SOLAR HEATING AND COOLING STANDARD SETTING:

AN INSTITUTIONAL ANALYSIS CASE STUDY

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ABSTRACT

As a companion to other studies of the standards problem for photovoltaics, this paper reports results of an institutional analysis case study of the effort to create solar thermal standards during the period 1974-78. The standards setting institutional arena is described. In the US, most standards are achieved through a voluntary consensus process; there are mandatory standards only when referenced or formally adopted by a governmental body. The justification most frequently offered for having two systems is that the voluntary consensus approach resolves primarily technical issues, while the mandatory system encompasses political questions. This study found that the solar standards development process from 1974-78 was characterized by

* a horizontal rather than vertical structure;
* extensive public prompting, albeit by agencies for which standards development is at best a secondary mission;
* rapid acceptance of the concept of solar energy, despite continuing and considerable technical debate.

It is concluded that the development of standards is a story of the interaction of self-interest, and that the failure to account for significant interests (whether technical or political) can effectively scuttle a standard development effort. For the case reported here, the process for the development of solar standards was inclusive of many interests, and, as a consequence, appeared to proceed at a rapid rate. However solar standards development is entering a second stage, with the consumer/producer debate (the "political" dimension) assuming a more central role.

CONTENTS

This paper is one of a series resulting from institutional analysis of photovoltaic (PV) acceptance. These studies are undertaken with sponsorship of the US Department of Energy (DOE) as part of its Photovoltaic Program. In addition to institutional questions, DOE is interested in economic, marketing, and technological issues, and is sponsoring a series of studies and field tests on these topics. Institutional analysis studies have typically been undertaken in relation to particular PV field tests, though in some cases studies have focused on comparable technologies and institutional forces influencing their acceptance.

The nature of solar heating and cooling standard setting is the focus of this institutional case study. The case study takes as a central area of investigation the effort to create standards that was prompted by the 1974 legislation which created the DOE-HUD Solar Heating and Cooling (SHAC) Demonstration Program. This program involves direct federal assistance to prompt project developers to incorporate solar thermal approaches to heating and/or cooling into various building forms. In this context institutional analysis is directed to understanding the forces which influence rate and nature of standard setting as evidence of innovation acceptance.

Theory and Methods of Institutional Analysis

Institutional analysis focuses on the interactions of institutions in a given sector. When such an analysis is undertaken in order to ascertain means of facilitating innovation acceptance, particular attention is directed to 'routines' in the sector, so that the possible meaning and impact of an innovation is understood in context. An institutional analysis proceeds in a series of steps, beginning with sector identification and preliminary exploration. These two steps yield an hypothesized institutional arena, which is a formal representation of the institutional entities in a sector, and the routines of their interaction. A "perturbation prompter" is identified, enabling the analyst to follow the process by which an institutional arena handles a 'non-routine' using a research method specifically designed for the arena and nature of perturbation. The actions of the arena in handling the 'non-routine' are monitored and analyzed. (For a further discussion of the theory and method of institutional analysis see Nutt-Powell et al., 1978.)

Background of This Study

DOE is anxious to introduce PV into a number of economic sectors. Though the technology is not yet fully developed in terms of efficiency or cost competitiveness, these barriers should be overcome within a very few years. Thus studies to understand the institutional dimensions of PV acceptance are appropriate at this time.

Though it is a convention to think of standards as simply existing, in fact they are developed over time, and through increasingly formal processes. This intentionality in standards development can be viewed either as an opportunity or a barrier. Whsichever view is adopted, it is the case that the development of standards is a process of deliberate societal intervention. As such it can be understood using institutional analysis. Moreover an understanding of the "routines" of the standard setting process enables those wishing to accelerate the acceptance of an innovation to know better those processes used to set standards in relation to the innovation.

In this paper the concern is with standard setting for solar heating and cooling innovations. Though at the time used as a beginning point for the case study, PV was not in consideration. Indeed, as will be shown later in this paper, PV was incorporated into the standard setting process initiated for solar thermal.

This paper is divided into three sections. The first section presents the results of the first five steps in the institutional analysis. Here the standard setting institutional arena is summarized, and the approach used in gathering data on how it handled the need for solar setting discussed. (A more detailed discussion of the standard setting institutional arena is presented in Parker and Nutt-Powell, 1979.) The second section presents the findings of the institutional analysis data gathering activities. The third section presents conclusions.

THE STANDARDS SETTING INSTITUTIONAL ARENA

A Conceptual Framework for Standards

Most often, standards are defined and discussed in the context of a particular standard type. In the industrial sector, for example, the term standard is often used synonomously with the term specification to denote specific requirements that must be satisfied by physical products and materials. Alternatively, standard is used to define common units of measurement, for example, fixed intervals of time, or finite units of length, weight or mass.

Definitions of this sort are helpful in highlighting the differences among different standard types; however, they tend to obscure or, at the least, understate the common conceptual basis on which all standards are founded. More broadly conceived, standards are defined to include all things accepted for current use (e.g. products, procedures, actions) or things taken as bases for comparison. Acceptance for use can result from authority, habit or custom, or by virtue of general consent. Moreover, standards exist on many different levels; a standard might be applicable to a single individual, an entire society or even to all societies in the world.

Taken from this broader perspective, standards can be viewed as, at a minimum, norms and, where broadly accepted, as institutions. Like norms, they embody society's judgements about the desirability of actions, processes, products and events. Standards are a means of determining whether things are good or bad, superior or inferior, appropriate or inappropriate and so on. Additionally, because such judgements are known and acknowledged, whatever the level of acceptance may be, they serve as a basis for communication of agreed upon meanings. Thus, goods produced with certain materials or through certain established procedures are commonly thought of as safe and/or reliable. Because they are produced 'according to standards' they are viewed more positively than goods produced through other means. Likewise, certain modes of dress are taken to be 'stylish' or 'functional', while others are seen as 'in bad taste', or 'inappropriate'. These judgements are made based on standards related to clothing, the context, or both.

It is directly from this patterning, this routinization of behavior, that the benefits of standards accrue. Serving as models and codes for behavior, standards make life in human society predictable; they reduce chaos and impose a sense of order and stability on reality. True, there may be nagative externalities to such routinization; standards often constrain human behavior in ways that are thougt to be excessive and violations of individual freedom. Nonetheless, it is apparent that without some degree of predictability, human society could not exist--there could be no cooperation, no communication, no sharing of knowledge.

One can identify four primary contributions of standardization. First, there are important psychological gains. Because we can predict how others are likely to respond in any given situation, each action need not be a source of astonishment and danger. In this way, standardization helps to stabilize the many separate actions of individuals as well as their interactions with one another. Second, standardization makes possible an economic use of human resources. By definition, standardization implies that something has been tried before. As a result, the potentialities and consequences of engaging in a particular course of action are known. An awareness exists regarding the actions needed to accomplish a given objective, implying that the actions may simply be repeated when the result is desired. Third, standards make possible an economic use of physical resources. For example, a manufacturer of building materials, knowing the types and characteristics of materials acceptable for use, will gauge production decisions accordingly. The general facilitation and communication benefits are the fourth, and perhaps most basic contribution of standards. Because actions and behaviors are routinized and because we name them (even if we do not explicitly engage in them) they serve as useful points of reference. For example, an architect can merely name something in a word or two, say 'Steel 160', and others will know exactly what is meant. Taking a broader perspective, we may consider language and all forms of communication as forms of standards. words, pictorial symbols, physical gestures are given common definitions; meaning is retained, i.e. standardized. It is on this very fundamental level that standards help in the construction of a stable and ordered social reality. The world is constantly in flux, yet it is made both comprehensible and manageable because we routinize our behaviors and therafter 'name' them.

Approaches to Categorizing Standards

This section briefly discusses approaches to categorizing standards. These approaches are summarized in Table 1.

One beginning point is to identify the subject or topical area of a standard. This may be done on sectoral or functional lines. A sectoral view might distinguish standards pertaining to agriculture or transportation; a functional view might focus on research or finance.

A second approach is by aspect. here there are five elements. Definition relates to nomenclature, a common language for a given area of knowledge. Classification standards divide actions, products, events, processes and so on into different sets or groups on the basis of similar attributes. Specification standards establish requirements which a product, material, process or event should (or must) meet. A distinction is often made here between prescriptive and performance specifications. A fourth type is the recommended practice. This is similar to the specification, though typically service oriented, stating the manner in which some process or procedure should be carried out. The final type is measurement, a means of determining the characteristics or attributes of things. There are standard dimensions (weight, time, distance) and methods of measurement.

A third approach is by manifestation. Here one considers manner of development (natural, formal), source, enforcement, and purpose (quality, uniformity, simplication and regulation.)

TABLE 1

APPROACHES TO CATEGORIZING STANDARDS

APPROACH	EXAMPLE
By subject/topic	
Functional	finance, service, research
Sectoral	agriculture, housing, military
By aspect	
Definition	a vacuum cleaner is...
Classification	words naming places, things, ideas are nouns; words describing or qualifying nouns are adjectives
Specification	
prescriptive	product X may contain no more than 50 percent water, 30 percent bone and 20 percent chemical preservatives, by weight
performance	prison bars must be able to withstand 18,000 cycles of a hacksaw blade
Recommended practice	guidelines for merchandise display
Measurement	econometric method for determining the GNP
By manifestation	
Manner of development	
natural	a gentleman tips his hat to a lady
Source	ASTM A629, performance standard for prison bars
Enforcement	The fear of hellfire ensures certain behavior by members of many fundamentalist sects.
Purpose	
quality	FHA's Minimum Property Standards are created to quarantee that publicly insured housing is decent, safe and sanitary.
uniformity	35mm slides and projectors
simplification	reducing paint brush types from 480 to 138
regulatory	Step-rates for electricity use, with a base "life-line" rate

Standards Development in the United States

Most standardization activities in the U.S. are carried out through a loosely structured system of industry, producers, consumers and government, known as the voluntary consensus system. Over 400 private orgainizations participate in this system; however standards writing activities are actually highly concentrated. (Three organizations alone accounted for more than one half of all industrywide standards in 1964, and another fifteen for most of the remainder.)

This system is called voluntary for two reasons: first, participation in the system is voluntary, as it aims to include in standards development all those who might be affected by the standard; second, standards produced by the system are, in most cases, intended for voluntary use. The system has no formal enforcement powers as it is premised on the belief that the standard that is developed by all affected parties will be the one that is widely used.

Standards produced through the voluntary consensus system become mandatory only when they are referenced or formally adopted by a governmental body. State and local governments, for example, reference hundreds of standards developed by the system for use in building codes. Similarly, the Environmental Protection Agency, the Food and Drug Administration and other government agencies have adopted standards originating in the voluntary consensus system for regulatory purposes. In the standards writing community, standards of this type, whether developed by the governmental body or adopted for its use from voluntary standards, are known as mandatory standards.

The justification most frequently offered for having these two systems of standards development is that the voluntary consensus approach resolves primarily technological issues, while the mandatory system encompasses political issues as well. According to this view, most industrial standards answer simple technological questions; for example, the load bearing properties of different building materials. It is commonly believed that the standard setting tasks of this kind yield best to the combined efforts of all interested parties--industry, the governmnet, the consumer, the engineer--in short, any "analytic talent" willing to participate.

Setting a limit on "how much is safe" (for example, on the amount of sulphur to be permitted in stack emissions or the chemical content of foods) is by comparison a political question (that is, one for which there are several compelling standards of judgement, meaning that the issue cannot be settled on the basis of technical expertise alone.) The bifurcation yields a tendency to de-politicize tehcnical questions and, conversely, to de-technicalize what are called 'political' questions. Nevertheless it is obvious that to the extent that an issue can be reduced to technical terms (that is, terms which themselves are, by definition, standardized) the higher the probability of a standard being set.

Because most standards are premised on the achievement of consensus, the standards writing community usually classifies standards according to the level at which consensus is achieved. The American Society for Testing and Materials (ASTM) identifies five levels of consensus:

(1) the company standard;

(2) the industry standard;

(3) the professional standard;

(4) the government standard;

(5) the full consensus standard.

In the company standard, consensus is achieved among employees of a formal organization. In the industry and professsional standards, consensus is achieved among all firms in an industry and all members of a profession, respectively, In all three enforcement is largely internal. There are two types of government standard, the purchasing specification and the mandatory standard. Finally, a full consensus standard implies consensus of a substantial number of elements of a community having an interest in the development and/or use of a standard.

Nearly all of the standards just described (all but the company level) are developed by trade associations and professional societies, as these groups provide the trusted means for formally assembling participants for standard setting. To these organizations are added a small group of less easily categorizable organizations including the ASTM, the National Fire Protection Agency (NFPA), Underwriters Laboratory (UL), the National Bureau of Standards (NBS) and others with a central interest in standard setting. Theoretically, any organization with authorization for standard writing in its by-laws can write or initiate the development of an industry, profession, government and/or full consensus standard. However, in the loosely organized voluntary consensus system, no particular group or organization has official responsibility for initiating or developing standards in any one area.

No standards excepting mandatory standards have full legal standing. As a consequence of different membership policies, widely varying technical skills and resources, and different standard development procedures, the standards produced by different standard writing organizations are normally accorded varying degrees of status and respect. For example, standards produced by trade associations and professional societies are usually not considered full-consensus standards because their membership is restricted to individuals and firms in their industry. However, in the event that these organizations do desire to attain full consensus status for their standards, they can do so by submitting them to the American National Standard Institute (ANSI), the national coordinator and clearinghouse for standards and the only recognized non-governmental organization in the system, for determination of national consensus. The standards of some organizations (ASTM, for example) which have more open membership policies and formal procedures for assuring that all groups have a voice in standards development are more easily accorded full-consensus status.

Though these are no official rules for producing a full consensus standard, the procedures of standard writing efforts aiming to qualify for full consensus standing generally are founded on similar legal principles. Most organizations have explicit procedures to ensure conformance with the principles of due process, including: an adequate notice of the proposed standards undertaking to all persons, companies and organizations likely to be affected; opportunity for participation in meetings, standard drafting sessions and the like; and careful attention to minority opinions. Additionally, most standard writing organizations aiming to produce full consensus standards have rules and procedural standards intended to safeguard the standards development process from anti-competitive motives, including rules regarding the make-up of the standing technical committees, rules governing voting authority as well as provisions for the review and possible revision of existing standards.

PERTURBATION PROMPTER/RESEARCH DESIGN

In September, 1974 the President signed the Solar Heating and Cooling Demonstration Act of 1974 (PL 93-409). This bill provided for a major federal effort to prompt the acceptance of solar thermal technologies in various building uses. The Energy Research and Development Administration (ERDA) was designated lead agency in the implementation of the program. (This role was assumed by ERDA's successor agency, the Department of Energy (DOE).) ERDA chaired an interagency task force which developed an initial program, which had the Department of Housing and Urban Development (HUD) taking responsibility for housing applications and ERDA (later DOE) responsible for engineering development as well as demonstrations in commercial and institutional settings. Certain of the demonstration activities subsumed efforts previously initiated by the National Science Foundation (NSF). (DOE, 1978.) This effort in solar technology development followed on the 1973-74 oil embargo, and the general societal concern for environmental issues.

For purposes of this analysis, the formal initiation of the Solar Heating and Cooling Demonstration Program is taken as the perturbation prompter in the standards setting institutional arena. There are two general resons for this designation. First, the program promised a substantial influx of funds into the solar industry, providing for an expansion of production activities. Thus the four general contributions standards identified in the discussion of the conceptual framework--psychological gain, economic use of human and physical resources, and facilitation/communications benefits--are all pertinent to an industry incipiently chaotic. Second, the legislation mandated "interim criteria" for solar technologies, and efforts toward "definitive criteria."

A case study approach was used for the perturbation monitoring and analysis portions of the institutional analysis method. Based on the preliminary exploration of the standards setting institutional arena reported in Parker and Nutt-Powell (1979), a selected list of key institutional entities was identified. Individuals with responsibilities in the area of solar standards development were interviewed and various published and file material on the SHAC program were reviewed.

FINDINGS

The development of solar standards during the period 1974-78 is an interesting case reflecting the increasing role of the public sector in the voluntary consensus process. Indeed it may be argued that a wholly new full consensus standards process is being created by the need to generate standards in areas such as solar, where innovation development and acceptance is being accelerated by deliberate federal government policies and programs.

The findings presented in the following paragraphs are organized chronologically. Table 2 is a summary of key events in solar standards development in the US during the study period.

Following on the Oil Embargo of the winter of 1973-74, the Congress began active consideration of solar legislation. This same urgency regarding alternative energy sources was found throughout the country. A first manifestation in terms of solar standards occurred in May, 1974. ASTM staff member Jack Bystrom, with committee responsibilities in both nuclear power and space, had been encouraging an expansion of the space committee's topic to include terrestial applications. These efforts were successful with the May, 1974 change of committee title of E.21 to Space Simulation and Application of Space Technology. At the same time a new subcommittee (E.21.10) on Solar Energy Utilization was authorized.

In September, 1974, the Solar Heating and Cooling Demonstration Act was signed. As described earlier, the legislation provided for demonstrations in residential, commercial and institutional settings, with a strong emphasis on commercialization of solar technologies. The time lag characteristic between legislative passage and program

TABLE 2

CHRONOLOGY, SOLAR STANDARDS DEVELDPMENT
1974-1978

Winter, 1974	Oil Embargo
May, 1974	Executive Sub-committee E.21.90 of ASTM Committee E.21 on Space Simulation authorizes the formation of a new subcommittee (E.21.10) on Solar Energy Utilization. E.21 name changed to Space Simulation and Application of Space Technology
September, 1974	Solar Heating and Cooling Demonstration Act signed.
April, 1975	Need for solar standards in general raised at ASTM meeting on steam generation turbines in nuclear power plants by Federal Energy Administration representative.
Spring, Summer 1975	E.21.10 organized into five technical task forces: (1) Environmental Parameters; (2) Component Evaluation; (3) Systems Evaluation; (4) Reliability and Durability; and (5) Safety.
June, 1975	Broader group on solar standards exclusively, including FEA, ERDA, HUD, ASHRAE, AIA, ACRI, NBS, ANSI, ASTM.
October 14-15,	First National Conference on Solar Standards held at ASTM, co-chaired by ANSI. Attendance: approximately 325. ASHRAE establishes committees on thermal storage and solar collectors. ANSI creates Energy Council.
April 1976	E.21 meets. Establishes new subcommittees on solar electric and power applications. Scope of E.21.10 revised to focus on solar heating and cooling applications.
September 1977	HUD Interim Solar Standards issued.
October 1977	E.21 meets. Subcommittee E.21.10 requests development of new ASTM main committee on solar energy utilization. Encourages accelerated standards development through DOE.
June 1978	New ASTM main committee, E.44, created on Solar Energy Conversion.
September 1978	Second National Conference on Standards for Solar Energy Use held in New York City.

implementation accounts for the time which passed until the next evidence of consideration of solar standards. That over six months passed between the September, 1974 signing and the April, 1975 initial discussions of standards is indicative of the secondary importance of standards in program development and implementation for the lead agencies, even though the act specifically cited the need for both interim and permanent standards development. It is worth noting at this point that neither ERDA (later DOE) nor HUD, the two lead agencies involved in implementation of the legislation, had as a primary mission the development of standards. Thus it is not surprising that the event prompting formal consideration of solar standards was a passing observation at a meeting considering standards in quite another energy area.

As recalled by Walt Cropper of ASTM, the "germinal" meeting on solar standards occured in April, 1975, at the Federal Energy Administration (now DOE). Attended by approximately twelve persons, including E.A. Kuhn of FEA, the meeting was a working session on improving the use of steam turbines in relation to nuclear power plants. Norm Lutkefedder, Kuhn's deputy, pointed out a related issue, the need to develop standards on equipment, design, installation and uses of solar systems, especially to facilitate HUD's solar demonstration program. Without standards, it was stated, there would be nothing for FHA and other funding sources to use to determine eligibility for loans, tax credits, and other promotional programs. Those present at the meeting aggreed to pick up the issue in a later meeting.

HUD staff assigned to direct the solar heating and cooling program had previous experience with HUD's Operation Breakthrough. Their initial thoughts on the standards issue included the realization that building and construction standards could not be set by a single agency. Thus the followup meeting in June 1975 included representatives of federal agencies (HUD, FEA, ERDA, NBS) as well as ASHRAE, AIA, ACRI, ANSI and ASTM. From these discussions emerged the idea of a national conference on solar standards.

Concurrent with the preparations for this first national conference (which was held with financial assistance from HUD), ASTM's Solar Energy Utilization subcommittee (E.21.10) was organizing itself into five technical task forces: (1) Environmental Parameters; (2) Component Evaluation; (3) Systems Evaluation; (4) Reliability and Durability; and (5) Safety.

The conference, attended by approximately 325 persons, was held in October 1975 at ASTM in Philadelphia, with ANSI co-chairing. David Moore, who directs HUD's solar heating and cooling program, saw two main purposes: (1) To inform the standards community about solar energy, the new legislation and the need to apply standards to solar; and (2) To inform the solar community about the voluntary consensus standard setting process, and to indicate where solar programs could get assistance.

To Walt Cropper this national conference was "exceptional" in its influence and impacts on the field. It initiated a very large and active ASTM standards committee, prompted the unusual step of an ANSI-created Energy Council, and lead to a proliferation of related committees, such as ASHRAE's committees on thermal storage and solar collectors. The combination of a highly visible federal program and the mystery of a new technology proved very attractive, making the conference an important forum and meeting place of ideas and people. The fortuitious confluence of factors meant that standards activity on solar had an extraordinary degree of visibility and activity.

According to Cropper, the solar committee is a departure in ASTM's experience in a least two respects. First, committee membership has grown much faster than the norm, with current membership in excess of 300. Though many of the original participants have dropped, they have been readily replaced as well as adding additional members. (A list of attendees at the January, 1979 meetings of the solar committee, found in Appendix A, reflects the number and range of organizations and locations represented.) Second, while most ASTM committees are vertical (such as the Committee on Glass and Glass Products) the solar committee is horizontal. By having a 'topic' as opposed to 'product' definition, and thus covering an entire industry (inclusive of competitive materials and approaches), the standards development process is rendered more complex.

The activity created by the October, 1975 conference sustained efforts in solar standards for a considerable period, helped along by the rapid increase in use of solar heating and cooling equipment caused by the federal programs for residential, commercial and institutional application. In October 1977 HUD issued Interim Solar Standards. The development of these standards had been assisted substantially by work in E.21.10, which had its scope revised in April 1976 to focus on solar heating and cooling applications. At that same time new subcommittees on solar electric and power applications had been formed for E.21.

By October 1977 E.21.10 had requested the development of a new ASTM main committee on solar energy utilization. This request was honored in June 1978, with the creation of E.44, Solar Energy Conversion. (The scope of activities of the fourteen E.44 subcommittees is found in Appendix B.)

In September 1978 a Second National Conference on Standards for Solar Energy Use was held in New York City. The stated purpose of this conference--to emphasize the development and use of standards for materials, products, and services that are necessary for bringing the benefits of solar energy to the national economy and standard of living--reflects the extent to which solar standard setting has moved to a second plateau of standard development. No longer an unknown technology turned to in a time of national crisis, solar energy is showing evidence of general acceptance as a concept, and is, therefore, a matter of direct contention among broader interests as to nature and form of relative desirability. Compared to attendance at the first conference, the 1978 conference had more state and local public officials, as well as more consumer and labor representatives. The key actors from 1975--federal HUD and DOE officials, and ASTM and ANSI staff, together with industry representatives--were also present. The extent to which federally-prompted commercialization had succeeded, at least conceptually, is evidenced by the emerging adversarial positions of consumer and producer. Consumers were arguing for governmental regulation to ensure confidence in products, while producers were resisting market controls and arguing for entrepreneurial freedom. Interestingly these arguments seemed unrelated to the technical issues discussed in many papers.

In summary, the standards development process from 1974-1978 is characterized by

* a horizontal rather than vertical structure;
* extensive public prompting, albeit by agencies for which standards development is at best a secondary mission;

* rapid acceptance of the concept of solar energy, despite continuing and considerable technical debate.

The implications of this process are discussed in the concluding section.

CONCLUSIONS

If one were forced to draw a single conclusion about the standard setting process, one would say that the development of standards is a story of the interaction of self-interest, and that the failure to account for significant interests (whether technical or political) can effectively scuttle a standard development effort. For the period of time reported here, the process for the development of solar standards was inclusive of many interests, and as a consequence, appeared to proceed at a rapid rate.

The horizontal structure of this standard setting process was a departure from ASTM practice. This structure was adopted in part as a result of the general societal concern with alternative energy sources (notably solar), but the broader structure was incrementally achieved. First, a horizontal linkage between two energy sources (nuclear, solar) occured in the person of ASTM staff member Jack Bystrom. This facilitated the amplification of E.21's mission and name, and the creation of the Solar Energy Utilization subcomittee. The linkage from nuclear to solar was also made by energy officials in the informal April, 1975 session. Thus the initiation of this standards effort was in response to national policy objectives on energy, as opposed to industry-prompted objectives for economic efficiencies. The appropriateness of this horizontal structure for the voluntary consensus process on solar standards is illustrated in the rapid expansion of committee membership, and the ease of replacement of members who drop out. This broader mandate provides for ready inclusion of both "technical" amd "political" interests and issues. This tends to encourage contributive rather than adversarial participation. In commenting on the process, Walt Cropper used the phrase "well-focused effort," with responses of interested parties "well thought out and constructive." He further noted that "the expected jockeying for position as been noticeably absent."

In presenting the findings it was noted that neither of the two lead agencies--HUD and ERDA--had standard setting as a primary mission. While this delayed the initiation of the effort to create solar standards, it was most likely for the better. We reach this conclusion because the standard setting effort was not undertaken artificially or prematurely. Though the legislation establishing the solar heating and cooling demonstration program had called for relatively rapid consideration of standards, work on standards development was not initiated until there existed a critical mass of felt need. That is, even though a number of individuals (ASTM staff, FEA staff, HUD staff, for example) had given some thought to solar standards and how to create them, a deliberate effort to begin the standards development process was not undertaken until a sufficient number of those individuals separately and then together identified and articulated the need to begin standards development. In the context of the solar heating and cooling demonstration program, there was a 6+ month hiatus between the President signing the bill, and the first stirrings of a standards development effort. This period of time was devoted to putting together an operating program. The need for standards could then be sensibly set within the imperative to provide FHA and other funding sources with a basis to determine eligibility for loans, tax cridits and so on. Once identified the early stages of the standards development process went rapidly, with only six months elapsing between the first mention of the need (April, 1975) and a major national conference (October, 1975). Thus while the public prompting clearly was critical to the speed of implementation between April and October (and equally clearly is a continuing important factor in standards development) it could not have caused this effort to begin in advance of that point in time when the critical mass of felt need was achieved.

That the concept of solar energy has been so rapidly accepted is evidence of standardization in terms of the benefits of facilitation of communication, and psychological gain. It is clear that the country needed an alternative energy source to fossil fuels, one both domestic and non-controversial. Solar energy has been a convenient conceptual solution, used readily by both public and private officials as a response to the energy crisis. It is on this level that solar energy is "accepted". The nature of the debate between consumer and industry advocates at the Second National Conference in September 1978 is indistinguishable from consumer-industry debates in other product fields (for example, automobiles). The comparison between the discussions in this vein, and those of the solar technicians would lead one to wonder if they are discussing the same product. Thus standards have several levels of differentiation. The "standards" which respond to psychological gain, and communication needs, are very different from those which would provide benefits in terms of the economic use of physical or human resources.

It is in this respect that we conclude that the solar standards development process is entering a second, and very different phase. The consumer producer debate will occupy a more central position, and will involve an increase in sophistaction on the part of these participants regarding the technical areas of discussion. But the consumer/producer debate will also be constantly attempting to catch up with technical developments. Thus there exists a danger of premature and/or forced standard setting in either the policital (communication and psychological gain) or technical (economic use of physical or human resources) dimensions. The standards used in each are not the same, though they (ostensibly) deal with the same topic. It is in this respect that great care and precision must be exercised in setting standards, and in providing for the future modification of any standards set. The tradition of government involvement in standard setting is toward the more rigid (mandator, as in regulations; specification, as in procurements). To follow this tradition could have potentially damaging effects on both the particular product (be it solar thermal or photovoltaic energy) and the overall effort to achieve a national energy policy. Rather a continued involvement in the newer, horizontally structured voluntary consensus process seems appropriate.

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APPENDIX A

Attendance at E44 Meeting - January 15 - 17, 1979

NAME	AFFILIATION	LOCATION	STATUS
Abbot, John	Hockey Town	MA	M
Abbot, Kathy	Hockey Town	MA	M
Anson, Bruce	Rohm & Haas	PA	M
Baboff, Leon	Uniroyal, Inc	CT	V
Barkman, Erik	Reynolds Metals	VA	V
Barnes, Hugh C.	Reynolds Metals	VA	V
Beach, Charles D.	Florida Solar Energy Center	FL	M
Benning, Albert C.	Harshaw Chemical	OH	M
Biermann, Wendall J.	Carrier Corp.	NY	M
Bishop, Charles J.	SERI	CO	V
Blackmon, James B.	McDonnell Douglas	CA	V
Bowen, John C.	Ametek	PA	V
Bradford, Phillips V.	Phelps Dodge Ind.	NJ	M
Brax, Harri J.	W.R. Grace & Co.	SC	V
Brown, Paul W.	National Bureau of Standards	DC	M
Buckley, Norman A.	Sunbeam Corp.	IL	M
Burgess, Carton M.	GMC Corp.	NY	M
Bystrom, John H.	ASTM	PA	S
Carson, Thomas C.	ASG Industries	TN	M
Cassel, David E.	Mueller Assoc.	MD	M
Castillo, Allan P.	Olin Corp.	CT	V
Cheng, Craig F.	Argonne Nat. Lab.	IL	V
Cherne, Jack M.	TRW Systems & Energy	CA	M
Chopra, Preme S.	Argonne Nat. Lab	IL	V
Cingo, Ralph	Rockwell International		V
Clark, Elizabeth J.	National Bureau of Standards	DC	M
Cohen, Arthur	Copper Development Assoc.	NY	M
Cohen, Rebecca	National Consumers League	DC	M
Collins, Denver	State Industries	TN	M
Craig, Arthur G.	Alum. Co. America	PA	M
Cummings, Josephine	So. Calif. Gas Co.	CA	M
Curtis, Henty	NASA Lewis Res. Ctr.	OH	V
Darby, Joseph B.	Argonne National Lab	IL	M
Division, Ralph M.	Climax Molybdenum	PA	M
DeBlasio, Richard	SERI	CO	M
Diamond, Ronald	Optical Coating Lab. Inc.	CA	V
Dodd, James H.	Wyle Laboratories	VA	M
Drake, Charles G.	Reynolds Metals	VA	V
Dunn, Jerry R.	Texas Tech. Univ.	TX	M
Edwards, Robert B.	NIBCO inc.	IN	M
Elicaim, Henri	Janson Jerusalem Solar Inc.	NY	V
Engen, Byron	Owens - Corning Fiberglass	OH	M
Flanagan, Lawrence J.	Grumman Energy Sys.	NY	V
Freeborne, William	HUD	DC	M

NAME	AFFILIATION	LOCATION	STATUS
Gillet, Drew	Northeast Solar Energy Ctr.	MA	V
Goodman, Ronald	Libbey - Owens Ford	OH	V
Gross, Gordon	SERI	CO	M
Grupta, B.P.	SERI	CO	V
Habelka, Frank Jr.	City of Datona Beach	FL	V
Hadely, Henry C.	SES Inc.	DE	M
Hahn, Robert	Optical Coating Lab.	CA	M
Hancock, Omar	Florida Solar Energy Ctr	FL	M
Hardy, Donald	SERI	CO	V
Heffner, Grayson C.	PRC Energy Analysis Co.	VA	M
Henderson, James B.	Wolverine Div. UOP	AL	M
Herlihy, John		NY	M
Hibbard, D.S.	Anaconda Co, Brass Div.	CT	V
Hightower, Stan	Bureau of Reclamation	CO	V
Hill, James B.	Allegheny Ludlum Steel	PA	M
Hodges, Robert M.	Dow Corning Corp.	MI	M
Hogan, Stephen J.	SERI	CO	M
Hollander, Peter	Franklin Institute	PA	V
Holt, Vernon E.	Bell Telephone Labs	NJ	M
Hudson, William T.	Independent Living	GA	M
Jaffe, Peter	JPL	CA	V
Jones, Gerald W.	Western Scientific Servs, Inc.	CO	M
Judge, Mark	Olin Corp.	IL	V
Kaszeta, William J.	SES Inc.	DE	V
Landers, Thomas L.	Solartech Systems Corp.	TX	M
Lewardowski, Allan	SERI	CO	M
Lloyd, Dick	Arkla Ind.	IN	V
Losey, Robert E.	Wyle Labs	AL	M
Loveless, Fred	Uniroyal, Inc.	CT	V
Lumsdaine, Edward	New Mexico State Univ.	NM	V
Masters, Larry W.	National Bureau of Standards	DC	M
Matthews, Kent R.	Johns - Manville	CO	M
McCluney, Ross	Florida Solar Energy Center	FL	M
Miller, Louis M.	Watts Regulation Co.	MA	M
Miyazaki, Shu	Sears Roebuck & Co.	IL	M
Moore, William	Revere Solar	NY	V
Nuss, Gary	SERI	CO	M
Passerini, Ed	Center for Renewable Resources	AL	V
Patrick, Stephen L.	Wyle Labs	AL	V
Pernisz, Udo	SES, inc.	DE	V
Platt, Michael D.		NY	M
Ribbons, Robert	Dupont	DE	M
Richards, Mikel	American Solar King	TX	M
Richmond, Joseph	National Bureau of Standards	DC	M
Riley, Julia	SERI	CO	M
Robitaille, Dennis	Climax Molybdenum	MI	M
Rouse, Roland	Mass. Solar Action Office	MA	V
Royal, Ed	Jet Propulsion Lab	CA	M
Rupp, Matthew W.	DSET Laboratories	AZ	M

NAME	AFFILIATION	LOCATION	STATUS
Sasaki, James	Nat. Research Council of Canada	ONT	V
Schafft, Harry A.	National Bureau of Standards	DC	M
Scott, John L.	South Florida Test Service	FL	M
Sedrick, Arthur V.	Kalwall Corp.	NH	M
Settle, Evan E.	Reynolds Metals	VA	M
Shimamoto, David S.	Monsanto Corp.	MO	V
Shorey, Joan	Solar Lobby	DC	M
Smith, Milton L.	Texas Tech Univ.	TX	M
Spanoudis, Louis	Owens Illinois Inc.	OH	M
Storti, George	Solarex Corp.	MD	V
Straub, Fred C.	Franklin Institute	PA	V
Streed, Elmer	National Bureau of Standards	DC	M
Szoke, Stephens	Brick Institute of America	VA	V
Szwarc, Val	SERI	CO	V
Tarbet, George W.	Dunlop Research Center	ONT	M
Turillon, Piere	International Nickel	NY	V
Vernon, Richard	NASA - Lewis	OH	V
Virgin, Don G.	Virginia Electric & Power	VA	M
Volgstadt, F.R.	Perfection Corp.	OH	M
Waksman, David	National Bureau of Standards	DC	M
Watts, Skip	Uniroyal	CT	V
White, James S.	Kemlite Corp.	IL	M
Winslow, Don	Uniroyal	CT	V
Yaeger, Raymond	Franklin Institute	PA	V
Yamasaki, Roy S.	Nat. Research Council Canada	ONT	M
Yarosh, Marvin M.	Florida Solar Energy Center	FL	M
Zerlaut, Gene A.	DSET Laboratories	AZ	M

Status Key

V = Visitor
M = Member
S = Staff

APPENDIX B

SCOPES OF E-44 SUBCOMMITTEES

.01 NOMENCLATURE: To establish nomenclature and definitions for terms used in solar energy applications that are consistent with the related technical disciplines and are not adequately defined in standard dictionaries, and to coordinate with E44 subcommittees and other related ASTM Committees.

.02 ENVIRONMENTAL PARAMETERS: To identify environmental parameters and establish standard measuring and reporting procedures for data pertinent to solar energy conversion. An additional function of E44.02 shall include the review and acceptance of environmental data. This data shall be disseminated to other E44 subcommittees.

.03 SAFETY: To identify safety hazards in, and review standard procedures for, the design, installation, operation and maintenance of solar energy conversion systems. This subcommittee shall provide safety issues to be considered and write safety standards where required. In general, the safety related provisions will be written by subcommittees E44-04 to E44-14.

.04 MATERIALS PERFORMANCE: To provide standards related to the reliability and durability of materials in solar energy applications.

.05 HEATING AND COOLING SUBSYSTEMS: To provide standards required to evaluate the design, performance and reliability of collector, storage, transfer, control, energy conversion, and auxiliary energy hardware components or subsystems.

.06 HEATING AND COOLING SYSTEMS: To promote knowlege and the development of standards relating to methods and applications of Solar Energy Conversion. These methods and application shall include ACTIVE SYSTEMS for the following: Heating and Swimming Pools; Heating of Domestic Water; and Space Heating and Cooling.

.07 PROCESS HEATING SYSTEMS: To provide standards related to the design and performance analysis of process heat systems and desalinization systems and components, including the following subsystems: collector, energy storage, energy conversion, and master control.

.08 SOLAR THERMAL CONVERSION POWER SYSTEMS: To provide standards required to evaluate the design and performance of solar thermal conversion power systems, including the following subsystems: collector, receiver, energy storage, energy conversion, and master control.

.09 PHOTOVOLTAIC ELECTRIC POWER SYSTEMS: To provide recommended practices, test methods, definitions, and other standards for evaluating the design and performance of photovoltaic power systems. These systems shall include all components necessary for the conversion, conditioning, storage, control and distribution of power to an application load.

.10 <u>WIND DRIVEN POWER SYSTEMS</u>: To identify the need for wind driven power systems standards, to formulate such standards, and to recognize needs for new information. The Subcommittee shall establish standard definitions, procedures, and specifications, including: (1) the evaluation of wind resource characteristics; (2) design and testing of wind systems; and (3) interface of wind systems to end uses.

.11 <u>OCEAN-THERMAL POWER SYSTEMS</u>: To provide standards required for the design and performance of ocean thermal energy conversion (OTEC). Specific areas to be addressed will include power system components (heat exchangers, piping, valves, pumps, screens, cable, turbines, generators) and ocean engineering components (hull and moorings).

.12 <u>BIOMASS CONVERSION SYSTEMS</u>: To provide standards related to the growth, handling, conversion, and use of biomass as a renewable fuel and chemical resource. Biomass is here defined as any non-fossil materials derived from living organisms. The sub-committee activity will include consideration of methods of test, specifications, recommended practices, nomenclature, promotion of knowledge, and stimulation of research.

.13 <u>ADVANCED ENERGY SYSTEMS</u>: To foster the dissemination of knowledge, to stimulate research, and to develop recommended practices, methods of test, definitions, and other standards needed to further establish technically feasible but economically unproven solar energy conversion concepts not represented by other subcommittees of ASTM Committee E-44.

.14 <u>PASSIVE HEATING AND COOLING SYSTEMS</u>: To develop, provide and publicize, as needed, standard definitions, practices, methods, classifications and specifications as required to evaluate characteristics and performance of materials, products, components and systems used in passive solar applications.