against major structural defects (also for years 1-2 should the builder refuse or be unable to honor his warranty.)

Basically, each builder enrolls as a participant by meeting certain standards for technical competence. The plan costs \$2.00 per \$1000 of the final sale price of the home. From this \$2.00, \$1.00 goes to the national insurer, 50¢ goes to the National HOW Office and 50¢ goes to the local state office.

When the insurance company receives its payment (after year 1 or 2) it takes 15% of it for overhead-the maximum allowed); the number of claims are calculated (usually 5%). The rest of the subscription payment goes to the National HOW Office and is subsequently distributed as a rebate to local offices.

In the National Office, there are 40 staff personnel, (25 executive; 15 clerical). The Virginia local office operates on a budget of \$50,000 per year overhead of about \$5,000 a month for everything). It is an average size office with 2 secretaries and 3 executives.

APPENDIX CCalifornia Solar Energy Consumer Warranty Insurance Authority

During the 1977-78 session of the California legislature, a bill (AB 2982) was introduced to enact the Solar Energy Consumer Warranty Authority Act and establish the Solar Energy Consumer Warranty Insurance Association. The proposal provided for the following:

1. A non-profit corporation would be created under the Insurance Commissioner's office which would function as an insurance pool for the expressed warranties of manufacturers and installers.
2. Any manufacturer or installer whose systems have been tested and certified by the Energy Commission and whose systems have qualified for the tax credit shall be required to be members of this pool.
3. Each company shall pay 2% of the price of each system sold to provide full capitalization of the insurance fund. The cost to the company, shall be prorated by the extent and term of coverage offered.
4. The corporation shall be organized with a Board of Directors consisting of a majority of members from the industry, with public members from the Energy Commission and the Dept. of Consumer Affairs.
5. The corporation shall cover the cost of system repairs in the event of failure of a company within the warranty period or refusal of a company to honor its warranty. It shall provide the consumer with the full dollar amount he/she would have received if the warranty were honored. It shall also refer

the consumer to qualified companies capable of performing the repairs within the consumers service area.

6. The corporation shall have the power to expel members who fail consistently to live up to their warranties. They shall also inform the testing and certification program of the Energy Commission where substantial system and warranty failures are occurring. The industry version rejected some of the main precepts of the legislation described above by lessening some warranty requirements provided by the state and attempting to ensure that industry had absolute control over the program. This particular program has been closely linked with a proposed certification plan for equipment, CAL-SEAL, a mission delegated to the California SEIA.

Mr. GORE. I agree, just off the top of my head, that there are quite a few pluses and minuses. We explored this at a workshops. I held in my district earlier this year. I tend to think it might be a good idea if it can be done well. I will be very interested in seeing what you come up with.

Mr. SHERMAN, you are in the process now of revising the HUD Intermediate Minimum Property Standards. Is that correct?

Mr. SHERMAN. Yes, sir. What we do is this. For the demonstration program, we find out problems. We find out good areas. We find out where we are lacking information. What we try to do is take the Intermediate Minimum Property Standards and update them as a result of what we learned in the demonstration program.

The public law that we are operating under, however, requires that, at the end of the demonstration program, we publish a definitive set of standards. We are working towards that end, as opposed to having separate standards for HUD and separate standards outside HUD. We are working toward a nationally recognized standard as opposed to the specific updating of this thing.

Mr. GORE. How are you involving the public, the manufacturers, the vendors in that process?

Mr. SHERMAN. Again, it is a national consensus standard, which was explained in some detail by Mr. Butt. It is working through the ASHRAE. It is working through that process with the National Bureau of Standards and the general consensus standard where consumers, industry, Government, and all are represented by different categories.

Mr. GORE. Mr. Conner, do you think they have sufficient opportunity to participate?

Mr. CONNER. Yes, I think so. We have tried to work our standards program into the consensus standards process as thoroughly as possible. In other words, everything that we have done, such as the minimum property standards, has been provided to ASTM, ASHRAE, the other standards committees. We go and participate in those committees to present the information and try to help them as much as possible in the production of these consensus standards. We also work with them closely to try and insure that there is adequate consumer representation and adequate comments provided from all interested parties.

Mr. GORE. What if somebody calls the 800 number, and they have a consumer problem—first of all, is the 800 number busy a lot?

Mr. SHERMAN. Yes, it is busy a lot.

Mr. GORE. What are you doing about that?

Mr. SHERMAN. Not much.

Mr. GORE. Why not?

Mr. SHERMAN. It is so popular. It is very hard to increase it to a degree. We had it up to seven phones operating constantly.

It is just a matter of how big does it get in relationship to the overall program. It is running right now at \$5 million a year.

Mr. GORE. We are trying to encourage people to get accurate information about solar energy and to encourage its wider use.

When I had this workshop I referred to, a lot of people said they had called and called and called and had a real problem getting through.

Mr. SHERMAN. There is also an address that you can write to. It is not only a phone number. So, that helps a little bit.

What we also do is, we track the number of phone calls on literally a daily basis. We try to keep it at a constant high level so that the phones are busy almost all the time.

Mr. GORE. You try to keep the phones busy almost all the time?

Mr. SHERMAN. We want to keep the people working, answering questions. So, we try to keep it on a constant level. We do not want everybody sitting around twiddling their thumbs.

If—and I explained this in the hearing the other day—the phone calls drop to any degree, we will plant the phone number in a magazine article or someplace else so that people in that location—

Mr. GORE. So that it stays busy.

Mr. SHERMAN. So that it stays busy and people are still asking questions. We don't want them sitting around because it is cost-ineffective. So, we are constantly sending out the phone number whenever we see a drop in calls. So, we are trying to keep it busy all the time to keep information getting out.

But I think there is a point of diminishing returns on how many people you can have manning phones.

Mr. GORE. I guess so.

Mr. SHERMAN. This helps a bit. We do have it open for everybody's time 9 o'clock in the morning until 5 o'clock at night. In other words, in California it is 9 o'clock in the morning until 5 o'clock at night as well as here from 9 to 5. So, that means it is actually open from 9 in the morning until 8 at night, which is quite a number of hours.

Mr. GORE. Do you have somebody in that operation that has specific responsibility for consumer problems? You indicated that not many of the calls you were getting related to those.

Mr. SHERMAN. No, I was personally involved in a couple of cases that came to us. One of the things we did, if it was a manufacturer we knew or heard about or somebody we could do something about, we actually made a phone call and asked questions.

Now, I do not know if we can do this on a continuing basis because of the staff size. But 2 weeks ago that specific thing happened. Somebody called and said, "I am having a problem with this house. I bought it without Government assistance. This guy is now applying for a grant with you. Should he get a grant if my house doesn't work?" We got on the phone right away and asked this guy why he wasn't servicing that house. He went right out and serviced that house.

But that is a very hard kind of thing to do on a continuing basis. But, to the extent that we get them, we respond to them.

Mr. GORE. I do not want to take too much time in my part of the questioning.

By way of conclusion, I would just like to say that I have worked with a lot of the agencies and offices that are represented here today. I think that the problems we are talking about are not out of the ordinary. I think that we are dealing basically with a group of very enthusiastic and hard-working, capable, competent people. I think, for the most part, you are doing a very good job. But I think that problems do exist. I think that more attention should be given to consumer protection.

As one member of this subcommittee, I am going to address the problem of warranties in the report and see how we can perhaps stimulate greater awareness of the need to build consumer confidence in some of these solar units so that we do not experience the problems which we could experience if they reached too high a level.

Thank you, Mr. Chairman.

Mr. MOSS. Mr. Greene?

Mr. GREENE. Thank you, Mr. Chairman.

The key element of the Government's acceleration program with respect to solar has been the tax credit, which is yet to be passed by the House and the Senate. But the House-passed version of that bill suggests that the Secretary of Housing and Urban Development and the Secretary of Energy are to consult with the Secretary of the Treasury on the matter of standards.

What can we expect from your individual departments as to what you will be recommending to the Secretary of the Treasury when this piece of legislation becomes law?

Mr. CONNER. We have had some discussions with the Treasury Department on this. At this time it looks like the "Intermediate Minimum Property Standards" are the best set of standards currently available. I think we would tend to rely on those.

Mr. GREENE. Mr. Sherman, would that be HUD's probable recommendation?

Mr. SHERMAN. Those are the only standards that are now currently available. We would like to drop those as soon as possible in favor of a national consensus standard. But right now that is all there is. If the tax credit passed today, I would say let's meet those in lieu of none.

Mr. GREENE. So, what we will expect to see then is HUD's "Intermediate Minimum Property Standards" being made applicable and then, as consensus standards are developed, those will be incorporated into the tax credit standards. Is that correct?

Mr. CONNER. That is correct.

I might mention that the HUD "Intermediate Minimum Property Standards" do incorporate the consensus standards that now exist. For instance, there are now two standards from ASHRAE: One, 93-77 that has been discussed here; and also a 94-77 for the testing of storage systems.

So, as new consensus standards come along, we will be adopting those.

Mr. GREENE. A number of individuals have indicated concern about overregulation, overstandardization. Is there some policy with respect to that issue as it relates to incorporating consensus standards into the tax credit?

Mr. CONNER. Overregulation is certainly a concern. It is a concern of ours as well as the concern of all other parties. I think it is just something that we have to keep in mind anytime we are developing standards and try to insure that, when we do develop a standard, we get appropriate review from the interested parties, whether consumers or industry or whoever it might be; and make sure that their concerns are considered in the development of that standard.

It is a delicate problem. We are aware of it. We are trying to accommodate it as best we can.

Mr. SHERMAN. I think the only time the Government has to act in something like this is when there is a void. I think, when we took on the job of working in the solar energy industry, there was a void. There were no standards. That is why we developed them. Had there been standards out there, those standards would have been reviewed by us. If those standards were found to be developed by a consensus method with all parties equally represented and those standards indeed had consumer protection, then we would have, in the minimum property standards, just referenced directly those standards and not promulgated our own.

Mr. GREENE. That raises the matter that we have discussed previously today. That is the issue of the new technologies and the issue of consumer participation. Mr. Butt, in his commentary, indicated that he felt that consumers needed to be subsidized so they could participate in the standards development process and had to have access to expertise. Also, if I am stating his position fairly, he thought that he was doing a much better job—SEREF was doing much better with respect to those two issues than ASTM, ASHRAE, and some of the others.

Is his operation better?

Point 2: If he is doing what he should be doing and the others are not, what are we doing about the others?

Mr. CONNER. Let me say that each standard-writing organization has its own rules and regulations. They may vary slightly from one organization to another.

In regard to the SEREF work, that work is being done under contract to the Department of Energy. So, we had direct input into how that work was organized and in the participation. So, we worked very closely with SEREF in the initiation of that work to make sure that we got appropriate consumer representation and to make sure that the funding was provided, such that that did happen.

Mr. GREENE. Are they in fact better than the others?

Mr. CONNER. I do not know that I could say that they are better. I would say certainly they have as much, if not more, consumer participation in that activity than other organizations—more than any other I know of at this particular time.

Mr. GREENE. Since we expect that those standards, once they are developed—ASTM, ASHRAE, et cetera—will be incorporated into the minimum property standard and then referenced by the tax incentive program, which is very, very lucrative, shouldn't we insist that consumer representation of the level contemplated in the SEREF proposal be the standard for all of the standard-setting bodies that are operating in this area?

Mr. SHERMAN. I think the FTC has been involved in this in some way. I am not thoroughly conversant on the subject. I remember some kind of an issue with the Federal Trade Commission and the standard-setting bodies and some kind of regulation that came out within the Federal establishment setting some guidelines on what standards we recognize based on the amount of consumer and other types of representation on the standards. But FTC would be better; they do keep a watch on that, as I understand.

Mr. GREENE. Mr. Sherman, in a symposium on the solar marketplace, you indicated this year that warranties were a key consideration for

consumers and that you were, as I recall, strongly defensive of HUD's minimum warranty provisions.

Do you think that that should be incorporated into any tax credit proposal?

Mr. SHERMAN. I do not like to mandate anything. I do not know what all the ramifications of a mandate are. When you say it has to be this and nothing else, I do not know what that does to the whole marketplace, to all the other things. So, I am very leery of that.

I am not afraid to say that, if you want to participate in HUD's program, you have got to do this because I know HUD's program. So, I am not afraid to say that.

What it does to all other aspects of life, I have no idea. What it would do to the anticompetitive nature of this—maybe only the big company's could afford it, and the little ones cannot.

I just do not know what all the ramifications are. I would be very hesitant to answer whether we ought to make it a national mandate that it has to occur.

I think warranties are key. Whether it has to be our provision the way that we laid them out or not—we have 5-year provision in the warranties because we have a 5-year responsibility under the 93-409. Whether it should be 5, 2, 3, I don't know. And I am really reluctant to say that it ought to be national mandatory warranties.

Mr. GREENE. I guess I am a little unclear on this. Under the HUD hot water initiative, as I understand it, the Government grants approximately \$400 to an individual to install a system.

Mr. SHERMAN. Through the State.

Mr. GREENE. Through the State.

Under the tax credit program, in effect, we will be forgiving for an average price system somewhere in the range of \$600 from someone's tax bill. And they are getting a clear benefit from the Federal Government. Shouldn't the Federal Government use that leverage in some way to insist upon durability and reliability?

Mr. SHERMAN. Yes. I think through sets of standards. Whether warranties in and of themselves give you durability and longevity, I don't know.

Again, the level. I just cannot comment on it without an awful lot more study. I would not like to just say yes and then not know what all the ramifications of that thing may be.

Mr. GREENE. Is that issue being studied?

Can anyone on the panel answer?

Mr. ENGEL. I do believe FTC is beginning some studies on minimum warranties and the possibility of warranty reinsurance.

Mr. MOSS. Mr. Greene, will you check with FTC?

Mr. GREENE. Yes, Mr. Chairman.

Mr. MOSS. We will hold the record to get their response.

[The following letter and attachment was received for the record:]



OFFICE OF
THE CHAIRMAN

FEDERAL TRADE COMMISSION
WASHINGTON, D. C. 20580

The Honorable John E. Moss
Chairman, Subcommittee on Oversight
and Investigations
Committee on Interstate and
Foreign Commerce
House of Representatives
Washington, D.C. 20515

Dear Mr. Chairman:

In response to your request of September 16, 1978, I am including for the record of the Subcommittee's Hearings on Consumer Protection Problems in Solar Energy Commercialization the Federal Trade Commission's staff critique of the Solar Domestic Policy Review public release document. This latter document contained a discussion of a solar industry warranty reinsurance program, and the FTC staff response contains a brief discussion of the possible effects of such a program.

If you or your staff have any questions regarding the information provided, the Commission will be very happy to respond. Mr. Jon Wellinghoff of the FTC Energy and Product Information Division staff can provide more detailed explanations of the enclosed material. He can be reached at 724-1527.

Sincerely,

Michael Pertschuk
Chairman

Enclosure

FEDERAL TRADE COMMISSION

WASHINGTON, D. C. 20580

September 25, 1978

M E M O R A N D U M :

TO: Allan R. Hoffman
Chairman
Domestic Policy Review Integration Group

FROM: Linda Colvard Dorian *YCD*
Assistant Director
Division of Energy and
Product Information
Bureau of Consumer Protection

Terry Winslow *WTW*
Assistant Director
Bureau of Competition

SUBJECT: Response to the Public Review Copy of the Status
Report on Solar Energy, Domestic Policy Review

The Domestic Policy Review of Solar Energy, initiated by the President in May, recently released a Status Report on Solar Energy for public review and comment. The Federal Trade Commission staff has maintained an active interest in the solar energy industry during the course of its development. As a federal agency with primary responsibility for both consumer protection and competition issues, the Commission is vitally interested in the treatment of these issues in the formulation of a federal domestic solar energy policy. The following comments are offered for use in the preparation of final solar policy recommendations for the President. These comments reflect the views of the Commission's designated staff representatives to the Domestic Policy Review and are not intended to reflect official Commission or Bureau policy or the views of any individual Commissioner.

General Comments

The DPR Status Report on Solar Energy describes a variety of opportunities for federal action to encourage the development and use of solar energy. These include measures to assure consumer confidence in solar products through consumer protection mechanisms. The report also recognizes the role of competition in the solar industry and describes federal actions in that regard, although no specific options to encourage development of a competitive solar industry are included.

We applaud the inclusion of these consumer protection and competition concerns in a document with the potential significance and impact of the DPR Status Report. We are disappointed, however, that concepts as pervasive as the maintenance of competition and consumer protection were not made integral elements of each suggested solar incentive, but were instead given separate consideration as independent options. Since many of the options included in the report could seriously affect consumers and competition in the solar market, it is important to ensure consideration of these issues. We would urge that the final report submitted to the President either address the potential competitive and consumer impact of each option recommended or require that such an analysis be conducted before specific programs and policies are implemented.

We recognize that this report is merely one stage of a process and that many of the options will receive further analysis. However, the single phrase option descriptions contained in section VI of the Status Report do not provide the Commission staff or other public reviewers with adequate detail of the options under consideration to allow meaningful comment. Additional explication of the suggested approach and implementation of each option, as well as discussion and evaluation of the advantages and disadvantages of the various alternative options, is necessary. Our comments on the Status Report on Solar Energy are therefore somewhat general. If and when the DPR Integration Group is able to provide the FTC with more complete descriptions of each option, we will be able to provide a more detailed analysis.

Section IV: Federal Efforts Affecting The Solar Industry

Section IV of the Status Report, which summarizes current federal efforts relating to solar energy, omits a number of important issues. The approach followed in section IV is to describe only those federal programs aimed at assisting or directly affecting some aspect of the solar industry. Federal programs that affect solar indirectly, areas where no federal programs exist, and private activities in solar energy are not discussed. An example of one such significant omission is the report's failure to discuss federal programs and subsidies for conventional fuels. As a result, the report lacks a clear and complete analysis of the forces affecting the solar industry upon which federal action could be based. To the extent that these factors are not addressed in section IV (and consequently no options relating to them appear in section VI), there is a possibility that important data and issues are not reflected in the report.

The discussion of competition in section IV of the report (page IV-21) addresses the issue of small business participation in federal demonstration programs. Contrary to the statements in the report, we know of no "explicit mandates" for federal agencies to promote competition by requiring small business participation in federal programs. The Solar Heating and Cooling Demonstration

Act--the only statute that is cited--requires only that federal agencies take steps to assure realistic opportunities for small business participation. Furthermore, the act applies only to the demonstration program. While there is a high level of funding of small businesses in the demonstration programs, the same cannot be said for research and development. In DOE's Office of Conservation and Solar Applications, the following distribution of R & D awards for fiscal year 1977 to 1978 is expected: small business 17%, large business 34%, universities 18%, government 26%, and non-profit 5%.

Moreover, the DPR Status Report's emphasis on small businesses and the percentage of their participation in federal programs demonstrates far too limited an approach to competition policy. Competition is not a question solely of small businesses or percentages. It should be emphasized that our primary goal is to protect competition, not individual competitors, which means that such factors as access to markets, entry barriers, and particular marketing practices must be considered. Because a competitive solar market should produce the most goods at the lowest prices, thereby maximizing benefits to consumers, competition is essential to the ultimate success of the solar industry.

The report should therefore recognize and examine, to the extent possible, all facets of competitive activity in the solar industry, not simply the impact of federal solar programs on small business. In the private sector, the suggested examination could focus on such possibilities as undue economic concentration and unfair trade practices. Existing federal programs could be explored to determine whether their design, application, operation or procedural complexity have the purpose or effect of decreasing or interfering with free market competition, increasing costs to companies and to the government, disadvantaging particular companies or types of companies, and stifling or excluding new ideas. The level and character of federal programs and subsidies for conventional fuels with which solar energy must compete are also clearly relevant. These are all complex and difficult issues, but they must be developed before an effective federal program in this area can be devised.

Finally, the description of federal antitrust enforcement efforts contained in this section should be corrected. The Federal Trade Commission shares with the Department of Justice authority to enforce some antitrust statutes and has exclusive enforcement authority with respect to others. In addition, it appears that portions of section IV relating to existing federal data collection and dissemination programs, which appeared in an earlier draft of this report, have been accidentally omitted.

Section VI: Federal Options1. Consumer Information (page VI-4)

The first area identified by the DPR as presenting opportunities for federal action, Space Conditioning and Hot Water for Buildings, contains two consumer information options of critical importance to the creation of an effective solar consumer protection program. The apparent determination of the DPR Integration Group to promote federal programs to subsidize and assist the marketing of solar energy products should carry with it a commitment to consumer education on the relevant characteristics of solar energy systems. The government-sponsored acceleration of solar commercialization, the lack of consumer experience with solar technology, and the magnitude of the financial investment for the consumer imposes a special obligation on the government to provide accurate and comprehensible solar thermal and economic performance data.

To develop a meaningful federal program to measure and disseminate pertinent thermal and economic performance data for solar energy systems, it is necessary to determine the reliability and accuracy of currently available solar system performance data. Such data is currently derived from computer simulations. An analysis should be performed of the status of validation and correlation studies of such solar system performance predictors. There is no indication from the two consumer information option descriptions contained in the DPR Status Report that such a systematic analysis of the problem has been conducted or is intended.

Not only should the DPR consumer information option ensure the usefulness and accuracy of the thermal and economic performance data provided by federal sources to consumers; it should also develop and provide such data as quickly as possible. Currently, consumers have no validated mechanisms to determine if they are purchasing a "Cadillac" or a "Volkswagen" solar system. The federal government has sponsored a number of solar system performance simulation programs such as SOL-COST and R.S.V.P. which have yet to be validated. Empirical studies correlating these simulation methods (or their derivatives, such as F-Chart) with actual solar system performance indicates that there may be significant variations between actual and simulated solar performance data. If federal goals for solar energy commercialization in the residential sector are to be met, it is imperative that understandable and reliable performance data for all solar systems be provided to consumers as soon as practically feasible. The availability of such data is critical to the average solar consumer to ensure an optimum economic decision in the purchase of a solar energy device.

2. Establishment of Solar Infrastructure (pages VI-4 to 5)

A second area of opportunities for federal action to accelerate use of solar space conditioning and hot water in buildings sets forth recommendations for federal assistance in establishing a vigorous manufacturing, commercial, and labor base for solar. Six specific options are described. A healthy competitive market, like a stable industrial, marketing, and labor infrastructure, is an important element of expanded solar usage. We are somewhat disappointed that the DPR Status Report does not attempt to resolve some of the fundamental concerns relating to competition policy in the solar industry. Although we recognize the difficulty of dealing with these sorts of concerns in the abstract and with the limited time and resources available, at the least the report could recommend that the anti-trust agencies pay particular attention to the area. For example, the DPR could adopt the option suggested by the Institutional Incentives and Barriers Panel, that the antitrust agencies focus on anticompetitive conduct in the solar industry and undertake enforcement actions in appropriate situations. In light of the possible harm to consumers and to the viability of the solar industry from a lack of antitrust enforcement, these areas deserve more attention.

3. Warranty Reinsurance (page VI-4)

The DPR Status Report contains an option suggesting a program of warranty reinsurance for solar equipment, but no specific designs for such a program are forwarded. Prior to the institution of any federal warranty reinsurance program, however, it must be determined whether there exist private insurance carriers willing to provide the industry with warranty insurance. If private carrier warranty insurance is unavailable, a fully subsidized federal warranty insurance program may not be in the consumer's best interest, since this sort of program could result in a decline in the quality of solar system products.

Assuming private warranty insurance could be made available with some federal subsidy of a portion of the solar warranty risk, it is uncertain whether such a program will provide improved warranty protection for consumers. There is no data or discussion in the Status Report to indicate that warranties offered under a federal reinsurance program will be better for consumers than those offered by the solar industry without such a program. A reinsurance program could also require the prescription of a "minimum" warranty for solar equipment to qualify for federal reinsurance subsidization. In establishing such minimum warranty requirements, small solar manufacturers and solar innovators could be discouraged or priced out of market entry, to the detriment of competition in the industry.

The primary point to be emphasized is that the warranty reinsurance concept is one which should be developed cautiously to ensure that the final program has positive rather than negative effects on consumer protection and competition. One possible alternative to the warranty reinsurance concept

which could be studied is a federally subsidized insolvency pool, which would make direct payment for warranty claims to consumers who purchased solar systems from manufacturers unable to honor their warranties due to insolvency. This program could provide protection to consumers without requiring minimum warranties, which might restrict competition and innovation. Care must be taken, however, in developing even the insolvency pool concept to ensure that market access and incentives for product quality control are maintained.

4. Competition and Federal Programs

A number of options relating to increased levels of federally-funded research, development and demonstration appear throughout the options section of the memorandum. For example, in the industry and agriculture section, research and development of medium and high temperature applications and systems development are options suggested to increase the market acceptance of process heat and on-site electricity. In the utility industry, research and development on solar systems for utility applications in the future is a possibility. And in the area of space conditioning and hot water for buildings, several demonstration and research options are described.

Government research, development and demonstration awards constitute a large portion of the money spent annually on research, development and commercialization efforts in the solar industry. Companies receiving R & D awards experience the benefits and economies of larger, better-funded research operations, and may thus attain a superior competitive position. There may also be particular competitive advantages arising from the acquisition of federal demonstration awards since the chosen company may obtain production and training economies as well as profits.

The potential for various competitive advantages and disadvantages under federal programs does not mean that funding of solar research, development and demonstrations should be curtailed. Indeed, an argument can be made that, so long as the government funds energy industries with which solar energy must compete, the solar industry should receive federal money at a commensurate level. Our considerations suggest, though, that any current or expanded federal research, development or demonstration programs should attempt to evaluate and respond to the competitive impact of the awards. As we have noted, free market competition is the best way to ensure the most products at the lowest prices, and thus to foster increased acceptance of solar energy by consumers. The options forwarded in the DPR Status Report should therefore be designed to ensure that the federal role in the solar industry, through research, development and demonstration awards, promotes a competitive industry structure.

5. Role of Utilities (pages VI-8 to 9)

The third major area identified in the Status Report is the role of utilities. The report stresses that a "necessary element of successful utility solar programs is supportive utility rates and roles" (page VI-8). The two options in this area focus first

on the interaction of solar systems and utility rates, and second on the development of an "appropriate" role for utilities in financing, selling, leasing, servicing, or engaging in other activities relating to marketing solar equipment.

The assumption that utilities, with their large stake in conventional energy technologies, should necessarily play a role in the solar market should not be made without a good deal of consideration. Depending on how each individual option is implemented, a significant utility role in the solar market could lead to competitive injury. For example, current utility rate structures may allow or encourage utilities subject to a regulated rate of return to engage in cross-subsidization. This would give the utility's solar operation a distinct advantage over nonutility competitors by lowering the costs attributable to the solar marketing activities.

A balance must be struck between competitive and consumer interests in this area. Utilities have ready access to customers, are capable of providing reliable service, and have a number of marketing advantages. However, there are many potential disadvantages to a large utility role in solar as well, stemming from the opportunity utilities have to capitalize on their position as natural monopolies.

Federal options in this area should recognize the potential competitive harms and should include controls or guidelines as a part of appropriate utility options. The DPR Status Report could, for example, consider encouraging utilities to engage in marketing activities only through a completely separate subsidiary. Other methods for utilities to enter the solar market should be carefully structured to maintain and enhance competition. The potential for utility domination of this new industry is evident if these considerations are not properly addressed.

Mr. GREENE. On the matter of warranty reinsurance, Mr. Butt earlier today in his prepared statement attached apparently a proposal of SEIA on that matter. One of the things which he proposed was that individual warrantors, the seller of a solar system, would pay as much as 20 percent to consumers if they violated their own warranty. Is that something that is seriously being considered with 80 percent being paid by the Federal Government.

Mr. ENGEL. We are not at this point at the stage of working on any kind of specific formula.

In the DPR deliberations, basically we are playing around with alternative possible designs in terms of whether reinsurance is a viable mechanism. Our initial designs did consider reinsurance as a possible approach. However, further research has shown that there is not even an insurance industry of a large nature to reinsure. Possibly a direct program of warranty insurance by some sort of nonprofit corporation may be more appropriate. Then there would be a takeout by private insurers; something like the GNMA-FNMA relationship is now being explored.

In terms of the 80 percent/20 percent cost sharing, we are not seriously considering that. At this point we are not considering any formula—except for the fact, that as a prerequisite to any design, we are strongly recommending that the program be self-sustaining within a very short period of time and that premiums be adjusted accordingly.

Mr. GREENE. One of the implications of consensus standards, presumably, will be that most of these solar standards will be actually enforced by localities, either through State standards or through local standards. What involvement does DOE have in supporting appropriate expertise and knowledge of such standards at the local level?

Mr. CONNER. We have been working with major building code organizations now for more than a year on this subject. We have gone through some preliminary studies and have just recently—in fact, I think earlier this week—signed some contracts to do some very involved work toward developing what might be called a model solar code or a model document that could be adopted by the model code organizations in regard to solar equipment.

This work will involve, as I mentioned, all the major code organizations. Also, the plans include, once the code is developed, funding to support training and actual implementation of the code by the various States and localities.

Mr. GREENE. What involvement would the regional areas have in this particular endeavor?

Mr. CONNER. Regional solar energy centers will primarily be helping in the outreach portion of it in relation to the end use of the code, once it is developed, and in providing information within their region about the availability of this type protection and working with the States to provide technical assistance in the adoption of the code.

Mr. GREENE. Is any technical assistance being contemplated for consumer protection offices in States to pursue individuals who may be falsely advertising products or improperly or fraudulently bilking consumers?

Mr. CONNER. We would prefer that each State handle their own complaints themselves. I think the regional centers can certainly provide some technical assistance to the States to help educate them and in-

form them what to look for and get them technically up to speed so they can handle these kinds of problems.

Mr. GREENE. Could you describe briefly what sort of technical assistance you were noting? And what is the size of the program to provide that technical assistance?

Mr. CONNER. I do not think the details of that program have been worked out. These regional centers are still in various stages of implementation. The only one that is now actually operational is the Northeast center. The other three are still in various stages of planning. Some of them will shortly be operational, but right now I do not think those details have been worked out.

On this model code, I might also add that the plan is now to have a draft of this model code within 6 months. As I mentioned, the contracts were just signed. And then to have a code in final form by the end of 1979.

Mr. GREENE. Assuming that all goes well and on schedule, when can consumers expect that their local jurisdictions will have enacted the provisions of the model code which incorporate the standards?

Mr. CONNER. Once the code is available—which looks like now will be around the end of 1979, such as States could adopt it—I would expect, with the coordination that is going on now with the Council of Governors and other organizations that will be involved, that the implementation could be done in many States in a matter of months once the code is available. We will be laying the groundwork toward implementation during the development phase.

Mr. GREENE. Let me address this to each of you individually.

Earlier in the day, we reviewed a number of consumer protection problems. People in one way or another are having problems with solar installations.

If you were recommending to a consumer or were asked by a consumer today what your advice would be with respect to how to insure that he or she would get a safe, reliable, and effective system, what would you recommend to that consumer beyond that which was suggested earlier?

Mr. CONNER. Well, I am a very cautious person myself. So, the first thing I would do is try to get all the information I could, to learn something about solar myself, so I would know what they are talking about. The Solar Information Center is certainly a place to get that kind of information for the general public.

The next thing I would do is talk to several solar suppliers. Quiz them about their products. Get some feeling for what they are offering, what kind of warranties and so forth they might be offering. After I have talked to several, then I think I would be in a pretty good position to know which one I would choose.

Mr. GREENE. Mr. Sherman?

Mr. SHERMAN. I was happy to hear what I heard this morning. I think they pretty well covered just about everything that ought to be covered. With Mr. Meeker's thing, and what Mr. Butt said, and what Mr. Yarosh said, I think they pretty well hit just about everything. Anything I would say would be redundant.

Mr. GREENE. Mr. Engel?

Mr. ENGEL. I know what I would do if I were putting in a solar system here in Washington. I know two or three HVAC companies.

HVAC is heating, ventilating, air-conditioning. One is the company responsible for the furnace in my own home. In addition to heating, it is now carrying a line of three or four different manufacturers of solar systems. I respect that company. I would probably ask them to put in the solar system.

I would not try to find an entirely new company at this point. That would be my consumer decision.

Mr. GREENE. Dr. Power?

Dr. POWER. I would look for some kind of warranty, something to insure me that the installer and manufacturer were standing behind the product.

Mr. GREENE. Would the bottom line then be that consumers should be extremely careful as they proceed to make this kind of buying judgment?

Dr. POWER. Absolutely.

Mr. SHERMAN. "Careful" is a word that says be a little scared of what you are doing. I say "educated," knowledgeable and understanding of what they are going to get. "Careful" could be a good word, but I do not want to scare them because it can work and it can save them money. So, yes, careful, but careful means to educate yourself, know what you are doing, and work with familiar people.

Mr. GREENE. I have no further questions.

Mr. MOSS. Mr. Gore?

Mr. GORE. If I could summarize what a consumer should do—and I invite any of you to break in and correct me.

No. 1: Find out as much information as possible about solar energy and about the kind of system that they are considering purchasing.

Mr. SHERMAN. Its limitations and expectations.

Mr. GORE. Its limitations, its expectations.

Calculate costs over the reasonable lifetime of the system.

No. 2: Choose an installer, a supplier, that you have confidence in and that has a reputation in the community.

No. 3: Absolutely insist upon a written warranty and one that is reasonable.

What else should be added to that list?

Mr. MOSS. Ask for a financial statement to see how good they are for their warranty.

Mr. CONNER. If possible, talk to some people who have used that system.

Mr. GORE. Talk to others who have used that system.

Mr. CONNER. That is right.

Mr. GORE. And you can find their names from the supplier, the installer. Where else?

Mr. SHERMAN. The National Solar Heating and Cooling Information Center, to the extent that we have it, has a list of solar installations, to the extent that we can keep up with them—and they are rapidly increasing—in your area, and can turn you on directly to the people as opposed to through the manufacturer.

Mr. GORE. Thank you.

Mr. MOSS. Mr. Wunder?

Mr. WUNDER. I have no further questions.

Mr. MOSS. Mr. Sims?

Mr. SIMS. Thank you, Mr. Chairman.

I have just a couple of brief questions.

I want to tap the HUD and DOE experience in the fairly complex area of warranties and consumer complaints. In other words, who does the consumer complain to? If you have a situation in which the same manufacturer assembled the components, designed the system, and had a person install it, it is very easy. The consumer knows exactly who to go to if there is a problem.

If company A built some components, company B designed the system and assembled the components, and company C installed this system, and something goes wrong, who does the consumer turn to—particularly if the consumer is not a technically sophisticated person?

Mr. SHERMAN. I think that is an excellent question. We have wrestled with that.

What we say in the warranties that we require in the demonstration program is that the prime contact with the homeowner is the installer. Everything should flow through the installer. In other words, we require that the manufacturer of the solar equipment and all the pumps, the fans, and all the other things that may be involved, pass the warranties to the installer, who then in turn passes them to the consumer. This is, I think, fairly standard practice in the industry.

Take a radio. The John Doe Radio Manufacturing or Assembling Co. may not make the tubes. The consumer does not care about that. They want a warranty from the person that they see, namely, in solar, the installer. That is the way we are trying to make it work in the demonstration program.

Mr. SIMS. Have you had any experiences either HUD or DOE, in which the system designer and manufacturer says, "It's not my problem; the installer put it in wrong," and the installer says, "The designer is no good; if it had been designed well, it would have worked; I sure put it in right." Have you had experience like that? And, if the answer is yes, in such cases what does the consumer do?

Mr. SHERMAN. I think that is very astute, because you are right.

The biggest single problem with warranties is the ability to recognize whose problem it was. I have yet to see a warranty that somebody does not want to get out of by saying, "Your nails on that siding that you put on were supposed to be 8 inches on center, and you put them on $8\frac{1}{3}$ inches on center; therefore the warranty is null and void."

These problems crop up all the time. I do not think the country as a whole has solved that whole issue yet. I do not know that solar could be the first one to solve it. It almost has to go to court then, I guess. I hate to see that. But I do not know how to solve the jurisdictional problem of who they go to.

But that solar installer is who they ought to yell at. And then right up to their State or city consumer affairs right away, as soon as they do not get some kind of action.

Mr. SIMS. Have the responsible solar people, either in DOE or HUD, given any thought to the policy question of the Government providing some kind of refereeing service, either through the national SERI or the regional SERI's? The State and local building code and inspection people are clearly going to be hard-pressed, except in exceptional cases.

Mr. ENGEL. As part of the developing option on warranty reinsurance—it is constantly going through various iterations—one potential

option is also having the States create some sort of installer's insurance program. There would be a national manufacturers reinsurance program. There would be a kind of adjudication and agreements between the national program insuring the manufacturer's warranty and the State programs dealing with installer's warranty as to whose responsibility it was, if there needs to be a reinsurance to honor an existing warranty.

We sit there and it seems like we are a bunch of philosophers on Mount Olympus trying to debate how we should cut the piece on this. That is our latest version. It may change tomorrow.

Mr. SIMS. I presume that your thinking on this would be reflected in this document that you are going to provide for the record.

Mr. ENGEL. It depends at which time—

Mr. SIMS. Whatever your thinking is at the date you provide the document?

Thank you very much, Mr. Chairman. I have no further questions.

Mr. MOSS. We excuse you gentlemen with the thanks of the committee.

Mr. SHERMAN. Thank you.

Mr. MOSS. We stand adjourned.

[Whereupon, at 1:30 p.m., the subcommittee was adjourned.]



