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LEGAL BARRIERS TO SOLAR HEATING AND COOLING OF BUILDINGS

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NOTICE

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INTRODUCTION

Purpose

New laws are often born with bursts of enthusiasm, only to be quickly strangled by the tangled net of existing statutes, ordinances, regulations, and common law. This report assumes that encouraging the use of solar energy to heat and cool buildings will become a popular public policy. Our task was to look at present laws and ask if they would thwart such a policy. In a few cases we note the absence of a law in a critical area, or evaluate laws that have been proposed to fill the gaps. We did not examine the validity of the assumption that solar heating and cooling will become necessary; but it is clear that alternatives to our reliance on fossil fuels will be needed, and that harnessing insolation is one obvious possibility. The technology exists. It is the higher relative cost of solar heating and cooling that is restraining enthusiasm for its widespread application. As the cost of solar equipment falls and the price of fossil fuels rises, this impediment shrinks.

The existence of this study is a small rebuttal to the frequent statement that the federal government has only a shortsighted "crisis mentality." There is no immediate need, for instance, to make the owners of existing buildings rip out their gas furnaces and install solar collectors. Nor would it be wise to pass a law today saying that anyone who has a solar collector has an absolute right to receive sunshine on that collector, and that his neighbor must remove structures or vegetation that block the solar stream. Nevertheless, it makes a great deal of sense to gather firewood while there is still light.

In this report we look at ways solar energy will probably be used and ask what legal problems its would-be users may encounter. We consider the potential problems of commercial and industrial users as well as those in new subdivisions. It

is likely that so-called passive systems will be used along with active, so we look at some of their unique problems. As our assignment was to review existing literature, rather than concentrate on original research, some chapters reflect a paucity of material. There was so little material available on some crucial topics, like building codes and utility issues, that we were forced into original work. And in some other areas, like solar access, we could not resist adding our own thoughts to the body of available literature. The scope of our review was extremely broad; our intent was to give at least some consideration to every conceivable issue, even the less pressing ones.

It can be argued that most of the problems on our list, like building codes, labor law, patent, and warranty issues, pose no obstacle unique to solar energy. The implication is that since manufacturers, builders, etc., are accustomed to dealing with these problems on a regular basis, their applicability to solar energy presents no real barrier. After some reflection we believe this argument has only limited value. While it is true, for example, that building codes require each structure to be examined and approved by a building inspector, it does not follow that solar energy systems will add no additional cost or uncertainty to the process. For reasons explained at length in our building codes analysis, lack of familiarity with solar equipment could place a higher burden of proof on the developer, causing additional expenses for paperwork and delays. Whether such delays do, in fact, occur, the perception that they might could dissuade many developers from entering the solar energy field.

A related issue is the role of legislation in curing market uncertainties, such as those mentioned above in relation to building codes. A study of mortgage market reaction to solar equipped homes by Professor Charles Haar similarly concludes that lack of operating experience and evidence of resale value are significant obstacles to financing solar homes.* Both technical and institutional uncertainties exist. Technical uncertainty has to do with the lack of operating experience necessary to answer questions about collector reliability, material life, etc. These issues are important because of their bearing on the willingness of lenders to assume financial risks; greater uncertainty means a higher risk and

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* Charles M. Haar (principal investigator), Evaluation of Alternative Incentives for Overcoming Mortgage Market Constraints on Commercial Acceptance and Use of Residential Solar Heating and Cooling Technologies (Cambridge, Mass.: Regional and Urban Implementation, Inc., 1976).

therefore a higher market price. As this uncertainty is primarily an economic question — who should bear the risks -- it is therefore outside the scope of this project.

The problem of institutional uncertainty is more complex, but more relevant. The best example may be the administration of land use controls, such as aesthetics requirements, height limitations, and related health and safety codes. Because these laws reflect local preferences that have as much to do with subjective impressions of the quality of life as any objective criteria, their administration is subject to infinite variation. It is very hard to predict the impact of such laws on particular solar projects or on solar utilization in general.

In the course of investigating specific issues, this project will consider whether institutional uncertainty could be remedied by making relevant laws more explicit with reference to solar energy. For example, the authority of zoning boards to prohibit use of solar energy equipment in specified situations might be eliminated. Such legislation would involve fundamental, but not necessarily desirable, changes in the role of the institutions themselves, and the affected organizations can be expected to resist. As we mention throughout the study, such proposals should therefore be viewed with caution, particularly since the uncertainties may be only short-term phenomena.

Solar energy is often called free energy. This is a mistake, as a quid pro quo will be asked, just as it is for anything of great value. The application of solar energy will mean that property owners will lose some types of freedom while gaining others that are more appropriate to this new technology. It may be, for example, that we will have to give up the right to plant trees wherever we like on our property. In exchange, we may acquire the right to have more sunshine pass over our neighbor's lot unimpeded. Such bartering is the essence of civilization and the balances on the scales of justice. By planning ahead we can extract maximum satisfaction from the process. This study is an early, tentative step toward this goal.

Administration

ERDA's Division of Solar Energy awarded the present research contract to the Environmental Law Institute in July 1976. The Institute is a nonprofit research center located in Washington, D.C., whose activities include analysis of the law of environmental protection and natural resources use, the design of new institutional

arrangements to carry out environmental policy, the improvement of institutional ability to implement existing law, a publications program, and related educational undertakings. A staff of more than 40 professionals, including lawyers, economists, political scientists, and natural scientists work under grants from private foundations and from government agencies in a variety of fields, including energy policy. The Environmental Law Reporter, now in its seventh year, is the continuing publication of the Institute.

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SOLAR ACCESS AND LAND USE

Introduction

Sunlight radiates, unobstructed, through 93 million miles of space. It is only in the final few hundred feet before it touches earth that its flow is impeded. Although the distance is short, the legal problems of guaranteeing everyone equitable access to this golden bounty are great.

It is generally accepted that property owners in the United States have no right to receive solar energy that would reach their land only after slanting across property owned by others. There is a right, of course, to sunlight falling perpendicularly on your land, with the trifling exception of shadows cast by aircraft.[1]

The Need to Protect Solar Access

Legal experts writing about this problem are nearly unanimous in agreeing that some sort of access to solar energy should be guaranteed, although several advocate ascertaining how great the shading problem really is before we adopt legislative solutions that may be unnecessary or quickly outdated by technological advances.[2] Everyone agrees that alternative approaches should be studied.

There is very little empirical evidence as to whether shadows on solar devices will be a major problem. Those scraps of information that do exist suggest that sunrights may be a smaller problem than sometimes feared (at least in suburban settings). Of the 865 responses to a survey by the American Institute of Architects Research Corporation, a large majority thought zoning ordinances and land use provisions were not significant concerns.[3] Several communities have

studied aerial photographs of themselves and found that the roofs of nearly all homes are free of shadows during crucial periods.[4] Aerial photos of one community found the vast majority of homes' roofs were free of shade between 9 a.m. and 3 a.m. in all seasons.[5]

Perceived problems can retard the acceptance of a new technology as effectively as real problems. Less than a third of the lenders surveyed by Regional and Urban Planning Implementation Inc. (RUPI) thought that legal uncertainties over the right to solar energy would seriously affect financing.[6] Although the authors of this survey describe the 29 percent of lenders with "substantial" or "primary" concern as "relatively few," this percentage is significant for a group not trained to spot new legal issues. Several lenders indicated that they would be more concerned with sunrights when considering loans for apartments or commercial developments than for single-family homes, as the former are usually located in zones permitting high rise development.

The Scope of Protection Required

To date, discussions of legal issues relating to solar access have focused only on the requirements of active systems on single-family homes. Such a myopic approach is a serious mistake, since the sun shines just as brightly on other developmental and architectural possibilities. Therefore, this chapter will also look at the solar access needs of multi-family residences, commercial, and industrial structures, and of passive as well as active solar systems.

Many existing and planned solar structures are nonresidential. Recent examples are a bank in Santa Fe, a church in Colorado,[7] a California factory complex,[8] a Denver office complex,[9] and an Ohio warehouse.[10] A lowrise commercial complex is planned near Pittsburgh[11] and ways were even studied to adapt the 910 foot high First National Bank building in New York to solar.[12]

It is also incorrect to assume that only single-family home builders will find solar heating attractive. Ralph Johnson, vice president and director of the NAHB Research Foundation, recently said:

> Garden apartments in moderate climates probably offer the best early opportunity for new or retrofit solar space heating and hot water. . . Attached units are preferred because heat loss is less in attached housing. That is why attached for-sale townhomes are probably the second most likely market for solar installations. This type of housing often has flat roofs on which collectors can be at once hidden and properly oriented. 13/

In spite of the sunrights uncertainties, there is considerable interest in multi-family solar dwellings. When the Department of Housing and Urban Development (HUD) awarded its second round of solar residential grants, for instance, 1,035 out of 1,411 went to multi-family residences.[14]

Solar hot water heating is often more practicable than space heating, and even very tall buildings may find it cost effective. For example, over 60 percent of the hot water needs of a 16-story, 230-apartment building in Brookline, Massachusetts, are met by roof collectors.[15]

It is vitally important to examine the legal needs of passive solar systems, as few (if any) structures will rely exclusively on active systems.[16] Roughly defined, a passive system is one that does not use mechanical parts like fans. In a passive system, the collector is an integral part of the building. The roof, walls, and windows of a building, for example, may serve as its furnace or air conditioner. The design and landscaping of a passive solar house are the key to its success.

Passive components are being found as important as active in both residential and nonresidential projects. For example, the 185,000 square foot Oakmead Industrial Park project that is planned in Santa Clara, California, will obtain its heating and hot water partly from passive elements (collector panels will also be used). Passive elements include a white roof and overhanging canopy, thermopane glass and concrete walls.[17]

Similarly, a new office building complex in Denver needs both active and passive components to provide 80 percent of its heating and 60 percent of its cooling needs. Earth berms to direct wind flow away from building surfaces and west facing windows with special reflective surfaces are two passive techniques used here.[18] And a luxury hotel in the Virgin Islands is building a huge solar air conditioning system (with the help of an ERDA grant) that will save it an estimated $100,000 a year in fuel costs.[19]

Current active systems typically require a long southern exposure on a structure's roof, but some systems are set up on the ground like big metal pup tents.[20] Others rest against slopes with southern exposures. At least one engineering firm recommends using preexisting vertical wall panels as part of flat plate collectors to heat industrial buildings or warehouses that do not have to be kept very warm.[21] Collectors may be attached to secondary structures, especially in retrofit situations, when a primary structure is poorly oriented. Acorn

Structures, Inc. (a builder of prefabricated solar homes) offers solar garages to meet this need.[22] As collector efficiency drops greatly during the early morning and late afternoon, it may be less imperative to remove shadows during these periods.

Passive systems, on the other hand, have slightly different requirements. For "direct gain" heating, a structure should have large double-glazed windows on the south, and few or no windows on the north.[23] There are many, many varieties of passive systems, but this need for a southern exposure is common to most, and the need most relevant to sunrights law. The surface area exposed to solar radiation may not be much larger (and could even be smaller) than the square footage of roof collectors. But it is more "expensive" sunshine as more energy is absorbed from sunlight that passes over adjacent land (as opposed to sunlight coming from directly overhead). Passive systems that collect and store heat in shallow ponds on their roofs (such as the Harold Hays home in California) need fewer slanting rays, but almost totally unshaded roofs.

There are four potential levels of sunrights action: federal, state, local and private. The ideal approach will probably involve all four. States are the original holders of all governmental power; the federal and local governments have only what they have been given by the states. The federal government must find a constitutional basis for any action that it takes. Once it takes such action it may preempt the states from acting in that field if the federal scheme of regulation is pervasive, or if Congress states such an intent. However, federal preemption is very unlikely in the land use/building field. It is very important to understand that neat distinctions between federal, local and state powers and between judicial and legislative powers simply do not exist. Many proposals for allocating sunlight could be implemented by more than one level or branch of government.

The following analysis of solar access law deals first with existing laws—grouping them according to their usefulness—and then turns to proposals for new legal approaches.

Existing Legal Approaches of Limited Usefulness

The casters of shadows triumph over the would-be recipients of sunbeams under present common laws that may be applied when someone seeks solar access for heating or cooling. The first law that comes to mind when sunrights are

mentioned is the musty Ancient Lights Doctrine. The Doctrine has been repeatedly exhumed in current literature, unlike a second important analogy—the right, if any, to receive radio and television signals. A few other legal approaches have also been considered for their usefulness: public and private nuisance suits, and implied and prescriptive easements.

Doctrine of Ancient Lights

The Doctrine of Ancient Lights can be dealt with summarily. Existing literature contains excellent and long discussions of the history of this dim doctrine, and the laws evolving from it that still exist today in England and parts of the Commonwealth.[24] Very briefly, the Doctrine grants property owners a limited amount of indirect sunlight, if that light has been flowing through their windows, without interruption, for a given number of years.

Even if the Ancient Lights Doctrine is exhumed, it won't solve the solar access problem. The light guaranteed by the doctrine is not direct sunlight—only enough indirect light to go about your life indoors without grumbling. Furthermore, for the right to exist, light must have been flowing through your window, unimpeded, for many years (the period has varied over time, but relatively recent legislation set the period in Great Britain at 27 years).[25] For the Doctrine to be useful in solar access cases, it would require such great modification that even a willing judiciary may refuse to make the leap without a legislative assist. Even if the waiting period were substantially shortened to make it fair to owners of solar equipment, the result would probably be unfair to their neighbors, who would suffer great diminutions in the value of their property.

In spite of the Doctrine's obvious limitations, some commentators believe it may be a useful tool in modern America. Assuming, for the moment, that their argument has merit, the question arises whether the Doctrine could be revived.

A key case rejecting the Doctrine of Ancient Lights in the United States was based on holdings that were, in turn, based on perceived public policy. And public policy, of course, changes over time. Fountainebleau Hotel Corp. v. Forty-five Twenty-five, Inc. is the case in which the Florida court told the Eden Roc Hotel that it could not prevent the Fountainebleau from adding a wing where it blocked the sun from reaching the Eden Roc swimming pool.[26] Other states are under no compulsion to adhere to this Florida decision, although their courts may find it

persuasive. As the Florida court points out, the Doctrine has been unanimously repudiated in the United States[27] on public policy grounds, i.e., because the growth of American cities made it less suitable here than in England.[28]

Courts in the near future may feel, however, that public policy strongly supports the use of solar energy for heating and cooling. In fact, a law review article on view preservation suggests "there may be environmental value in revitalizing" the old doctrine in the U.S.[29] Lawrence Kressel, the author of this article, says that courts interested in reviving old doctrines look at the Oregon case of State ex rel. Thornton v. Hay in which a court applied another old doctrine to a modern problem.[30] The interesting 1973 case of Frankland v. City of Oswego is noted, where homeowners were found to have a right of action for view obstruction although they held no express easements of any sort.[31] He neglects to mention, however, that this standing to sue was based on the generally accepted right of property owners to sue when a zoning law is violated in a manner that particularly affects their property.[32] Kressel feels that this decision "may presage the American resurrection of the English doctrine of 'Ancient Lights.' "[33] A close reading of the case uncovers very little support for his optimism.

Radio and Television Transmissions

The right, if any, to receive radio and television signals is an interesting analogy to sunrights. Unfortunately, from the perspective of solar advocates, the leading cases have allowed broadcast signals to be blocked. In People ex rel Hoogasian v. Sears, Roebuck & Co.,[34] the Illinois Supreme Court refused to enjoin further construction of the Sears Tower, even though the completed structure—the world's tallest building—would allegedly interfere with the reception of over a hundred thousand television sets in its future "shadow." The plaintiffs argued that the tall building would be a public nuisance, but the court held that a property owner (Sears) has a right to put land to any reasonable use, subject only to restrictive legislation to protect public health and welfare. Furthermore, the court said, interference with television reception was not an actionable nuisance. The court noted that the broadcaster's choice of location may be responsible for poor reception, rather than the Sears Tower. This reasoning would not, of course, apply to a solar case as it is not feasible to reposition the sun. The issue of interference with television reception is not a settled one, as there are few cases on the

subject.[35] It should also be stressed that the Sears Tower was fought as a public, not a private, nuisance, so the case does not rule out the possibility of the latter, even in Illinois.[36]

Nuisance Law

A leading authority on nuisance law states that it is impossible to precisely define "nuisance."[37] Loosely, an act by another may be termed a "private" nuisance if it involves a substantial and recurring invasion of your interests in land. A "public" nuisance is usually defined in a law.[38] It interferes with the rights of the community at large.[39] An analysis of the applicability of nuisance law has been done by Ralph E. Becker, Jr. He doubts that existing nuisance law would solve the solar access problem since courts seldom call a particular use of property a "nuisance" if the legislature, through zoning laws, specifically authorizes that use.[40] Although, because of the expense and future shortage of fossil fuels there is a rather indirect impact on the public health, existing nuisance cases deal with more immediate dangers. A very tall building that shades many other structures would probably be a public nuisance in the very few states that define a public nuisance as one that interferes with any "considerable number of persons."

Other writers are equally pessimistic. Karin Hillhouse, for instance, concludes that "to succeed at [a private nuisance suit] a plaintiff must show irreparable damage and a greater hardship than would be caused by enjoining the defendant's activity, a standard a solar energy user probably could not satisfy."[41] Donald Zillman concurs, saying nuisance law "will not be of great help to either the party wishing to prevent solar use or the solar user wishing to secure his access to direct sunlight."[42]

Another limitation of nuisance suits is that only damages, and not injunctive relief, may be available in about half the jurisdictions (those using a "balance of conveniences" approach).[43] Still another drawback is that a court may have to agree that obstruction of light for solar heating and cooling is a distinct cause of action from traditional right to light suits.[44] The majority view is that a nuisance does not exist merely because a structure interferes with the flow of light and air to adjoining premises (Fountainebleau Hotel). As Becker concludes, "unless exceptional circumstances existed, a court would probably be unwilling to grant a right to light based on grounds of nuisance."[45]

In the unlikely event that a court found shadows to be a nuisance, the plaintiff may have to prove he is not "hypersensitive" to injury, or relief may be denied. There are no cases directly on point, but Amphitheatres, Inc. v. Portland Meadows[46] held that the owner of a drive-in movie theatre could get no relief from the bright lights on his neighbor's race track, even though the lights washed out the movie screen. The court said the theatre owner was abnormally sensitive to light. Too much light is, of course, the opposite of too little, but other courts may use the reasoning found in this case.[47]

Although it is doubtful that common law nuisance approaches will be of any help to solar system owners, municipalities (or states) could, of course, simply declare shadows falling on solar collectors to be a public nuisance. Sandy F. Kraemer and James Felt say that "certainly the preservation of the community by providing alternate sources of energy and reducing the demand for fossil fuels would fall within the guidelines of the general police power.[48] A statute declaring shadows on collectors to be a public nuisance would be subject to limitations on the police power, enabling authority, and due process. But courts generally defer to legislatures on the relative merits of conflicting uses.[49] A community considering such an approach may be wise to amend their zoning laws so that previously authorized uses are clearly prohibited by the new statutes.

At least one writer concludes that:

> . . . the legislative power to expand the scope of nuisance beyond its common law configurations may prove an effective device for securing rights to sunlight for solar collectors, although as a practical matter the power will probably remain unexercised until solar homeowners form a politically significant interest group. 50/

One small town, Kiowa, Colorado, has in fact plunged ahead and passed a zoning ordinance allowing a property owner with a solar collector to have a structure declared a public nuisance if it interferes with his collector.[51]

No compensation is required when a state reasonably regulates private property to secure the general health, safety, morals and welfare of a community. But an unconstitutional taking of property without compensation occurs when a regulation is too severe (this line is a difficult one to draw; see the section on transferable legal rights).

Even where legally possible, there are disadvantages to protecting solar access with a statutory public nuisance approach:

1. Lawsuits would be necessary in each individual case to prove the existence of a nuisance.

2. In some cases, the owners of restricted property may truly deserve compensation (if, for example, they were not allowed to add a needed story to their structure), and no compensation may be available in public nuisance suits.

3. Injunctive relief would not be available in many jurisdictions.

4. There would be no security for collector owners until after they had actually installed a collector and had won a nuisance suit; if one tried to sue before going to the expense of installing a collector, the suit may be dismissed as not being "ripe."

5. As a public nuisance is a crime, the state (not an aggrieved homeowner) is typically plaintiff. 52/ Therefore a homeowner may have to wait for the state to sue. This would rule out the possibility of private out-of-court settlements. Under some circumstances, however, a private individual may sue (have "standing") under tort theory if a public nuisance exists. This may happen if the plaintiff can show he was particularly damaged, in a way not shared by the public generally. The plaintiff's damage must be different in kind, rather than just degree, from the general public's. 53/ It is uncertain whether shadows cast on a collector would meet this requirement as no really analogous cases could be found. It is possible that a statute could get around this problem by stating that individual citizens may sue in the public interest.

6. As Prosser says: "There is perhaps no more impenetrable jungle in the entire law that that which surrounds the word 'nuisance'." When there are alternative routes open, it makes little sense to try to hack a clear path through this jungle. One ticklish situation, for instance, would arise when a bungalow owner living between two skyscrapers decided to put collectors on his roof. The majority view is that the person who in good faith comes to an existing public nuisance has rights to have it abated—even though it was there long before he arrived. 54/

Just as nuisance laws will not be of great help to solar homeowners, they will not help those protesting solar homes. It is unlikely that a solar collector would be found to be either a public or private nuisance as "the mere unsightliness of defendants premises" is usually insufficient to create a nuisance.[55]

Implied and Prescriptive Easements

Prescriptive easements. An easement is basically the right to use another's property for a narrowly defined purpose. For example, one landowner could "use"

another's land by enjoying the flow of light passing over it. Some countries recognize light easements created by "prescription," i.e., by a long, uninterrupted and uncontested use of the light slanting across another's land. In the United States, however, it is well settled that easements for light cannot be created by prescription.[56]

Daniel P. Moskowitz, a New York lawyer, hopes that courts will change their minds and approve prescriptive easements for light for solar energy purposes:[57]

> I perceive the proliferation of zoning ordinances and environmental regulations impinging on a landowner's once unlimited right to improve as reflecting societal disillusionment with the quality if not the physical scope of modern estate improvement. . . . The policy fulcrum has sufficiently shifted . . . in favor of access to light for solar energy purposes to permit judicial indulgence in a conclusive presumption of a grant, after continuous and notorious enjoyment for a prescribed number of years, of such access. 58/

Even the judicial recognition of such prescriptive easements would not, however, go very far toward solving the solar access problem. Solar homeowners would be put in the awkward situation of installing a collector and then anxiously waiting for the prescribed number of years to pass until they had an easement, praying their neighbors would do nothing in the interim to block the flow of solar energy. (Courts would probably say that the prescribed period begins to run when a collector is installed.[59]) Furthermore, under existing law there would be a "spite fence" problem. Most U.S. jurisdictions would not enjoin (or order removed) a fence or other structure built to block the sun reaching a neighboring collector, in order to preclude creation of prescriptive easements.[60]

In heavily developed areas where air rights are extremely valuable, landowners could be expected to do everything in their power to keep prescriptive easements from encumbering their property. Thus, any advantages to judicial recognition of this device would accrue only in residential or other uncrowded zones.

Still another disadvantage of prescriptive easements is that some sort of court test would be needed to prove their existence. This would involve considerable expense. Without a court decision (reflected in the land records), a solar-equipped building may be hard to sell. And, of course, prescriptive easements would be of no use whatever where existing structures already shade the roof on which you would like to put solar equipment.

An inherent difficulty with prescriptive easements is that it is very difficult to define their scope. A court may ask whether a balancing of the equities (weighing the benefits to the plaintiff against the hardship to the defendant) requires money damages instead of an injunction.[61] Most U.S. courts would issue an injunction if they found material interference with the reasonable heating needs of the plaintiff's building. Damages in lieu of an injunction would normally be awarded only if the interference was less than material.[62] But if the defendant would lose a lot of money because of an injunction, a court could refuse to grant one.[63]

A final example of the shortcomings of prescriptive easements is their inability to change with circumstances. Even if an easement is established, it may be lost if there is a substantial change in the size or location of the collector. Expansions of such easements are not allowed (additions wold have to qualify from scratch as prescriptive easements).

Because of all the above disadvantages, judicial recognition of prescriptive easements for light is probably not worth the considerable effort that would be needed to change present law.

Implied easements. This type of easement is created only under such special circumstances that it is of little use for our purpose. Implied easements arise only when both parcels of land were once owned by the same person, and the circumstances at the time one parcel is sold show an inarticulated intention to create an easement. An example would be when the new owner has no access to a public highway except over the seller's land. It is even harder to get an implied easement for light. About the only time it may sometimes happen is where property abuts land taken for a public highway.[64]

Existing Legal Approach of Untested Value: Transferable Development Rights

An innovative concept that is much discussed but that has received little actual application is transferable development rights (TDR). The development rights of any lot are governed by zoning laws that specify allowable heights, densities, setbacks, etc. To "transfer" such rights, the government must allow them to be sold separately from the land. What is sold is not air rights, but a governmental license to build. Everyone in an area could be given equal

development rights, but may not be allowed to fully use them (by erecting a big or tall building) because of solar skyspace easements acquired by the municipality through condemnation or zoning. In other words, a specific governmental restriction would be imposed within a general, less limiting governmental restriction. Under a TDR approach, the restricted property owners would be allowed to sell any development rights that they couldn't use to owners of property zoned for more dense developent. In effect, the government takes away with one hand what it gives back with the other.

TDR has been sparingly used to preserve unique historical sites and environmentally critical areas. It may have some limited applications to solar access planning. John Costonis, who helped develop the concept of TDR, has said:

> It is conceivable that if we hold density down substantially in an area to prevent interference with the sun's rays, we may create a situation of basic inequity among landowners within that area. This TDR scheme may provide a basis for permitting a landowner not permitted to achieve certain densities to receive the cash equivalent for his loss. 65/

This approach would also help prevent unjustified windfalls to the owners of lots allowed more intense development. The owner of a lot on which development was "frozen" could sell his development rights to the owner of less restricted property. The only way that the latter could build densely would be to buy such rights to add to his own. As there would be no assurance of the marketability of such rights, it may be necessary to have the government be the buyer of last resort. If sales between private individuals are to be fair, a large enough area must be involved to create a "rights market." Otherwise there could be forced sales and unreasonably high or low prices.

Courts require compensation be paid when property is "taken" for a public purpose, like roads and parks. On the other hand, when property is just "regulated" by zoning laws, no compensation need be paid simply because the value of property is affected. The line between taking and regulating is often difficult to discern, and varies among jurisdictions. Different courts use different tests to determine when regulation becomes a taking, so there is little uniformity of results even when the factual situations are very similar.[66] California, at one extreme, allows rather severe regulation of land without compensation. All jurisdictions allow large areas to be uniformly zoned for, say, single-family dwellings on large lots. When all

property in an area is zoned the same, compensation is seldom paid unless the property has quite clearly been taken for a public use, partly because there is no question of arbitrary treatment of individual lots.

TDR may help avoid an unconstitutional taking where the development on one lot is severely restricted for the benefit of another. Such situations would probably only arise in commercial and industrial zones where a building could be higher without shading its neighbor, but where expansion is constrained by a development rights restriction. Even if an unconstitutional taking is not involved, the public's sense of fair treatment may demand that TDR or some other form of compensation be applied.

Situations can be envisioned where a TDR approach would be the best alternative. Condemnation can obtain the same results as TDR, but at a more direct cost to the public. In some instances express easements secure solar access for downtown highrises, but they cannot be relied upon because they are voluntary. Zoning schemes that treat all lots equally (by not allowing very dense development on any lot) are also possible. The resulting cityscape would, of course, be very different.

To conclude, TDR is a very complex approach with dramatic side effects. It should probably not be used just to secure access, but may have an appropriate role as part of a comprehensive land use plan.

Widely Used Legal Devices that Provide Partial Solutions or That Raise Barriers

Existing laws can help solve solar access problems. The most useful may be express easements; restrictive easements; and land use planning, including zoning.

Express Easements

Easements are limited rights to use the land of another. The holder of an easement may not possess the land subject to an easement, but may only use specified parts of it for a special purpose. A right to enjoy the unhindered flow of sunlight across a neighbor's property would be called a "negative" easement because it does not give the holder a right to actually go on his neighbor's property, but only the power to keep his neighbor from doing anything to block essential sunlight. It would also be an "express" easement because the two landowners involved would intentionally and voluntarily bargain for it. You cannot acquire such an easement

just because you have enjoyed sunlight passing over your neighbor's property and have installed a solar collector in reliance on continuing sunlight.[67] The agreement would have to be in writing to be upheld in a court, because it involves real property interests.

Express easements for receiving light are recognized by the courts (e.g., West Annot. California Civil Code §801(8)), and are available in most states.[68]

The landowner receiving the benefit usually pays the other a flat fee for the easement. Traditionally, something of value had to be given in exchange for an easement, or it would not be enforced by the courts. But there is a legal trend away from requiring payment or any other "consideration."[69] In downtown areas, where air rights are extremely valuable, the owners of adjacent property may ask so much money in exchange for an easement that purchase is impractical. In such situations, the easement is sometimes leased on a monthly or annual basis.

When the parties to an express easement put it in writing, they may specify how long the agreement will last, and courts will uphold their instructions. If no termination provisions are in the contract, the easement will bind all subsequent owners of either lot, unless one of a narrow set of conditions occurs.[70]

There are several limits to the usefulness of express easements:

1. They are voluntary--courts cannot force their sale.
2. They may be prohibitively expensive (research is needed on how much they would actually cost in different zones and regions).
3. Their enforcement may involve long and costly court proceedings.
4. Neighbors are unlikely to go to the trouble and expense of drafting a legal document, particularly where they know or trust one another--the trouble therefore starts when one of the parcels changes hands.
5. They may give an unjustified windfall to an owner of "burdened" property who never had any intention of using his land in a manner that would block sunlight.
6. Quite a few property owners may have to be included in easement negotiations as the value of an easement may be reduced to zero if a very tall structure is erected on a lot slightly farther away, and shades the property of both the recipient and the grantor of the easement.
7. Express easements put the entire cost on the would-be solar homeowner. Public policy may suggest that the cost should be

shared or that the builder of the interfering structures should pay solar equipment owners for their "resource" (solar energy) rights. 71/

The major advantage of the express easement is that highly motivated individuals can usually obtain one through their own efforts without having to go through governmental red tape. Furthermore, it is an approach that would provide security in many established neighborhoods and districts as well as in new ones. Even if solar zoning laws are passed, property owners may want to negotiate express easements because (1) they want more protection than is afforded by the zoning law; or (2) they want a guarantee of permanence not found in easily changed zoning laws.

Restrictive Covenants

There are two legal tongue twisters that mean almost the same thing: "restrictive covenants" and "equitable servitudes."[72] A covenant is simply a promise involving land. It is usually found in a deed and frequently controls aesthetics—i.e., the appearance of property. Aesthetics may also be controlled by laws and ordinances, but private controls are more common because courts still have some question about governmental authority to legislate aesthetics (see next section).

In practice, today, private promises are all enforced like equitable servitudes, rather than as restrictive covenants. This is because money damages are usually less satisfactory than an injunction (see note 72) and because of the complicated ancient laws regarding covenants. Basically, an agreement restricting the use of land will be enforced in equity if the subsequent buyers of the burdened land had notice of the restrictions.

Covenants are of most potential use where new tracts are opened for development. Subdivision developers realize that some homogeneity in a neighborhood will appeal to potential buyers. For instance, a buyer will want to be sure that his new neighbors will not put neon light trim around their garage. In large subdivisons, covenants can be incorporated that guarantee access to solar power for home heating and cooling. They could be worded like a solar easement, or could specify generous setback requirements and strict height limits on trees and structures. Richard Robbins says that large scale developments could be required to provide such agreements.[73]

Restrictive covenants are included (or incorporated by reference) in every deed when individual lots are sold, and are also enforceable against future purchasers. The owner of another lot in the subdivision who would be harmed by your breach of a covenant has standing to sue you, despite his lack of direct participation in the contract.[74] Even when the deeds in a subdivision say nothing about such restrictions, if there is an obvious common building plan, adherence to implied restrictions may sometimes be enforced. The rationale is that a look around the neighborhood would give one adequate notice of a restriction.

It is critical that restrictions be written in clear, precise language. Otherwise, defendants could successfully argue that they were not given adequate notice, and were therefore deprived of their right to due process. If a reasonable restriction is unequivocally expressed, it will very probably be enforced, even if another covenant also exists that gives an architectural committee discretion to settle disputes.[75]

The limitations of covenants and servitudes as a tool to protect solar access are:

1. They offer little help to established neighborhoods.
2. They are inapplicable to much commercial and industrial land (although they would be useful in shopping malls or industrial parks—situations where a single developer plans a large area).
3. Their enforcement involves hiring lawyers and enduring delays due to crammed court calendars.

On the other hand, their benefits are great and they should be routinely used in subdivision, mall or industrial park situations. They cost nothing, and do not require unsophisticated individual property owners to draw up legal documents. The developer's lawyer has only to add a clause or two to the deeds.

Restrictive covenants could be used to hinder solar homes as well as encourage them. Covenants are often used to prohibit certain businesses or activities, but they also are used to create private architectural review committees with authority to reject changes in building appearance. This authority is often stated in extremely general terms, and could be exercised to prohibit use of a solar collector. Prospective solar users faced with the disapproval of a private architectural review board have several choices. They can negotiate, by offering to change the design or shield the system from public view. However, some architectural styles may be incompatible with some solar systems. Second, they

can simply ignore the review board, install the system, and let the review board seek enforcement from the courts. This is risky since if the court should enforce the covenant, the system will have to be removed.

The most likely course of relief against a recalcitrant board will be to seek declaratory relief in court, i.e., a statement from the court that the covenant is unenforceable, because it is not clearly and unequvocally expressed. Because the law on this subject is "highly technical, erratic, and in flux,"[76] the outcome of such challenges will be difficult to predict. A related justification for judicial refusal to enforce covenants arises where significant public policy objectives are hindered by the restriction. Although this doctrine would appear to be the most logical route for a solar litigant, the rule has been ambigously defined and inconsistently applied.[77] Usually, the rule can only be invoked if the government itself seeks to violate the covenant.

There is little question that a city could prohibit new covenants among private parties that unduly interfere with the use of solar collectors. The enforcement of existing private covenants can also be affected by changes in zoning in come cases.[78] Generally, the more restrictive provision will govern. But zoning can influence a court in determining whether to invalidate a restrictive covenant because of changing conditions.[79] In a few states, courts have gone substantially further and created a rebuttable presumption that the zoning change reflects changed conditions.[80] Thus, a zoning ordinance defining areas in which use of solar energy is expressly encouraged might convince some courts that the review board must allow for use of solar collectors.

The more difficult question is whether a government could effectively negate the architectural controls by legislating a right to use solar collectors despite the existence of contrary private agreements. Courts often cite the proposition that a valid covenant "is neither nullified nor superseded by the adoption or enactment of a zoning ordinance.[81] The most significant consequence of this rationale has been to require compensation where governmental action reduces the value of the covenant.[82] This remedy may be worthless to individuals challenging a zoning ordinance that authorizes use of solar collectors since it would be extremely difficult to demonstrate a loss in property value in such circumstances.

Zoning for Aesthetical Purposes

Private aesthetics controls—in the form of prescriptive easements—were discussed in the above section. This section will briefly consider the state of public regulations for aesthetic purposes, and possible remedies where such regulations could obstruct solar energy development. A right to sunlight falling on your roof is of little use unless you also have a right to put collectors on your roof to receive it. References to this potential problem in the American Bar Foundation (ABF) study have already been noted, and the issue is frequently cited at solar conferences and gatherings, although usually without reference to any actual experience.

Judicial consideration of aesthetics regulation has a long, complicated history.[83] The majority of courts, until quite recently, were very reluctant to support regulation solely for aesthetic purposes because of the inherently subjective nature of aesthetic judgments. For example, an Ohio court held in 1925:

> It is commendable and desirable, but not essential to the public need, that our aesthetic desires be gratified. Moreover, authorities in general agree as to the essentials of a public health program, while the public view as to what is necessary for aesthetic progress greatly varies. Certain Legislatures might consider that it was more important to cultivate a taste for jazz than for Beethoven, for posters than for Rembrandt, and for limericks than for Keats. Successive city councils might never agree as to what the public needs from an aesthetic standpoint, and this fact makes the aesthetic standard impractical as a standard for use restriction upon property. The world would be at continual seesaw if aesthetic considerations were permitted to govern the use of police power. We are therefore remitted to the proposition that the police power is based upon public necessity, and that the public health, morals, or safety, and not merely aesthetic interest, must be in danger in order to justify its use. 84/

In many cases, however, aesthetic values are joined with some other more acceptable public purpose, such as maintenance of property values.[85] This is particularly true where regulations seek to preserve areas attractive to tourists for their scenic or architectural beauty, such as in Santa Fe, New Mexico, and New Orleans, Lousiana. Courts usually uphold architectural controls in these circumstances. But these ordinances are, by their nature, exceptional, and are therefore not a significant barrier to solar energy equipment.

Another judicial approach to aesthetics regulation is what Professor Williams terms the "least common denominator test."[86] Under this view, some land uses are so obviously discordant and disruptive that they clearly fall within the

scope of permissible government regulation. Presumably, solar collectors would not come under this test, although some designs using empty beer cans or yards of highly reflective material, for example, might be an eyesore.

A few states, including New York, Oregon, Massachusetts, and Wisconsin, have discarded all pretenses and upheld regulation for purely aesthetic purposes.[87] Although these cases still represent a minority view, most commentators agree that the trend is to allow greater local flexibility. For example, the most recent major opinion in this area, Donnelly v. Outdoor Advertising Board,[88] characterized as "the modern trend in the law" that "aesthetics alone may justify the exercise of the police power."[89]

In contrast to the trend in favor of architectural controls and restrictions on billboards, several courts have recently held ordinances invalid that required homeowners to keep grass and weeds below a specified height. These cases have been reported in the press, but to the best of our knowledge not yet published.[90] The implication is that courts may apply a balancing test to restrictions on the appearance of property, rather than the traditional (more lenient) standard of reasonableness applied to zoning. If the property owner can assert some valid interest in the challenged use (appearance), courts may invalidate the ordinance even under the "modern view."[91]

Because implementation of these laws is inherently subjective, the potential user has no assurance his design will be accepted. For example, ELI interviews with solar users in Santa Fe found that stringent architectural controls there have generally not been a problem. For example, a new bank with several rows of solar collectors on its roof met with no objection from city officials. The problem will largely dissipate over time, since once a few designs have been accepted, the government cannot rationally discriminate against others with similar plans.

The uncertainty could be alleviated by a state law saying that local ordinances may not impede the use of solar collectors. However, such a blanket approach might unnecessarily interfere with the preservation of historical districts and other worthwhile social objectives. Some measure of control should at least be allowed to require reasonably attractive designs that do not significantly increase the cost of solar systems.

Solar systems need not be ugly. Although there are systems made out of beer cans and other scrap materials that could be considered unsightly, numerous

available designs prove that solar systems can suit public tastes. One prominent solar engineer stated recently:

> So long as the structure is still on the drawing board, I feel solar can be adapted to any architectural style. By giving and taking we've designed application for everything from salt boxes to contemporary designs to mountain cabins to a bank. If solar is going to work it has to be adaptable. 92/

Where existing structures make adaptation more difficult, screens will often suffice to shield the collector from public view.

The issue should therefore be stated in terms of balancing values rather than as an absolute rule. Where aesthetic considerations can be accomodated without excessive cost, this should be done. On the other hand, architectural controls should not be so rigid that solar collectors cannot be used, unless a legislative judgment is made that important historic values or other public benefits justify the restriction.

The best approach may be for local governments to adopt guidelines clarifying the status of any aesthetics regulations that might apply to solar systems. Using drawings or pictures, regulations could indicate the general type of systems or screens that are and are not acceptable. In this way, certainty could be provided but the regulatory scheme maintained.

Analysis of Proposals for New Laws and Legal Approaches

Criteria for Evaluation

First year law students are routinely told that there is no good place to begin their study, as the law is a "seamless web." A more apt description may be a tangled thicket. To avoid adding to the many poorly conceived laws that already burden us, we suggest that any proposed solar access laws be subjected to sharp scrutiny. The following list suggests qualities that should be found in a law protecting solar access. A good law should:

1. Maximize protection from shadows during the hours of high insolation to reasonably located active-type collectors for new structures.
2. Maximize protection of a similar nature to passive systems in new developments.
3. Maximize protection to property owners retrofitting their homes with cost-effective solar devices in established

neighborhoods where the use is in accord with existing zoning and where due process has been given affected nearby landowners.

4. Deny protection in retrofitting cases where the burden that would be imposed on a complaining neighbor clearly outweighs the potential benefit to the owner of the solar building.

5. Have a built-in flexibility to adapt to the availability of new technologies.

6. Minimize the administrative expense to the structure's developer, builder, and owner, and to the enforcing jurisdiction.

7. Minimize delay.

8. Arbitrate differences between neighboring landowners to reduce the likelihood of litigation between neighbors.

9. Allow private, alternative agreements among adjacent property owners.

10. Be politically acceptable.

11. Provide for all types of property zones.

12. Include standards for zoning boards telling them when variances or special uses should be allowed.

Proposals for Federal Involvement

The federal government has both direct and indirect powers that could be used to protect solar access. For example, reduction of our dependence on foreign fuels would justify an exercise of the right to provide for national defense.[93]

A more likely source of authority, however, is the nearly unlimited power to regulate interstate commerce. This power has been held to extend even to activities like a farmer growing crops on his own farm for his own use (the rationale is that he would otherwise have to buy such crops—perhaps from a source in another state). An analogy exists with homeowners collecting energy for their own use rather than buying it from a utility that may generate the power in another state or buy fuel from an out-of-state source.

The federal government also has the power to remove undue burdens on interstate commerce, and the remedy it chooses need not be a direct one.[94] For example, to control interstate pollution it is not required that the federal government control pollution directly. The utilization of solar energy is one way of reducing our reliance on other, more polluting forms of energy.

Mary White argues that, under the commerce clause, congressional regulation of activities affecting the use of solar energy seems feasible. This is because of the increasing interstate commercial marketing of solar devices, she says, and adds that even "free-flowing sunlight, not yet reduced to usable forms of energy, may be subject to federal regulation even before its products are marketed interstate."[95] White concludes, however, that there is no compelling reason for Congress to act in this matter as the states are capable of handling it.

The ABF report agrees that under the commerce, national defense, and other constitutional powers, Congress could claim the power to pass a federal act to guarantee unobstructed solar skyspace.[96] The same study says, however, that Congress is not likely to do this, because nationalizing air space lower than is necessary for commercial aviation would conflict too greatly with private property rights.[97] The federal role in land use regulation has historically been very narrow. The HUD section 701 program provides financing for land use planning that meets general criteria. Section 208 of the Federal Water Pollution Control Act requires state/local preparation of areawide waste treatment management plans that must include provisions for regulating the locations of pollution generating activities.[98] A more extensive federal land use bill was proposed but defeated in 1974. Despite this limited historical perspective, the federal presence in land use is probably limited more by political reasons than constitutional constraints.

In spite of the lack of evidence of a need for federal intervention, federal legislation has been proposed that would flatly prohibit states from allowing any construction that would block the sunlight needed by existing solar equipment being used for heating or cooling.[99] Whether enacted at the local, federal or state level, this type of legislation has many disadvantages. From the viewpoint of the owner of existing solar equipment, it is an ideal law. But it would not help persons who would like to install solar equipment but are already shaded, nor would it be the best solution for society at large. The bills may result in leapfrog development, which would, in turn, result in the use of more fossil fuel for transportation. Premature development may also be forced, as property owners would race to build while they could (the discussion on the disadvantages of prescriptive easements applies here). If a property owner failed to erect his building before his neighbor hooked up his solar system, his land may be drastically reduced in value (particularly in densely-built areas).

If preemptive laws are passed on the federal level (which we do not recommend at this point), they should be much more smartly tailored than these early, counter-productive efforts.

A more likely possibility is that Congress will use some of its indirect powers to aid solar collector owners. These are powers derived from other, specifically granted powers, such as the power to spend for the general welfare.[100] Examples the ABF gives of this second type of power are federal grants to state or local governments that are conditioned upon a state's encouragement of solar use.[101] For instance, federal financial aid could be restricted to states that encouraged planned unit developments or that enforced solar easements by providing for their inclusion in public records.

State and Local Approaches

Some of the approaches available at the state and local level have already been mentioned, such as solar easements and extensions of existing nuisance laws. Other methods might include legislation to ensure the effectiveness of private easements, various solar zoning schemes, land use planning approaches, or even more esoteric schemes using analogous bodies of law, such as water rights.

Several of these options can be dismissed rather summarily. Many of the alternatives that follow could be carried out at the state, local, or even federal level, but are traditionally dealt with locally.

The two tap roots of local laws are the authority to zone and the power of eminent domain. Many municipalities have been delegated the power of eminent domain by their state government,[102] but the state governments can also zone and condemn property.

Publicly negotiated skyspace easements. The ABF study includes a suggested statute that would allow cities to negotiate or condemn skyspace easements, and to either borrow money to pay for them or to assess the costs against those benefited. Assessments would be made on the basis of the benefit (such as the energy supplied, or the surface area of the collector, or the increase in property values). Such municipal action would be a taking of property, of course, and both the U.S. and state constitutions would therefore require compensation. Such programs may be so expensive that they would be useful only in very limited circumstances. Municipalities may presently have the power to condemn such

easements, but the AFB suggests state legislation that would make their authority clear.[103]

A possible legal problem here is whether these skyspace easements would be a "public use," a required objective for any condemnation.[104] Jurisdictions taking a narrow, literal view of public use may encounter problems with this approach, but the majority, and the trend, is toward a broader interpretation. Even in literal jurisdictions, however, if a state legislature declares a use to be public it will seldom be challenged.[105] The U.S. Supreme Court has upheld the condemnation of land for urban renewal, even though the primary beneficiaries were the future private homeowners.

Under the ABF approach, the skyspace easements would be transferred to the benefited private property owners. The new owners would then be assessed for the cost of the airspace. Violation of a skyspace easement would be considered a private nuisance--the injured party would bring a court suit for damages or for an injunction as in any nuisance case.[106]

Privately negotiated skyspace easements. As mentioned earlier, property owners can already negotiate privately with their neighbors for solar easements (see above discussion on the advantages and disadvantages of express easements). The most immediate and practical legal action states can take might be to follow the example of Colorado and enact legislation guaranteeing such express solar easements the status of regular easements.

Although solar easements may be enforced in some states without the aid of special, facilitating legislation, property law is peppered with snares for the unwary. For instance, some writers are uncertain whether easements for light would be viewed as being "in gross" or "appurtenant." The distinction, very roughly, is that the former are viewed as benefiting a person, not a parcel of land. This may be a problem because when either of the two lots are sold, courts will usually apply only appurtenant negative easements against the new owner(s). Moreover, it is unlikely that negative easements in gross can be assigned in any jurisdiction,[107] although it has been held that "commercial" easements in the gross can be assigned.

Easements for light and air are legal in most states.[108] But a statute will guarantee that such agreements can be enforced against new owners of the benefited and burdened properties even if there is no privity of estate, privity of contract, or other property law requirement. If appurtenant, skyspace easements may be sold, taxed, and leased just like any other property.

The ABF suggested statute for the protection of solar skyspace easements embraces easements, restrictions, covenants and conditions in any type of instrument (deeds and wills for example). It requires the skyspace to be described in three dimensions and/or as to times of day; provides for it to be duly recorded and indexed by the registrar of deeds; provides that such easements shall run with the benefited and burdened lands; and allows benefited landowners to enter upon burdened land in a reasonable manner to assure compliance. The ABF study argues that, without a statute such as the one they suggest, solar skyspace easements may be unenforceable following condemnation.[109]

Pending state legislation. Two types of legislation relating to solar easements have been proposed by state legislators. The first is much like the ABF suggestion. Colorado has been the first to enact this type: Florida, Maryland, and Arizona are considering bills almost identical to Colorado's. After stating that solar easements shall be in writing and shall be subject to the same conveyancing and recording requirements as other easements, such bills typically say that the easements shall include:

1. the vertical and horizontal angles, in degrees, that the easements extend over another's property;
2. terms and conditions of the grant, including conditions under which it will be terminated;
3. any compensation to be paid any party involved.

A clause stating that the act is necessary for the public peace, health, and safety (i.e., that it is a legitimate exercise of the state's police power) is usually tacked on. It is likely that such statutes would survive a judicial challenge, but there have not been any test cases.

A second, totally different, approach that has been suggested in several states is for a state to simply grant solar easements to collector owners. A Minnesota bill, for instance, would grant an easement for sunlight to the owner of a builidng that used solar energy for heating or cooling. Others would not be allowed to erect any object that would interfere with the solar system. If they did, they would be held liable to the solar homeowner for an amount three times the actual cost of implementing an alternative energy system.[110]

Colorado has considered legislation that goes a bit further and forbids property owners from allowing their trees and shrubs from growing in a manner

that would block another's solar collector or reflector between 9 a.m. and 3 p.m. Shadows cast at the time the device was installed are exempted.[111] Although the legislative authority on which these bills are based is not stated, they would probably be defended under the power of eminent domain or under the police power.

Analogy to water rights law. A creative state-level approach has been suggested by Mary D. White.[112] After noting that it is desirable to have a state-wide consistency in settling disputes, and that judges and lawyers work most easily with principles with which they are familiar, White suggests treating sunlight like other natural resources. She rejects the intricate laws developed to govern oil and gas because oil and gas, unlike sunlight, are very limited in quantity, and this scarcity permeates most aspects of oil and gas law.

White finds water law, however, to be a real possibility. Like sunlight, White argues, water is used rather than captured and sold. Both may be consumed, but both are renewable.

States use one or two basic approaches to water law: the prior appropriation doctrine (favored in the arid West), or the riparian doctrine (preferred in humid states with a lot of water). There is no separate federal water law, so state law is applied in federal courts. Under the riparian approach, property owners have a right to use water flowing past their land. Each owner of land along a stream has equal rights, typically, even though some own more waterfront than others. Some riparian states say owners have the right to an undiminished "natural flow." Others say one's right is to be free of "unreasonable uses" by others. In actuality, the downstream plaintiff who first made use of the water is often protected.[113] The trend, however, even in riparian states, is toward the adoption of some sort of permit system. White does not believe the riparian system is a good analogy for solar allocation. But she does suggest that a gentle changeover to a permit system along the lines proposed by the National Water Commission may be a good approach for riparian states.

In prior appropriation states, water laws are more developed because there has been more litigation over a scarce resource. In general, property owners must give notice of their intent to appropriate, and of the actual appropriation. The water must be put to a beneficial use within a reasonable time. (Notice is accomplished in various ways--in some states an open physical demonstration is needed; in others just the paperwork of filing for a permit.)[114]

White examines the issue of whether a "diversion works" is essential to a "diversion." This could be important in cases like Fountainebleau Hotel where sunlight was used for enhancing a swimming pool area, rather than as part of an active-machinery type of solar system. Sunbathers would probably not be considered a diversion works. In prior appropriation states, White notes, a strong showing that a use is beneficial helps mitigate the requirement for a diversion works. Economic benefits may be one thing a court would consider.

Defining "beneficial use" is the subject of much water law. White suggests that domestic heating and cooling could be given priority over recreational or frivolous uses. She correctly identifies the real question as whether a beneficial solar use would be preferred over a nonsolar use. For example, could the owner of an existing solar house enjoin construction of a conventionally-heated but economically valuable structure that would shade his collector? Under a water law analogy the newcomer would have to buy the solar homeowner's resource rights. A procedure much like that for getting an easement is proposed.[115]

The water law doctrines on abandonment, forfeiture and adverse possession could all be applied to solar rights, White says. She notes that water rights may be transferred separately from the land in prior appropriation states.[116]

White has drafted a proposed act for states that wish to apply water laws to solar energy.[117]

While it is possible that courts could apply White's reasoning and tailor water law to sunrights issues, there is little sense in making silk purses from sows' ears when silkworms are abundant. It is useful to ask, "In what factual setting would White's ideas work better than alternative, simpler approaches?" In new developments, restrictive covenants are a tested and available approach. In existing, dense neighborhoods it would be too late for shaded property owners to benefit from a water law analogy. A narrow situation remains: existing structures or lots or airspaces in developed neighborhoods that are presently unshaded. Even here it seems unfair to allot sunrights on a first-come, first-served basis when it may be possible to plan additions to structures so that they do not shade their neighbors. The application of a water law analogy would drastically increase the value of some parcels, while slashing the worth of lots to their north. Such unequal treatment may be unconstitutional. If the reduction in the value of a lot was great enough, it could even amount to a taking without compensation.

It will make economic sense to retrofit some structures with solar devices long before other buildings are "ripe" for such adaptation. Factors relevant to such decisions are the design and orientation of a building, as well as the microclimate around it and the financial position of its owner. It seems unreasonable to force property owners to install solar equipment prematurely just to protect their sunrights. Under water law, priority in time is stressed at the expense of fairness.

Conversely, under a water law analogy property owners may have to build additions to their structures prematurely if their neighbors hint they may install solar equipment. Substantial conflict with land use planning goals is possible. Furthermore, no compensation would be paid for lost development rights.[118] This would be particularly unfair in zones that allow highrise development where airspace is extremely valuable.

Many of the above problems stem from basic differences in the nature of sunlight and water. Traditionally, three things are required for a valid appropriation of water: 1) an intent to appropriate; 2) an actual diversion; and 3) the application of the water to a beneficial use.[119] There is no problem in applying the first concept to sunrights, but it takes a lot of creative thinking to make the last two fit. To divert means to turn aside or deflect. Sunlight may be absorbed or converted into another form of energy, but it is not often diverted. Although many courts now recognize "instream" values within the appropriation system,[120] "instream use" is not really analogous either.

Further problems would arise in attempting to define "beneficial use." Legislatures seldom define this term, and leave its meaning up to the courts.[121] Courts usually compare a use with other, conflicting uses to determine which is the most beneficial.[122] This must be done on a case-by-case basis and is easier to do with water than with solar radiation. With water, alternative uses of water are evaluated. But with solar rays one would usually be comparing apples with oranges: the value of a solar air conditioning system to one building, for example, versus the value of a five-story addition to an adjacent structure. It seems unlikely that many cases would arise where the addition of a solar device would shadow another's solar device.

Sunshine falls everywhere; usable water is found only in particular places. Through careful planning it will often be possible to "have our cake and eat it too" with regard to solar power. Usable water is in a much more limited supply: as there is not enough to go around, latecomers are excluded.

White does not handle the problem of passive systems well. "Passive uses are less likely to be vigorously defended or to have a measurable economic value," she writes. By analogy to water law in appropriation doctrine states, passive uses may not give rise to a right. Perhaps she misunderstands what the term "passive" means to most persons in the field as she excludes from passive "all uses in which some structure would be evident or necessary."[123] As commonly used, a passive system simply means one without moving machinery. It may involve structures like windows or heat-absorbing walls or earth berms.

Still another problem with White's suggestion is that so many, many more people would seek solar rights than presently file for a permit or go to court to secure water rights. Conceivably, nearly every property owner in the U.S. could try at some time to secure solar rights. In states like Colorado where court proceedings are necessary, courts could be overwhelmed.

To summarize, a simpler, more certain, and more equitable approach is necessary. Stretching water law to cover solar access issues may dampen enthusiasms for this new technology.

Solar zoning. The local approach most extensively analyzed by legal experts is the manipulation of zoning laws. The power to zone is, of course, derived from the police power of the state and is delegated to local governments. Although enabling legislation for zoning and some form of subdivision control exists in all fifty states, many localities do not exercise this authority. One expert estimates that only 5,000 out of 60,000 jurisdictions with power over land use exercised zoning powers in 1974.[124] Existing authority to plan for solar energy may therefore be adequate but not in and of itself sufficient to solve the problem. Individual programs would also result in considerable waste of resources. Each government would have to undertake a technical evaluation of solar energy, which could be done much more efficiently through a centralized authority.

Zoning law can both facilitate and frustrate the collection of sunlight for heating and cooling structures. Relevant factors controlled by zoning include height, setback, and sideyard restrictions; percentage-of-lot-area-covered limitations; use and accessory use limitations; aesthetic controls; structure orientation, etc. For instance, in commercial zones existing buildings are often just as tall as the zoning laws allow, and could not, therefore, increase their height by even the thickness of a collector. In residential areas only one accessory

structure is often allowed, a regulation that rules out a detached collector if a garage or tool shed already exists. There are many other similar problems with existing laws.

The types of problems that may arise will depend, in part, on whether an area is zoned for residential, commercial, or industrial uses. A commercial zone is one that allows activities involving the exchange of goods, the provision of services, and related activities.[125] This is an extremely broad category, and local ordinances often split it into many types of commercial zones, each with its own particular regulations. General Commercial is a broad subcategory, ranging over downtown shopping areas to modern malls. The most important restrictions in this zone deal with parking requirements,[126] which are neutral as far as solar energy is concerned.

Very dense central-city areas are often zoned Restrictive Central Commercial. More bulk per acre is allowed here than anywhere else, which may make it unfeasible to protect solar access for passive systems here. Because this property is so valuable, owners tend to build up to their height limits. Vegetation is limited, and is not as tall as structures. For these reasons, rooftop shadows may not be a problem. "Snob zoning" raises its nose in these districts in the form of aesthetic protections against tawdry-looking establishments.[127] Problems are not anticipated, however, as solar devices are at least as sightly as air conditioners, and both are located on roofs—where pedestrians cannot see them.

Areas zoned Local Retail are usually surrounded by homes. They allow convenient, small neighborhood shops. Commercial activities are typically limited to one or two floors.[128] Various amounts of parking may be required. The suitability of such zones for solar equipment will probably be very similar to the surrounding residential areas.

Office-Residence Districts may erect obstacles in the way of potential solar users since they are transition areas and often include offices, apartments, etc. Heights may vary.

The direction a highway runs may be the key factor in the suitability of Highway Commercial zones for solar utilization. These zones are the ribbons of franchises along either side of busy highways. The intensity of development falls off greatly as one moves away from the highway, so passive systems may well be possible when the highway runs east-west. There are so many possible types of

development in such a zone that it is dangerous to generalize any further about its applicability to solar access.

Another zone that defies generalization is Heavy Commercial, which may include nuisances like gas stations and open service yards.[129]

Industrial zones are those where goods are produced and processed. Traditionally they were unrestricted areas, but now they are apt to be regulated by performance standards. These standards set upper limits on the levels of various types of nuisances that will be tolerated, such as noise, smoke, odors, and vibrations. In Heavy Industrial zones, greater nuisances are allowed than in "light" or "intermediate" districts. (The federal air pollution control law and state-wide laws on air and noise pollution often supercede local zoning. In a state with stringent air pollution laws solar collectors may be slightly more feasible in industrial areas.)

It is possible that roof collectors in some heavy industrial zones would be coated with so much soot and other grime that they would not be practicable. Ground collectors may be too vulnerable to breakage in areas with a lot of activity and traffic, and may present safety hazards. On the other hand, there would clearly be no aesthetic objection to solar devices in industrial zones.

There is one type of industrial zone that is ideal for solar heating and cooling: Garden Factory Districts. These zones allow research activities and very light manufacturing in a campus-like setting. Provisions for large yards and off-street parking are typical. Effort is often put into landscaping, which could be coordinated with passive solar structures. Structures are usually low, and widely separated, so there should be few problems with using either active or passive approaches to heating and cooling. The first really big factory complex in the U.S. to be solar heated will be in an industrial park setting.[130]

It is hard to generalize about the content of a good zoning law in terms of solar access, except to say that it should be flexible, specific enough to give ample notice, and include a stated purpose of encouraging solar heating and cooling. It is difficult to draft a law that would deal specifically with every possible situation. If one wrote a law, for example, removing sideyard requirements so that a house could be placed where it caught the most sunlight, the purpose of the law may be defeated if the new house was so close to the property line that it shaded the neighbor's ground collector or passive heating wall. Likewise, zoning laws

preventing tall trees may actually raise energy demands by eliminating the cooling benefits of such trees. Most writers assume that strict height limits will be an integral part of any solar zoning, because tall buildings will not have enough roof area for collectors. This is a dubious assumption, as some skyscrapers must run their air conditioners in winter to remove heat from lights, bodies, and machines. This is an area where more research is needed. We may well find that the winter heating requirements of many tall buildings could be met by collectors that would fit on their roofs.

Most proposals for mandatory solar zoning are limited to areas zoned for single-family houses, provide for some sort of administrative appeal to relieve undue hardship, and would be enforced like regular zoning laws. Some give all homeowners sunrights; others use a first-in-time-wins approach. An example of the latter is Robbins' suggestion that prescriptive easements to perpetual use of skyspace arise "after seven full years of an actual collectors use, or notice of a proposal or seven years of official designation. Such a right, though, could be terminated by the underlying landowner's petition for a building permit."[131] It seems unfair to force an adjacent landowner to develop his land before he is ready as the only means to keep his land free from an easement.

Zoning schemes may encounter some problems with the Fifth Amendment of the U.S. Constitution which requires that compensation be paid when property is "taken" (as opposed to being merely "regulated'). A property owner denied the right to grow a tall tree where she wants it, or add an addition, may argue that her property has been "taken." Hillhouse says that the outcome of such a contest could "vary with the vagaries of different state court attitudes."[132]

Although zoning power is generally exercised on the local level, state legislation could be passed to require local governments to use their zoning power to facilitate solar energy utilization. The ABF has drafted a statute that would accomplish this.[133] Richard Robbins also says that local governments should be "required to regulate height, location, setback, and use of energy sources to encourage use of solar systems."[134] In addition to height, setback, and location, the construction, bulk, and repair and maintenance of buildings can be regulated. City councils can be instructed to not unreasonably restrict construction where site, slope, and tree structure make incident solar energy collection unfeasible.

Oregon has amended its city and county zoning enabling acts to allow local jurisdictions to adopt ordinances "protecting and assuring access to incident solar energy."[135] Enabling legislation does not itself directly affect the public but allows lower levels of government to do so.

Robbins says that enabling legislation should specifically refer to vegetation and setback controls as these are not always included in general delegations of authority.[136]

One of the more interesting ABF suggested statutes would require municipalities to create three categories of solar overlay zones that would prevail over conventional zoning.[137] In Mandatory Use Districts, if a solar energy system was economically justified in a new structure, or if the energy system of an old structure was replaced, use of solar energy would be required. Skyspace would be protected by city action if private agreements could not be reached.[138] Cost-effectiveness would probably be judged in relation to conventional energy systems. (Mandatory requirements for solar energy are considered further in another chapter of this report.)

The same backup municipal protection would be offered in Affirmative Solar Use Districts. Building codes in both Mandatory and Affirmative districts would be revised to encourage solar use.

The third category, Other Solar Use Districts, would find a city protecting solar skyspace for most uses, and also granting exemptions from other hindering regulations.

"Where requirements for solar energy use are applied rationally without discrimination and in relation to a proven need to conserve energy, the statute should be upheld," the ABF concludes.[139]

Robbins proposes special districts where solar energy use would be required in new construction. If this was done where there were no problems with shade trees or mixed heights, and where solar systems were cost-effective, Robbins suggests such a law would be upheld. He cites analogous regulations for the control of air and water pollution and in regulating the waste of natural resources.

A related suggestion made in the ABF report is to allow large-scale developers a bonus credit (allowing more intensive development of their land) in exchange for their compliance with standards guaranteeing solar access.[140]

Melvin Eisenstadt and Albert Utton feel that zoning is the most practical method of creating solar rights, particularly in established neighborhoods.[141] Where

the zoning regulation may amount to a taking of property, the possibility of zoning with compensation is suggested.[142] This is a combination of police and eminent domain powers.

Kraemer points out the similarity between solar zoning and setback and height limitations: both prohibit a landowner from occupying some of the air space above his land.[143] He also notes that "no citizen has a protected, vested right in old zoning law," so solar zoning laws could be applied to old neighborhoods as well as new ones if a legislature determines change is needed.[144] Grandfather clauses would probably allow old structures to remain either for their useful life or for a given number of years. Of all alternatives for protecting property owners' access to solar energy, Kraemer and Felt believe that best is the implementation of a shade control law that would affect only trees and shrubs.[145]

Kraemer has also advocated the creation of solar radiation overlay zones. He suggested that the Colorado legislature require each governmental unit with zoning power to provide for, or to deny, such overlay zones in their jurisdiction. A person who wanted to install a collector in a jurisdiction with overlay zoning would apply for an overlay zone. Local authorities would then find the direct path between the proposed collector and the sun as of noon, December 21. Adjacent, affected property owners would be given a hearing. If the zone was approved, both the collector owner and the local government could sue to enforce it. Violation would be both a public and a private nuisance.[146]

Disadvantages inherent to any approach based on zoning include:

1. The expense and general impracticability of applying it to areas that are already built up; structures cannot be moved to meet new requirements for southerly setbacks.
2. Zoning boards are notoriously susceptible to local politics and special interest groups and often grant or refuse variances almost on whim.
3. It would be very expensive for a state or locality to intelligently redesign zoning plans.
4. If there are no restrictions in their enabling legislation, zoning laws can typically be changed by only three readings by the relevant local authority.
5. It has traditionally been very difficult to successfully challenge the decisions of zoning authorities in the courts. 147/
6. It can be expensive to appeal zoning decisions.

7. Blanket zoning for solar access may conflict with other energy-conserving techniques: compact, contiguous development, for example, cuts the fossil fuels needed to heat and cool structures and for transportation.

Land use planning to provide for solar access. Many solar access issues arise because the value of solar energy was not considered at the design stage. For example, the placement of a building on a lot may determine whether neighboring buildings are shaded. By careful consideration of solar access issues before buildings are completed and vegetation planted, many conflicts could be avoided without resort to new legal theories for the protection of solar energy systems.[148]

Many existing controls on construction and land use might be used, with slight modification, to provide for solar access. Several states—including Arizona, New Mexico, and Virginia—have enacted information and promotional activities that could include educating builders about design criteria for solar energy.[149] A bill in Oregon suggests a more aggressive approach; the extension service program is directed to use county extension agents to disseminate information about solar energy.[150] A similar measure has been proposed at the federal level.[151]

Planning for solar energy is challenging even when solar access is the sole goal of a plan. To complicate matters, it has been suggested that land use patterns appropriate to solar energy may not coincide with other methods to conserve energy. The following discussion took place at a recent conference on Energy Conservation and the Law:

QUESTION: I wonder if the excellent discussion on land use and energy is operating from a sufficiently broad technological base. For example, the currently available solar energy technology is supplemental home heating, that you can buy off the shelf now, and it works. For such technology you would want new construction to be dispersed houses where the roof area was sufficient to support it. The condensed housing that you spoke of would be inappropriate. . . .

CORBIN HARWOOD: You pointed out one very difficult and obvious problem in this area. Some aspects of energy efficient land use require condensed development, other aspects of energy efficient land use do require dispersed land development. . . all I can say is that each community must assess whether or not these new technologies are available to its constituents. Certainly provisions should be made for the use of new technologies.

GRANT THOMPSON: And I think that question illustrates the great difficulty of making these social issues, because although one

> might get benefits from solar energy by dispersed housing, you at the same time increase the travel load by dispersing housing. And it is very difficult to make those tradeoffs where figures don't exist and you have to work hunches. 152/

Since communities should be interested in minimizing total demand for nonrenewable fuels rather than simply encouraging solar energy, it might be argued that some land use schemes to facilitate solar energy are inefficient. A holistic approach is suggested by an ordinance adopted in Davis, California.[153]

A more traditional approach is to require consideration of energy conservation objectives in comprehensive plans. Comprehensive plans are used in many states to guide long-range policy in local zoning.[154] A growing minority of states require localities to adopt comprehensive land use plans that conform to standards set by the state.[155] Oregon, for example, requires that energy conservation be included as a goal in all local plans.[156] Courts in some states have also ruled that zoning must be in accordance with a comprehensive plan. The American Law Institute Model Land Development Code (an influential, but strictly advisory document) recommends that certain local regulatory powers be conditioned on adoption of a "Local Land Development Plan."[157]

Provision for solar energy in comprehensive plans was suggested by the American Bar Foundation,[158] and has so far been considered in at least two states. The ABF proposal requires local governments to include specific considerations for using solar energy in their comprehensive plans. Plans must be reasonably specific as to the circumstances in which use of solar energy is to be encouraged or required, including the locations where solar skyspace is protected. A bill proposed in Arizona provides authority for cities, towns, and counties to regulate access to sunlight, but does not require it.[159]

Energy impact statements. Another approach that avoids direct regulation, but shifts more of the burden to the builder, is the use of an energy impact statement requirement. Since federal adoption of the National Environmental Policy Act in 1969, more than half the states and many localities have adopted requirements for environmental impact statements in some form.[160] California has gone furthest towards a requirement that agency decisions conform with the contents of impact statements, but even in other states they serve important educational and informative purposes.

Nine states explicitly require that impact statements discuss the effect of projects on the consumption of energy; two specifically require discussion of energy conservation.[161] For example, guidelines for impact statement preparation in California specifically require applicants to discuss:

1. The degree to which current energy conservation technology has been used
2. Ways to encourage energy conservation by shifting to less energy-intensive transportation modes and fuels
3. Proximity to existing resources, including labor and material supplies
4. Measures to eliminate unnecessary grading during construction
5. The use of total energy systems and other technological innovations to reduce the energy needed for heating and cooling

Since large land developments will come under the impact statement requirement in most states, this procedure might be used to assure consideration of solar energy utilization. This requirement would also increase awareness and understanding of solar energy opportunities among developers. This approach was suggested by the American Bar Foundation and in a bill considered but not adopted in Colorado.[162] A bill in Tennessee would require state housing authorities to consider solar energy.[163]

Although impact statements can provide useful information, some proposals have gone further and included more action-oriented requirements. Florida, for example, requires construction of buildings to allow for a later connection of solar heating and cooling equipment.[164] A bill in Colorado would require that subdivision regulations include standards and technical procedures for solar energy use. The builder would also have to demonstrate energy efficient design, e.g., proper orientation of the structure to minimize energy consumption.[165] Proposals suggested by the ABF provide that solar energy be used where "cost effective" or in designated districts. Enforcement is accomplished through inspections required for building permits and by restrictions on utility service. Variances are allowed for demonstrated hardship but legal challenges to any severe restrictions would remain a serious threat to the implementation of the statute.

Flexible zoning techniques. Although most communities have no direct provision for energy conservation in their land use planning, many use flexible

zoning procedures that could be modified to include solar access in the design process. Flexible land use approaches encompass a variety of planning techniques characterized by a discretionary governmental review procedures.[166] For example, planned units developments (PUDs) minimize zoning restrictions and allow developers to propose a layout, building design, and uses, all as one package. Often the local ordinance provides some criteria, but review of the site plan is performed through a flexible, case-by-case procedure. Although the PUD concept is specifically authorized in only a few states, communities in many other states have used it without serious legal problems.

PUDs are flexible enough to incorporate any design objective, including solar assess. Developers could be required to indicate the impact of shadows in their proposals and to justify any significant lack of solar access. This could be done by legislatively established criteria or administratively through regulations or, with less certainty, through case-by-case negotiation.

Other flexible zoning techniques that provide governmental rewards in return for the developer's attainment of specified objectives also may be applicable. This type of zoning, generally referred to as "incentive" or "bonus" zoning, is most appropriate when the public benefit could not be obtained directly by police power regulation. For example, a Milwaukee ordinance allows increased floor area in exchange for adding plazas, arcades, and other open space around office buildings.[167] It may not be constutionally permissable to impose this type of design regulation directly, but the use of bonuses may benefit everyone. This approach might be appropriate for solar access in high density areas; a developer who made design allowances for the solar access of neighboring buildings could be granted higher density rights.

Flexible zoning techniques, particularly PUDs, have been criticized because of their potential for abuse.[168] Certainly they should not be viewed as a panacea for all the inadequacies of traditional zoning methods. Whatever their other limitations, flexible zoning techniques offer a promising method for providing solar access. As they are becoming increasingly common, this opportunity should not be overlooked.

Condemnation approaches. As an alternative to using its zoning powers, a state or local government might try to use its power of eminent domain to condemn the airspace needed for solar easements. This may be extremely expensive, as the

owner of condemned property must be paid. Some of the expense could be recouped by selling or leasing the condemned airspaces to those they would benefit. For eminent domain to be valid, a public benefit must be found. There may be a public benefit even if a few private property owners are primarily benefited.[169]

Conclusion

Our tentative conclusion is that a combination of approaches will probably work best. Protecting solar access is the hardest to do in existing densely built communities. Fortunately (from a legal viewpoint), the owners of structures in these areas are currently the least interested in solar heating and cooling. This is because many existing structures are inherently unsuitable for solar power because of their orientation or architecture, and because most would require extensive insulating and other expensive modifications before solar systems would be feasible. There has been more interest in retrofitting for solar water heaters, but such devices take up relatively little roof space, so a sunny spot can often be found. Future innovations in solar technology may suggest presently undreamed-of solutions for the retrofit problem. From a legal viewpoint we are fortunate to have this lagtime to hammer out really workable, just, and inexpensive approaches.

Model statutes should be drafted now in case the prices of fossil fuels skyrocket and there is an immediate demand for solar energy retrofits. Such model statutes should be kept on the shelf, however, until needed. They should be constantly reviewed in light of technological breakthroughs.

For new subdivisions, malls, and industrial parks, state laws should be passed to encourage or mandate the use of covenants to protect the sunrights of all property owners. Such restrictive covenants will leave a few gaps: houses on the edge of one subdivision and bordering on another would not be protected, nor would custom-built individual homes (a very small part of the market). Some factories and commercial structures would also escape the net.

All of these gaps, however, could be filled by good land use planning. The federal government could encourage states to institute energy-conserving land use plans that also facilitate solar heating and cooling.

The direct federal role is, therefore, nonexistent. Pursestring persuasion is perhaps the only realistic option, combined, of course, with research and educational programs. It should be up to states and localities to choose and enact

model laws that meet the special needs of their geographic regions. The following actions should be taken in all states, with technical assistance from the federal government:

1. Require that new developments include provisions for sun rights. This can be done with restrictive covenants, height restrictions, or other traditional land use controls and will be described in detail in a study to be done for HUD. Since solar energy is likely to be much more economic for new buildings than for existing ones, this approach alone could significantly mitigate the problem.

2. Review the economics of using solar energy in existing buildings in different regions. This will depend on local fuel costs, insolation intensities, heating needs, and the characteristics of the buildings. Since in some areas of the country solar energy is not likely to be competitive for at least 10 years, comprehensive legal protection may be premature.

3. Where solar technologies are found to be economically competitive in the near future, determine whether shading is a problem by using aerial photographs and by educating homeowners to inspect their own situations. At least two communities have used this approach and found that shading is not a significant problem in residential areas.

Where solar is economic for existing buildings and shading problems are also found to occur frequently, several steps should be taken:

1. Confirm the right of individual property owners to negotiate easements to light and air. This has already been done in Colorado. States could also facilitate the process by creating a simplified form and recording procedure to eliminate the expense created by involving lawyers.

2. Restrict new vegetation that would shade an existing solar collector. This rule might be modified to apply only to roof-top collectors or to allow for arbitration where the plant grower can demonstrate that his needs could be easily accomodated.

3. Add solar energy impacts to the list of factors to be considered in comprehensive plans and applications for building permits. This would ensure that potential conflicts with solar energy use are considered when applications are made for rezoning or building renovation, without necessarily specifying the resolution of particular problems.

The above procedures should be adequate to protect access to the sun for the vast majority of solar users. However, in some cases additional measures may still be necessary, e.g., where the owner of property adjoining a solar collector refuses to

be accomodating out of spite. At least two approaches to help the solar user in such circumstances are currently justifiable:

1. Adoption of a legislative declaration that solar energy utilization serves a strong public purpose could benefit the solar user in any litigation. More specifically, the legislature could specify a preference for solar users in a limited set of situations where the competing use clearly serves a lesser public interest. For example, interference with the operation of a solar collector by a "spite fence" or decorative addition could be declared a public nuisance.

2. In established, residential neighborhoods where significant changes in land use are unlikely in the near future, use of a roof-top collector might be accorded a guaranteed right to sun over neighboring proerty. This should be accomplished through a public zoning process and preferably a referendum to guarantee acceptance by the affected property owners. Otherwise, protracted legal battles could create uncertainty equal to that in existence prior to the legislation.

NOTES: SOLAR ACCESS AND LAND USE

1. See William L. Prosser, Law of Torts, 4th ed. (St. Paul: West Publishing Co., 1971), pp. 69-70; United States v. Causby, 328 U.S. 256 (1946).
2. The American Bar Foundation, Ralph Becker, Daniel Dawes, Melvin Eisenstadt, William Harris, Sandy Kraemer, Albert Utton, Mary White, and others have all agreed on this broad point. A possible exception is Daniel P. Moskowitz. He writes, "If a duty not to obstruct the access to light exists, a [parabolic] reflector . . . could conceivably be annexed to the otherwise obstructing building and thereby perpetuate the access to light." The conflict between a solar building owner and a neighbor who wishes to build may, therefore, "be more apparent than real." "Legal Access to Light: The Solar Energy Imperative," Natural Resources Lawyer 9 (1976): 177, 192. Alan Miller, Steven Rivkin, Ralph Becker, and Robert Shaw are among those who feel more information is needed before we jump into solar solutions with both feet.
3. Steven Rivkin, Sun Rights and Land Use (Washington, D.C.: AIA Research Corporation, forthcoming), § 6.1.
4. James D. Phillips, Assessment of a Single Family Residence Solar Heating System in a Suburban Development Setting, Solar Heated Residence Annual Research Report, prepared with the support of the National Science Foundation (NSF-RA-N75078, July 1975), p. 92, n. 77.
5. Scrutiny of aerial photographs of Long Island, New York, revealed that over half of all existing buildings were suitable for solar water heating and that all new buildings could be equipped with solar water heaters. Fred S. Dubin, Analysis of Energy Usage on Long Island from 1975 to 1995: The Opportunities to Reduce Peak Electrical Demands and Energy Consumption by Energy Conservation, Solar Energy, Wind Energy and Total Energy Systems, sponsored by the Suffolk County Department of Environmental Control (Suffolk County, N.Y., 1975).
6. David Barrett, Peter Epstein, and Charles M. Haar, Financing the Solar Home: Understanding and Improving Mortgage Market Receptivity to Energy Conservation and Housing Innovation (Cambridge, Mass.: Regional and Urban Planning Implementation, Inc., 1976), p. 84.
7. Solar Utilization News, Nov. 1976, p. 5.
8. Terrence M. Green, "Factory to be Heated by Solar Energy," Los Angeles Times, 31 Oct. 1976, pt. 9.
9. Solar Utilization News, Nov. 1976, p. 5.
10. Ibid., Oct. 1976, p. 7.
11. New York Times, 13 Sept. 1974, sec. 8, p. 1, col. 8.
12. Ibid.
13. Professional Builder, June 1976, p. 105.
14. Solar Energy Intelligence Report, 25 Oct. 1976, p. 170.
15. New England Solar Energy Newsletter, Oct. 1976, p. 2.
16. In the June 1976 issue of Professional Builder, at pages 105-06, Ralph Johnson (vice president of NAHB Research Foundation), Fred Dubin, and D. Elliot Wilbur, Jr. all agree that energy-saving designs are as important as active solar equipment.
17. Green, "Factory to be Heated by Solar Energy."
18. Solar Utilization News, Nov. 1976, p. 3.
19. Energy Digest, Nov. 1976, p. 12.
20. Such as the $4,000 A-frame solar furnace offered by Waverly Homes in Denver.

21. Solar Utilization News, Oct. 1976, p. 7.
22. Solar Energy Digest, Oct. 1976.
23. "Solar," Sunset, Nov. 1976, pp. 78, 86.
24. See Melvin M. Eisenstadt and Albert E. Utton, "Solar Rights and Their Effect on Solar Heating and Cooling," Natural Resources Journal 16 (1976): 363; and Moskowitz, "Legal Access to Light."
25. Right to Light Act, 1959, 7 & 8 Eliz. 2, c. 56, §§2, 3.
26. 114 So.2d 357, 181 Fla. Supp. 74 (1959).
27. Eisenstadt and Utton, "Solar Rights," p. 368. Professors Eisenstadt and Utton note, however, that the doctrine was generally upheld in the U.S. in the first half of the nineteenth century. Ibid., p. 367.
28. Ibid. There was a strong feeling that it was important to allow landowners to improve their estates, with as few restrictions as possible.
29. Lawrence Kressel, "Hanson v. Salishan Properties, Inc.: Preservation of View-Limitations as to Height of Improvements and Architectural Control in Uniform Long Term Lease," Environmental Law 5 (1974): 183.
30. 254 Or. 584, 462 P.2d 671 (1969).
31. 267 Or. 452, 517 P.2d 1042 (1973).
32. 517 P.2d at 1054.
33. Kressel, "Preservation of View," p. 191, n. 39.
34. 287 N.E.2d 677, 52 Ill. 2d 301, cert. denied, 409 U.S. 1001 (1972).
35. Efforts to enjoin high voltage electrical transmission lines because they interfere with radio broadcasts have failed. This situation is less analogous to solar access that Sears because it is not just a matter of a shadow being cast, but of active interference. An example of a radio case is Cook v. Penn Power & Light Co., 32 Daugh. 341, 14 Pa.D. & C. 599 (1931).
36. Louis H. Mayo, Legal-Institutional Implications of Wind Energy Conversion Systems (Washington, D.C.: George Washington University, Program of Policy Studies in Science and Technology, NSF Grant APR 75-19137, May 1976 preliminary draft). (Readers wishing to obtain the forthcoming final report should contact the Program of Policy Studies in Science and Technology, (202) 676-7382.)
37. Prosser, Law of Torts, § 86, p. 571.
38. See Rogers v. Ray, 10 Ariz. App. 119 (1969), which says that for a public nuisance to exist, a criminal ordinance or statute must be violated.
39. Prosser, Law of Torts, § 87, p. 573.
40. Ralph E. Becker, Jr., "The Common Law—An Obstacle to Solar Heating and Cooling?" Journal of Contemporary Law (in press, to appear in Winter 1976-77 issue; page references below refer to May 1976 draft).
41. Karin H. Hillhouse, Solar Energy and Land Use in Colorado: Legal, Institutional, and Policy Perspectives, Interim Report of the Solar Energy Project to the National Science Foundation (Washington, D.C.: Environmental Law Institute, April 1976), p. 33. See also Phillips, Assessment of Single Family Residence Solar Heating System, pp. 127-29.
42. Donald N. Zillman and Raymond Deeny, "Legal Aspects of Solar Energy Development," Arizona State Law Journal 1976: 25.
43. Becker, "The Common Law," p. 11.
44. Ibid.
45. Ibid., p. 12.
46. 84 Or. 336 (1948).
47. See David Bersohn, "Securing Insolation Rights: Ancient Lights, Nuisance, or Zoning?" Columbia Journal of Environmental Law (in press; page references

below refer to Dec. 1976 draft) for a fuller discussion of the hypersensitivity defense to a nuisance action.

48. Becker, "The Common Law," p. 16.
49. 66 C.J.S. Nuisances §§ 7.b.-c. (1950).
50. See Bersohn, "Securing Insolation Rights," p. 25.
51. Zillman and Deeny, "Legal Aspects of Solar Energy Development," p. 54.
52. Prosser, Law of Torts, § 86, p. 573.
53. Ibid., § 88, p. 586.
54. Ibid., § 91, p. 611.
55. Ibid., § 87, p. 577.
56. Parker & Edgarton v. Foote, 19 Wend. 309, 318 (Sup. Ct. 1838); Fountainebleau Hotel Corp. v. Forty-five Twenty-five, Inc., 114 So.2d 357, 181 Fla. Supp. 74 (1959).
57. Moskowitz, "Legal Access to Light," p. 194.
58. Ibid., p. 193.
59. Restatement of Property § 458l (1944).
60. See Cohen v. Perrino, 355 Pa. 455, 50 A.2d 348 (1947); and cases cited in Annot., 133 A.L.R. 692 (1941).
61. Washington Lodge v. Frelinghuysers, 138 Mich. 350, 101 N.W. 509 (1904).
62. Moskowitz, "Legal Access to Light," p. 203.
63. Moskowitz says, "See the result reached in Boomer v. Atlantic Cement Co., 26 N.Y.2d, 219 (1970)." Ibid.
64. Rose v. State, 19 Cal. 2d 713, 123 P.2d 505 (1942).
65. Proceedings of the American Bar Foundation Workshop on Solar Energy and the Law, Interim Report to the National Science Foundation (Chicago: American Bar Foundation, 1975), p. 20.
66. For an excellent discussion of this very complicated body of law, see Philip Soper, "The Constitutional Framework of Environmental Law," in Federal Environmental Law, eds. Erica L. Dolgin and Thomas G. P. Guilbert (St. Paul: West Publishing Co., 1974).
67. See Sandy F. Kraemer and James G. Felt, "Solar Rights: New Law for a New Technology" (unpublished paper on file with the authors, 1976 draft), p. 7.
68. Hillhouse, Solar Energy and Land Use in Colorado, p. 33.
69. Becker, "The Common Law," p. 14.
70. For instance, the easement is extinguished if the two lots become owned by the same person; if both parties sign a written release; if the owner of the privilege does a physical act that shows she intends to never make use of the easement; if the owner of the land subject to the restriction uses his land for a long time in a manner inconsistent with the easement; or if the owner of the restricted land changes his position in reasonable reliance on the statements or acts of the easement holder.
71. See discussion of water law as an analogy for sunrights law, below.
72. Their enforcement is somewhat different. Equitable servitudes are enforced by courts of equity, and restrictive covenants by courts of law. Money damages would only be available for restrictive covenants. The remedy for breaches of equitable servitudes may be "specific performance," i.e., a court order telling the violator to physically do or refrain from doing something. The same court may sit as a court of law on some days and a court of equity on others. No jury is sworn in an equity court, and some evidence not allowed in law courts is considered.
73. Richard L. Robbins, "Building Codes, Land Use Controls and Other Regulations to Encourage Solar Energy Use" (Paper presented at the Consumer

Conference on Solar Energy Development, Albuquerque, N.M., Oct. 2-5, 1976), p. 9. See Ayres v. City Council of Los Angeles, 34 Cal.2d 31, 207 P.2d 1 (1949).

74. See, e.g., Wing v. Forest Lawn Cemetery Ass'n, 15 Cal.2d 472, 480, 101 P.2d 1099, 1103 (1940); Rogers v. Reimann, 277 Or. 62, 69, 361 P.2d 101, 105 (1961).

75. Kressel, "Preservation of View," p. 188.

76. Norman Williams, Jr., American Land Planning Law, 5 vols. (Chicago: Callaghan & Co., 1974-75), 5: § 154.02.

77. Ibid., § 154.10.

78. See generally Note, "Legal and Policy Conflicts Between Deed Covenants and Subsequently Enacted Zoning Ordinances," Vanderbilt Law Review 24 (1971): 1031.

79. Schulman v. Sherrill, 432 Pa. 206, 246 A.2d 643 (1968).

80. Hysinger v. Mullinax, 204 Tenn. 181, 319 S.W.2d 79 (1958).

81. Dolan v. Brown, 338 Ill. 412, 419, 170 N.E. 425, 428 (1930).

82. See "Legal and Policy Conflicts Between Deed Covenants and Subsequently Enacted Zoning Ordinances," pp. 1040-46.

83. See generally Note, "Beyond the Eye of the Beholder: Aesthetics and Objectivity," Michigan Law Review 71 (1973): 1438; Basile J. Uddo, "Land Use Controls: Aesthetics, Past and Future," Loyola Law Review 21 (1975): 851; Comment, "Planning and Aesthetic Zoning—Getting More Out of What We've Got," Journal of Urban Law 52 (1975): 835; Williams, American Land Planning Law, 1: § 11, 3: § 71; Comment, "Architecture, Aesthetic Zoning, and the First Amendment," Stanford Law Review 28 (1975): 179; and Comment, "Aesthetics Off the Pedestal: Massachusetts Supreme Judicial Court Upholds Aesthetics as Basis for Exercise of the Police Power," Environmental Law Reporter 6 (1976): 10036.

84. City of Youngstown v. Kahn Bros. Bldg. Co., 112 Ohio St. 654, 661-62, 148 N.E. 842, 844 (1925).

85. See cases cited in Williams, American Land Planning Law, 1: § 11.14, and ordinances summarized ibid., 3: § 71.14.

86. Ibid., 1: § 11.15.

87. Ibid., § 11.19-11.21.

88. 339 N.E.2d 709, Environmental Law Reporter 6 (1976): 20123 (1975).

89. 339 N.E.2d at 717, Environmental Law Reporter 6 (1976): 20123, 20125 (1975).

90. See, e.g., Washington Post, 25 June 1976, p. C1, and ibid., 1 Sept. 1976, p. A14.

91. One of the grass-cutting cases was decided in Wisconsin, one of the states that fully supports aesthetic regulation.

92. George Lof, quoted in "Professional Builder's Report on Solar Energy," Professional Builder, June 1976, pp. 101, 106.

93. William Thomas, Alan Miller, and Richard Robbins, "Legal Issues Related to Use of Solar Energy Systems" (Aug. 1976 draft of forthcoming article in American Bar Foundation Research Journal).

94. Ibid.

95. Mary D. White, "The Allocation of Sunlight: Solar Rights and the Prior Appropriation Doctrine," University of Colorado Law Review 47 (1976): 423.

96. Thomas, Miller, and Robbins, "Legal Issues Related to Use of Solar Energy Systems."

97. Ibid.

98. See generally Russell E. Train, "The EPA Programs and Land Use Planning," Columbia Journal of Environmental Law 2 (1976): 255.

99. In other words, the federal government would preempt the states in this matter.
100. Thomas, Miller, and Robbins, "Legal Issues Related to Use of Solar Energy Systems."
101. Ibid.
102. Ibid.
103. Ibid.
104. Ibid.
105. Ibid.
106. Ibid.
107. Ibid. In an unclear situation, courts usually presume that an easement is appurtenant. This writer thinks solar easements would be found appurtenant as they benefit the use of the land.
108. Hillhouse, Solar Energy and Land Use in Colorado, p. 33.
109. Thomas, Miller, and Robbins, "Legal Issues Related to Use of Solar Energy Systems."
110. Minn. H.F. 2064 (1976).
111. Colo. S.B. 38 (1976).
112. White, "Allocation of Sunlight."
113. Ibid., p. 446.
114. Ibid., p. 437.
115. Ibid., p. 441.
116. Ibid.
117. Ibid., p. 443.
118. If solar equipment were found to be a "beneficial use" it could, under water law, be given an absolute preference over the construction of a conventional structure. A person wanting to build conventionally may be obliged, under water law, to buy the other's resource rights. The result is just the opposite of that when express easements are used because the shadow-caster pays, rather than the owner of the benefited (solar-heated) property.
119. Dan A. Tarlock, "Recent Developments in the Recognition of Instream Western Water Law," Utah Law Review, 1975, no. 4, pp. 871, 877.
120. Ibid.
121. Ibid., p. 883.
122. Ibid.
123. White, "Allocation of Sunlight," p. 440.
124. Peter Wolf, The Future of the City: New Directions in Urban Planning (New York: Watson-Guptill Publications, Whitney Library of Design, 1974), p. 149.
125. Williams, American Land Planning Law, 4: chap. 94.
126. Ibid., § 94.05.
127. Ibid., § 94.04.
128. Ibid., § 94.03.
129. Ibid., § 94.07.
130. Green, "Factory to be Heated by Solar Energy."
131. Robbins, "Building Codes, Land Use Controls and Other Regulations to Encourage Solar Energy Use," p. 17.
132. Hillhouse, Solar Energy and Land Use in Colorado, p. 34.
133. Thomas, Miller, and Robbins, "Legal Issues Related to Use of Solar Energy Systems."
134. Robbins, "Building Codes, Land Use Controls and Other Regulations to Encourage Solar Energy Use," p. 5.

135. 1975 Or. Laws ch. 153.
136. Robbins, "Building Codes, Land Use Controls and Other Regulations to Encourage Solar Energy Use," p. 5; see Goreib v. Fox, 274 U.S. 603 (1927); Stevens v. City of Salisbury, 240 Md. 556, 214 A.2d 775 (1965).
137. Thomas, Miller, and Robbins, "Legal Issues Related to Use of Solar Energy Systems."
138. Ibid.
139. Ibid.
140. Ibid.
141. Eisenstadt and Utton, "Solar Rights," p. 413.
142. Ibid., p. 386.
143. Kraemer and Felt, "Solar Rights: A New Law for a New Technology," p. 9.
144. Ibid., p. 21.
145. Ibid., p. 25.
146. Letter from Sandy Kraemer to Governor Richard Lamm of Colorado (20 Jan. 1975).
147. Robert C. Ellickson, "Alternatives to Zoning: Covenants, Nuisance Rules, and Fines as Land Use Controls," University of Chicago Law Review 40 (1973): 681, 702. "Many courts have stopped trying to police local zoning and consistently sustain the local government's action under the 'presumption of validity' given to zoning provisions."
148. This potential has been recognized in a Request for Proposal issued by the Department of Housing and Urban Development, "Assessment of Planning for Solar Access in Future Residential Development" (RFP H-2573, 2 Dec. 1976).
149. See National Conference of State Legislatures Renewable Energy Project, Turning Toward the Sun, 2 vols (Denver, RANN Document No. NSF-RA-G-75-052, n.d.), 1:27-29.
150. Or. H.J.R. 3 (1975).
151. S. 3105, 94th Cong., 2d Sess. (1976) (Energy Extension Service Bill). See also Alan Hirshberg, "Public Policy for Solar Heating and Cooling," Bulletin of the Atomic Scientist, Oct. 1976, pp. 37, 42.
152. Energy Conservation and the Law: Proceedings of the American Bar Association Annual National Conference on the Environment, Warrenton, Va., April 30-May 1, 1976, pp. 76-77.
153. Ordinance No. 784, adopted by the City Council of Davis, Cal. (15 Oct. 1975).
154. See generally Donald Hagman, Urban Planning and Land Development Control Law (St. Paul: West Publishing Co., 1971).
155. See Corbin Harwood, Using Land to Save Energy (Cambridge, Mass.: Ballinger Publishing Co., forthcoming).
156. Oregon Land Conservation and Development Commission, "Statewide Planning Goals and Guidelines" (1 Jan. 1975), Goal 13.
157. American Law Institute, A Model Land Development Code (Philadelphia, 1975), §§ 2-209(2), 2-211, 2-212, 3-101, 3-201, 4-102(1).
158. Thomas, Miller, and Robbins, "Legal Issues Related to Use of Solar Energy Systems."
159. Ariz. S.B. 1066 (1976).
160. See generally Kenneth Pearlman, "State Environmental Policy Acts: Local Decision Making and Land Use Planning," Journal of the American Institute of Planners 43 (1977): 42.

161. Harwood, Using Land to Save Energy.
162. Colo. H.B. 1166 (1976).
163. Tenn. S.B. 419 (1975).
164. Fla. Stat. Ann. § 553.87 (West Supp. 1975).
165. Colo. H.B. 1166 (1976).
166. See generally Michael Meshenberg, The Administration of Flexible Zoning Techniques, American Society of Planning Officials Advisory Service No. 318 (Chicago, 1976).
167. Ibid., p. 43.
168. See Williams, American Land Planning Law, 2: § 48.01.
169. Berman v. Parker, 348 U.S. 26 (1954).

2

BUILDING CODES

Summary

Although building codes have not yet been serious barriers to solar heating and cooling, the typical building code provisions for testing and approval of new materials and systems are serious potential barriers. Other miscellaneous code provisions pose less significant problems.

This finding comes from our reading of the three most widely adopted model building codes and their companion model mechanical codes. These model codes themselves have potential for fragmenting markets and introducing uncertainty, delay, and expense in processing permit applications. Locally adopted codes based on model codes, as well as locally written codes, are even more likely to have such potential. Because of this, and because our recommendations do not depend on the vagaries of local codes, we have not examined local codes.

Our proposed solution calls for programs to encourage the passage of state (or local) legislation that would result in adoption of the evolving standards for solar systems, and listings by the federal government initially and by the private sector eventually, to help put solar systems on the same footing as competing systems.

Introduction

A building code is a set of regulations relating to building construction that defines terms, sets standards for materials and equipment, tells how materials and equipment may and may not be put together, and provides for enforcement through permits, inspections, etc. The definition provisions can be critically important.

For example, "height" may not include heating, ventilating, and air conditioning equipment on the roof, and "heating appliance" may not include equipment that does not burn fuel or use electricity to produce heat. Definitions may also determine who may install something; for example, certified plumbers may be required to do all "plumbing" work.

The standards provisions are generally of two types. Specification standards specify what kinds of materials and equipment may be used, and how. For example, glass for a particular purpose must be tempered and 1/8 inch thick, all gas water heaters must be AGA-approved, or so many nails of a certain kind and size must be used in wood frame construction. Performance standards, on the other hand, merely spell out what the particular part of a structure must be able to do. For example, certain walls must have a fire resistance rating of one hour. Specification standards are easier to administer, but are inflexible. Performance standards are flexible and allow for innovation, but also require more trained personnel, time, and money to administer.

The enforcement (administrative) provisions of a code are also very important. Before any construction (including not only new construction, but alterations and all but minor repairs to existing buildings), a building permit must generally be obtained. Before granting the permit, a building official will decide whether the details in the plan submitted conform to code requirements. If the plan only calls for materials, equipment, and methods that are specifically provided for in code specifications standards, approval is routine. If the plan calls for innovative materials or systems, however, the building official has the discretion to approve or disapprove the plans, or require testing and submission of evidence that the construction proposed is in no way inferior to the traditional construction provided for in the code. This takes more time and costs more than the routine procedure, and approval is not assured. The building official may permit alternative materials, equipment, or methods that are as good as those specified in the code, but he is not bound to do so.

Our review of the literature revealed the frequent assumption that because there is no specific provision for solar heating and cooling systems in building codes, there is no barrier in the codes.[1] Steven Rivkin has said that "rather than serving as a retardant, existing building codes have no bearing at all on the development of solar systems."[2] Rivkin's statement seems contrary to his

description in The Building Code Burden[3] of the difficulties in adopting innovations. For example, plastic pipe for waste drains and plumbing vents is a much less radical innovation than a solar system. It can easily be shown to be the equal of the cast-iron pipe it is offered to replace for these purposes. Plastic pipe has been adopted by builders wherever permitted because it is cheaper to buy and install; but plumbers and cast-iron pipe producers have resisted its use for this very reason. The pressure of labor organizations and cast-iron pipe producers has made the widespread adoption of this innovation slow and difficult.[4]

We suggest that building codes may not yet be seen as a barrier to solar equipment because solar systems in general have not been economically competitive with the usual fuel-burning and electric equipment, and have not substantially threatened labor. (See the discussion of labor jurisdiction problems in the chapter on labor.) If the channels for manufacturing, marketing, and installation of solar equipment turn out to be the same as for currently used heating and cooling systems, less resistance may be encountered than with other innovations. We have no reason to assume, though, that solar systems will be so fortunate.

In the sections that follow we show how three model codes may be significant barriers to widespread use of solar heating and cooling. These codes are: (1) the Basic Building Code of the Building Officials and Code Administrators, International (BOCA), found mostly in the East and Midwest; (2) the Uniform Building Code of the International Conference of Building Officials (ICBO), found mostly in the West; and (3) the Standard Building Code of the Southern Building Codes Conference (SBCC), found mostly in the South.[5] According to a 1970 survey by Field and Ventre of local building departments, 63 percent of the 919 cities reporting had adopted one of these three model codes if they had a building code at all.[6] Since then, a few states have adopted versions of one of these three codes as state-wide mandatory building codes (Idaho, Indiana, Massachusetts, Minnesota, Montana, New Jersey, New Mexico, Oregon, and Washington).[7] Hence it is reasonable to study these codes as representative of building codes generally. Locally written codes would probably be less flexible and present equal or greater barriers to solar systems. The codes will be discussed in the order given above.

BOCA Basic Building Code

The BOCA Basic Building Code has been adopted, often with some local revision, in many cities and counties of the densely populated northeastern and north central states, and in several states as mandatory statewide codes (Connecticut, Michigan, Virginia, and New Jersey). The Maryland state government recommends that local governments within the state adopt this code by reference. Massachusetts has adopted a state-written code patterned on the BOCA code.[8] In Field and Ventre's 1970 survey, 60 percent of northeastern and north central cities reporting said they used this code.[9]

For our analysis, we used the BOCA Basic Building Code, 6th edition, 1975, and accompanying mechanical code and plumbing code. Although many jurisdictions will have adopted earlier editions, it seems unlikely that enough changes affecting solar energy systems have occurred to justify a search through earlier editions. Three broad types of code provision are discussed: administrative provisions (found in article 1); mechanical equipment provisions (found in articles 11 and 18, and by reference in the BOCA Basic Mechanical Code); and structural, materials, and design requirements (found throughout the rest of the code).

Administrative provisions. The BOCA Basic Building Code applies to all building construction, alterations, additions, etc., except as is otherwise specifically provided (§§ 100.2 and 101.1). The purpose of the code is to insure public safety, health, and welfare, insofar as they are affected by building construction: structural strength, adequate exits, sanitary equipment, light and ventilation, fire safety, and the like are covered by the code (§ 100.4).

Building officials not only may require what is specifically called for in the code, but also determine, on a case-by-case basis, any additional requirements essential for structural, fire, or sanitary safety not covered by the code (§ 101.3). Building officials may also adopt regulations to interpret and implement code provisions and designate requirements applicable because of local climatic or other conditions (§ 109.1).[10] Building officials must promulgate regulations for the use of "new materials" consistent with the code and with accepted engineering practice (§ 108.6).[11] Accepted engineering practice is defined as what conforms to accepted principles, tests, or standards of nationally recognized technical or scientific authorities (§ 201.0). When specific code provisions or approved rules do not cover

a matter, accepted engineering practice is a set of regulations, specifications, and standards listed in code appendices (appendices B and C). These are specific standards of the American National Standards Institute (ANSI), the American Society of Mechanical Engineers (ASME), the National Fire Prevention Association (NFiPA), the American Society for Testing Materials (ASTM), etc., as well as BOCA's Basic Mechanical Code and Basic Plumbing Code (see § 109.2).

Because, as will be shown, there is no set of specific requirements for solar heating and cooling systems in the building code, mechanical code, or plumbing code; nor nationally recognized standards adopted by reference; solar systems are subject to the full range of local building officials' discretionary powers. The power to determine special requirements for structural, fire, or sanitary safety may be of limited applicability to solar systems.[12]

The powers to make rules to secure the broad purpose of the code, and to designate requirements because of local climate or other conditions, should enable building officials to enact any rules they desire for solar systems (subject, of course, to judicial review). The rules promulgated by a building official could promote adoption of solar systems, or make them too uneconomic to consider. They could vary with time and place, introducing uncertainty, fragmenting the market, and seriously impeding the widespread adoption of solar systems.

The power to determine rules for the use of new materials appears more limited, and may encourage standards for solar systems comparable to those for other heating and cooling systems. It could be used to require, for example, that all equipment meet nationally recognized standards and bear seals of an accredited authoritative agency, once such standards and agency have been established. Until then, equipment could be required to meet tests analogous to those for conventional systems. (This is discussed further in the section on mechanical provisions.) Absent national standards, however, the required tests are likely to vary greatly with time and place. Even if nationally recognized standards are not specifically adopted by reference, the mere existence of national standards would probably not only be persuasive to local building officials or boards of appeal, but also to the judges who would review decisions to deny permits.

Under the BOCA code, building officials have still another discretionary power. When there are practical difficulties in carrying out structural or mechanical provisions of the code or approved regulations, building officials may

vary or modify the provisions for the particular case if the spirit of the law is observed and safety is assured (§ 110.0). If an application is refused, the applicant for a building permit for a solar system could appeal to a board of appeals, arguing that the proposed solar system is as good or better than the conventional system it would replace or supplement (§ 127.1). The applicant could also argue that the provisions of the code for heating and cooling systems do not fully apply, an argument developed below. If this appeal fails, there is provision for court review (§ 127.6). Nevertheless, a modification and appeals procedure is not a satisfactory alternative to clear advance notice of requirements for solar systems. At least, this procedure cannot impose requirements more stringent than those already in the code and approved rules.

Unfortunately, the effect of the broad discretion given building officials, together with a lack of clear provision for solar systems, produces considerable room for uncertainty and fragmentation of markets even under these model provisions. Variations from the model provisions adopted by local legislatures can aggravate this.

Mechanical provisions. These provisions of the BOCA code are not specifically applicable to solar heating and cooling systems (at least to the specifically solar parts of these systems; blowers and the like are covered). Even when mechanical equipment (heating, air-conditioning, or ventilating equipment) is explicitly covered by the code, or under the approved regulations, the equipment may not be installed without a certificate of approval (§ 103.1). This clearly implies that building officials may issue regulations to cover equipment overlooked by the code. Any equipment for which provision is made, or the installation of which is regulated, may not be installed or altered without a permit (§ 113.1).

Article 11 controls the construction, inspection, and maintenance of all heating, blower, and exhaust systems with respect to structural strength, fire safety, and operation (§ 1100.1). Such systems and equipment constructed, installed, and maintained in accord with the BOCA Basic Mechanical Code are acceptable (the mechanical code is the accepted engineering practice; § 1100.2). Plans and specifications for the installation of a heating appliance, or of a heating, blower, or exhaust system, must be submitted to the building official and a permit secured before work is begun (§ 1101.1). A heating appliance is "any device designed or constructed for the generation of heat from solid, liquid or gaseous fuel or

electricity" (§ 201.0). Heating system is not defined, but the mechanical code does define central warm air heating system as "a heating system consisting of an air heating appliance . . ." and defines a forced air heating system and gravity heating system in terms of a central warm air heating system (§ M-201.0). (Mechanical code sections begin with M- and plumbing code sections begin with P-; the building code sections have no letter prefix.) Boiler is defined in both the building code and the mechanical code as "a closed heating appliance intended to supply hot water or steam for space heating . . ." (§§ 201.0 and M-201.0). Clearly, this building code contemplates a fuel-fired or electric system, not a solar system. Article 11 has requirements for inspections, tests, boiler rooms, gas- and oil-burning equipment, etc., but ultimately they all relate to heating appliances.

In the absence of provision in the building code itself, we may seek provisions in the mechanical code for solar heating systems. The design and installation of all mechanical systems must comply with the mechanical code. Mechanical systems include heating systems, ventilating systems, cooling systems, steam and hot water heating systems, etc. (§ M-100.1). Plumbing systems, sometimes referred to as mechanical systems, are not covered by this code (§ M-100.2).[13]

The purpose of the mechanical code is to establish minimum performance standards, implemented by specific requirements, to protect the public from inadequate, defective, or unsafe installations (§ M-101.1). In line with this purpose, building officials may approve alternative systems to those specifically prescribed, if they find proposed designs are satisfactory and comply with the code's intent, and that the materials, methods, and work offered are at least the equivalent of that prescribed in quality, strength, effectiveness, fire resistance, durability, and safety (§ M-120.1). Note that these requirements go beyond mere considerations of safety to consumer protection. Carrying the burden of showing durability, quality, and effectiveness equivalent to, say, a gas heater or electric air-conditioner could be difficult or even impossible because of the lack of data on solar systems. Building officials might reasonably deny building permits solely because the short-term warranties on systems indicate that manufacturers themselves lack confidence in the systems' durability. In light of the high first cost and lengthy payback period for solar systems, building officials could even require, and courts could well uphold, longer lifetimes and warranties than for conventional systems.[14]

Building officials must require that sufficient evidence be submitted to substantiate any claims made regarding alternative system's use; they may accept authenticated reports from BOCA or other recognized authoritative sources on proposed new materials and systems (§ M-120.1). Recognized authoritative source is not defined, but the intent is probably much the same as in references to nationally recognized testing or inspection agency. This latter term means an agency acceptable to the authorities having jurisdiction, that provides uniform testing and examination procedures under established standards, is properly organized, equipped, and qualified for testing, and has a follow-up inspection service (§ M-201.0). Examples are Underwriters' Laboratories, Inc. (ULI) and the American Gas Association (AGA). The lack of nationally recognized standards and a nationally recognized testing or inspection agency is a clear disadvantage for solar heating and cooling sysems under this code.

Under the mechanical code, all warm air heating, ventilating, and air-conditioning equipment and appurtenances must be of an approved type (§ M-300.3). All blowers and fans must bear the label of a nationally recognized testing or inspection agency (§ M-318.1). Article 3 of the mechanical code has various requirements for furnace locations (a furnace is "a completely self-contained fuel-fired heating unit. . . ." § M-201.0), appliances on roofs, etc. As with article 11 of the building code, these contemplate conventional, nonsolar equipment. Article 4 of the mechanical code has various requirements for boilers and steam and hot water heating systems, also contemplating nonsolar equipment. Presumably, building officials would apply requirements for piping (such as use of approved materials at the temperatures and pressure intended, conforming to standards listed in appendix C). This should create no problems for solar systems, since they operate at lower temperature and pressures than conventional systems.

Cooling equipment is subject to article 18 of the building code and article 8 of the mechanical code. The mechanical code's provisions do not apply to the use of water or air as a refrigerant (§ M-800.1). This means that low-technology systems using nocturnal heat radiation, cool night air, evaporative systems, etc. are not covered. The testing and approval procedures for alternative systems would therefore apply. For high-technology systems using solar collector heat with an absorption refrigeration system, the provisions would apply to the refrigeration part of the system. Since such equipment is the same as for conventional systems,

solar cooling systems should be under no disadvantage. The strictly solar part of a high-technology system would have to meet the testing and approval procedures for alternative systems.

We find then that the mechanical provisions of the BOCA Basic Building Code and Basic Mechanical Code do not specifically apply to solar systems (or at least to their uniquely solar parts like collectors and storage units). Solar systems are therefore at a potential disadvantage to conventional systems, which have nationally recognized standards and certification agencies.

Miscellaneous provisions. This is the area in the model code most likely to be amended by adopting jurisdictions to meet local conditions. While reading the following, it should be kept in mind that local requirements could vary considerably.

Height regulations are sometimes mentioned as a potential problem for rooftop collectors. This code does regulate building heights (§ 305), but height is measured from the grade to the top of the highest roof beams of a flat roof, or to the mean level of the highest gable or slope of a hip roof (§ 201.0). Evidently, this code does not pose a height-regulation problem for rooftop collectors. Zoning laws, however, also limit height of structures and may apply to what is mounted on the roof.

Roof slope is not regulated, but the overhang of roof eaves is limited to three feet (§ 311.2). There are similar limitations on awnings (§ 313.2). This may be a problem for some passive designs in which large southern windows are to collect heat in winter but be shaded in summer. However, a building official would probably approve a modification (under § 110.1).

An unrealistically high demand may be put on solar systems by lighting, ventilating, heating, and cooling requirements (72 degrees in winter and 78 degrees in summer, assuming outside temperatures given in the ASHRAE Handbook of Fundamentals, adopted as a standard by reference in section M-108.1). The smaller the system loads are, the more competitive solar systems can be, since solar systems require high first costs relative to conventional systems. The code provides standards of natural light (§ 502.1) and natural ventilation (§ 503.1) that may be satisfied by openable windows of specified size relative to room area (§ 506.2) or by alternative devices (§ 506.4) or by artificial light and ventilation (§§ 504.0 and 514.0). The result of these provisions is to increase heat losses or

gains through window glass, increase infiltration losses through cracks, or require mechanical systems to bring in outside air. These all increase the loads on heating and cooling systems and hence boost the first costs of a solar system. The importance of this is recognized in the current efforts to develop more energy conserving building standards, such as ASHRAE Standard 90-75, which would greatly reduce average required heating and cooling loads.[15]

Solar collectors pose several possible problems, depending on how they are to be used: on a roof; as roofing or the roof; as a wall or a wall veneer; as a separate structure on the ground; or as an awning, either supported from the ground or not. Safe support is of course required (§ 701.1). Whenever there is reason to question safety for the intended occupancy or use of any structure, the building official may require a load test or accept certified reports of such tests from accredited testing authorities (§ 701.3). As there is no nationally recognized standard or accredited testing authority for solar systems, the building official could impose costly and time-consuming tests. The applicant would have to pay for these tests.

Solar collectors and storage units that are preassembled or shipped in knock-down form for assembly at the site would be treated as prefabricated subassemblies under this code (§ 1900.1). Prefabricated subassemblies are subject to the same kinds of rules for approved materials and methods (§ 1900.2), and for new materials tests and evaluation (§ 1900.3), but the rules go even further. When reliable experience records are lacking, building officials may require accelerated tests of prefabricated subassemblies to determine durability, weather tightness, and weather resistance, or accept certified reports of approved and recognized testing authorities (§ 1907.3). When not available from existing authoritative test data, building officials may also require comparative tests of traditional standard construction (§ 1907.4). This could mean, for example, side-by-side testing of a traditional roof versus a solar-collector roof, a most costly testing procedure.

ICBO Uniform Building Code

The ICBO Uniform Building Code has been widely adopted, with local or state amendments, in cities and counties of the West and Midwest, and as a mandatory statewide code in several states (Alaska, Idaho, Indiana, Minnesota, Montana, New Mexico, Oregon, and Washington).[16] According to Field and Ventre's

survey, model codes are most evident in the West and South, and 92 percent of 244 western cities responding said they use ICBO's Uniform Building Code.[17]

For our analysis, we used the 1976 edition and accompanying mechanical and plumbing codes.[18] As with the BOCA code, many jurisdictions will have adopted earlier editions (the 1973 edition in particular), but the latest edition indicates changes since 1973, and they do not make any difference for our purposes.

Administrative provisions. The ICBO code's purpose (§ 102) and scope (§§ 103 and 104) are much the same as BOCA's. But unlike the BOCA code, the ICBO code does not grant building officials the power to impose special requirements on a case-by-case basis or to adopt regulations to supplement the code. In other words, building officials have less discretion to impose local and different requirements. The provisions for testing and approval of alternative materials and methods alone, however, raise nearly as high a potential barrier. Building officials may approve any alternative if they find that the proposed design is satisfactory and complies with general design and structural strength requirements (loads on roofs, floors, etc., chapter 23), and that the material, method, or work offered is at least the equivalent of that prescribed in quality, strength, effectiveness, fire resistance, durability, and safety (§ 106). As with the BOCA code, the concern reaches beyond safety to consumer protection. Building officials must require sufficient proof for any claims made regarding the alternative's use (§ 106) and when there is insufficient evidence to show code compliance or to substantiate claims for alternative materials or methods, building officials may require tests by an approved agency at the expense of the owner (§ 107). If no appropriate test methods are specified, building officials determine the test procedure.

The ICBO code also creates a five-member board of appeals to determine the suitability of alternative materials and methods (§ 204). Although this is not spelled out, an applicant for a permit that is denied, or other aggrieved party, may presumably appeal to this board.

Building officials do not appear to have the power to grant modifications, since permits presuming to give authority to violate or cancel provisions of the code are invalid except to the extent that the work or use authorized is lawful (§ 302(c)).

Despite differences from the BOCA code, the ICBO code's administrative provisions may also encourage market fragmentation, uncertainty, delay, and added expense where solar systems are not specifically covered in the mechanical provisions.

Mechanical provisions. Uniike the BOCA code, the ICBO code itself has no provisions for mechanical equipment, except for requiring that the habitable rooms in residences have heating capable of maintaining 70 degrees at three feet above the floor (§§ 1311 and 1410). In the chapters dealing with the various kinds of occupancies,[19] there are provisions for "special hazards" requiring chimneys and heating apparatus to conform to the Uniform Mechanical Code.

The Uniform Mechanical Code covers heating, ventilating, cooling, and refrigerating systems (§ M-103). (The ICBO codes themselves do not use the M- and P-prefixes like the BOCA codes, but this abbreviated citation has been adopted here.) As with the BOCA code, various national standards are adopted (§ M-103). There are provisions for alternative materials and methods (§ M-105) and a board of appeals (§ M-203) that are essentially the same as those in the Uniform Building Code (§§ 106 and 204). Heating, ventilating, and cooling appliances must be approved by building officials for safe use or comply with applicable nationally recognized standards as determined by an approved testing agency. Every installer must show that an appliance is constructed in conformity with the mechanical code's requirements. The label of an approved testing agency that is attached to the appliance is acceptable proof (§ M-502). Absent such a label, the procedures for testing and approval would apply. The provisions in this mechanical code are keyed to listing with an approved testing agency and installation must conform to the conditions of listing (§ M-504), and they assume the appliance either consumes fuel or electricity (see, e.g., section M-507 labeling requirements). Under this mechanical code, too, the lack of nationally recognized standards and an approved testing agency to certify compliance and provide listing and labels is a serious liability for solar heating and cooling systems.[20]

Miscellaneous provisions. There are quite a few variations here from the BOCA code. Similarly, we would expect more variation among adopting jurisdictions, due to amendments.

As with the BOCA code, "height" is defined in terms of the roof, which would ignore solar equipment on the roof (§ 409). But the ICBO code limits the aggregate area of all penthouses and other roof structures to one-third of the area of the supporting roof (§ 3601(b)). It is not clear whether solar collectors would be considered roof structures, but examples given (towers, spires, and radio masts, § 3602) suggest that they would. On the other hand, roof structures are supposed to

be constructed with walls, floors, and roof (§ 3601(d)), which would hardly apply to, say, a radio mast. We expect that this one-third limitation would not apply. If the limitation does apply, building officials have no power under this code to grant a modification.

A roof must be sloped enough to assure drainage of water, but there is no limitation on slope (§ 2305(f)). Roof overhangs are limited to a percentage of yard width (§§ 504 and 1306(d)) and awnings are similarly limited (§ 4506). This may hinder some passive designs. Awnings must be collapsible, which would probably rule out mounting collectors on them (§ 4506(b)).

There are lighting and ventilation requirements (§§ 605, 705, etc. through 1405) for each occupancy, and minimum heating requirements of 70 degrees three feet off the floor in habitable rooms of residential occupancies (§§ 1311 and 1405). These requirements are higher than necessary for health and comfort, and may make solar equipment somewhat less competitive.

The ICBO code sets minimum load strengths applicable to collectors used as roofs or walls, or mounted on roofs or walls (chapter 23). Unlike the BOCA code, there is no provision for special load tests, but the general testing and approval procedures would be applied to collectors on roofs or as wall veneers. Prefabricated construction rules apply only to structural units that have been built up or assembled prior to incorporation in the building, (§ 5001(c)). Under these rules, collectors to be used as roofs or walls could be tested for durability and weather resistance (§ 5003).

Such miscellaneous requirements as these do not appear to be particularly serious barriers, especially when compared to potential testing and approval problems generally.

SBCC Standard Building Code

The SBCC Standard Building Code has been widely adopted in southern cities and counties. It has not been adopted anywhere as a mandatory statewide code.[21] According to Field and Ventre's survey, 56 percent of southern cities responding said they used this code.[22]

For our analysis, we used the 1976 edition of the building code and accompanying mechanical and plumbing codes.

Administrative provisions. The SBCC code has administrative provisions very similar to those of the BOCA code. Its statement of purpose (§ 101.2) and scope (§§ 101.3 and 101.4) are much the same. As under the BOCA code, building officials may set requirements for strength, stability, safety, or health for situations not specifically covered (§ 103.5). Likewise, alternative materials and methods may be authorized by the building official. The alternative must be shown to be at least the equivalent of that prescribed in quality, strength, effectiveness, fire-resistance, durability, and safety (§ 103.6). Building officials may require tests at the expense of the applicant by an approved agency (§ 104). Building officials' actions are subject to review by a board of adjustments and appeals (§§ 111-113). Building officials do not, however, have the rulemaking power of officials under the BOCA code. The board of adjustments and appeals (instead of the building official, as under the BOCA code) may vary the application of any provision to any particular case when the enforcement of the provision would do a manifest injustice and be contrary to the spirit and purpose of the code or the public interest, or when the building official's interpretation should be modified or reversed (§ 113.1(a)). Thus, there is some possibility for relaxing the code's rules, but only after the delay involved in an appeal.

Mechanical provisions. As with the other codes, the SBCC code adopts its companion mechanical code for heating, ventilating, and cooling equipment (§ 801.1) and plumbing code for "plumbing" (§ 808). There is an additional Standard Gas Code for installation of consumer gas piping and gas appliances. As with the other codes, solar systems are not specifically mentioned or provided for, and there are the usual provisions for testing and approval of equipment not specifically approved by the code. The lack of generally recognized standards and testing procedures, along with a lack of listing, may cause the same fragmentation, uncertainty, delay, and expense that are described above.

Miscellaneous provisions. The SBCC code also includes various provisions that might be considered minor barriers. For example, as a variant from the other codes, the SBCC code states that when the aggregate area of all roof structures exceeds one-third of the roof area, the building's height is measured to the top of the highest roof structure (§ 402.2(a)). These miscellaneous provisions would have to be kept in mind while designing a building, but would probably have no great impact on use of solar equipment.

Summary and suggested solution

Testing and approval procedures. Solar heating and cooling are not specifically provided for in these model codes, nor, presumably, in the thousands of local codes based on, or similar to, them. Thus, solar systems are vulnerable to testing and approval requirements that could vary greatly with time and place. These local varying requirements, if applied strictly, could make solar systems less competitive than conventional systems due to the uncertainty, delay, and expense in processing permit applications. They could easily fragment a potential national market into hundreds or thousands of small markets, or result in unnecessarily expensive products designed to meet the strictest standards found anywhere.

The best long-term solution to this problem would be nationally recognized standards and testing procedures for solar heating and cooling systems and a nationally recognized accreditation agency to certify compliance with these standards and grant listings. These standards should be adopted by reference in all local and state building codes, and listings should be accepted as sufficient proof of code approval if the equipment is installed in compliance with the conditions given in the listing. This would merely put solar heating and cooling systems on the same footing as gas and electric systems.

While this is already a long-term goal of the solar heating and cooling demonstration program, nationally recognized standards and a nationally recognized testing and listing agency are years in the future. The question thus arises of what might be done in the meantime.

A feasible short-run policy is to adopt the evolving federal standards and test procedures for solar systems, components, and materials. Federal legislation could make the standards mandatory nationwide; or could make adoption of the federal standards by states voluntary, but with incentives to make state adoption likely. Alternatively, legislation could be left to the states (they could adopt the federal standards on their own, as a few already have).

The great advantage of the first of these options is that it would quickly result in uniform nationwide standards. Although definitive standards for solar systems have not been developed, the interim criteria for residential and commercial solar systems, the intermediate minimum property standards for solar heating and domestic hot water systems, and test procedures developed by the NBS

are clearly the best currently available set of standards for solar systems.[23] The federal enactment of such building standards, although it has not been done before, would certainly be sustained by the courts as within the broad powers of Congress to regulate commerce (see the chapter on mandatory installation). Opposition to such precedent-setting legislation (even in so limited a field as solar standards) might be overwhelming. Nonetheless, the feasibility and desirability of doing this as opposed to the alternatives is worthy of serious study.

The other option of leaving the states the power to decide whether to adopt the federal standards, either with or without incentives to do so, would probably have less opposition. This alternative would not, however, necessarily yield national uniformity. Considering the still developing nature of the current federal standards, the most reasonable approach appears to be to encourage state legislation to adopt the interim standards pending the development of the definitive standards, with incentives to make adoption as broad as possible. This could permit the states to adapt the standards to local conditions where justified, but with federal review to assure the reasonableness of the local variations.

A new Minnesota law requires a state agency to promulgate standards for solar systems based on the interim criteria, and to update them as later federal standards are developed, or as new technology becomes available.[24] This law effectively adopts the latest federal standards. To protect against attack on grounds of unconstitutional delegation of powers to the federal government (to legislate in an area of state responsibility), the Minnesota law has the state administrative agency adopt the new versions of federal standards as they develop. This mechanism also facilitates changes in response to new technologies that might be unreflected in the federal standards. "Reasonable conformance" language would allow for some leeway to adapt to local conditions. Model legislation could be written along such lines and also provide for the adoption of industry's consensus standards once they are developed. It would be best for the federal government to do this by bringing together the model building codes organizations to develop the proposed legislation. This is being done now with the adaptation of ASHRAE Standard 90-75 for a model code. This would greatly enhance potential for prompt and widespread adoption. The use of rewards and penalties in a grants-in-aid program is another possible way to encourage adoption of such proposed legislation.

A vital issue, whichever alternative is chosen, is who should be responsible for certifying system and component compliance with the standards. Early

experience with federal certification of systems for the HUD demonstration program proved unsatisfactory, and may lead to opposition to any federal certification program. Yet if systems are to be subject to a single set of standards, the government developing them is the most qualified to apply them for certification. The certification program could be made self-supporting. Testing for certification should be available to all, and certification should be frequently reviewed (especially when standards are changed). The federal government, however, has not generally wished to pass on the relative merits of one commercial product versus another, which certification inevitably involves. A study should be made of whether federal, state, or private certification is most feasible and desirable.

Miscellaneous provisions. Although testing and approval procedures appear to be the most important barrier in building codes, miscellaneous building code provisions could pose problems for some active and passive solar designs. Some examples have already been suggested; the local variants of codes are likely to produce many others. Even before the development of definitive standards and certification of solar systems, the federal government could support a cooperative effort by model building codes organizations to seek out and revise provisions that unreasonably discourage solar systems. To avoid duplication of effort it may be desirable to wait for the final definition of standards before beginning this effort.

A suggested statute has been drafted to encourage use of cost-effective solar systems by requiring state and local governments to revise present building codes.[25] This proposal would require an appropriate state agency, and every locality, to ascertain whether their building regulations unreasonably impede the installation and use of solar systems. If they do, the agency would have to alter them or recommend changes to the appropriate legislature. The state agency would have to promulgate standards for certification of solar systems, certify systems on petition for review, promulgate standards for building codes, and, if localities fail to revise their building codes, to administer regulations for them. Unfortunately, although systems are to "satisfy prevailing technical performance criteria" as well as be cost-effective, there is no specific reference in this proposed legislation to evolving federal standards and developing consensus standards. If this proposal were revised to refer to those standards as the basis for the state standards, it would be a useful addition to the proposal outlined in the preceding

section. As much as possible, a nationally consistent set of standards should be encouraged.

An additional proposal in this suggested statute would allow citizens to petition the state agency or locality for exemptions from building code provisions if: (1) the solar system is certified by an engineer or architect as being cost-effective and substantially equivalent to code requirements; (2) the system is certified as being acceptable to the state agency; or (3) the system is certified as being acceptable to HUD. (This reference to HUD certification may, or may not, refer to the systems listing available from ERDA's Technical Information Center. The reference should be made clearer.) Even when exemptions are granted, the solar system as installed or operated must not constitute a private or public nuisance. This opportunity to petition the state agency, together with a right to appeal directly to the state agency for a hearing when a permit is denied locally would encourage at least statewide consistency. This proposal merits support, although the burden imposed on the applicant would probably discourage all but the most determined solar advocates.

Performance codes. There have been other suggestions for changes in building codes that would promote innovation in general. Most notable is the proposal for performance-oriented building codes.[26] Such codes could provide the flexibility needed for solar systems. However, building code departments, which would presumably administer the codes, are usually only funded for, and experienced in, administering straightforward specification codes.[27] Even if the performance code only applied to solar systems, the limited capabilities of building officials might be overtaxed, and solar system builders would be left in the same disadvantageous situation relative to builders of familiar conventional systems.

For this reason, it makes sense to essentially integrate solar systems into the present specification-oriented codes by allowing listed systems to be used in accordance with their terms of listing. Unlisted systems would still have to be shown on a case-by-case basis to conform to the current standards. If the standards applied by the listing agency are performance-oriented, there need be no stifling of innovation in solar systems, components, or materials; yet local building officials would be able to do business as usual.

Building codes could also be used to provide incentives for solar systems, or even mandatory installation requirements under certain circumstances. With the

possible exception of stricter standards for energy conservation in buildings (such as ASHRAE 90-75), there appears to be no need to provide incentives in building codes once the barriers are removed. Such incentives are better left to subsidies, loans, loan guarantees, property tax exemptions, or income tax deductions or credits.

APPENDIX

IAPMO's Uniform Solar Energy Code

This code is currently the only model code for solar heating and cooling systems from the model-code-generating organizations. Seeing the need for a uniform solar energy code for the thousands of Uniform Code jurisdictions, IAPMO (The International Association of Plumbing and Mechanical Officials) passed a resolution at the September 1975 Annual Business Conference to form a committee to draft a basic solar energy document. The first edition of the code was published in mid-1976. IAPMO adopted the code at the September 1976 Annual Business Conference. It was adopted without substantial amendment of the draft. IAPMO admits the imperfection of the code in its foreword, but offers it for adoption anyway. IAPMO urges users of the code to tell the association of any amendments they find necessary, so that uniformity can be maintained and other jurisdictions can benefit.

Although it was laudable of IAPMO to try to provide a model code for solar heating and cooling systems, we believe that this particular version should not be adopted at all. There are too many errors, omissions, and lack of particular standards. The most disappointing aspect of this effort, however, is that it is not keyed to the evolving federal standards and developing private-sector standards for solar heating and cooling systems, but goes off on a tangent of its own. Even for what it tries to do, it is seriously flawed. (For another criticism of this code see "Solar Energy Code: From Flaw to Law" and "IAPMO Publishes 'Uniform Solar Energy Code'," CRC 3 (No. 3. 1976): pages not numbered, a periodical by the American Institute of Architects Codes and Regulations Center.) A chapter-by-chapter analysis follows.

The very title, Uniform Solar Energy Code, is unsuitable: This code only covers some aspects (mostly plumbing components) of the solar heating and cooling of buildings. It does not provide for photovoltaics, for example (beyond a definition in section 117(d)). But the sweeping definition of solar systems would include photovoltaics and other systems not provided for: "Solar System — As used in this Code, is any configuration of equipment and components to collect, convey, store

and convert the sun's energy for a purpose" (emphasis added, § 120(f)). Even for solar heating and cooling, this code is not as comprehensive as the Intermediate Minimum Property Standards for Solar Heating and Domestic Hot Water Systems developed by the NBS for HUD. A more suitable name would have been "Uniform Solar Heating and Cooling Code." Even better, it could have taken the form of amendments to the Uniform Mechanical Code and Uniform Plumbing Code.

Chapter 1* defines terms used in the code. Some of its definitions are not very helpful. For example, absorption refrigeration is defined as a cooling system operated by a solar system (§ 102(b)). Does this mean that any solar-operated cooling system is an absorption system for purposes of the code, such as an electric air-conditioner operated on power from solar cells? (Surely it does not mean that a gas-fired absorption refrigeration system is a solar system.) Because the code is not keyed to the federal solar heating and cooling demonstration program, technologically simpler systems of solar cooling are ignored, such as nocturnal heat radiation. (See § 3(2) of the Solar Heating and Cooling Demonstration Act of 1974, Pub.L. 93-409.) There is no definition of tank (or storage tank), although this term is used repeatedly (e.g., §§ 20.6 and 601).

Chapter 2, on the quality of materials, is helpful because a table in it lists nationally recognized materials standards that would apply to many plumbing-type parts of a solar system. Standards cover pipes, valves, certain water heaters, tanks, pressure vessels, and a few miscellaneous components. They do not cover such important components as glass and plastic for glazing or aluminum for collectors. (This latter item may be just an oversight or it may reflect lobbying by the Copper Development Association, author of the appendix.) This chapter also

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* The inconsistencies in labeling of chapters, sections, and paragraphs in this code bear noting. According to the table of contents, the code consists of "Part One" and "Appendices." There is no part two. Although the first chapter is labeled "Part I," the second is labeled "Chapter 1," and the third, "Chapter 2," etc. The sections in part one are labeled "10.1" to "10.5" and "20.1" to "20.13." The sections in what are titled Chapters 1 through 9 are labeled "sec. 101" through "sec. 901," except that in chapter 2 they are lettered rather than numbered. Generally, paragraphs are labeled "(a)," "(b)," etc., but the paragraphs of sections 20.3, 20.5, 20.6, 101, and 301 are not labeled at all. Section 402 begins with three unlabeled paragraphs, then has a fourth labeled "(a)" and a fifth "(b)." This makes citing paragraphs needlessly untidy: For example, "§ 301, second unlabeled paragraph." There is no labeling of parts within the appendices, which make up half the code.

provides approval procedures for alternative materials (especially paragraphs (e) through (j)).

Chapter 3 provides general requirements for plans and for certain aspects of installation, mostly piping and leak testing. When required, plans must be both prepared and certified by a registered professional engineer (§ 301, second unlabeled paragraph). It is not clear why architects could not do such work. This may just reflect the composition of the drafting committee, where engineers were represented but architects were not.

In existing buildings where solar installations are to be altered, repaired, or renovated, the code allows deviations from its provisions if necessary and first approved by the building official (§ 304). To permit approval of deviations by the building official is contrary to the usual practice under the uniform codes and seemingly inconsistent with the code's own provision that approval of any plans or specifications does not sanction any violation of the code (§ 20.5, seventh unlabeled paragraph). (Section 20.5 should, but does not, refer to section 304 as an exception, if that is what is intended.)

All welding must be done by approved welders and conform to unspecified, nationally recognized standards (§ 316(c)). There is no provision in this code, however, for the approval of a particular group to install solar systems generally. This is in contrast to IAPMO's Uniform Plumbing Code, which specifies approved plumbers for all plumbing work (§ P-2.2).

Chapter 4 provides more requirements for piping, including several provisions to avoid contamination of drinking water with water from solar system lines (§§ 401 and 402). The provisions of this chapter seem reasonable, except that use of PVC or other plastic pipe would require approval as an alternative material. (Section 403 permits use of copper, copper alloy, galvanized malleable iron, or galvanized steel pipes.)

Chapter 5 has similarly reasonable provisions for joints and connections.

Chapter 6 provides for tanks. This chapter refers to storage tanks, heat exchanger tanks, prefabricated tanks, gravity tanks, concrete tanks, metal tanks, and expansion tanks (open expansion tanks and airtight or closed type tanks). Unfortunately, these terms are not defined. Storage or heat exchange tanks must be constructed in accord with unspecified nationally recognized standards that are approved by the building official (§ 601(a)(4)). Tank covers must be capable of

supporting an earth load of at least 300 pounds per square foot, unless buried more than three feet deep (§ 601(a)(6)). This seems to apply even if tanks are not buried. All devices attached to or within a tank must be accessible for repair and replacement (§ 601(a)(7)). Accessible is defined as having access, but this may first require the removal of an access panel, door, or other obstruction (§ 102(d)). Unless several feet of earth is the equivalent of an access panel or door under this code, this implies that a buried tank may not have any devices (not even pipes!) connected to it.

Chapter 7 provides for collectors in just over a single page. One remarkable provision requires collectors to be located to take advantage of the sun (§ 702(b)). Such a superfluous provision is of little help and invites ridicule. This chapter sets out several unspecific requirements which would baffle rather than guide designers and building officials. To be useful, this chapter needs references to existing standards, or needs to set its own performance standards. For example, collectors manufactured as a complete component must be listed by an "approved listing agency" (§ 701(h)). Frames and braces exposed to the weather must be constructed of materials "suitable" for exterior locations (§ 701(a)). Glass used in collector construction must be "tempered" (§ 701(e)), and plastic used in collector construction must be "suitable" (§ 701(f)). These requirements are not unreasonable, yet without mention of a listing agency (if any exists), or without specific standards for frames and braces, tempered glass, or plastics, these requirements have no utility.

The collector assembly must be capable of withstanding stagnant conditions (high solar flux/no flow) (§ 701(g)). Again, this is reasonable, but much too general. On the other hand, a specific requirement that collectors mounted on the ground must be installed at least six inches above ground level (§ 701(c)) may be too specific for either climates without snow or for climates with deep snow and heavy drifting.

Chapter 8 provides insulation requirements for pipes, ducts, and tanks. For ducts, section 802 refers the user to the Uniform Mechanical Code. The standards for insulation show a lack of understanding of either insulation principles or the need to leave design decisions to the designer. First, the formula for calculating the thickness of insulation on pipes does not consider the thermal conductivity of the insulating material used (§ 801(f)). (This does not appear to have been a

typographical error since the errata sheet provided in October, 1976, corrects certain typographical errors in the formula, but still ignores thermal conductivity.) Whether copper or fiberglass is used as insulation, the same thickness is required. Also, the formula does not directly compute the insulation thickness: the user must solve an equation after making certain substitutions. This is simple algebra, but the formula offered should directly yield the desired answer. The formula, had the assumptions been correct, should have been restated as $L = r_o(q_o/q_s-1)$, where L is the insulation thickness, instead of $q_o = q_s(r_s/r_o)$, where the thickness is not a term.

Tanks must be insulated so that no more than 2 percent of the stored energy will be lost in 12 hours (§ 803). Here, tank probably means any heat storage unit. (Elsewhere the term usually seems to refer just to heat storage units holding water. See, for example, §§ 309 2(d).) This standard means that the insulation must be good enough that only half the energy in the tank would escape through the insulation in more than 17 days of storage. Since storage capacity is often only for one or two days (rarely beyond three or four days), this requirement is probably too stringent. In any event, this standard ignores the role of the designer in deciding what is appropriate. The "losses" from the tank may be intended, for example, to heat that portion of the building where the tank is located, and may not be lost. Or, if only short-term storage is needed, relatively little insulation is required.

Even worse is the equation and example given "for illustrative purposes only." The example assumes that useful heat energy is stored in a tank as long as it is above zero degrees, either Celsius or Fahrenheit. But this means that the amount of heat in the tank depends on the unit of measurement that the user prefers, which is obviously incorrect. Besides, no useful heat is stored in a tank below the design minimum temperature of the space to be heated, if heat is to be applied to the inside air; or below the outside air temperature (which is not necessarily at zero degrees, Celsius or Fahrenheit), if heat is to be applied to outside air. This procedure also does not directly compute the desired result. Instead, the user is told to first use one formula twice, to compute heat stored at the beginning temperature and at the end of 12 hours, and then to use those results in another formula to compute heat loss. A better approach would be to use a single formula. Given the code's assumptions, which are not correct, the procedure could have been simplified to:

(heat loss) = (change in temperature in 12 hours/starting temperature).

Chapter 9 provides simply that solar system ducts be installed in accord with Uniform Mechanical Code requirements (§ 901). Design decisions are wisely left to the designer.

Appendix A to the code offers a way to compute collector size. The material is copyrighted by the Copper Development Association Inc., an association that represents manufacturers of copper solar equipment. The method assumes too much that should be left up to the designer: that the collector is of copper, that it is water-cooled, and that there are about 1.5 to 2.0 gallons of water in heat storage for each square foot of collector (at 64). This method not only overlooks air-cooled or aluminum collectors, which are common, but it ignores the effects of heat generated indoors by appliances, lights, and people, and also heat collected by windows, which can be substantial in a good passive design (at 61). These assumptions used would probably result in the sale of more copper collector than is needed. (This may explain the Copper Development Association's assumptions.)

There should be no provisions in a solar heating and cooling code (even in its appendix) that favor one technology or material over another without regard to performance characteristics and cost effectiveness. This code implies, however, that copper, water-cooled collector systems are the norm. The building official or designer is given no guidance for evaluating the design of the competing systems. This appendix has been offered only as a guide, not as specific requirements, but it should not have been included.

The last part of the code, appendix B, simply provides for conversion of customary units into metric.

Although a model code for solar heating and cooling systems is needed, this particular version should not be adopted as a supplement to the other Uniform Codes. It has too many errors and omissions, and it lacks particular standards and reference to the federal and private-sector standards for solar heating and cooling systems.

NOTES: BUILDING CODES

1. Mary Schiflett, "State and Municipal Legal Impediments and Incentives to the Use of Solar Energy" (Paper presented at Solar Energy Barriers and Incentives Conference, Houston, Tex., April 19-24, 1976), p. 7.
2. AIA Research Corporation, Early Use of Solar Energy in Buildings, 2 vols. (Washington, D.C., Aug. 1976), 2: II-32.
3. Charles G. Field and Steven R. Rivkin, The Building Code Burden (Lexington, Mass.: D.C. Heath and Co., Lexington Books, 1975).
4. See ibid., pp. 37, 57, 58, 80, 81, 85, 87, 90, 92, 96, 97; Alan Hirshberg and Richard Schoen, "Barriers to the Widespread Utilization of Residential Solar Energy: The Prospects for Solar Energy in the U.S. Housing Industry," Policy Sciences 5 (1974): 464.
5. The Uniform Solar Energy Code of the International Association of Plumbing and Mechanical Officials is discussed in the appendix to this chapter. This code is a newly written code with such flaws that it should be withdrawn until it can be completely rewritten. In any event, it has not yet seen wide adoption, if any.
6. Field and Rivkin, The Building Code Burden, p. 43.
7. Information supplied by the Office of Building Standards and Codes Services, National Bureau of Standards.
8. Information supplied by the Office of Buiilding Standards and Codes Services, National Bureau of Standards.
9. Field and Rivkin, The Building Code Burden, p. 43.
10. But such rules may not waive working stresses or fire resistive requirements of the code or violate accepted engineering practice involving safety (§ 109.1).
11. New materials is not defined; we assume this would include innovative equipment as is used in solar systems. Regulations may be made effective four weeks after the intention to adopt them has been published, and after a public hearing (§ 109.3).
12. A number of specific code provisions apply structural requirements, as shown later. Solar systems pose, if anything, less of a fire hazard than conventional systems using fire and electricity. Sanitary requirements, such as that the water and antifreeze in the system be kept out of the drinking water supply, should be no major problem.
13. The BOCA Basic Plumbing Code and the plumbing provisions of the Basic Building Code, article 17, do not apply to solar space heating and cooling systems. Although there is what could be called plumbing in solar systems, the codes do not apply to chilled water piping used in comfort cooling, or to hot water piping for building heating (§ P-100.2). Water supply and drainage connections to and from the system, of course, are plumbing (ibid.). Solar hot water heaters are plumbing, but there is nothing in this code that would appear to prevent use of solar hot water heaters (see, e.g., § P-1606.0), provided there is a backup system to assure that minimum temperature requirements are met (120 degrees F, § P-201.0). All automatic gas and eletric hot water tanks must be listed by the AGA or ULI (§ P-1606.4.5). The same kinds of requirements for testing and approval of alternative systems as for space heating and cooling equipment could be imposed.
14. Standards requiring durability may be crucial to solar development, lest solar systems suffer the loss of public confidence like the heat pumps marketed throughout the South in the 1950s and 1960s. See Howell's pessimistic scenario for

solar: John R. Howell, "The Implementation of Solar Energy Technology—The Next 25 Years" (Paper presented at Solar Energy Barriers and Incentives Conference, Houston, Tex., April 19-24, 1976), pp. 6-8, especially p. 7.

15. The 1976 code changes adopted by BOCA include energy provisions based on ASHRAE Standard 90-75.

16. Information supplied by the Office of Building Standards and Codes Services, National Bureau of Standards.

17. Field and Rivkin, The Building Code Burden, pp. 42, 43.

18. The Uniform Mechanical Code is by ICBO and IAPMO--the International Association of Plumbing and Mechanical Officials. The Uniform Plumbing Code is by IAPMO alone.

19. Occupancy means "the purpose for which a building, or part thereof, is used or intended to be used" (§ 416).

20. As under the BOCA code, the piping within a solar space heating or cooling system is not "plumbing," but the supply and drain piping would be (§ P-117(i)). Water heaters other than gas water heaters must be made in accord with approved standards satisfactory to the building official. These standards are not spelled out, but the usual testing and approval provisions for alternatives should apply (§ P-1306(a)), putting solar equipment at its usual disadvantage.

21. Information supplied by the Office of Building Standards and Codes Services, National Bureau of Standards.

22. Field and Rivkin, The Building Code Burden, p. 43.

23. See National Bureau of Standards, Plan for the Development and Implementation of Standards for Solar Heating and Cooling Applications, Initial Report prepared for the Energy Research and Development Administration (NBSIR 76-1143, Aug. 1976). This details what has been done and is planned in standards development.

24. Minn. Stat. § 116H.127 (1976): The building code division of the department of administration in consultation with the agency shall promulgate rules by December 31, 1976, concerning quality and performance standards which are in reasonable conformance with the Interim Performance Criteria for Solar Heating and Combined Heating/Cooling Systems and Dwellings, National Bureau of Standards, January 1, 1975; and the Interim Performance Criteria for Commercial Solar Heating and Combined Heating/Cooling Systems and Facilities, National Aeronautics and Space Administration, February 28, 1975, to insure that within the existing state of development, solar energy systems as defined in section 2 of this act, which are sold or installed within this state, are effective and represent a high standard of quality of material, workmanship, design, and performance. The department of administration in consultation with the energy agency shall modify existing standards and promulgate new standards subsequent to December 31, 1976, as new technology and materials become available, or as standards are revised by the federal government.

Manufacturers or retailers of solar energy systems shall disclose to each bona fide potential purchaser of a system the extent to which the system meets or exceeds each quality standard.

25. William Thomas, Alan Miller, and Richard Robbins, "Legal Issues Related to Use of Solar Energy Systems" (Aug. 1976 draft of forthcoming article in the American Bar Foundation Research Journal).

26. See, e.g., Field and Rivkin, The Building Code Burden.

27. Richard Schoen, Alan S. Hirshberg, and Jerome M. Weingart, New Energy Technologies for Buildings (Cambridge, Mass.: Ballinger Publishing Co., 1975), p. 115.

3

HOME FINANCING

Because solar homes cost more than conventional ones, persons seeking to finance or retrofit homes with solar energy systems may encounter legal blockades. Different types of legal problems are associated with new home and retrofit financing, so they will be discussed separately.

Financing New Solar Homes

Persons seeking to finance a solar home may not be able to get as large a loan as they need because of (1) federal laws regulating savings and loan institutions; (2) lenders' hesitancy to endorse solar homes (due partly to unfavorable loan-to-value ratios and the underwriting criteria lenders use); and (3) because of secondary market constraints.

Federal Regulatory Restraints

Federally chartered savings and loan companies (representing three-fifths of the assets of all savings and loans) are regulated by the Home Owners' Loan Act of 1933.[1] This act says that if a savings and loan makes a home loan of over $55,000 (a figure that has been raised periodicially over the years), the entire amount of the loan must be put into a "basket" that can never hold more than 20 percent of the corporation's assets. This is important because these imaginary baskets fill quickly. They must hold all loans on apartments and shopping centers, and some other categories of loans. In regions like Washington, D.C., with very expensive homes, nearly all the baskets are full and home loans for over $55,000 are often not even considered. Such restrictions may make it impossible for average-income families to finance average-priced solar homes.

There are several possible legal changes. The law could be amended to raise the $55,000 limit; it could be amended to state that only dollars in excess of $55,000 (and not the entire amount of a loan) must go into the basket; or the law could make exceptions on public policy grounds for energy-conserving homes. For the few homes participating in HUD's demonstration program, this law has already been amended. The maximum dollar limit is raised by the amount a solar heating or cooling system exceeds the cost of a conventional system.[2] The Regional and Urban Planning Implementation, Inc. (RUPI) study is among those recommending a ceiling adjustment. Legislation has already been proposed that would increase (by 20 percent) the loan amount that may be made, insured, or purchased by the Farmers Home Administration, the Federal Housing Administration, and the Government National Mortgage Association, if the increased purchase price is due to solar heating or cooling equipment.[3] An even better approach, however, is to raise the ceiling, but to also require the use of life-cycle costing when assessing a property (life-cycle costing is discussed in more detail later in this chapter).

Financiers Approach Solar Homes Cautiously

Lenders are also concerned about the reliability of solar systems, and about the need to finance two separate heating systems, because building officials or lenders often require a 100 percent backup conventional heating system.[4] In a recent survey of lenders, only 43 percent thought that a solar energy heating system would add to the value of a home. And an astonishing 16 percent thought the presence of such a system would reduce a home's value. When appraising a home, most lenders would exclude part or all of the costs of a solar system.[5] They are very concerned about the market value of a house and often consider solar equipment an "overimprovement." Residential appraisers do not try to estimate a home's future value, but only recognize its current selling price.[6] They may also be conservative in matters of aesthetics—an architect building a home in Palm Desert, California, had a difficult time persuading his mortgage company to approve an insulating earth berm reaching the south exterior wall.[7]

With regard to farm houses, a bill has been introduced in the U.S. Congress to amend section 303 of the Consolidated Farm and Rural Development Act[8] to make it clear that the term "improving farms" includes the acquisition and installation of solar heating and cooling equipment.[9]

Another type of problem is that many lenders use borrower underwriting criteria that exclude consideration of the cost of heating and cooling a home when they assess an applicant's ability to pay. Currently, most lenders figure an applicant's ability to pay by adding principal payments, interest payments, taxes and insurance costs. If the total equals more than 25 percent of the applicant's income, the loan is denied. It has been suggested that utility costs be added to this calculation. The suggestion is a double-edged sword: although solar homes would look better in comparison, fewer applicants would qualify for home loans at a time when a high percentage of Americans are already priced out of the home market.

Nevertheless, all lenders in the recent RUPI survey said that energy costs would become increasingly important to their lending decisions, and RUPI recommends the consideration of home energy costs in lender underwriting procedures. They found that excluding energy costs when figuring an applicant's ability to pay "may be an important constraint on the availability of financing for solar homes."[10] The American Bar Foundation study includes a suggested statute that would require lenders to consider fuel and equipment costs in all their financial decisions.[11] It is likely, however, that financiers will begin to take such steps even without legal measures, because it will be in their obvious self-interest to do so.[12]

One factor that lenders should consider (but that is frequently ignored) is that although solar homes are more expensive, their owners can capitalize part of their heating costs rather than face steadily increasing monthly energy bills. This advantage, according to at least one solar system manufacturer, is already attracting average-income homeowners to the solar market.[13]

Life-Cycle Costing Makes Solar Homes Financially Palatable

To fully appreciate the financial attractions of a solar home, a consumer must also understand and use life-cycle costing. As nearly all the expense of a solar energy system is the initial cost, its financial advantages over a conventional system are apparent only over a period of use. It is often suggested, therefore, that life-cycle costing should be used to appraise solar structures. Life-cycle costing estimates the net costs of a solar energy system over its useful life. It includes acquisition costs, savings, operating costs (if any), maintenance costs, and salvage value.[14]

Several states now require life-cycle costing for government buildings, and others are considering bills to require life-cycle costing to be used in evaluating bids for government purchases.[15] Other states should make similar changes in their laws controlling government procurements, particularly those states that have laws requiring the award of contracts to the lowest bidder. The Energy Task Force of the National Conference of State Legislatures, and the Energy Conservation Project of the Environmental Law Institute are among the groups advocating a switch to life-cycle costing.[16] On the federal level, the Federal Supply Service of the GSA has awarded some contracts (one for water heaters and one for air conditioners) on the basis of life-cycle costing.[17] Such an approach should be mandated by Congress.

Representatives of the savings and loan industry say that savings and loans are open-minded about life-cycle costing, and that perhaps one-third are already using this tool in their evaluations of projects.[18]

This statement is corroborated by the RUPI study, which found that a "sizable percentage" of lenders surveyed were probably concerned with information on both payback periods and life-cycle costs. (RUPI defines "payback period" as the time needed to completely return an initial investment; i.e., in the form of net savings in heating costs.)[19] The lenders also considered other factors in their appraisals, and would not make or refuse a loan solely on the basis of life-cycle costs or payback period. Unfortunately, the RUPI effort also discovered that many lenders were unfamiliar with even the concept of life-cycle costing, and that very few would regard it as a more useful tool than payback period or capitalized value.[20]

An obvious problem with life-cycle costing is that Americans move so frequently. The U.S. League of Savings Associations estimates that the average owner-occupied home mortgage runs six or seven years.[21] Others say we move even more frequently.[22] The implications of our transiency are that some lenders do not believe that solar systems will be widely accepted until payback periods are shorter than a mortgage's life.

Another general problem with life-cycle costing is the unpredictability of future events. When looking ahead twenty years, it is extremely hard to make a worthwhile guess as to the prices of alternative energy sources or the type of solar incentives that the federal or state governments may pass or the durability of various types of solar systems.

In spite of the above problems, it would seem reasonable to replace the arbitrary $55,000 mortgage ceiling with an approach based on life-cycle costing. In an era of soaring fuel costs, when it is certain that fossil fuel prices will continue to escalate, and possible that fuel may even be rationed, it makes sense to wrench the attention of the savings and loan industry away from the past and to focus it on the future.

Secondary Market Constraints

Savings and loan institutions, mutual savings banks, and other types of companies that make loans directly to homeowners already look a little way into the future as they usually plan to sell their mortgages to the secondary market. The secondary market is comprised of both public and private buyers. The two main public entities are the FHLMC ("Freddie Mac" — Federal Home Loan Mortgage Corporation) and FNMA ("Fannie Mae" — the Federal National Mortgage Association.) FHLMC has pursued a policy of encouraging low and moderate income housing. Partly for this reason they have adopted the same $55,000 figure as the Home Owners' Loan Act, and will not buy mortgages over this amount. Private entities in the secondary market are not limited by this figure.[23]

Both FHLMC and FNMA are extremely conservative when asked to underwrite unproven technologies. (See chapters on building codes and warranties for detailed discussions of the need for performance standards.) It is the position of both these institutions that the expenses associated with solar equipment should not be mortgagable until they achieve more "market acceptance."[24]

The FHA can also be expected to act conservatively. Although in some ways the FHA has been a leader in encouraging solar homes -- such as in promoting Minimum Property Standards that support better insulation in new and existing homes and in including such costs in the appraised value of the home -- FHA appraisals will probably be more conservative when it comes to including the value of solar energy equipment.[25] It has been suggested by some FHA officials that capitalized net cost savings may be a better way to evaluate a home than its market value. But this is a minority view.

While it is true that the number of FHA insured loans has dropped to 7 percent of the market, the FHA's actions still have a broad impact. For one thing, the FHA's clients are usually among the least wealthy homeowners, those who

would now find it nearly impossible to acquire a solar home, but who might benefit most from such a home because of the rising costs of conventional fuel. Secondly, FHA's Minimum Property Standards have a great influence outside of the FHA. They are, in fact, frequently used by builders as their "maximum" standards.

Financiers' Liability for Defective Homes

A final point is that lenders are not very concerned that they may be held liable if a solar system in a house they finance proves defective.[26] That they could conceivably be held liable is a question that would not even have been asked until recently. In the California case of Conner vs. Great Western Savings and Loan Ass'n.,[27] Great Western was sued by persons who had bought homes in a large development that Great Western financed. Although not a joint venturer, Great Western's role went beyond that of a typical money lender as it had the right to exercise extensive control over the project. The homes were very defective, and the court said Great Western knew or should have known of the inexperience and undercapitalization of the developers. It was held that Great Western had a duty to the homeowners in spite of the absence of any privity of contract. A duty of due care may arise, the court said, out of a voluntarily assumed relationship if public policy dictates it. (Recent changes in California law limit a lender's liability to situations where he has assumed an entrepreneurial role in a development.)

Financing Solar Retrofits

An entirely different set of legal problems are encountered when homeowners seek financing to retrofit their homes with solar equipment or better insulation. Once again the villain is the Home Owners' Loan Act of 1933. The act allows federally-chartered savings and loans to make only first liens on residential properties. As personal installment loans or homeowners' improvement loans generally involve significantly higher interest rates than mortgages, homeowners would prefer long-term second mortgages to raise money for energy-saving retrofits, at interest rates only a little above those on the first mortgage. Not all savings and loans are subject to the Home Owners' Loan Act, of course, but similar restrictions are generally included in state charters.[28]

Because essentially all the costs of solar energy are capital costs (as there are no fuel costs), solar energy is extremely sensitive to interest rates, and its

feasibility may, indeed, hinge on them. "In other words," says one study, "if either the cost of capital or the rate of interest doubles, the cost of solar energy nearly doubles."[29]

Denied a second mortgage, homeowners have several options. If they only want to retrofit their homes with a solar hot water heater, a personal or home improvement loan is a reasonable option. The RUPI study does not anticipate any barriers in this situation. The FHA has encouraged its area officers to accept solar hot water heaters as proper objectives for home improvement loans.[30] Although the interest rates will be higher than for mortgages, the total cost of a solar water heater is comparatively low. Legislation to amend the National Housing Act (§ 2(b)) has been suggested that would raise any legal limits on home improvement loans by the amount necessary to install solar equipment.[31]

For more expensive retrofits there are sometimes several other options. The homeowner can completely refinance the whole property — and pay a higher interest rate on it all. Savings and loans are usually willing to do this because real property is appreciating so rapidly and because interest rates have generally risen lately. This option does not, of course, solve the high interest problem. Another possibility does, however — in California and some other western states, mortgages sometimes contain "open-ended" clauses that allow a homeowner who has built up equity to borrow back up to the amount of the original loan, at the original terms. This is a fine arrangement from the borrower's perspective. Although it does not violate any federal laws, the managers of eastern savings and loans seldom use it.[32] Such clauses can be individually bargained for, but there is such great disparity of bargaining power in the home loan market that this approach would not help the vast majority of homeowners locked into existing mortgage contracts. An amendment could be added to the Home Owners' Loan Act requiring lenders to agree to modify loan contracts when a homeowner wants to retrofit for solar energy.

A new financing gimmick called a "wrap-around mortgage" may also benefit some homeowners. Although it is not as attractive to the borrower as an open-ended clause, in a time of rising interest rates it may be cheaper than refinancing or than a second mortgage. A new loan is "wrapped around" an existing mortgage which is preserved. The new mortgage is for an amount equal to the outstanding balance of the first mortgage plus any additional funds loaned. Its interest rate is

always somewhat higher than that on the first mortgage, but equal to or lower than the current market rate on similar properties.[33]

Recent interpretations of the Home Owners' Loan Act have removed a former legal barrier by making it possible for savings and loans to classify wrap-around loans on residential and nonresidential properties as a first lien, if they establish certain asset accounts.[34]

Wrap-around mortgages are still a basically untested idea in home loans. They are more widely available on nonresidential properties, and could be used to finance solar retrofits to factories and commercial buildings.

The suggestions above may be politically palatable as well as intellectually appealing, for both lenders and borrowers will benefit if homes are retrofitted for solar energy. Borrowers are better able to meet their mortgage payments when they are not paying hundreds of dollars for fossil fuels. As Peter Damon, a bank officer in Boston, has said, such a loan program "could be regarded as a program defensively designed to improve the overall quality of the outstanding portfolio's security."[35]

1. 12 U.S.C. § 1461 et seq. (1970).
2. 42 U.S.C. § 5511 (Supp. IV 1974).
3. H.R. 15015, 94th Cong., 2d Sess. (1976).
4. "Solar," Sunset, Nov. 1976, p. 83.
5. David Barrett, Peter Epstein, and Charles M. Haar, Financing the Solar Home: Understanding and Improving Mortgage Market Receptivity to Energy Conservation and Housing Innovation (Cambridge, Mass.: Regional and Urban Planning Implementation, Inc., 1976), pp. 111, 108.
6. Peter S. Damon, "Financing Solar System Costs" (Paper presented at the Consumer Conference on Solar Energy Development, Albuquerque, N.M., Oct. 2-5, 1976), p. 2. Damon is senior vice-president with the Charlestown Savings Bank in Boston, Mass.
7. "Solar," p. 89.
8. 7 U.S.C. § 1923 (1970).
9. H.R. 15014, 94th Cong., 2d Sess. (1976).
10. Barrett, Epstein, and Haar, Financing the Solar Home, p. iii.
11. William Thomas, Alan Miller, and Richard Robbins, "Legal Issues Related to Use of Solar Energy Systems" (Aug. 1976 draft of forthcoming article in the American Bar Foundation Research Journal).
12. One indication of lenders' growing interest in solar structures was the comprehensive seminar, Solar Energy Technology and Economics--A Seminar for Mortgage Lenders and Appraisers, sponsored by the University of Colorado at Denver, Oct. 21-22, 1976.
13. R.W. Barker, vice-president for marketing for Solaron, quoted in "A Giant Step for Solar Heating," Business Week, 18 Oct. 1976, p. 100.
14. Ivan Tether, "Purchasing Strategies for Reducing the Direct Consumption of Energy," Energy Conservation Project Report, no. 7 (Sept. 1976), p. 25. (ECP Report is a publication of the Environmental Law Institute, Washington, D.C.). See also Rosalie T. Ruegg, Solar Heating and Cooling in Buildings: Methods of Economic Evaluation, Final Report to the Office of Housing Technology, National Bureau of Standards (Springfield, Va.: National Technical Information Service, NBSIR 75-712, July 1975).
15. See, e.g., Cal. Gov't Code § 14951 (West Supp. 1975); Fla. Stat. Ann. § 14951 (West); N.C. Gen. Stat. §§ 143.64.10-143.64.14; and Wash. Rev. Code Ann. § 39.35.010 et seq. (West). Massachusetts legislation (1976 Mass. Acts ch. 433) requires life-cycle energy cost estimates to be made for all public buildings constructed by state and municipal governments, and that solar energy be specifically considered.
16. See National Conference of State Legislatures, Energy Task Force, Energy Report to the States, 19 March 1976, pp. 4-5; and Tether, "Purchasing Strategies," p. 32. Rosalie T. Ruegg, an economist with the National Bureau of Standards, concurs that life-cycle costing should be applied to solar systems. See Rosalie T. Ruegg, "Life-Cycle Costs and Solar Energy," ASHRAE Journal, Nov. 1976, pp. 22-25.
17. See U.S. General Services Administration, Federal Supply Service, Life Cycle Costing in the Procurement of Room Air Conditioners: LCC Procurement Case 1 (Washington, D.C., July 1975); Life Cycle Costing in the Procurement of Water Heaters: LCC Procurement Case 2 (Washington, D.C., July 1975).

18. Comments of Harold Olin, director of architectural and construction research for the U.S. League of Savings Associations, to a Consumer Action Now conference in Oct. 1976.
19. Barrett, Epstein, and Haar, Financing the Solar Home, p. 79.
20. Ibid., p. 80.
21. Ibid.
22. David Morris says developers consider five years as the life of their buildings. "Solar Energy is Really Power for the People," Planning, Sept. 1976, p. 18.
23. Material in the last three sentences of this paragraph is based on a conversation with Phil Gasteyer, associate director of the U.S. League of Savings Associations.
24. Barrett, Epstein, and Haar, Financing the Solar Home, pp. 138, 140.
25. Ibid., p. 135.
26. Ibid., p. 83.
27. 73 Cal. 2d 369, 447 P.2d 609 (1968).
28. Conversation with Phil Gasteyer.
29. William Schulze, Shaul Ben-David, Roberta Katson, and Fred Roach, "An Economic Analysis of Solar Water and Space Heating" (Paper presented at the Consumer Conference on Solar Energy Development, Albuquerque, N.M., Oct. 2-5, 1976), p. 35. The authors are with the Department of Economics at the University of New Mexico.
30. But as the FHA relies on the National Bureau of Standards, the problem of the lack of standards is quickly encountered.
31. H.R. 15015, 94th Cong., 2d Sess. (1976).
32. Conversation with Phil Gasteyer.
33. Ronald H. Timms, Wrap-Around Mortgage Lending (Chicago: U.S. League of Savings Associations, April 1976). Timms is a mortgage specialist; this report was prepared to aid savings associations executives.
34. Ibid., p. 1 (Nov. 1975 opinion from the Office of General Counsel of the Federal Home Loan Bank Board).
35. Damon, "Financing Solar System Costs," p. 8.

4

UTILITIES

In the midst of a natural gas shortage, steadily increasing oil prices, and rising prices for the costs of constructing new electrical generating stations, Americans received one bit of good news: a study for the Energy Research and Development Administration finds that solar heating is competitive with other energy sources in many parts of the United States.[1] One sector of the business community may not have greeted this news with enthusiasm. Public utilities, which currently provide a substantial portion of the energy used to heat buildings, could lose some potential customers if solar-powered heating systems become widespread. Although it is highly unlikely that solar energy use could grow quickly enough to reduce the demand on existing powerplants,[2] it would undoubtedly shrink future needs.

Moreover, the use of electricity by solar building owners as a backup source of energy could cost utilities far more to serve than other residential customers. The solar user may need backup service only infrequently, after extended periods of extreme termperatures or cloudiness. If the timing of this need coincides with the peak demand on the utility, extra generating capacity will be necessary to provide this occasional service. Since even idle capacity must be paid for, the costs of serving the occasional user may be higher than those for a customer who uses the same amount of electricity, but has a steady demand. The owner of a solar system using electrical heating as a backup may in fact impose a demand at times of utility peak demand. The issue must be determined for each utility as the time of the peak and the need for backup service will vary substantially among utilities.[3] Although the battle has hardly begun, one utility has already tried to retaliate by

imposing a rate structure that reflects the potentially higher costs of serving solar customers.[4]

On the other hand, some utilities may see the opportunity to profit from participation in the solar energy market. Natural gas companies may soon have to locate alternative sources of energy because proven gas reserves are steadily declining,[5] and at least one gas company has begun experiments with solar-assisted gas heating systems.[6]

Utility decisions like the above could help determine the rate at which solar energy is utilized—if at all. Utilities are powerful institutions in the energy market, with many weapons in their arsenal. This article will address some of the issues emerging from the relationship of utilities to solar energy, focusing on the regulatory process in which those issues will be decided.

Utility Regulation: A General Overview

Over 75 percent of the electrical generating capacity in the United States is the property of private power companies.[7] Although these companies are privately owned, their operations are regulated by state public utility commissions (PUCs) because of the "natural monopoly" nature of the utility business. It would be counterproductive to have competing electrical generating and transmission systems in the same area.

Federal jurisdiction over utilities is limited primarily to regulation of the wholesale rates of interstate sales of electricity, and of the siting of hydroelectric plants.[8] The Federal Power Commission (FPC) does set accounting standards and reporting requirements that are valuable sources of information. This agency has generally been conservative in its policies. For example, it rarely supports legislation to expand its jurisdiction or increase its involvement in utility rate making.[9]

Recent regulations issued by the FPC offer some hope for a more active energy conservation program.[10] The commission announced recognition of the shift in public concern for the "proper utilization and conservation of our natural resources including fuels and raw materials as well as air, water and land," although action reflecting these concerns was left for a later date.[11] Utilities were asked to submit more detailed rate reports including "a complete explanation as to the method used in arriving at the cost of service allocated to the sales and service for

which the charge is proposed and showing the principal determinants used for allocation purposes."[12]

Recent congressional proposals would expand federal regulation of utilities.[13] One proposal, for example, would dictate permissible rates and other essential utility policies.[14] While Congress almost certainly has the power to regulate utilities under the interstate commerce clause, or on grounds of national security,[15] it seems likely that states will continue to exercise primary responsibility for utility practices.

State public utility commissions have generally acted as overseers rather than initiators of policy, although this may be changing in some states.[16] This is partly due to the regulatory principle that management decisions are best made by the utility, limited only by broad public interest principles. As a practical matter, utility commissions have also lacked the resources and staff to take an aggressive posture. The Colorado PUC, for example, has only fourteen professionals, which is fewer than the management professionals available to one large utility. However, it should be noted that in most states there is no legislative barrier to utility commissions undertaking more assertive programs, and some PUCs have become more active in recent years.

From the standpoint of solar energy use, the crucial regulatory function is rate approval. Typically, regulatory agencies first decide how much a utility will be allowed to earn, and then approve rate schedules designed to produce the approved profit margin.[17] The rate of return is a function of the rate base (those investments on which the utility may make a profit). Operating expenses (including fuel costs), taxes, and other noncapital costs are then added, to determine the utility's total revenue needs. A utility decision to market or lease solar collectors would have to be approved by the utility commission before these expenses could be added to the rate base. It should also be noted that the utility only profits if it makes an investment in capital. Therefore, a utility might finance the purchase of solar collectors by homeowners, but it would stand to profit less than from an investment in generating facilities.

Rate structures are also designed to reflect different costs of service. For example, residential consumers have traditionally paid higher rates than large industrial customers because of the lower costs of billing and metering a single large user. Industries willing to accept interruptible service, that is, the possibility of service cutoffs during peak periods, also receive a lower rate.

Challenging a public utility position is often expensive and difficult. Utility presentations to a regulatory commission are a business expense; consumer groups and energy conservationists rarely have access to equal resources. For example, a recent estimate found that the Virginia Electric Power Company alone spends about $250,000 on a single rate hearing.[18] Once the regulatory agency makes its decision, judicial review is usually very limited, in deference to administrative expertise on technical issues. Although many cases can be cited where courts remanded decisions for lack of substantial evidence,[19] the burden is clearly on the challenger.

There is one major exception to the scope of utility commission jurisdiction: publicly owned utilities are usually exempt from state jurisdiction because they are already publicly controlled. Some utility critics view locally owned utilities as one alternative to the unresponsiveness of privately owned systems.[20] Whether or not this argument is valid, in the short run municipal utilities are too small to play a major role in national energy issues. They accounted for only 10 percent of total installed capacity in 1972.[21]

Within the broad regulatory process outlined above, several principal issues should be discusssed as they relate to solar energy. The sections that follow consider three general topics: service and rate discrimination; scope of PUC jurisdiction and its consequences for solar users; and utility participation in the solar market.

Rate and Service Discrimination[22]

One crucial question in utility regulation is whether utilities may adopt rates or service policies that either favor or hinder the development of solar heating and cooling. At one extreme, public utilities could refuse to provide any backup service on cloudy days. At the other extreme, the utilities could refuse certain services to customers who did not install solar equipment. Whether the policy favors or hinders solar development, the legal question is the same: may a public utility provide services and rates which treat solar customers differently from other customers?

State Antidiscrimination Laws

One of the major purposes for public regulation of electric utilities is the prevention of unreasonable discrimination or undue preferences.[23] Nearly every

state has a statute prohibiting conduct that favors one class of customer while harming another. Typical of these statutes is New Jersey's:

> No public utility shall:
>
> a. Make, impose or exact any unjust or unreasonable, unjustly discriminatory or unduly preferential individual or joint rate, commutation rate, mileage and other special rate, toll, fare, charge or schedule for any product or service supplied or rendered by it within this state;
>
> b. Adopt or impose any unjust or unreasonable classification in the making or as the basis of any individual or joint rate, toll fare, charge or schedule for any product or service rendered by it within this state.
>
> No public utility shall make or give, directly or indirectly, any undue or unreasonable preference or advantage to any person, locality or particular description of traffic, or subject any particular person, locality or particular description of traffic to any prejudice or disadvantage. 24/

Such antidiscrimination statutes only proscribe policies that are "unreasonable," "unjust," "undue," or "unlawful."[25] Whether a particular utility rate or service unlawfully discriminates is a question of fact to be determined on a case-by-case basis by the state utility commission.[26] It is, therefore, very difficult to predict how any given discriminatory practice will be dealt with.

In general, the cases and state utility decisions suggest that utilities have substantial freedom to treat different classes of customers differently. For example, large industrial users of electricity often receive special low promotional rates—a practice defended on the grounds that it costs the utility less to serve very large customers.[27] Many states have permitted their utilities to grant special promotional rates or other considerations to attract new industries to the state and thereby reduce the unit cost of power for all electricity consumers. Such promotional considerations have included reduced rates or even payments to customers who install electric heating, unusually large residential capacity, electric water heaters, electric appliances or electric wiring. They have also included the subsidization of the installation of wiring, street lights, piping, and underground service for select customers.[28]

Only two general principles can be culled from the reported decisions. The first is that preferential treatment is more likely to be found reasonable if it produces indirect benefits to all customers.[29] This principle would favor discrimination that benefits solar systems if that discrimination would reduce rates

for all customers by reducing the utility's needs for capital equipment and fuel. Some decisions have gone even further by suggesting that for a practice to be unreasonable or unjust it must not only benefit one class of customers, but must also burden another class.[30] Under those decisions a practice that assists solar owners without burdening other customers is more likely to be found reasonable.

A second principle that emerges from the cases is that utilities may treat different classes of customers in different ways if there is a reasonable economic basis for distinguishing them.[31] Thus, if solar customers cost more or less to serve than do other customers, they may validly be charged different rates and receive different services. Bases for such a distinction might be the unpredictable nature of the demand for electricity imposed by solar customers, their use of less electricity than other residential customers, or the ability of solar customers to use their storage facilities to control the time of day they demand power. Arguably, less direct benefits such as reduction in the national demand for fossile fuels should also be acceptable.

Regardless of whether a particular discriminatory practice is unlawful, customers who feel they are victims of unreasonable treatment (if, for example, the utility refuses to provide them with backup power service) may find it extremely difficult to obtain relief. Public utility commission hearings can be long and expensive. Also, utility commissions have broad discretion to determine what is, and isn't, discriminatory.[32] Customers can seek help in the courts only after exhausting their administrative remedies.[33] Once in court, the customer must bear the burden of proving that a given practice is unreasonable;[34] the general rule is that a utility commission's findings will be upheld if the record of its proceedings shows a substantial basis for its findings.[35]

State antidiscrimination statutes are not the only bar to discriminatory practices by utilities. The federal antitrust laws may also outlaw rates or services that single out the owners of solar energy systems for special treatment. It is now clear that the antitrust exemption for state action will not totally immunize public utilities from antitrust liability. In a decision handed down last term, the Supreme Court said that a privately owned public utility is not exempt from possible antitrust liability when it furnishes its customers light bulbs without charge.[36] The state action antitrust exemption was found not to apply, although the light bulb promotional practice had been approved (as part of the utility's rate structure) by

the state public utility commission, and could be discontinued only with the PUC's permission. In reaching its holding the court noted ". . . state authorization, approval, encouragement, or participation in restrictive private conduct confers no antitrust immunity."[37]

There are several grounds on which utility discrimination toward solar heating and cooling could be deemed anticompetitive, and therefore a violation of antitrust laws. Perhaps the most obvious is where the utility charges a very high price or even refuses to provide backup service to solar customers. When done to protect the utility's monopoly position, such refusals may violate the Sherman Act's prohibition against monopolization.[38] An antitrust violation might also be found if a utility subsidizes its entrance into the solar heating and cooling market by distributing its losses across all utility customers. This could give it an overwhelming advantage.[39] Finally, a utility's use of rate discrimination to favor or hinder solar heating and cooling is arguably a violation of the Robinson-Patman Act. That act makes it illegal to make some purchasers pay more for commodities of like grade and quality if such discrimination tends to lessen competition or create a monopoly.[40]

There may also be constitutional restraints on the ability of a utility to discriminate for or against solar systems. If a state utility commission approves a discriminatory practice, it may run afoul of the U.S. Constitution's command of equal protection. However, under recent readings of that constitutional provision, a state has substantial leeway in discriminating if it has any reasonable justification.[41]

Service Discrimination

An extremely important service discrimination issue is whether a public utility can refuse to provide backup electricity for structures with solar heating or cooling systems. The short answer is that it appears a utility may not--unless it can demonstrate a compelling case that backup service would cause substantial harm to the utility's existing customers. Refusal to provide service would not only transgress the federal antitrust laws and the antidiscrimination statutes discussed above, but would violate the utility's common law and statutory duty to provide utility service.

The basic concept of a public utility is of an entity that has dedicated its property to serve the public without discrimination. Almost every state has a

statutory provision requiring utilities to "furnish adequate and safe service,"[42] "provide such service, instrumentalities, and facilities as shall be safe and adequate and in all respects just and reasonable,"[43] or "furnish reasonably adequate service and facilities."[44] The Supreme Court enunciated the underlying purpose of these statutes in the following terms:

> Corporations which devote their property to a public use may not pick and choose, serving only the portions of the territory covered by their franchises which it is presently profitable for them to serve, and restricting the development of the remaining portions by leaving their inhabitants in discomfort without the service which they alone can render. 45/

The duty to provide adequate service has, of course, some limits. Utilities will be excused from providing service when prevented from doing so by acts of God, labor disputes, and shortages of fuel supply.[46] In some cases utilities have been excused from providing service where to do so would be unusually expensive, although there is substantial precedent to the contrary.[47]

As with most issues in public utility regulation, the duty to serve requirement is interpreted on a case-by-case basis with "reasonableness" and the "public interest" as the touchstones. In the case of backup service for solar heating and cooling systems, the public interest probably demands that the utilities provide service. The major argument against providing backup service is that it requires the utility to build and maintain expensive peaking equipment that would only be used infrequently, i.e., when cloudy periods have drained the storage facilities of solar structures, and their owners are consequently demanding power simultaneously with the peak demand from other customers. This argument is of small consequence, as utilities can condition the receipt of solar backup power on the installation of equipment that will draw power from the utility only during nonpeak periods. Even if such a condition did not eliminate the peak demand induced by solar customers, the public interest in fuel conservation might justify the enforcement of the duty to serve.

How will the duty to serve affect discrimination in favor of solar customers? In particular, can a gas company refuse to provide gas connections to new residences that do not install solar heating and cooling equipment? All indications are that such a discriminatory practice would be viewed as reasonable. Present natural gas shortages argue strongly for conditioning the receipt of gas on the

implementation of various conservation measures. Some states have taken measures to restrict gas to certain customers or to eliminate its availability for some uses. For example, New York banned the use of gas in swimming pools and in buildings without adequate insulation.[48] A few states have banned its use in decorative lighting.[49]

Rate Discrimination

Utility rate structures have become a hot political issue.[50] At rate hearings across the country, utility regulators have become the arbiters of the merits of different, extremely complicated, theories for utility pricing. The major participants in this debate, in addition to the utilities themselves, are industrial, consumer, and environmental representatives. As a special subgroup of consumers, solar energy users also have a great deal at stake.

A relatively simple example demonstrates the importance of this relationship. A homeowner considering a solar system is told he can expect to reduce his annual outside energy consumption by 70 percent. The homeowner purchases the system and it performs as promised. However, the homeowner finds that his utility bills have dropped far less than expected, and his total dollar savings amount to only 50 percent. The difference is attributable to a declining block rate schedule, which imposes a higher fee for the first block purchased. This pricing system is the most common rate structure for residential customers, and was designed to encourage long-run growth in demand.[51]

Another common utility rate structure provides a lower overall price to all-electric customers. This practice is essentially a holdover from the days of competition between gas and electric companies for new business. At the time such rates were adopted, growth was a source of declining costs, and therefore thought to benefit all of a utility's customers. Although this situation does not currently exist, the all-electric rate continues in many places.[52] The current justification by utilities is that the demand imposed by all-electric users is largely offpeak, that is, when the demands on the utility's capacity are low.[53] Since arguably, the all-electric rate is only for those using electricity for heating as well as other needs, solar users might not qualify. The result would be higher than expected costs to solar users.[54]

Some utilities also provide standby or breakdown service to customers whose entire electrical requirements are not regularly supplied by the utility.[55] Although

under current definitions this rate would not apply to customers using solar energy strictly for heating and cooling, future solar technologies that use solar energy to generate electricity would be affected.[56] Utilities may argue that the rationale for standby service—the irregular and unpredictable nature of the customer's demand—also applies to solar energy users, and that they therefore should be included in this category. Since such service may include a high minimum monthly charge, the impact on solar users would be adverse.

From the standpoint of the utility company, the solar energy user is also a rather special customer. The usual residential consumer varies his demand with the outside temperature. This demand may vary considerably with the seasons, but the general range and timing are relatively predictable. In contrast, most solar buildings will use their backup systems only occasionally, after a cloudy period or severe weather. If the utility has to maintain capacity to meet this infrequent demand, the costs of serving the solar customers may not be covered by prevalent rates. Of course, this assumes the solar user requires auxiliary service at times the utility is operating at peak, an issue we address below.

The possibility of conflict between solar energy users and utilities has already surfaced in Colorado. Public Service Company, a Colorado utility, requested a rate schedule for new residential customers designed in part to capture the extra costs imposed by solar heated dwellings.[57] The rate schedule they proposed was a demand/energy rate. It has two components: an energy charge, reflecting the total kilowatt-hours used, and a demand charge, based on the maximum kilowatt demand during any fifteen minutes. The theory underlying this division is that the demand charge reflects the cost of generating capacity, as opposed to the cost of the fuel used to serve the customer. This rate structure has traditionally been used for large commercial and industrial customers whose demand was considered high enough to justify the added costs of metering.

Solar energy advocates were extremely critical of the demand charge concept.[58] The impact on solar users would be devastating since the occasional user would pay a relatively high charge for any occasional demand, despite very low amounts of total energy consumption. One calculation indicated that a solar system which provides 70 percent of heating needs would reduce the homeowner's electric bill 35 percent under the existing declining block rate, but only 15 percent under the demand charge.[59] The economics of solar energy are presently marginal in most places, so this difference could have been a fatal blow.

Solar advocates counterattacked by questioning whether the demand from solar heated buildings was likely to coincide with the utility's peak period; if not, no capacity charge was justified. Several studies have attempted to answer this question by simulating the performance of solar-heated buildings, and comparing their needs for backup energy with utility load curves.[60] One recent study examined six different utilities and concluded:

> No general statement can be made .... This analysis must be performed on an individual utility basis, since variations in the ambient weather conditions, load curves, and generation mixes of utilities will be the prime determinants in the magnitude of the impact. 61/

The same studies have also noted the importance of thermal energy storage systems as a potentially significant factor. A simple rock bed or water tank, for example, might easily store a day's worth of heating needs. An appropriately designed building with an adequate storage system could always be served off-peak.[62]

As an alternative approach fair to both homeowners and the utility, solar advocates support time-of-day pricing. Time-of-day rate structures charge more for power consumed during peak periods and less during other hours, such as late at night. A homeowner with an energy storage system (whether or not he also had a solar unit) could buy energy during off-peak times, but use it to provide heat during peak periods. The argument is complicated by questions about the added cost of time-of-day meters and utility claims that present off-peak periods are needed to allow for maintenance. The Colorado Public Utility Commission initially granted the utility's request,[63] but following a rehearing decided that there were numerous general questions that should be addressed in a generic rate hearing.[64] During the interim, the demand charge was left as an option since some all-electric customers might benefit (relative to a declining block rate).

Several other rate structures have been proposed that have different implications for solar users. A few utilities have flat rates for residential customers. Flat rates are simply a set amount per unit of energy, regardless of the amount purchased.[65] This rate structure is neutral with regard to energy savings. However, since demand costs are not charged separately, the solar user may be subsidized by other customers if his needs occur during peak periods.

Lifeline rates have been adopted in a few states.[66] Under this system, less is charged for the first units of energy. Its goal is to ease the burden on low-

income consumers.[67] This rate may incidentally benefit solar users whose needs for supplemental sources of energy are small enough to fall within the "lifeline" amount.

A final type of utility pricing is interruptible rates. This rate has traditionally been available only to industries willing to accept the risk of service interruptions in return for lower rates. Some studies have pointed out that a solar user willing to accept the risk of going without utility service on infrequent occasions could save the utility substantial amounts in capital requirements, justifying a lower rate. If the peak occurred only rarely, this alternative might be considerably less expensive than additional units of storage or collector area.[68]

The legal principles involved in rate regulation are similar to those discussed for service discrimination. The same prohibitions on discriminating among customer categories apply, as do the ambiguities as to what constitutes "discrimination."

A rate structure that adversely affects solar energy users may be difficult to challenge under current case law. Several cases have upheld the legality of rate structures that subsidize all-electric customers, despite antidiscrimination laws.[69] For example, in Rossi v. Garton,[70] a New Jersey court held that an allowance of $150 to anyone installing electric home heating did not violate the state's antidiscrimination statute.[71] The court interpreted the statute to bar only "unjust" discriminations, and concluded that only arbitrary discriminations are unjust:

> If the difference in rates is based upon a reasonable and fair difference in conditions which equitably and logically justify a different rate, it is not an unjust discrimination. 72/

A New York public utility commission summarized the requirements for promotional rate structures as follows:

> (1) Promotional inducements may never vary the rates, charges, rules, and regulations of the tariff pursuant to which service is rendered to the customer.
>
> (2) Promotional inducements must be uniformly and contemporaneously available to all persons within a reasonably defined group.
>
> (3) The costs of the promotional practices must not be so large as to impose a burden on customers in general and must be recoverable through related sales stimulation within a reasonable period of time.
>
> (4) The size and nature of the allowance or other promotional inducement must be reasonably related to the objective sought to be achieved and reasonably expected to promote the interests of the utility and its customers. 73/

If a rate structure that provides a direct subsidy for the use of one source of energy is legal, then a rate structure that incidentally burdens a competing source of energy is, presumably, also valid.

Such facile judicial acceptance of promotional rate structures should not be expected in the future. Until the late 1960s, the cost per unit of electricity for at least some types of power plants declined steadily. Utilities could therefore argue that promotional rate structures would, over time, bring new business that would justify additional power plants. These new plants would then lower the bills of all customers of the utility.[74] More recently, the lack of new sites for low-cost hydoelectric power, changes in regulatory practices, and increased environmental costs have forced the long-run cost of power to steadily rise.[75]

In these circumstances, promotional rates lose much of their appeal. A New York court recognized the common impact of rising fuel prices in a recent decision overturning a subsidy for all-electric homeowners.[76] The subsidy, which was to run for a year, was intended to lessen the impact of higher electric rates on residential customers who had previously been induced to buy all-electric homes by favorable rates. The court held that the subsidy "constituted undue preference and advantage" in violation of the state antidiscrimination law.[77]

As a result of this change in financial realities, it may be more defensible for public utility commissions to grant subsidies for conservation than for promotion of energy consumption. Several utility commissions have explictly authorized programs to finance the installation of insulation to conserve natural gas.[78] Since it can be reasonably claimed that conservation by some consumers contributes to the eventual economic benefit of all, earlier precedent in support of promotional practices should be applicable. Some states have adopted legislation specifically authorizing conservation programs, eliminating any doubt about their validity.[79]

Regulatory Burdens on Multi-User Solar Systems

In certain areas it may be difficult to retrofit individual existing buildings with solar collectors. The roofs of some buildings may be ill-suited to accept collectors, others may be shaded by existing structures, while still others with large flat roofs may have excess room for collectors. In those situtations there may be substantial advantages to the development of joint or multi-user solar systems--

systems that share the available space that is suited for accepting collectors. There may also exist similar advantages to the use of communal heat storage systems.

Possible advantages of shared solar systems include not only more efficient use of existing space but reduced construction and maintenance costs, and increased efficiency. In addition, very large systems may be able to avoid the problems inherent in interacting with a utility by building their own source of backup power.

There appear to be several situations where shared solar systems may be desirable. They include:

* Apartment buildings, including condominiums and cooperatives
* Mobile home parks
* District heating and cooling plants
* Shopping center complexes
* Industrial parks

Already, a number of shared solar facilities have begun operation. A 230-unit appartment building in Brookline, Massachusetts is generating hot water from roof-top collectors.[80] And joint systems are being used or planned for the Oakmead Industrial Park in Santa Clara, California,[81] a Denver office complex,[82] and a luxury hotel in the Virgin Islands.[83]

Scope of PUC Jurisdiction

In most states solar systems would not fall within the jurisdiction of state public utility commissions (PUCs), where those systems are operated and owned by a single entity on its own property for its own use (as may be the case with a university heating plant that services several dormitories and classroom buildings). And, to the extent that joint systems are operated by municipal utilities within the bounds of the franchising municipality, there should be no PUC jurisdiction in most states.[84]

But if two or more separate entities share a solar system, will they be subject to the jurisdiction of a PUC and the various burdens that accompany such regulation? Any regulatory jurisdiction that does exist over multi-user systems will be at the state level. Neither the Federal Power Commission nor any other federal agency has authority to regulate the production, sale, or shipment of heated or cooled water.[85]

At the state level, PUC jurisdiction over multi-user solar systems will turn on the interpretation of utility commission statutes. While electric utilities are almost universally regulated, regulation of utilities supplying heat or cold is not nearly so pervasive. Nevertheless, some states do have statutes granting the PUC jurisdiction over entities that provide heat or cold to the public. For example, the definition of public utility in Wisconsin includes every entity that

> may own, operate, manage or control any . . . plant or equipment or any part of a plant or equipment . . . for the production, transmission, delivery or furnishing of heat . . . either directly or indirectly to or for the public . . . 86/

And Illinois law defines a public utility as every entity that

> owns, controls, operates or manages within this state, directly or indirectly, for public use, any plant, equipment or property used or to be used for or in connection with, or owns or controls any franchise, license, permit or right to engage in . . . the production, storage, transmission, sale, delivery or furnishing of heat, cold, light, power, electricity or water . . . 87/

In these states the key legal issue on which jurisdiction turns is whether the heating or cooling entity is providing its services to the public. In short, a shared solar system will not be found to be a public utility if its energy is not provided "to the public."

The majority rule appears to be that a company is serving the public if it has "dedicated its property to public use."[88] Such dedication exists if the entity is serving, or has evidenced a readiness to serve, an "indefinite public" which has a legal right to receive service.[89] Evidence of dedication to public use includes a willingness to serve all who request service, wide solicitation of customers, the actual provision of service to all who ask for it, voluntary submission to state regulation, or an attempt to exercise the power of eminent domain.[90] It is important to note that this test does not require that an entity provide unlimited service to all who apply. It need only be willing to serve demands within its geographic area and to the extent of its capacity.[91]

Under a minority rule, certain activities that do not involve a dedication of property to public use may nonetheless be "so affected with the public interest" as to give rise to utility commission jurisdiction. This view has, for example, prevailed in at least one case involving a shopping center that generated its own electricity.[92]

It is difficult to predict whether multi-user systems will be subject to the burdens of PUC regulation. Under the rules discussed above, it is at least arguable that a multi-user solar system would fall within PUC jurisdiction in states whose utility statutes purport to regulate heat and cold. This uncertainty may discourage investors from developing shared solar systems.

Consequences of PUC Jurisdiction

There are several reasons why the owners of a shared solar system should fear PUC jurisdiction. If a shared solar system is found to be a public utility, it must file reports and accounts,[93] serve all customers who demand service within a given area,[94] submit its rate schedules to the PUC for approval,[95] continue providing service until given permission to discontinue,[96] provide safe and adequate service,[97] and comply with limitations on the issuance of securities.[98]

Perhaps the most significant burden that PUC jurisdiction would place on shared solar systems would be the duty to apply for certificates of public convenience and necessity. State utility regulatory statutes universally require that every public utility must obtain a certificate before beginning operation or even construction of its equipment.[99] Not only are certification proceedings often long and expensive, but the PUCs use the certification process to protect the monopoly of existing utilities. The general rule is that an existing utility shall be given a monopoly in its area unless the public convenience and necessity require otherwise. In practice this means that a new utility is almost never permitted in an area already served by an existing utility. Even where the existing utility is providing woefully inadequate and inefficient service, it will be permitted to exercise monopoly control over its service area if it promises to correct its shortcomings.[100]

The obvious question is whether a multi-user solar system found to be a public utility will be certified to provide heat and cold to areas being served by existing utilities. If the existing utility already provides heat and cold, the answer is fairly simple—the existing utility will probably be permitted to retain its monopoly in the absence of some overwhelming reason to the contrary.

The question is more problematical where the existing utility is providing heat and cold indirectly (by selling gas or electricity). In such instances, there appears to be little justification for denying certification to the shared solar

system. A recent study completed for the Energy Research and Development Administration concludes that there is substantial case precedent for certifying solar energy systems despite the fact that conventional facilities exist for providing heat and cold.[101] The precedents cited in that study suggest that new energy forms should be permitted to compete with existing energy forms if the new form is cheaper, cleaner, or in some way more efficient. An electric light company, for example, was certified despite the existence of an acetylene light company, on the grounds that the electric company provided a new and different service.[102] A gas company was certified for the same region served by an electric plant, although it would serve the same needs as the electric plant. The certification was justified because gas was cheaper and different.[103] Similarly, because an electric railway offers a different form of motive power than a steam railway, an electric railway won certification where a steam railway was already available.[104] Finally, several decisions allowed the certification of natural gas companies that would operate in areas already served by manufactured gas companies. Natural gas, the court said, is cleaner and more serviceable.[105]

Despite these precedents supporting certification of solar public utilities in areas served by competing utilities, it is clearly within the authority of some PUCs to deny certification. The mere possibility of PUC jurisdiction over shared solar facilities, and the threat that such jurisdiction may be used to prevent operation of the facilities, is a substantial barrier to the development of joint solar systems.

There are several obvious ways to eliminate these threats. The first, and simplest, would be for PUCs to declare that they will not choose to exercise jurisdiction over solar heating and cooling plants. This raises the question of whether utilities threatened by competition from the solar plants can compel the PUC to exercise its jurisdiction. This issue is likely to hinge on statutory construction issues: first, whether the challenged activity is a public utility, and second, whether the PUC <u>may</u> or <u>must</u> exercise jurisdiction over a public utility.

Because PUCs may be forced to assert jurisdiction over shared facilities, legislative action may be the only feasible approach. Legislative action may take several forms. A law might simply state that the public interest demands that shared solar facilities be permitted to compete with existing utilities. Such an approach would not preclude PUC regulation of other aspects of joint solar heating and cooling plants. A more drastic approach would be for the legislature to

completely exempt solar facilities from PUC jurisdiction. A related proposal has been put before the California legislature:

> . . . a person (a) using a power source other than a conventional power source for generating electricity solely for his own use and not for resale to others, except to an electric utility, and utilizing a transmission service . . . shall not be subject to regulation by the commission as a public utility. 106/

While this statute applies only to electrical generators, it could easily be broadened to encompass suppliers of heat and cold. Finally, the U.S. Congress could pass legislation to preempt state regulation of solar energy facilities. As discussed above, such preemptive action appears within Congress's authority, but is unlikely.

Public Utilities and Solar Commercialization

Our discussion so far has been confined to the role of utilities in providing backup service to solar energy users. An equally significant possibility is the direct involvement of utilities in the solar energy market. Utility participation might come in a variety of forms, from simply financing homeowners' purchases of collectors, an approach used in some states to help homeowners install insulation,[107] to the actual provision of solar collectors by utilities as an alternative form of energy service.

Many utilities are already considering such programs. The Southern California Gas Company, for example, is testing the use of solar assisted gas heating for apartment buildings.[108] Other utilities are also experimenting with solar energy,[109] and the utility-funded Electric Power Research Institute has a division devoted exclusively to solar energy projects.[110]

The merit of utility participation in the solar market is a hotly contested issue.[111] Utility advocates point to several possible advantages:

> First, although solar energy utilizes the "free" energy from the sun, it requires additional first or capital cost. Since the construction industry is highly "first-cost sensitive," we expect that solar energy will have some difficulty finding early, rapid acceptance. A utility company is used to high first-cost (capital intensive) business ventures. Utility company sponsorship in the "lease to the user" mode will do a lot to reduce this barrier. . .
>
> Second, the sponsorship of a utility company may help overcome market "fragmentation." If the utility company buys the equipment and leases it in a large-scale fashion, the solar industry will face at least one aggregated market (to the gas company). This may provide a large enough incentive to actively stimulate a solar energy system fabrication industry.

> Third, because a utility company already has a sales/distribution/service network which operates within the housing industry, the Utility Company scenario provides a way of "product fitting" solar energy systems.
>
> Finally, because of the traditional anti-innovation bias within the industry (a bias which is quite understandable given the industry environment), utility company sponsorship will help overcome some of the traditional "institutional-cultural biases" against solar energy which exist within the housing industry. 112/

On the other hand, utility critics have been quick to raise the spectre of utility "ownership of the sun," with the attendant evils of "excessive profit-taking and monopolistic favoritism in equipment purchases."[113] While some of this opposition no doubt arises from ideological beliefs, specialists in utility economics have also raised serious questions about the desirability of using utilities to promote solar energy. Roger Noll, although he ultimately concludes that a limited form of utility involvement may be desirable, notes two dangers:

> . . . a regulated utility has an incentive to invest in solar technology that is too durable, that is excessively efficient in converting sunlight to usable energy, and that requires inefficiently little maintenance. If permitted this would lead to excessive costs and prices for solar energy, and inefficiently slow adoption of the technology.
>
> Second, regulated utilities can use solar technology strategically to recapture some of the monopoly profits that regulation takes away and to foreclose competition in the solar energy business. 114/

A compromise suggested by some utility critics is the use of publicly-owned utilities, which are considered more amenable to public control.[115] Even if this approach avoids some of the perverse incentives that exist for regulated, privately-owned utilities, too few consumers are served by public utilities to make it a realistic option in the near future.

While these issues will undoubtedly be debated by economists for years to come, it is likely that some utilities will enter the solar market. Unless the political strength of utility opponents becomes much stronger, utilities should be able to convince their regulators of the desirability of what can be portrayed as an energy conservation program. The economic grounds for opposing the concept are sufficiently complex and esoteric to justify a decision either way. Moreover, gas utilities will have a strong incentive to undertake such activities because of the declining availability of their product. Without some new source of energy services, gas firms face the prospect of steadily declining reserves.

It is, therefore, appropriate to examine the legal framework in which utility participation in the solar market will be regulated. Several alternative regulatory policies will be discussed, and their legal consequences distinguished.[116] First, utilities might ask for a monopoly on the distribution of solar systems. They might hope to do this by denying backup energy to persons not using utility-supplied solar equipment. The utility could either rent or sell the equipment to the customer, but no other business could market competitive systems. Such a program would be extremely controversial; the necessary regulatory approval is unlikely. It is difficult to imagine any justification for the creation of a monopoly in solar equipment sales. In contrast, the generation of electricity is a natural monopoly that requires regulation to substitute for price competition.[117] Conceivably, electric utilities could argue that the use of solar collectors for heating so strongly affects the reliability of their systems that regulatory control over their use is justified. However, this issue could be addressed through appropriate rate structures.

Exclusive marketing rights would also probably run afoul of federal antitrust laws or state policies against anticompetitive practices. The Supreme Court decision Cantor v. Detroit Edison, discussed previously, limited state activity to provide exemptions if the challenged activity is central to the purposes of a state's regulatory program.[118] The light bulb exchange program under attack failed to meet the test since "there is no reason to believe that [without the program] Michigan's regulation of its electric utilities will no longer be able to function effectively."[119] A regulatory authority would have to offer a more convincing rationale for a program that even more clearly contravened federal antitrust principles.

It is far more likely that utilities will be allowed to compete with other distributors, than that they will be granted exclusive marketing rights. Utilities' sales programs could be part of utilities' regulated services, or through independent, separate subsidiaries. Precedents exist for both arrangements. For example, Pacific Telephone in California leased and installed mobile radio telephones for a number of years as an independent business. The company eventually decided that regulation was desirable, and filed an application with the state PUC. The commission accepted jurisdiction, and the service became a regulated business in competition with other unregulated concerns.

A utility is likely to view a regulated mode as desirable because of the opportunities for cost sharing and risk spreading. Stated in terms favorable to the utility, it has been observed that

> A regulated utility may be able to overcome [some of the initial market resistance to solar energy] . . . if it is permitted, through rates it charges its customers, to spread at least some of the costs associated with its solar energy program among all of its customers and thereby reduce the unit cost to those persons who choose to utilize solar devices or systems. 120/

On the other hand, utility critics have suggested other possible incentives, in the opportunity for manipulation of expenses between the regulated and unregulated markets:

> Because the utility is always more expert than the regulator on the technical and economic conditions facing the firm, a technological advance that provides more flexibility in firm operations can be used strategically by the utility to work a better deal from the regulated market. For example, a joint solar/gas utility would have to work out a method to allocate its costs between solar-assigned and gas-only services. If it could succeed in effectuating an allocation that, in fact, attributed too much cost to gas, it would succeed in taking advantage of its monopoly in the gas business to subsidize its solar energy business. 121/

We question whether the use of an unregulated subsidiary is any less subject to manipulation than a regulated component of a utility. In both situations, common expenses will be incurred for such things as advertising, equipment, etc., that could be allocated to either the utility or its solar business. Nor is there any inherent reason why accounting requirements should be any different simply because of the status of the solar entity. The process of allocating costs will require value judgments in either case; one man's accounting trick is another's example of a natural advantage.

Indeed, the principal reason for seeking utility participation in the solar business is the existence of economic advantages, such as the possibility of discounts for large purchases, access to the capital market at more favorable interest rates, an efficient distribution and billing system for energy services, and other relevant expertise. As long as these natural advantages are not abused through tying agreements or other illegal arrangements, no harm is done. Whether or not the solar business is regulated, close scrutiny by the public utilities commission will be desirable. The regulatory process is certainly accustomed to

the notion of cost sharing; lifeline rates, for example, diverge from simple cost-of-service principles, but are justified by other social objectives. The conservation of nonrenewable resources could easily be recognized as a benefit to all consumers of the utility, and therefore warrant some sharing of expenses from the solar business.[122] In any case, such cost sharing is likely to be tightly constrained by federal antitrust laws. Utility practices that are not explicitly authorized by utility commissions and perhaps by legislative action as well may be vulnerable to treble damage suits, a very effective weapon. Any effort to destroy competition by selling below market rates would very likely be challenged, whether or not the lower price is attributable to lower costs or profits.[123]

In addition to antitrust considerations, another important legal issue is the scope of PUC jurisdiction over a solar business. Competitors of a utility entering the solar business are likely to contest PUC jurisdiction. They would hope to prevent the utility from obtaining the advantages associated with a regulated rate of return.[124] This is likely to be particularly important in the early stages of the solar market, when small differences in price may be far less important to consumers than questions of reliability and performance guarantees.

The broad legal issues surrounding the exercise of PUC jurisdiction are described in the preceding section on regulatory burdens. Initially, there is a question of statutory construction—does the service fall within the businesses enumerated by the state code. Thus, jurisdiction could be based on a provision in the statute for the regulation of "heat services" or, less directly, on the grounds that such services are undertaken "in connection with or to facilitate" the utility's primary business. In the case of solar energy, for example, it could be argued that the impact of solar energy use of the utility's service is so great that combined regulated service is in the public interest.

The difficulty of drawing clear boundaries in this area is illustrated by the California case involving the exercise of jurisdiction by the California PUC over the rental and service of mobile radio telephones by Pacific Telephone.[125] The company had for some years offered the same service on an unregulated basis. At the company's request, the PUC accepted jurisdiction; a private competitor appealed. A divided California Supreme Court approved jurisdiction on the grounds that the service was closely related to the company's regulated businesses. As the Court interpreted the statute, the most relevant issue was the use to which the

technology was to be applied. Since telephone communication was intended, the service fell within the statute. Presumably, a similar argument could be made in behalf of regulating solar equipment as an energy service within the broad meaning of the statute. However, the issue is so borderline that the outcome is likely to rest on the wording of different statutes and the attitude of specific regulatory agencies and reviewing courts.

An alternative to utility participation in the solar energy market is to restrict such activities as much as possible. The extent to which such prohibitions could be imposed also depends on the ability of a PUC to assert jurisdiction over the offending activity. There is no legal basis for seeking jurisdiction unless the challenged activity affects the utility's regulated business.[126] However, it seems likely that a sufficient nexus between solar energy and other energy services exists to justify jurisdiction if the PUC chose to exercise it. As a mixed question of fact and law, the agency's judgment is likely to receive only limited deference.

On the other hand, there are instances where utility companies were essentially forced to accept limitations on their outside activities. AT&T, for example, accepted a limitation on unregulated businesses as part of a settlement to an antitrust suit in 1956.[127] The New York Public Service Commission limited participation by utilities in solid waste disposal to expenditures for modifications of, or additions to, boiler equipment and the purchase cost of processed solid waste fuel. The utilities were willing to accept such restrictions to avoid being stuck with a larger bill.[128] Even where regulatory commissions lack direct leverage, they have other means of exerting influence. Opposing the preferences of the PUC is bad business from the utility standpoint.

As a final alternative to the distribution of solar equipment, utilities might undertake to act simply as financiers or insurers. This may be an undesirable role from the standpoint of the utility since the profit allowed on its loans is likely to be less than the utility's usual rate of return on investments. Borrowing for solar purposes would also compete with more profitable utility programs, increasing their tremendous capital needs. There are precedents in the insulation financing programs discussed earlier, but the amount of money that would be involved in solar systems is substantially greater—insulation is usually a matter of a few hundred dollars; a solar system costs several thousand and up.

An assertive PUC might try to force a utility to finance solar purchases. The utility's certificate of operation is a license subject to conditions on whatever

terms the regulatory agency believes necessary.[129] A reluctant utility might be ordered to finance public purchase of solar collectors much in the way utilities have been ordered to use expensive technology to reduce air pollution.

Conclusions

In each of the three areas discussed, service and rate discrimination, regulatory jurisdiction, and utility participation in the solar market, significant uncertainty exists over appropriate regulatory policies and the impact of current law. From the perspective of conservationists and solar energy advocates, this problem is compounded by differences among utilities and states. Very few generalizations are possible. Examining these issues for each utility could be slow, complex, and expensive. This situation could very well impede the commercialization and acceptance of solar energy systems. Utilities are not likely to risk significant sums without some assurance of protection from the antitrust laws. Other distributors may be reluctant to start their own retail businesses if utilities are expected to enter the market. Homeowners will want to know the net cost and savings of their solar systems, a calculation that depends on expectations about future rate structures and available sources of auxiliary energy. Builders of multi-family dwellings may think twice about installing a solar system if they may be subject to PUC regulation.

The time is clearly ripe for legislation and administrative attention to these questions. There are actions that should be taken by the federal government, state governments, and public utility commissions. The federal government should address those technical issues, such as appropriate methodologies for evaluating the impact of solar systems on utility load patterns, that are common to every state and utility. This is already being done to some extent; several of the studies cited earlier were funded by the federal government. But a larger, more systematic effort in cooperation with utility regulators and utility representatives is appropriate. The federal government should also offer a clearinghouse for technical information and assist states in the formulation of policy agendas.

State legislatures must decide the broad policy issues involved in solar utility relationships. For example, a decision to subsidize the use of solar collectors can be clarified by technical studies about the effect of direct incentives for energy conservation. Political judgments must also be made about the

importance of the broad public interest in conservation of nonrenewable fuels, reduced dependence on foreign oil, etc. Moreover, a political decision must be made as to the relative merits of different forms of incentives--tax credits or loan subsidies may be a more equitable and efficient approach than the use of utility rate structures. Since these alternatives are not available to PUCs, state legislatures must make these choices. The federal government may also play some role.

Within the broad policy established by the state, considerable discretion must still be exercised by public utility commissions. The specifics of rate structures, scope of regulatory jurisdiction, and particular utility programs are too technical to be decided by legislative bodies. Until recently, any expectation that PUCs would voluntarily address such questions with more than a rubber stamp for utility proposals was unrealistic. Fortunately, the increasing political interest in utility regulatory decisions has made many of these agencies much more responsive. Still, such assertiveness remains the exception rather than the rule. To assure resolution of these issues through administrative processes, state legislation should require PUCs to investigate and recommend appropriate policies, subject to legislative review.

These recommendations are obviously directed more to the process of decision making than to substantive solutions for the issues we have raised. Unfortunately, the issues defy simply universal answers. The most important short-term need is to alleviate the uncertainty in the existing regulatory environment. The general approaches we have suggested would go far to meet this need.

1. Gerald Bennington, Marcia Bohannon, and Peter Spewak, An Economic Analysis of Solar Water and Space Heating, prepared for the Energy Research and Development Administration (MITRE Corporation, M76-79, Nov. 1976).

2. Recent estimates are that electric utilities will have to increase their generating capacity by 57 percent by 1985 in order to meet the expected growth in demand. Wall Street Journal, 24 Feb. 1977, p. 1. See also Energy Users Report (BNA), 23 Dec. 1976, p. G-3. Space heating accounts for about 20 percent of national energy needs, and the Energy Research and Development Administration target is incorporation of solar energy systems in 10 percent of new building starts by 1985. Energy Research and Development Administration, National Program for Solar Heating and Cooling (Oak Ridge, Tenn.: ERDA Technical Information Center, Document No. ERDA-23A, 1975). One estimate by a solar architect is that only 10 percent of existing homes are suitable for retrofit with solar energy, although the figure may be as high as 40 percent for commercial buildings. High Country News, 12 March 1976, p. 6. For a slightly more optimistic assessment by a solar industry representative, see Sheldon Butt, "Solar Market Capture and Market Penetration: Solar Heating and Cooling" (unpublished paper on file with the authors, 5 Oct. 1976).

3. See Stephen L. Feldman and Bruce Anderson, The Public Utility and Solar Energy Interface: An Assessment of Policy Options, prepared for the Energy Research and Development Administration (ERDA Contract No. E(49-18)-2523, 1976), pp. 47-48.

4. The Public Service Company of Colorado cited the increasing use of solar heating as one justification for a controversial new rate structure. See note 57 below.

5. See generally William Rosenberg, "Conservation by Gas Utilities as a Gas Supply Option," Public Utilities Fortnightly, 20 Jan. 1977, p. 13. The validity of claims that proved gas reserves are declining is currently the subject of intense controversy. See, e.g., James Miller, "Natural Gas: The Hidden Reserves," Washington Post, 13 Feb. 1977, p. C1. Whatever the outcome of this statistical debate, it remains likely that natural gas will never be as cheap or as taken for granted as it once was.

6. Solar assisted gas energy, or SAGE, is the name of a project of the Southern California Gas Company. See Feldman and Anderson, Public Utility and Solar Energy Interface, p. 22; and Alan Hirshberg, "Public Policy for Solar Heating and Cooling," Bulletin of the Atomic Scientist, Oct. 1976, pp. 37-40. The company recently requested a rate increase to pay for a solar demonstration project. Solar Energy Intellegence Report, 14 Feb. 1977, p. 31. A recent survey found over 100 utility projects involving solar energy, most of them in the area of heating and cooling buildings.

7. Public Power, Jan.-Feb. 1975, p. 28.

8. 16 U.S.C. §§ 791-825 (1970). See generally Edward Berlin, Charles J. Cicchetti, and William J. Gillen, Perspective on Power (Cambridge, Mass.: Ballinger Publishing Co., 1974); Thomas B. Stoel, Jr., "Energy," in Federal Environmental Law, eds. Erica L. Dolgin and Thomas G. P. Guilbert (St. Paul: West Publishing Co., 1974), p. 928; and Dow Chemical Co., Environmental Research Institute of Michigan, Townsend-Greenspan and Co., and Cravath, Swaine & Moore, "Legal and Regulatory Considerations," in Energy Industrial Center Study, prepared for the National Science Foundation, Office of Energy R&D Policy (Grant No. OEP74-20242, June 1975), pp. 311-96.

9. Berlin, Cicchetti, and Gillen, Perspective on Power, pp. 60-72; Steven Breyer and Paul MacAvoy, "The Federal Power Commission and the Coordination Problem in the Electrical Power Industry," Southern California Law Review 46 (1973): 661, 695-701; and Alfred E. Kahn, The Economics of Regulation, 2 vols. (New York: John Wiley & Sons, 1970-71), 2: 76.

10. Chapter I--Federal Power Commission, Part 35—Filing of Rate Schedules, 40 Fed. Reg. 48673 (1975).

11. Ibid., p. 48674.

12. Ibid.

13. E.g., H.R. 12461, 94th Cong., 2d Sess. (1976). See Robert Samuelson, "Battle Lines Are Being Generated for Reform of Electric Utility Rates," National Journal, 16 Oct. 1976, p. 1474; Hal Willard, "Electric Power: The Struggle Over Controls," Washington Post, 8 Aug. 1976, p. C3.

14. Willard, "Electric Power," p. C3.

15. A possible limitation is suggested by the Supreme Court decision in National League of Cities v. Usery, 426 U.S. 833 (1976). The Court held that federal regulations of the wages paid by state governments to their employees constituted an unconstitutional infringement on state sovereignty. The Court also granted certiorari in a Clean Air Act case testing the limits of federal authority to order indirect source controls such as parking bans and automobile inspection programs. Brown v. EPA, 521 F.2d 827 (9th Cir. 1975), cert. granted, 426 U.S. 904 (1976). Direct federal regulation of utilities would not be affected by these cases, but proposals to require state programs could be.

16. Samuelson, "Reform of Electric Utility Rates." See also Richard Morgan and Sandra Jarabek, How to Challenge Your Local Electric Utility (Washington, D.C.: Environmental Action Foundation, 1974).

17. Berlin, Cicchetti, and Gillen, Perspective on Power, p. 59.

18. Washington Star, 26 Jan. 1977, p. B1.

19. E.g., Southwestern Gas & Electric Co. v. Town of Hatfield, 219 Ark. 515, 243 S.W.2d 378 (1951). See generally Frank E. Cooper, State Administrative Law, 2 vols. (Indianapolis: Bobbs-Merrill Co., 1965), 1: 744-46.

20. "Utilities and Solar Energy: Will They Own the Sun?" People and Energy, Oct. 1976, p. 2; Mark Northcross, "Who Will Own the Sun?" The Progressive, April 1976, pp. 14, 16; and Richard Morgan, Tom Riesenberg, and Michael Troutman, Taking Charge: A New Look at Public Power (Washington, D.C.: Environmental Action Foundation, 1976).

21. Public Power, Jan.-Feb. 1975, p. 28.

22. The analysis in these sections draws heavily from existing treatises on public utility regulation, particularly A. J. G. Priest, Principles of Public Utility Regulation, 2 vols. (Charlottesville, Va.: Michie Co., 1969); and George E. Turner, Trends and Topics in Utility Regulation (Washington, D.C.: Public Utilities Reports, Inc., 1969). For an extremely lucid discussion of the economic issues raised by utility regulation, the reader is directed to Kahn, The Economics of Regulation. For a review of more recent developments, see Berlin, Cicchetti, and Gillen, Perspective on Power; Charles Cicchetti, William J. Gillen, and Paul Smolensky, The Marginal Cost and Pricing of Electricity: An Applied Approach (Springfield, Va.: National Technical Information Service, NTIS PB 255 967, 1976); and Samuel Huntington, "The Rapid Emergence of Marginal Cost Pricing in the Regulation of Electric Utility Rates Structures," Boston University Law Review 55 (1975): 589.

23. To economists "price discrimination" is value neutral and includes any case where the same product is sold at more than one price. For purposes of this discussion, "discrimination" is used in its more general sense to refer to any distinction in favor of or against a person. The economists' definition pinpoints the issue nicely: what is the relevant "product" or service? The way the product is defined will determine a fair price.

24. N.J. Stat. Ann. § 48:3-1, 48:3-4 (West).

25. Priest, Principles of Public Utility Regulation, 1: 286-88.

26. Ibid.

27. E.g., Re Pacific Gas & Elec. Co., 9 P.U.R.3d 97 (Cal. Pub. Util. Comm'n 1955).

28. See, e.g., Re Promotional Activities by Gas and Electric Companies, 68 P.U.R.3d 163 (N.Y. Pub. Serv. Comm'n 1967); Re Promotional Practices of Electric and Gas Utilities, 65 P.U.R.3d 405 (Conn. Pub. Util. Comm'n 1966); Re City Ice & Fuel Co., 260 App. Div. 537, 23 N.Y.S.2d 376 (1940); Gifford v. Central Maine Power Co., 217 A.2d 200 (Me. Sup. Ct. 1966); Re Delaware Power & Light Co., 56 P.U.R.3d 1 (Del. Pub. Serv. Comm'n 1964); Virginia State Corp. Comm'n v. Appalachian Power Co., 65 P.U.R.3d 283 (Va. Corp. Comm'n 1966); and Superior Propane Co. v. South Jersey Gas Co., 60 P.U.R.3d 217 (N.J. Bd. Pub. Util. Comm'rs 1965). See also Oklahoma v. Oklahoma Gas & Elec. Co., 9 P.U.R.4th 369 (Okla. Sup. Ct. 1975). But utility commissions have not been reluctant to strike down promotional practices they found to be of little value to the utility or the bulk of its customers. Re Southwest Gas Corp., 61 P.U.R.3d 467 (Cal. Pub. Util. Comm'n 1965); Re Carolina Power & Light Co., 52 P.U.R.3d 469 (N.C. Util. Comm'n 1964); Re Portland General Elec. Co, 67 P.U.R.3d 417 (Ore. Pub. Util. Comm'n 1967).

29. Belnap, McCarthy, Spencer, Sweeney & Harkaway, "Memorandum: Legal and Regulatory Analysis of Conservation Proposal for the Federal Energy Administration, Energy Resource Development" (8 Dec. 1976), p. 14; and cases cited above at note 28.

30. Priest, Principles of Public Utility Regulation, 1: 295, 300-02. California Portland Cement Co. v. Union Pac. R.R., 12 P.U.R.3d 482, 485-86 (Cal. Pub. Util. Comm'n 1955).

31. Priest, Principles of Public Utility Regulation, 1: 288.

32. See Pittsburgh v. Pub. Util. Comm'n, 168 Pa. Super. Ct. 95, 78 A.2d 35 (1951).

33. Ten Ten Lincoln Place, Inc., v. Consolidated Edison Co., 273 App. Div. 903, 77 N.Y.S.2d 168 (1948); Smith v. Southern Union Gas Co., 58 N.M. 197, 269 P.2d 745 (1954).

34. E.g., North Carolina ex rel. Util. Comm'n v. Carolina Power & Light Co., 250 N.C. 421, 109 S.E.2d 253 (1959); Priest, Principles of Public Utility Regulation, 1: 324-25.

35. Chicago Bd. of Trade v. United States, 223 F.2d 348 (D.C. Cir. 1955).

36. Cantor v. Detroit Edison Co, 96 S. Ct. 3110 (1976).

37. Ibid., p. 3116.

38. Refusals to deal are a classic violation of section 2 of the Sherman Act, 15 U.S.C. § 2 (Supp. IV 1974). See, e.g., Otter Tail Power Co. v. United States, 410 U.S. 366 (1972), where a public utility was found to have violated section 2 of the Sherman Act by refusing to sell electricity to a municipally operated distribution system.

39. Such conduct could be viewed as temporary price cutting to put rival solar firms out of business. See Porto Rican American Tobacco Co. v. American

Tobacco Co., 30 F.2d 234 (2d. Cir 1929). Or, it might be viewed as an illegal tying arrangement in situations where a solar customer's receipt of favorable treatment is conditioned on his acceptance of the utility service. Tying arrangements are another classic antitrust violation. See 15 U.S.C. § 14 (1970); International Business Machine Corp. v. United States, 298 U.S. 131 (1936).

40. Robinson-Patman Act § 2(a), 15 U.S.C. § 13(a) (1970).

41. The Fourteenth Amendment permits the States a wide scope of discretion in enacting laws which affect some groups of citizens differently than others. The constitutional safeguard is offended only if the classification rests on grounds wholly irrelevant to the achievement of the State's objective. State legislatures are presumed to have acted within their constitutional power despite the fact that, in practice, their laws result in some inequality.

McGowan v. Maryland, 366 U.S. 429, 425-26 (1961).

42. Or. Rev. Stat. § 757.020 (1974).

43. N.Y. Pub. Serv. Law § 65 (McKinney).

44. Wis. Stat. Ann. § 196.03(1) (West). For a general discussion of a utility's duty to serve, see Note, "Utility's Duty to Serve," Columbia Law Review 62 (1962): 312; and Donald P. Hodel and Ronald G. Wendel, "The Duty and Responsibility of Oregon Public Agencies to Provide Adequate and Sufficient Electrical Utility Service," Oregon Law Review 54 (1975): 539.

45. New York & Queens Gas Co. v. McCall, 245 U.S. 345, 351 (1918).

46. Priest, Principles of Public Utility Regulation, 1: 237-38.

47. Ibid., pp. 240-42.

48. New York Pub. Serv. Comm'n, Case 26286 (April 16, 1974); and National Swimming Pool Institute v. Alfred Kahn, 364 N.Y.S.2d 747, 9 P.U.R.4th 237 (1974). See also "Ban on Heated Pools Leaves Californians Boiling," New York Times, 5 Feb. 1976.

49. Colorado Pub. Util. Comm'n, Decision No. 87640 (Oct. 21, 1975); Leroy Fantasies, Inc. v. Swidler, 44 App. Div. 2d 266, 354 N.Y.S.2d 182, 4 P.U.R.4th 334 (1974), appeal denied, 34 N.Y.2d 519, 316 N.E.2d 884 (1974).

50. See generally Samuelson, "Reform of Electric Utility Rates"; Willard, "The Struggle Over Controls"; and "Bigger Electric Bills Ahead for Big Business," Business Week, 29 Nov. 1976. Several periodicals are devoted exclusively to utility issues. Public Utilities Fortnightly emphasizes the utility perspective; Power Line presents an environmentally oriented view.

51. See Berlin, Cicchetti, and Gillen, Perspective on Power, chaps. 1-3.

52. The all-electric customer is given a small advantage. See, e.g., Federal Power Commission, National Electric Rate Book: Colorado (Washington, D.C.: Government Printing Office, Aug. 1975), p. 3. (Rate books are published for each state and updated periodically.)

53. Letter insert in monthly bill from Potomac Electric Power Co. to customers (Jan. 1977).

54. In conversations with officials at the Energy Research and Development Administration, the authors were told that denials of all-electric rates to solar users have already occurred.

55. E.g., Southern California Edison, Schedule No. 5: "Standby."

56. For a description of technologies for generating electricity from solar energy, see Wilson Clark, Energy for Survival (Garden City, N.Y.: Anchor Press, 1974), pp. 383-95.

57. Testimony of James H. Ranniger, Manager of Rates and Regulation for the Public Service Company of Colorado, Colorado Public Utilities Commission Investigation and Suspension Docket No. 935 (22 Sept. 1975), p. 14.

58. Testimony of Dr. Ernst Habict, Jr. and Dr. William Vickrey for the Environmental Defense Fund, Colorado Public Utilities Commission Investigation and Suspension Docket No. 935 (25-26 Sept. 1975). See generallly Gary Mills, "Demand for Electric Rates: A New Problem and Challenge for Solar Heating," ASHRAE Journal, Jan. 1977, p. 42.

59. Mills, "Demand for Electric Rates," p. 42. The solar system would save more of the entire bill but for non-heating demands for electricity for appliances.

60. Results of these studies are summarized in G. F. Swetnam and D. M. Jardine, Energy Rate Initiatives Study of the Interface Between Solar and Wind Energy Systems and Public Utilities, prepared for the Federal Energy Administration (MITRE Corporation, Technical Report 7431, draft, 20 Dec. 1976); and Feldman and Anderson, Public Utility and Solar Energy Interface.

61. Stephen L. Feldman and Bruce Anderson, Utility Pricing and Solar Energy Design (NSF/RANN Grant No. APR-75-18006, 1976), p. 117.

62. Present solar building designs do not generally avail themselves to the exclusive use of off-peak electric power but generally will use a portion of their auxiliary energy during peak periods. This situation can be remedied by modifications to the control system, storage and collector size, use patterns or a combination of these factors. By designing the solar building to utilize only off-peak energy, the building owner may incur increased capital costs, these in turn may be offset by a decrease in his energy bill due to the use of lower cost off-peak electricity.

Ibid., p. 28. This analysis only holds true as a description of heating needs. The technology for cooling with solar energy is less advanced; solar energy cooling and storage could be analyzed in the same way but remains more hypothetical than real. Ibid., p. 18. See also S. A. Klein, W. A. Beckman, and J. A. Duffie, "A Design Procedure for Solar Heating Systems," Solar Energy 18 (1976): 113.

63. In the Matter of Proposed Increased Rates and Charges Contained in Tariff Revisions Filed by Public Service Company of Colorado, Decision No. 87460 (Colo. Pub. Util. Comm'n, Oct. 21, 1975).

64. Home Builders Ass'n of Metropolitan Denver v. Public Service Co. of Colorado, Decision No. 89573 (Colo. Pub. Util. Comm'n, Oct. 26, 1976).

65. "Flat rate" is also used to denote a rate in which the total bill is the same no matter how much power is used, as opposed to a rate in which the per-kwh charge is the same no matter how much is used.

66. E.g., Miller-Warren Energy Lifeline Act, 1975 Cal. Stats. ch. 1010. For other examples, see Energy Users Report (BNA), 16 Dec. 1976, p. A-25.

67. See "'Lifeline Rates'--Are They Useful?" Energy Conservation Project Report, No. 4 (Jan. 1976), p. 13 (ECP Report is a publication of the Environmental Law Institute, Washington, D.C.). Some authorities question whether the lifeline concept is an effective method to aid lower income groups since these persons often consume relatively high amounts of energy.

68. Feldman and Anderson, Utility Pricing, p. 120.

69. N.J. Stat. Ann. § 48:3-1, 48:3-4 (West).

70. 88 N.J. Super. 233, 211 A.2d 806, 60 P.U.R.3d 210 (1965).

71. N.J. Stat. Ann. § 48:3-1, 48:3-4 (West).

72. 88 N.J. Super. at 236, 211 A.2d at 808, 60 P.U.R.3d at 212.
73. Re Promotional Activities by Gas and Electric Corps., 68 P.U.R.3d 162 (N.Y. Pub. Serv. Comm'n 1967).
74. See Priest, Principles of Public Utility Regulation, 1: 318.
75. From 1956 to 1970, the average cost of electricity in the United States declined from 2.61 cents per kwh to 2.10 cents. While average rates declined, the costs of supplying electricity to certain types of loads and to customers during peak hours increased rapidly. Utilities subsidize some customers by overcharging others. Since 1970, costs have increased steadily; the average cost per kwh in 1975 was 3.21 cents, despite an equally steady rise in consumption during the same period. Samuelson, "Reform of Electric Utility Rates," p. 1475. See also Paul Joskow, "Inflation and Environmental Concern: Structural Change in the Process of Public Utility Price Regulation," Journal of Law and Economics 17 (1974): 291. The extent of economic distortion in the cost of new generation facilties is described in Stephen O. Anderson, "Economics of Electricity Generation: The Context of the 1976 California Nuclear Powerplant Initiative," in Federal Reserve Bank of San Francisco, California Energy: The Economic Factors (1976).
76. Lefkowitz v. Public Serv. Comm'n, No. 593 (N.Y. Ct. App. Dec. 28, 1976), aff'g 377 N.Y.S.2d 671, 50 App. Div. 2d 338 (Sup. Ct. 1975).
77. 377 N.Y.S.2d at 674.
78. E.g., Re Pacific Power & Light Co., Case No. U-1046-29, Order No. 8567, 69 P.U.R.3d 367 (Idaho Pub. Util. Comm'n 1967); In the Matter of the Application of Michigan Consol. Gas Co. for Authorization of a Program for the Conservation of Natural Gas, 1 P.U.R.4th 229 (Mich. Pub. Util. Comm'n 1973). Related decisions by public utility commissions have allowed the restriction of energy to approved uses and the prohibition of energy use by uses considered wasteful.
79. Cal. Pub. Util. Code §§ 25007, 2781-88 (West); N.J. Stat. Ann. §§ 48:2-48:23 (West).
80. New England Solar Energy Newsletter, Oct. 1976, p. 2.
81. Terrence M. Green, "Factory to be Heated by Solar Energy," Los Angeles Times, 31 Oct. 1976, pt. 9.
82. Solar Utilization News, Nov. 1976, p. 3.
83. Energy Digest, Nov. 1976, p. 12.
84. In many states, municipal utilities are exempt from PUC jurisdiction. E.g., Fla. Stat. Ann. § 266.02 (West). But see Wis. Stat. Ann. § 196.58(5) (West).
85. Generally, the Federal Power Commission has jurisdiction only over hydroelectric plants and the interstate transport and sale of electricity. See 16 U.S.C. §§ 797, 824 (1970).
86. Wis. Stat. Ann. § 196.01 (West).
87. Ill. Rev. Stat. ch. 111 2/3, § 10.
88. E.g., Allen v. California R.R. Comm'n, 179 Cal. 68, 175 P. 466 (1918).
89. "The principal determinative characteristic of a public utility is that of service to, or readiness to serve an indefinite public . . . which has a legal right to demand and receive its services or commodities." Motor Cargo, Inc. v. Board of Township Trustees, 52 Ohio Op. 257, 258, 117 N.E.2d 224, 226 (C.P. Summit County 1953). See generally A. J. G. Priest, "Some Bases of Public Utility Regulation," Mississippi Law Journal 36 (1965): 18. See, e.g., Peoples Gas Light & Coke Co. v. Ames, 359 Ill. 132, 134 N.E. 260 (1935); Bricker v. Industrial Gas Co., 58 Ohio App. 101, 16 N.E.2d 218 (1937); Cawkes v. Meyer, 147 Wis. 320, 133 N.W. 157 (1911); Claypool v. Lightning Delivery Co., 38 Ariz. 262, 299 P. 126 (1931); Story v.

Richardson, 186 Cal. 162, 198 P. 1057 (1921); Sutton v. Hunziker, 75 Idaho 395, 272 P.2d 1012 (1954); Missouri v. Brown, 323 Mo. 818, 19 S.W.2d 1048 (1929); Re Nafe, 4 P.U.R.3d 369 (Ohio Pub. Util. Comm'n 1953); Limestone Rural Tel. Co. v. Best, 56 Okla. 85, 155 P. 901 (1916); Schumacher v. Railroad Comm'n, 185 Wis. 303, 201 N.W. 241 (1924).

90. See Dow Chemical Co. et al., Energy Industrial Center Study, p. 373 and cases cited therein.

91. E.g., Camp Rincon Resort Co. v. Eshleman, 172 Cal. 561, 158 P. 186 (1916); Higgs v. City of Fort Pierce, 118 So.2d 582 (Fla. 1960); State Pub. Util. Comm'n v. Bethany Mut. Tel. Ass'n, 270 Ill. 183, 110 N.E. 334 (1915).

92. Cottonwood Mall Shopping Center, Inc. v. Utah Power & Light Co., 440 F.2d 36 (10th Cir. 1971).

93. E.g., Fla. Stat. Ann. § 366.05(1) (West).

94. See notes 43-48 above and accompanying text.

95. E.g., Cal. Pub. Util. Code § 454 (West).

96. E.g., Wis. Stat. Ann. § 196.81 (West).

97. E.g., Cal. Pub. Util. Code § 761 (West).

98. E.g., Fla. Stat. Ann. § 366.04 (West).

99. E.g., Ill. Rev. Stat. ch. 111 2/3, §56.

100. See, e.g., Kentucky Util. Co. v. Public Serv. Comm'n, 252 S.W.2d 885 (Ky. Ct. App. 1952); William K. Jones, Regulated Industries: Cases and Materials (Brooklyn: Foundation Press, 1967), p. 347, n. 2.

101. See generally Wilson, Jones, Morton & Lynch, The Sun: A Municipal Utility Energy Source, prepared under an agreement with the city of Santa Clara, Cal., with the support of the Energy Research and Development Administration (Santa Clara, Cal., 1976).

102. Re Markham, 1916A P.U.R. 1007, 1012 (Mo. Pub. Serv. Comm'n 1915).

103. Re Gas Fuel Service, 3 P.UR. (Nn.s) 55, 60 (Cal. R.R. Comm'n 1933).

104. Southern Pacific Co. v. San Francisco-Sacramento R.R., 1929A P.U.R. 116, 112 (Cal. R.R. Comm'n 1928).

105. E.g., McFayden v. Public Util. Consol. Corp., 50 Idaho 561, 299 P. 671 (1930).

106. Cal. A.B. 4069 (1976).

107. See note 78 above and accompanying text.

108. See note 5 above.

109. A recent survey found more than 100 electric utilities supporting solar energy research. Most of these projects involved the use of solar energy for heating and cooling buildings. Electric Power Research Institute, Survey of Electric Utility Solar Projects (Palo Alto, Cal., ER 321-SR, 1977).

110. For a description of EPRI solar research projects, see Electric Power Research Institute, Electric Power Research Institute: Solar Energy Program, Fall of 1976 (Palo Alto, Cal., EPRI RP549, 1976). A summary is also provided in Feldman and Anderson, Public Utility and Solar Energy Interface, pp. 27-32.

111. See generally Feldman and Anderson, Public Utility and Solar Energy Interface; and Sweetnam and Jardine, Energy Rate Initiatives Study.

112. Alan Hirshberg and Richard Schoen, "Barriers to the Widespread Utilization of Residential Solar Energy: The Prospects for Solar Energy in the U.S. Housing Industry," Policy Sciences 5 (1974): 453, 468.

113. "Utilities and Solar Energy: Will They Own the Sun?"; and Northcross, " Who Will Own the Sun?"

114. Roger Noll, "Public Utilities and Solar Energy Development" (unpublished paper on file with the authors, 1976). This paper appears as a section of Feldman

and Anderson, Public Utility and Solar Energy Interface, pp. 176-98; citations will be provided to this latter version, in this instance p. 183.

115. See notes 16-17 above and accompanying text, and Morgan, Riesenberg, and Troutman, Taking Charge: A New Look At Public Power.

116. This delineation follows that used in Feldman and Anderson, Public Utility and Solar Energy Interface, pp. 178-81.

117. See Kahn, The Economics of Regulation, 1: 11, 12.

118. 96 S. Ct. 3110 (1976).

119. Ibid., p. 3118. Compare Gas Light Co. of Columbus v. Georgia Power Co., 440 F.2d 1135 (5th Cir. 1971) (electric utility rates and practices immune from private antitrust suit where PUC gave lengthy consideration to challenged activities); Washington Gas Light Co. v. Virginia Elec. & Power Co., 438 F.2d 248 (4th Cir. 1971) (electric utility rate preference for underground transmission lines immune from private antitrust even though PUC did not specifically approve).

120. Jay Lake, "Legal Aspects of the Use of Solar Energy for Water and Space Heating" (unpublished paper on file with the authors, 1976), pp. 17-18.

121. Noll, "Public Utilities and Solar Energy Development," pp. 183-84.

122. Lake, "Legal Aspects of Use of Solar Energy," pp. 17-18.

123. Turner, Trends and Topics in Utility Regulation, pp. 407-09.

124. See, e.g., Commercial Communications, Inc. v. California Pub. Util. Comm'n, 50 Cal. 2d 512 (1958) (challenge to exercise of jurisdiction by PUC over rental of mobile radio telephones by a regulated utility).

125. Ibid.

126. See Turner, Trends and Topics in Utility Regulation, p. 20.

127. United States v. Western Electric and AT&T, 13 Rad. Reg. (P-H) ¶ 2143, 1956 Trade Reg. Rep. (CCH) ¶ 71,134 (D.N.J. 1956) (consent judgment).

128. P. M. Meier and T. H. McCoy, Solid Waste as an Energy Source for the Northeast, prepared for the Energy Research and Development Administration (Upton, N.Y.: Brookhaven National Laboratory, No. 50550, 1976), p. 96.

129. See, e.g., Colo. Rev. Stat. § 40-3-111, 40-4-102. This power is frequently exercised in the context of environmental controls; the PUC may license a new facility subject to the condition that it meet all air pollution standards, which require the use of expensive sulfur-removal technology for coal-fired plants. See "Pawnee Plant for Morgan Stirs Up Verbal Dust," Denver Post, 9 May 1976, p. 18.

5

MANDATORY INSTALLATION

The most direct way to hasten the introduction of solar heating and cooling would be simply to require all structures in a community to use solar systems. Related, but less severe approaches would be to require only new buildings to use solar energy, or merely to require new buildings to be designed so that they are amenable to future retrofitting with solar devices.

Whether applied to new or existing buildings, such mandatory requirements could be drawn broadly or narrowly. They might require that buildings have collector panels and associated equipment unless installation and use of these devices is technologically or economically infeasible. If the goal is to simplify future retrofits, the law could merely require that each new building be equipped with a "T" connector on its hot water line, or it could require the installation of piping, roof supports, and heat storage space for a solar device.

Because interest in solar energy is fairly recent, and because of a reluctance to force installation of expensive additions to already expensive American construction, it is not surprising that there are few models for this kind of solar energy law. Florida has taken an extremely small step in this direction by requiring a very small modification of the plumbing in structures being built. The goal is to make it easier to add solar energy devices at a later time:

> Single-family residences; solar water heating requirements.
>
> Notwithstanding the provisions of sections 553.12 and 553.13, no single-family residence shall be constructed within the state unless the plumbing therein is designed to facilitate the future installation of solar water-heating equipment. The words "facilitate the future installation" as used in this section shall mean the provision of readily

> accessible piping to allow for pipe fittings that will allow easy future connection into the system of solar water-heating equipment. It is the intent of the legislature to minimize cost of rearranging plumbing should solar water heaters be added to buildings. (Effective October 1, 1974.) 1/

According to Turning Toward The Sun,

> The state has interpreted this law as requiring a T-pipe fitting on the inlet water pipe of the water heating unit. This [building] code provision for solar retrofitting does not presume the future solar collector to be either a roof or a ground mounted system, and therefore does not require any special orientation or structural considerations for the placement of the collector device. 2/

The American Bar Foundation study also contains a suggested statute that deals with this question:

> § 1(a) Municipalities that regulate land use shall enact regulations to encourage or require use of available solar energy systems in construction of new buildings of appropriate design, and in reconstruction and alteration of present buildings. These regulations shall consider the type, placement, and expected life of the buildings, as well as height and bulk of other structures, placement of potential structures, vegetation shadow areas, and cost-effectiveness of solar energy systems. Where solar energy systems are required, the municipality shall create and protect solar skyspace to the extent necessary to make the systems cost-effective.
>
> (b) Municipalities may create zones or districts where available solar energy systems are encouraged or required on appropriate buildings. 3/

Such legislation may be expensive to implement and limits a property owner's freedom of choice. But it does have parallels in other areas of the law. For example, in a few communities, food waste disposal units are mandatory. The principal legal question concerning all such mandatory requirements is whether they constitute a "taking" under the Fifth Amendment to the Constitution. Our state and local governments have the power to regulate private actions for the public welfare. This regulatory power, called the "police power," is extremely broad, but it is not unlimited. The Supreme Court has called the police power "one of the least limitable of governmental powers."[4] But when regulation exceeds some hard-to-define point and affects the interests of citizens in a way that violates the instincts of a court, it becomes a "taking of property," which must be paid for. Governments can "take" property when no physical invasion is involved. A diminution of value can be a taking. In Pennsylvania Coal Co. v. Mahon, the Supreme Court said: "The general rule at least is that while property may be

regulated to a certain extent, if regulation goes too far it will be recognized as a taking."[5] The question, of course, is whether mandatory requirements for solar energy devices involve regulation beyond that "certain extent" as the Court so Delphically expressed it.

Mandatory Retrofitting of Solar Equipment

One method for determining how far regulation can go before it becomes a taking is to look at mandatory installation requirements for other devices on buildings. We have chosen to examine the legality of regulations that require building owners to install improvements, even though their buildings, when constructed, conformed to the building code. This situation presents the most difficult legal case; if it could survive legal challenge, then less stringent regulations would also be upheld.

One writer has stated the problem this way:

> Regulations requiring property owners to engage in specified conduct at their own expense, or to make prescribed conditions or expenditures for specified public purposes, are also frequently employed. . . . Since the economic consequences of such demands are generally immediate, direct, and quantitatively certain, a potential conflict with constitutional just compensation requirements is obviously presented. 6/

There are countless cases that uphold the right of the state to require various, often expensive, additions to buildings. Many of these cases deal with rooming houses and apartment buildings: the state traditionally plays an important protective role here because of the presumed inability of lodgers and tenants to put market or political pressure on landlords. For example, in Queenside Hills Realty Co. v. Saxl, a lodging house built in 1940 in compliance with all applicable laws became subject to a 1944 requirement that a sprinkler system be installed in all lodging houses. The Supreme Court upheld the retroactive application of the law:

> In no case does the owner of property acquire immunity against exercise of the police power because he constructed it in full compliance with the existing laws. 7/

But because courts recognize that the retroactive application of building requirements creates difficult practical problems, the courts require a greater showing of public need than for prospective applications. The Supreme Court of Illinois made this distinction when it held that regulations could be valid only if it appears "the public welfare demands retroactive application." Cautioning that the

power is "circumscribed by the facts of each situation," the court added the caveat that affected property owners should not suffer "unreasonable exactions."[8]

Unfortunately, there is little guidance concerning what constitutes a reasonable or an unreasonable exaction. A New York Court of Appeals decision, Adamec v. Post, offered this guidance:

> A small additional cost in erecting a new building in conformity with a regulation calculated to "secure the general comfort and health of the public" ... may be reasonably justified by the result to be attained, while the cost of alteration of an old builidng to conform to such a regulation may be too great to be reasonably required for a doubtful or slight public benefit. 9/

The principle of the Adamec case, that a building owner may be forced to spend an amount that roughly correlates with the public benefit that will be gained, could bar the mandatory imposition of solar equipment. The benefits of solar energy to the nation are clear, but it would presently cost property owners so much more to heat and cool their structures with solar power than it would for them to use conventional systems that a law requiring solar systems on all existing building would probably succumb if constitutionally challenged.

Is it possible to require mandatory retrofitting on buildings if the regulation permits building owners to show that for their own case solar energy heating and cooling is not feasible or is uneconomic? A recent Supreme Court of Missouri case, City of St. Louis v. Brune,[10] suggests that this case-by-case approach would be constitutional. In Brune, a St. Louis ordinance required the installation of bathtubs and showers, supplied with hot water. The court, noting that these appliances were not essential for healthful living, did not strike the entire ordinance, but found that "its effect and its reasonableness vary as to each property affected and a decision must be made on each separate state of facts as they arise."[11] The facts considered material by the court in Brune were that the buildings to which the ordinance was being applied were located in a deteriorating part of the city, had neither sale nor loan value, were seventy years old, and would have required an investment of approximately $7,800 per builidng. The court found that the ordinance was "unconstitutional as applied to these two properties,"

> [and] unreasonable, arbitrary and confiscatory as so applied, and consequently a deprivation of due process; and that, as so applied, it would have no substantial or reasonable relationship to the public health, welfare, or safety. 12/

In addition to the economic facts relevant to retrofit situations, there are also physical considerations (like solar access, insolation, and orientation) that influence the effectiveness of a solar collector. Nevertheless, a carefully drawn ordinance would probably be upheld if it permitted building owners to be excepted if they could demonstrate that it was uneconomic for their building to use solar energy, or that their building's location was inappropriate.

One other feature of a constitutional law needs to be discussed. This is that the mandatory imposition of retrofitting on a massive scale might find many building owners short of capital. Therefore, this sudden demand for an expenditure may impose special hardships that would form the basis of challenges. Giving the building owner a reasonable time to comply would make a mandatory ordinance more constitutionally palatable. For instance, persons who had installed a new conventional heating system just a week before the ordinance took effect, should be permitted to amortize their fossil fuel system over its life before being required to install a solar system. The case of the new equipment owner is only the strongest form of the general point that existing equipment should not be ripped out immediately, but rather should be allowed to serve some or all of its remaining life. According to the study done for the Energy Research and Development Administration for the city of Santa Clara, California, elimination of nonconforming buildings is usually set over the relatively long period of a structure's useful life.[13] Such an approach furthers the goal of the mandatory installation law--saving scarce fossil fuels--as a lot of fuel is consumed in the manufacture, transportation, etc., of all energy systems.

The following guidelines would help insure that a requirement of mandatory installation of solar devices in exising buildings would be upheld:

1. The ordinance should only require the installation of devices that are cost-effective for most applications.

2. The ordinance should contain a convincing showing that solar energy would have substantial public benefits in the particular jurisdiction.

3. The ordinance should excuse building owners from compliance if they can show that either economic or physical facts make the use of solar devices impossible or uneconomic for their structure.

4. The ordinance should permit existing devices (heating and cooling plants, hot water heaters, and the like) to be amortized over some period close to or equal to their actual life.

Mandatory Installation of Solar Equipment in New Structures

For new construction, building regulations are much more likely to survive judicial scrutiny. Building codes, zoning regulations, and site plan review are all well accepted features of American regulation; in some places, aesthetic zoning rules regulate the very look of new construction within specified areas. In new subdivisions, the orientation of the streets and houses can be affected by legal controls because they are not yet in place. Within the building shell, building codes already speak (either in specification or performance language) about the kinds of heating, cooling, and hot water heating equipment that is acceptable. Major expenditures are often required. Adequate insulation, solid foundations, and the like, cost money, yet they can clearly be mandated.

The only substantial legal question is whether the state or local building code enabling legisation is broad enough to include energy regulation. This question has been favorably resolved in a number of states either by interpretation of the agencies or the attorney general or, more conservatively, by amending the enabling legislation to specifically mention energy regulation.

As in the case of existing buildings, a law that is valid in general may be invalid as applied to specific structures that have special reasons for not being able to comply. Thus, a method for obtaining variances or exemptions for special hardship cases should be a feature of the law. With that single caveat, we conclude that there are no legal barriers to flatly requiring the installation of solar energy devices on structures not yet built.

Role of the Federal Government in Mandatory Installation

Traditionally, building regulation has been the subject of state or local law. (increasingly, building codes are becoming statewide, although studies have shown that in the United States there are still between 5,000 and 8,000 different building code jurisdictions.) But there is one area in which the federal presence already exists: the Minimum Property Standards (MPS) of the Department of Housing and Urban Development. The MPS technically apply only to construction that is supported directly or indirectly by federal funds (including loan guarantees from the Federal Housing Administration or the Veterans Administration). The number of homes so financed is relatively small. In fact, however, many home builders follow the terms of the MPS because they do not know in advance what type of

financing a future, unknown buyer will select. There are no adequate figures available as to what percentage of homes comply with the MPS, but some HUD sources have suggested a minimum of 20 percent.

The MPS currently regulate a variety of contruction methods and items that must be included if a home is to qualify for federal financial assistance. (For example, there is a current dispute concerning whether the MPS should require smoke detector units; the home builders are concerned that additional regulations will price still more potential buyers out of the market.) There appears to be no legal barrier to amending the MPS to require all new construction to provide for actual or future solar energy utilization.

Conclusion

Although we anticipate that carefully drawn mandatory installation laws would probably survive legal challenges, we doubt the wisdom of such laws at this stage in the development of solar energy technology. Because of what we understand to be the economic cost/benefit ratios between solar energy and other heating and cooling modes (particularly regulated natural gas), we believe that mandatory installation would be an unwise policy.

NOTES: MANDATORY INSTALLATION

1. Fla. Stat. Ann. § 553.87 (West Supp. 1975).
2. National Conference of State Legislatures Renewable Energy Project, Turning Toward the Sun, 2 vols. (Denver, RANN Document No. NSF-RA-G-75-052, n.d.), 1: 24.
3. William Thomas, Alan Miller, and Richard Robbins, "Legal Issues Related to Use of Solar Energy Systems" (Aug. 1976 draft of forthcoming article in American Bar Foundation Research Journal).
4. Queenside Hills Realty Co. v. Saxl, 328 U.S. 80, 83 (1946).
5. 260 U.S. 393, 415 (1922).
6. Arvo Van Alstyne, "Taking or Damaging by Police Power: The Search for Inverse Condemnation Criteria," Southern California Law Review 44 (1971): 1, 48-49.
7. 328 U.S. at 83 (1946).
8. Abbate Bros., Inc. v. City of Chicago, 11 Ill. 2d 337, 142 N.E.2d 691, 694 (1957).
9. 273 N.Y. 250, 256, 7 N.E.2d 120, 122 (1937).
10. 515 S.W.2d 471 (1974).
11. Ibid., p. 476.
12. Ibid., p. 477.
13. Wilson, Jones, Morton & Lynch, The Sun: A Municipal Utility Energy Source, prepared under an agreement with the city of Santa Clara, Cal., with the support of the Energy Research and Development Administration (Santa Clara, Cal., 1976).

6

ERDA PATENT POLICY

ERDA contracts for research, development, and demonstration of solar heating and cooling systems include clauses that specify who has what rights in resulting patents, inventions, data, etc. This chapter deals with the regulations and statutes that dictate the terms of these clauses, and examines their effects as possible barriers to achieving the objectives of the solar heating and cooling program.

The objectives of ERDA's patent policy are to encourage participation in ERDA's research, development, and demonstration work; promote early use of the work results; and foster competition and prevent undue market concentration. In general, we find that the statute and regulations seem well designed to achieve these objectives. Some modifications, however, would be helpful, especially in the expression of underlying policy. Before turning to the details of ERDA patent policy, we will briefly discuss the nature of patent rights, and broadly summarize ERDA patent policy.

Patent Rights

The purpose of the U.S. patent system is to promote the progress of science and the useful arts by securing to inventors, for limited times, the exclusive right to their inventions (U.S. Const. art. I, § 8, cl. 8). A patent grant gives the patentee the power to exclude others from practicing (that is, making, using, or selling) the invention for 17 years (35 U.S.C. § 154). The patent does not necessarily give the patentee himself any right to make, use, or sell the article that is the subject of the invention, since the invention may, for example, be an improvement on an

article that is patented by another. The patentee usually is able to make, use, and sell the article.

The patent grant takes nothing from the public that the public already had, or that was obvious on the basis of then-existing knowledge. In exchange for the patent, the patentee must disclose enough information for another, who is skilled in the particular art, to make the patented article. After 17 years, the invention becomes available to all for free. In the meantime, the patent tells others what has already been done (and is usually available for licensing) and stimulates competitors to make improvements or invent around the patent.

If persons without a license practice a patent by making, using, or selling the patented article, the patentee may sue them for infringement, seeking an injunction, damages, or both (35 U.S.C. §§ 281-284).

The owner of a patent can either assign or license it to others. In an assignment, the patentee conveys the whole right to the patent (at least within a particular territory) to the assignee. (In the assignment, the assignor sometimes becomes the licensee of the new owner of the patent.) In a license, the patentee grants the right to make, use and/or sell the patented article, but not the title to the patent.

A nonexclusive license amounts to little more than the licensor's waiver of his right to sue for infringement by the licensee. The patentee can grant as many nonexclusive licenses as he wants. But only one exclusive license may be granted for any particular territory. An exclusive license conveys some power to defend the licensee's rights against third parties. An exclusive license can grant the power to sue in the exclusive licensee's own name, but usually the licensee must join the patentee in any suit to enjoin infringement. An exclusive licensee usually has rights that can be sublicensed to others; the nonexclusive licensee usually does not. If instead of an exclusive license, the patentee grants an assignment of an undivided right in the patent, then either the assignor or the assignee can sue for infringement.

The licensor-patent owner is not required to defend the patent against infringement, for the benefit of his licensees, unless he has agreed to do so in the license agreement.

Summary of ERDA Patent Policy

There is no separate ERDA patent policy for the solar program.[1] ERDA's general patent policy for research, development, and demonstration is stated in roughly 25,000 words of proposed regulations (hereinafter "Regs.").[2] It is reprinted and discussed at some length in the 1,750 plus pages of the ERDA-76-16 Report, The Patent Policies Affecting ERDA Energy Programs.[3] (All citations in the text consisting of page and/or appendix numbers refer to this report.) The policy embodied in these regulations is largely dictated by section 9 of the Federal Nonnuclear Energy Research and Development Act of 1974 (hereinafter "Act").[4]

ERDA's basic patent policy is to take title to all patents for inventions made under ERDA research, development, and demonstration contracts, and to give contractors only revocable, nonexclusive licenses to their inventions, unless certain criteria are met (Act §§ 9(a) and (f)). This is consistent with the general patent policy of the federal government, which is to take the principal or exclusive rights to inventions developed under federal contracts where a principal purpose of the contract is to develop or improve products intended for commercial use by the general public (as opposed, for example, to procurement of military hardware).[5]

The criteria for grant of greater rights than the usual revocable, nonexclusive license are rather more broad areas of consideration than criteria (see Act § 9(d) and (e)). The purpose is to give ERDA maximum flexibility in negotiating contracts appropriate to the factual setting of each contract and the broad objectives of the program (app. C.2 at 9). Regardless of the rights given, the contractor must furnish prompt written reports of all inventions and discoveries (Act § 9(b)).

Grants of greater than usual rights may be made either at the time of contracting (Act § 9(d)) or later when a particular invention has been identified (Act § 9(e)). Even when greater rights are granted, ERDA retains a power to march in and terminate or modify the grant to the contractor under certain conditions (Act § 9(h)). Most important among these conditions are: (1) when necessary to fulfill health, safety, or energy needs; (2) when the contractor has not satisfied ERDA that he has taken effective steps, or will within a reasonable time, to accomplish substantial use of the invention; or (3) when the grant of greater rights has tended to lessen competititon or cause undue concentration (Act § 9(h)(5), (6), and (7), respectively).

ERDA has the express power to license its patents to others on either an exclusive or nonexclusive basis (Act § 9(g)). Exclusive licenses may be terminated or modified like the greater rights given to contractors (Act § 9(h)).

A major point, not set by statute, is that ERDA also takes the right to practice background patents[6] of the contractor for the government's research, development, and demonstration purposes; and to license third parties to use background patents on reasonable terms if (1) the technology developed under the contract cannot be practiced without the background patents, (2) the contractor has failed to meet the commercial needs for the results of the contract to ERDA's satisfaction, and (3) there is no competitive alternative (Regs. § 107-5(b) and 5(a)(k) [sic]). The purpose of this rule is to avoid the problem of the government having rights that cannot be practiced either by it or on its behalf.

Title vs. License

In the public hearings and written comments on ERDA patent policy, a frequent suggestion was that the inventor-contractor should get title to patents, or at least exclusive rights to develop them (apps. B.3, B.4, C.1, C.2, and C.3). The key right of the patentee, the power to keep others from making, using, or selling the patented article, can be held by the patentee, his exclusive licensee, or each co-owner of a patent.

A nonexclusive licensee like the usual contractor under ERDA's current policy, however, cannot keep others from the practice of the invention, even if he is the sole licensee. The typical contractor under ERDA's policy is apparently a sole licensee with a nonexclusive license (a kind of exclusive licensee in fact, but not in law). Under government licensing regulations, however, an exclusive licensee can sue at his own expense any party who infringes his patent rights.[7]

ERDA can take all suitable steps to protect inventions to which the government holds title, as well as require contractors or others acquiring rights in them to protect such inventions (Act § 9(k)). This necessarily includes a power to sue for infringements in the government and implies that contractors or other licensees should be given the power and duty to do so as well. Contractors or other licensees could not discharge this duty without exclusive licenses.

The government is not obliged to protect licensees against infringements, though authorized to do so. In fact, the federal government has a poor record for

defending its own patents against infringment; it is the general policy of government agencies not to try to stop unlicensed commercial uses of government-owned patents (app. A.4 at 4). Whether the government should be in the business of actively enforcing its own patent rights is the subject of some disagreement,[8] but a licensee should certainly have the power to defend his rights unless he is one of several nonexclusive licensees. As said earlier, usually the contractor-licensee is a sole licensee in ERDA's research, development, and demonstration program.

When the licensee will require protection against infringement by competitors, it should be ERDA's policy to grant an exclusive license, subject to modification or termination under march-in rights. The license should specify the licensee's powers and duties to defend the patent. It would appear, however, that there is ordinarily no need for contractors to be granted title to their inventions. In the rare case where it is appropriate, ERDA can waive title to the invention in favor of the contractor (Regs. § 109-6).

When there is no real need for the licensee to have the usual patent protections, as for example with very large businesses (discussed later), or where ERDA intends to grant several licenses immediately rather than wait for the contractor to develop and initially market the invention, ERDA's present policy of granting only a nonexclusive license is correct.

Revocable vs. Irrevocable Licenses

Another recurring suggestion is that the contractor-inventor ought to get more than a revocable license, as an inventor could presently end up with no rights in his own invention. For example, under its march-in rights, ERDA could revoke a nonexclusive license to give an exclusive license to another. Or if a contractor has an exclusive license, it could be modified to a nonexclusive license to give a nonexclusive license to another. ERDA has these powers to ensure that a contractor does not simply sit on his patent. It is government policy to put patents to work and bring new concepts to the marketplace within a reasonable time.

It is hard to see how ERDA could assure the development of a worthwhile invention without either such a march-in right or else a right to demand specific performance of a contract clause requiring the marketing of an invention. The latter alternative would no doubt be more objectionable to contractors than the present march-in rights.

Some commenters argue that if an invention is worthy of development, it will be developed, and that the inventor is usually more able to develop an invention than a third party (see, for example, app. C.3 at 64). But it can as reasonably be argued that if an invention has not been developed, and it is not worthy of development in the eyes of the contractor, he should have no objection to termination of his rights. We are convinced it is reasonable for ERDA to march in when the inventor has made no serious effort to market the invention and another person is willing to try to use the patent. We consider later whether the standards ERDA uses in such cases are specific enough to be fair.

One situation demands special treatment. This is where the contractor has failed to develop an invention because it is his second-best way of satisfying some market need, especially where the patent's practice would require the use of background patents developed at the contractor's expense. If ERDA is to revoke the contractor's rights and force the contractor to license a third party to use the background patents together with the ERDA-financed invention, it would discourage the participation of firms with many background patents or those firms working on alternative means of satisfying market needs. Special care should be taken here if the contractor is a small business and the would-be licensee is a large business. While ERDA may not wish to foreclose some flexibility in such cases, announcement of a general policy not to compel licensing in specific classes of cases should be made in the regulations to avoid discouraging worthy participants in the research, development, and demonstration program.

Specificity vs. Flexibility

Despite the great length of ERDA's patent policy regulations, they are remarkably unspecific. It is useful for ERDA to have maximal flexibility to tailor contracts to the particular project, contractor, etc. But a lack of specificity does not necessarily help ERDA outside of contract negotiation or aid in achieving the objectives of attracting participants promoting early use of results, and fostering competition.

ERDA recognizes the importance of the perceptions of potential contractors, whether or not they are correct, since perceptions largely determine participation (p. 242). As one commenter said: "In spite of the lengthy and complex patent provisions, the contractor has no assurances whatsoever at the time

of contracting [assuming no advance grant of greater than the usual rights] as to what his patent rights will be. . . . While the contractor may request waivers,[9] there are no indications to suggest the conditions under which a waiver will be granted, nor are there any guidelines to assure that ERDA will follow a uniform policy in granting a waiver. Whether or not a waiver is granted is entirely up to ERDA's discretion, with the contractor having no recourse to what he considers an unfair decision."[10]

The "standards" for modifying a contractor's exclusive license, for example, are so vague as "necessary to fulfill health, safety, or energy needs" and "unless the recipient of such waiver demonstrates to the satisfaction of the Administrator or his designee that effective steps have been taken, or within a reasonable time thereafter are expected to be taken, necessary to accomplish substantial utilization of the invention" (Regs. § 109-6(i)). What will satisfy the administrator? What is an effective step? What is a reasonable time? What is substantial utilization? These phrases are merely adopted from the Federal Nonnuclear Research and Development Act (§§ 9(h)(5) and (6)); without elaboration in the regulations, they are not a useful guide for either the ERDA administrator or the contractor.

In deciding whether to grant a waiver of rights in an invention made after signing the contract, ERDA is to consider 12 factors, including the "purpose and nature of the invention," "the small business status of the contractor," and "extent to which the invention is concerned with the public health, public safety, or public welfare" (Regs. § 109-6(c)). While these are proper considerations, they have little predictive value for the contractor. He can know only the areas of ERDA's interest, but not what standards will be applied.

ERDA officials have given assurances in public hearings that ERDA will be liberal in applying patent policies, unlike some other agencies. Business planners place a very high value on certainty, however, even at the expense of some leniency. A somewhat stricter policy than ERDA says it intends to implement, specified in concrete terms, would certainly be more attractive to contractors. Some flexibility in negotiations could still be retained.

Ironically, ERDA's regulations are so unclear that they give the impression of being less liberal than ERDA actually intends. Thus, a contractor under an older set of regulations (by the former Office of Coal Research) refused ERDA's offer of a new contract under the proposed regulations, and preferred to contract under the

old regulations. Despite the protestations of an ERDA representative at the hearing, this contractor still believed the old regulations were more liberal. The witness testified: "Now, I personally have probably spent something like 40 hours in the last three months with government lawyers, with our lawyers and industry lawyers. If there is a mistake, it is a big mistake in interpretation. It has proceeded to a relatively high level and has been explored very thoroughly."[11]

We have referred to ERDA thus far as if it were a single entity with a single understanding of the regulations. Actually, the regulations have been written by officials in the ERDA headquarters Office of General Counsel, but are applied by patent counsel in the regional offices. According to what we were told by contractors and officials in the Division of Solar Energy, the understanding of the regional counsel is that the regulations are to be applied strictly. They have the natural assumption that what the government pays for, it should own (patents, data, etc.), and that the regulations state the policy they must follow. Unfortunately, this subverts the tacit policy held by the headquarters officials, but not expressed in the regulations, to cooperate with contractors with special problems where possible.

Since neither contractors nor the regional counsel applying the regulations can decipher the intent of the regulations, the regulations should be made much more explicit and specific. To ensure that regional personnel are aware of policies, guidelines and copies of public pronouncements should be sent to them so that there is no discontinuity between headquarters' pronouncements and regional application of policy.

It is particularly important that those applying the regulations understand them, since contractors may be reluctant to appeal over the local official's head; such an appeal can result in a favorable outcome in the particular case, but great difficulties in dealing with the regional official later. This can have a chilling effect on contractors and may cause some to walk away from a particular contract rather than jeopardize their chances for contract work in the long term. It would be helpful in this matter for there to be a procedure so that early in negotiation of contracts any questions over policy can be settled without contradicting the regional patent counsel. A procedure for counselling potential contractors on patent policy matters would also be helpful; this could be operated by telephone through the ERDA headquarters officials in such a way that errors in interpretation of policy by regional patent counsel could be detected early and corrected.

The patent policy regulations should reflect ERDA's patent policy as clearly as possible so that regional personnel will feel free to grant more than the usual minimum rights in contract negotiations whenever such leniency is in accord with current tacit policy. More specific standards are also needed for revocation, modification, termination, waiver of identified inventions, background patents licensing, and anything else that ERDA will do after the negotiation stage when the contractor has signed. The liberal use of examples, as is done by the Internal Revenue Service in their regulations (26 C.F.R.), would also be helpful. ERDA should retain much of its present flexibility for negotiation, although examples could also be used here to clarify what is intended.

Small vs. Big Business Concerns

Under the Solar Heating and Cooling Demonstration Act, agencies are to take steps to assure that small business concerns[12] will have realistic and adequate opportunites to participate in the program.[13] The Federal Nonnuclear Energy Research and Development Act requires ERDA to consider the small business status of applicants in granting waivers or licenses (Act § 9(j)). The proposed regulations for ERDA patent policy also refer to the need to consider small business status in granting waivers or licenses, but do not indicate the effect of this consideration on determinations specifically (e.g., Regs. § 109-6(b)(13)).

Under the present policy, there are two major barriers to small business participation. The first is procedural. As one representative of small business said: "The need to formally request a waiver, and to provide thirteen categories of supporting evidence, will undoubtedly inhibit smaller companies from making those requests. The required boiler-plate will be easy for a large government contractor to prepare, but an impossible task for smaller companies."[14] James E. Denny, ERDA assistant general counsel for patents, has suggested that small businesses that are scared of the red tape should try the telephone (app. C.2 at 272). But whom should they call? And how should they know to call? A potential contractor reading the proposed regulations has no way of knowing that ERDA intends to do otherwise than the regulations say. An informal telephone counselling service to firms confused by the regulations could be valuable. The regulations could, for example, tell what number to call; they could at least indicate ERDA's willingness to cut the red tape when possible.

The second barrier is the general perception that waivers will not be widely available. For the larger firms, patent rights, even if desirable, are not essential.[15] While a large firm can rely on its superior financial resources, managerial skill, and marketing power, the smaller firm often needs exclusive rights to a patent to attract risk capital for new products and to keep competition from larger firms manageable.

It typically costs ten times as much to reduce an invention to practice as to conceive it, and a hundred times as much to bring the product to market from invention. Even so, ERDA normally grants only nonexclusive rights to a patent merely conceived under a contract, even if the contract includes no funds for further development of the invention. Without assurance that competitors will not be granted similar nonexclusive rights once a small business concern has developed the invention and marketed it, a small business would not be able to use the results of its own invention. Even if government funding would take the invention from conception to reduction to practice, it would still only pay about 10 percent of the typical cost of bringing the product to market. The consideration of such realities may, but then again may not, lead ERDA to grant exclusive rights.

We suggest that the regulations be revised to allow for a two-tiered system for minimum rights to the contractor. Under this system, the norm for small businesses would be to grant a limited-term exclusive license, and the norm for large businesses would be to grant a nonexclusive license as is now done. (Medium-size contractors could possibly be given some kind of intermediate position, such as a short-term exclusive license to supplement the nonexclusive license.) Unless this is done, ERDA will be likely to have to draw almost exclusively on larger firms for research and development. For such work, the only smaller concerns willing to participate will be those that are willing to work solely for the benefits of the contract itself, without hope of developing the results of the contract. Of course, for demonstration work not involving development of patentable inventions, or for supply of hardware, the present policies are no deterrent. Small business concerns, however, should be able to participate in all phases of the research, development, and demonstration program.

Limited-Term Exclusive License

If the contractor or other licensee is to be able to protect himself from infringement, his license must be exclusive. It is not essential, however, that the exclusive license run the entire 17 years of the patent's life. Three to five years, with perhaps one renewal if the licensee has not yet been able to recoup his investment, should ordinarily be long enough. The license should require the licensee to bring the invention to the point of practical application within a given period, and specify expenditures or other minimum efforts. If the licensee complies with the terms, his license should be immune to revocation. Such a procedure is already authorized by government regulation (41 C.F.R. § 101-4.103-3).

Under such a procedure small businesses should be given an edge. For example, they might be given five years, renewable, as opposed to three years, nonrenewable, for larger businesses (if exclusive licenses are to be granted to larger businesses at all). Because of their more limited resources, small firms will ordinarily require longer periods to develop inventions than larger firms. This policy should encourage small business participation in research, development, and demonstration, as well as assist them in developing contract results. Although it would slightly delay the delivery of benefits to the public, this approach would foster competition and decrease market concentration.[16]

Background Patents Rights

As mentioned earlier, ERDA generally takes rights in needed background patents for the limited purposes of its research, development, and demonstration program and for licensing third parties when contractors fail to commercialize resulting patents. Background patents include patents on any inventions or discoveries that are not subjects of the contract, and are owned or controlled by the contractor at any time through the completion of the contract (Regs. § 107-5(a)(k)(1)). It appears from this that contractors must hold on to all patents they have during a contract, if the patents may conceivably be needed to satisfy a later government demand for background-rights licensing.

Because it is ERDA's policy to have energy-related patents in the hands of those who would work them, it is not desirable to limit contractors' powers to assign or license patents that are not the subject of a contract, but that might conceivably be needed for the application of its results. The contractor may not

even know of the existence of these relevant patents at the time of contracting (Regs. § 107-5(b)(2)), but may later wish to assign or exclusively license them to another who has greater use for them. The regulations should deal with this specifically and permit the assignment or exclusive licensing.

The most undesirable effect of ERDA's background rights provisions is that they discourage those potential contractors who would be most valuable to ERDA. The more prior work a potential contractor has done in a particular field, the more likely he is to have a strong patent position that needs protection. This would be especially true of small businesses, which may have patents as their key assets. Few potential contractors would object to use of their background patents for further research, development, and demonstration work (especially if they were promised licensing for any improvements). Most would object, however, if their competitors were licensed, especially if the technology to be licensed is their second-best product for some market need.

The chilling effect of these provisions would be lessened by specifically defining the conditions for background licensing to third parties. It would be best to have a two-tiered system in which the norm would be to demand background rights from large but not small businesses. Alternatively, additional criteria could be provided that must be satisfied before competitors of smaller businesses were licensed.

James E. Denny of ERDA has paraphrased the background patents provisions as saying: "If you have technology that is necessary in the energy field, then we will ask you to license for reasonable royalties. Beyond that, I think it does not become involved" (app. C.2 at 420). Considering the position of solar energy in the energy field as a whole, it is difficult to imagine what patents a solar contractor could have that would be necessary in the energy field. If ERDA actually intends to require background patents licensing only under such narrow, reasonable circumstances, the background patents provisions in the regulations should be revised to reflect this.

Mandatory Licensing

Under the Federal Nonnuclear Energy Research and Development Act, ERDA reported to Congress and the President on the need for legislative changes in ERDA's patent policies, including recommendations on mandatory licensing in the

energy field (Act §9(n)). Under a compulsory (mandatory) licensing system, a patent owner can lose the right to exclude others from practicing his invention under stated conditions. Compulsory licensing seriously undermines the value of any patent subject to the conditions by taking away the usual bargaining leverage of the patentee, the threat of suit for injunction.

ERDA recommended against mandatory licensing. The problem is discussed at length in the ERDA-76-16 Report (pp. 192 ff.), and is the subject of further study by ERDA. We see no need to repeat the arguments here; we agree with ERDA's conclusion.

No New Legislation Needed

ERDA's general conclusion in its report to Congress was that new legislation on ERDA patent policy is not presently needed (pp. 254-55). We agree; the basic system seems sound, and the modifications that we suggest can be done within ERDA's present statutory authority.

NOTES: ERDA PATENT POLICY

1. Although HUD has a residential solar heating and cooling demonstration program, there is no HUD policy to require a patent clause in their contracts. This may be because HUD's program is aimed more at demonstrating existing, off-the-shelf, technology than at researching and developing new devices. ERDA's program seems to focus more on developing new systems and technology for commercial and general applications. It is not clear whether some part of ERDA's commercial demonstration program for solar heating and cooling should be exempt from the patent policy discussed here. See Energy Research and Development Administration, The Patent Policies Affecting ERDA Energy Programs, A Report to the President and the Congress of the United States, 3 vols. (Washington, D.C.: Government Printing Office, ERDA 76-16, Jan. 1976), 1: 120 ff., especially p. 121. ERDA's division of procurement indicates that patent clauses are always required in ERDA solar contracts.

2. Patents, Data and Copyrights: Proposed Policies and Procedures, 41 C.F.R. Part 9-9, 40 Fed. Reg. 48363 (1975).

3. ERDA's Division of Solar Energy was unable to provide us a copy of draft revised proposed regulations currently circulating within the agency, which reportedly will be published early in 1977. This chapter is thus based on the original version of the proposed regulations, and hopefully some of our suggested modifications will be already made in the regulations when they are published.

4. 42 U.S.C. § 5908 (Supp. IV 1974).

5. Section 1(a)(1) of both President Kennedy's Memorandum and Statement of Government Patent Policy, 28 Fed. Reg. 10943 (1963), reprinted in ERDA, Patent Policies, 2: app. A.3; and President Nixon's Memorandum and Statement of Government Patent Policy, 36 Fed. Reg. 16887 (1971), reprinted in ibid., app. A.6.

6. There are background patents and foreground patents. If a patent is an improvement on another patent, the new patent is the foreground patent and the old patent is the background patent, without which the foregound patent often cannot be practiced.

7. If the Attorney General consents, a licensee may join the government as a party complainant, but without expense to the government (that is, the licensee must pay costs and any final judgment or decree that may be rendered against the government). The government may intervene in such a case at its own expense. 41 C.F.R. § 101-4.105 (1976).

8. See, for example, ERDA, Patent Policies, 3: app. C.2 at 493 for arguments against such suits.

9. Waivers are grants of greater than the usual rights to the contractor.

10. Letter from John R. Pegan, senior patent attorney for U.S. Steel, to James E. Denny, ERDA assistant general counsel for patents (Dec. 22, 1975), reproduced in ERDA, Patent Policies, 2: app. B.4, p. 235.

11. Testimony of Dr. John Dicks of the University of Tennessee Space Institute at Public Hearings on ERDA Patent Policy, Germantown, Md., Nov. 18 and 19, 1975, reproduced in ibid, 3: app. C.2, p. 223.

12. Small business concerns for government procurement purposes are defined in 41 C.F.R. § 1-1.701-1 (1976).

13. Solar Heating and Cooling Demonstration Act of 1974, § 14, 42 U.S.C. §5512 (Supp. IV 1974).

14. Testimony of Norman A. Jacobs, president of the Licensing Executive Society, at ERDA Patent Policy Hearings, reproduced in ERDA, Patent Policies, 3: app. C.2, p. 264.
15. Representatives of Hughes Aircraft and General Electric, for example, admitted not needing exclusive rights to compete. Ibid., app. C.2, p. 428.

7

ANTITRUST AND FOSTERING COMPETITION

This chapter examines the possible effects of federal antitrust law, and related laws, on the development of the solar heating and cooling market. Antitrust law is concerned with fostering competition and preventing undue concentration, and is derived from the antitrust statutes: the Sherman Act, Clayton Act, Robinson-Patman Act, and the Federal Trade Commission Act. Related laws for fostering competition are concerned with government procurement policy and small-business policy. This study discusses problems relating to (1) traditional antitrust issues, (2) procurement and small-business policy, (3) government patent policy, and (4) utilities regulation. The first two are discussed in this chapter. The latter two are discussed in the chapters on ERDA patent policy and utilities.

The field of antitrust law is so broad and complex that this subject could easily fill a book. In this brief chapter, not all matters can be covered fully, but the field is so important that it cannot be ignored.

Basic Antitrust Issues

The sweeping provisions of the antitrust laws prohibit restraints on trade that would deny our country a competitive economy. Congress chose not to make the prohibitions narrow, since such rigidity would have handicapped business and also facilitated evasion of the spirit of the law by failing to list all possible forms of anticompetitive conduct. The generality of the statutory language gives the Justice Department, the Federal Trade Commission, and the courts great discretion in interpreting the law and applying it to specific cases. The ultimate

responsibility in this lies on the courts. "In the antitrust field the courts have been accorded by common consent, an authority they have in no other branch of enacted law." U.S. v. United Shoe Machinery Corp., 110 F.Supp. 295, 348 (D.Mass. 1953), affirmed, 347 U.S. 521 (1954).

Among the practices made illegal by the antitrust laws are price fixing by competitors, division of markets among competitors, refusals to deal with certain customers or groups of customers, attempts by wholesalers to control the retail price of their products, exchanges of technical and price information among competitors, mergers that reduce competition, certain joint ventures among competitors, exclusive territorial distributorships, refusals to sell a product to a customer unless he also purchases a second product, and certain types of discriminatory treatment of customers including price discrimination. In fact, it is all but impossible to imagine an anticompetitive act in the solar heating and cooling market that could not be attacked under existing antitrust law. The problem, if any, would not be one of power to act, but a lack of funding or a lack of importance attached to the solar market. Congress has mandated a study by the FTC on competition in the whole energy industry.[1] When released, the FTC's report should provide a highly detailed discussion of antitrust and related competitive issues for solar energy as well as the rest of the energy field. It is not clear at this time what effect this report will have on antitrust enforcement in the energy field.

Antitrust law applies to the solar heating and cooling business just like any other. Participation in the solar heating and cooling demonstration program does not grant any immunity from antitrust laws.[2] The only provision in the Solar Heating and Cooling Demonstration Act relevant to antitrust requires that federal officers and agencies take steps to assure that small-business concerns will have realistic and adequate opportunities to participate in the programs to the maximum extent possible.[3]

One example of how a deceptive practice issue might arise in the context of the solar energy business is provided by a recent national advertising campaign of a major oil company, a campaign that many persons find misleading. The ads have, for example, used cost figures for solar heating units based on an installation in the cold New England area, without disclosing that fact; and they have discussed solar energy in a way that implies it will not be cost-effective until the year 2000, using photovoltaics as the example. The ads are not accused of being literally false, but

of being deceptive in their implications. Antisolar ads, especially if done on a large scale, could have a negative impact on the development of solar markets if consumers believe them and do not purchase solar equipment. This could retard development of the solar heating and cooling market, to the competitive benefit of the advertising conventional-energy or HVAC-equipment suppliers. A comparable potential problem with utility companies could arise from the use of similarly misleading material in bill mailings and other advertising.

Under the FTC Act, the dissemination of any false advertisement is defined as "an unfair or deceptive act or practice in or affecting commerce" within the meaning of section 5 of the FTC Act (15 U.S.C. § 52(b)). Advertising that can be interpreted in a misleading way is construed against the advertiser; the public need not make an inquiry into the truth of advertising. Neither actual damage to the public nor actual deception need be shown for the FTC to order a business to stop deceptive advertising. The FTC itself has the expertise to determine whether ads can deceive or mislead the public. Resort Rental System, Inc. v. FTC, 518 F.2d 962, 964 (9th Cir. 1975). An ad can be deceptive both for what it actually says and for what it fails to say. FTC v. Simeon Management Corp., 391 F.Supp. 698, 702 (N.D. Cal. 1975). The FTC can combat any trade practices in their incipiency that have a strong potential for stifling competition. The FTC need not show that a practice has totally eliminated competition; it is enough that it finds the practice unfairly burdens competition for a not insignificant volume of commerce. FTC v. Texaco, Inc., 392 U.S. 316 (1966).

It would thus appear that the FTC could, and should, investigate the allegedly deceptive advertising on solar energy that has occured. If the FTC finds it deceptive, it has wide discretion to choose appropriate remedies; its choice will not be disturbed unless it has no reasonable relation to the unlawful practices found. Adolph Coors Co. v. FTC, 497 F.2d 1178, 1189 (10th Cir. 1974).

If other antitrust problems should arise, the antitrust laws would be similarly equipped to deal with them. A more detailed consideration of traditional antitrust problems is not needed here.

Competitive Considerations in Procurement

The objectives of antitrust law (fostering competition and preventing undue concentration) can also be promoted through government procurement policies.

This is especially applicable in programs for research, development, and demonstration, like the solar program, where the objective is the promotion of a new market that is still highly competitive.

The solar industry is in an early stage of development. At this point, it consists primarily of many small firms making, selling, and designing solar equipment. A recent development is the entry of larger firms doing research, development, and demonstration, mostly under government contracts. The research, development, and demonstration work is being done by energy giants, nonenergy giants (with and without competing interests), medium-sized firms (mostly from aerospace work), university research labs, and the smaller firms (who tend to supply the hardware). In ERDA's solar research and development work the dollar shares are reported to be roughly 20 percent for large firms, 40 percent for university research labs, and 40 percent for small firms.[4] The small-business shares in solar heating and cooling work are said to be even greater than this. In HUD's residential demonstration program, virtually all work is reportedly being done by small businesses.[5]

The participation of small businesses, and aid to them, is discussed at length later. It would appear that there is little, if any, anticompetitive potential in HUD's program. There may be problems with ERDA's program, since competitive considerations, aside from small-business status, are not generally part of the process of deciding who receives grants. (Note: the rights in patents, etc. that a contractor acquires will depend on competitive considerations. See the chapter on ERDA Patent Policy.)

Two firms that are leading suppliers of nuclear power reactors (and fuel), General Electric and Westinghouse,[6] along with TRW, another high-technology giant, were given responsibility by ERDA's predecessor, the National Science Foundation, for producing estimates of the contribution of solar energy to the nation's energy supply at the end of this century. Their estimates ranged from 1.6 to 3.1 percent of projected demand satisfied by solar heating and cooling of buildings. These estimates have been criticized as being absurdly low, because of the contractors' alleged antisolar biases.[7]

While we are not in a position to evaluate whether these projections are realistic, we should point out that ERDA and other energy-related agencies should avoid the possibility of having their contractors' credibility challenged, especially

in consulting work bearing on energy policy. These agencies should consider the possible conflicts of interest and competitive impact of their proposed contracts and results on potential contractors.

Solar equipment competes with other solar equipment and with conventional heating and cooling equipment, like gas and electric heaters and air conditioners. Solar equipment also competes with the gas and electricity supplied by the utilities (utility problems are discussed in a separate chapter). Less directly, it competes with the gas, coal, oil, uranium, etc. that utilities use to generate power for electric heating and cooling, and the machinery that the utilities use to generate power.

To maximize competition, it would be preferable if the manufacturers, distributors, and installers of solar equipment be independent of, rather than affiliated with, these competitors; and that no single competitor have an unduely large share of the market.

The American Bar Association's House of Delegates has recommended, as a general proposition, that regulatory agencies give greater consideration to impact on competition in decision making, whenever consistent with the agency's statutory mandate.[8] In particular, we would suggest that contracts for research, development, and demonstration should be awarded only after the assessment of the impact on competition of each particular award and of the awards generally.

One proposal would require a contribution from the grantee that is as large as practicable. There would be no award without a determination that there was limited opportunity to induce nonfederal support, venture capital was not available, and the magnitude of investment exceeded the capabilities of the potential grantee. This proposal would also require an economic assessment so that there would be no award where there would be any adverse impact on market, intermarket, or industry competition, market or industry concentration, or market or industry barriers to new firm entry. There would also be no award where any participant would have any interest in delaying the completion of the contract or the commercial adoption of any innovation resulting from the contract, or in altering any research findings, because this would affect any assets of the participant or of any of its affiliates. Criteria to be applied to proposals to carry out these actions would be required to be developed in cooperation with the FTC and the attorney general and be published in the Federal Register, subject to veto by Congress.

Aside from the any language, which seems overbroad, such an economic assessment may be what is needed. Another provision would require advance clearing with the attorney general of any award to a profitmaking enterprise with assets of $250 million or more, including affiliates. A questionable provision would require 90 days prior notice of all proposed contracts in the Federal Register, giving names, assets, and brief descriptions of the proposed award. This would give contract officers an opportunity to consider public comments. While this would make sense as applied to very large corporations or awards, it would be overly broad if applied to small awards to small businesses.

While this proposal is not exactly what appears to be needed, some legislation to provide for explicit consideration of competitive and conflict of interest questions is needed for the solar heating and cooling program. Otherwise, support may be given to organizations whose interests are contrary to the objectives of the program.

Aid for Small-Business Concerns

As a further supplement to antitrust law, aid can be given to small-business concerns to promote the antitrust objectives of fostering competition and avoiding undue market concentration. There are already a number of aids for small-business concerns in the Small Business Administration (SBA) and in the Small Business Office of ERDA's Division of Procurement. These could be supplemented with others or be given additional funds earmarked for solar small-business concerns.

A small-business concern for the general purposes of the SBA "is one which is independently owned and operated and which is not dominant in its field of operation" (15 U.S.C. § 632). The SBA has defined small-business concern in great detail, using such criteria as number of employees and dollar volume of business; the definition varies from industry to industry to reflect differences in industry characteristics (under 15 U.S.C. § 632).[9]

The SBA has several kinds of programs for aiding small-business concerns, including small-business loans, grants for studies, subcontracting programs, aid in procurement, studies of federal programs and recommendations for program changes to agencies, aid in research and development, and pooling agreements exempt from antitrust laws. Each of these areas is discussed in turn, with suggested changes.

Loans. The SBA can make loans to small-business concerns either directly or in cooperation with lending institutions. These loans can be made to enable small-business concerns to finance plant construction, conversion, or expansion, including the purchase of land; to finance the purchase of equipment, facilities, machinery, supplies, or materials; or to supply such concerns with working capital to be used in the manufacture of equipment or materials as may be necessary to insure a well-balanced national economy. There are limitations on amounts available, and conditions that must be met before making a loan, such as that a loan cannot be made where otherwise available in the commercial loan market (15 U.S.C. § 636(a)).

Special funding for loans for solar small businesses[10] could be studied. A common cause of the failure of small businesses is undercapitalization. No doubt a loan program could save some firms, lower barriers to entry, promote competition, and dilute concentration. Loans or guarantees may be hard to administer, however, since it would be difficult to determine which of the many possible recipients could most aid in the development of solar heating and cooling.

Studies. The SBA can make grants to state agencies, colleges, and certain other organizations to do studies, research, and counselling on the managment, financing, and operation of small businesses, and also to collect the technical and statistical information needed to carry out programs for adequate small-business participation in government procurement (15 U.S.C. § 636(d)). The funds under this program are quite limited ($40,000 per year per state). Without special funding for solar heating and cooling, such studies would probably not be made.

Subcontracting programs. The SBA can arrange to supply other agencies with equipment, supplies, or materials, and then subcontract out the work to small businesses (15 U.S.C. § 637(a)). Every contract for property or services (including research and development) over $1,000,000 made by a government agency must require the contractor to conform to a small-business subcontracting program, if the procuring agency finds that the contract offers substantial subcontracting possibilities (15 U.S.C. § 637(d)(2)). These provisions as such are not being applied to the solar heating and cooling demonstration program, but analogous rules are.

In the latest Program Opportunity Notice from ERDA for demonstration of commercial solar heating and cooling systems, there are requirements for small-business participation in not less than 50 percent of the teams granted contracts.

This comes under an ERDA mandatory small business subcontracting program, as authorized by the Office of Federal Procurement Policy, Executive Office of the President.[11] Under this program, the following priorities are to be observed:

> (1) At least 50% of the awards shall be made to teams offering a) solar energy systems supplied by small business concerns and b) other substantial small business participation;
>
> (2) If priority (1) awards cannot be completely achieved, the remaining portion of the "At least 50%" objective shall be accomplished by awards to teams offering solar energy systems supplied by Small Business concerns;
>
> (3) If priority (2) awards cannot be completely achieved, the remaining portion of the "At least 50%" objective shall be accomplished by awards to teams otherwise proposing to sub contract 20% of ERDA prime contract award value to small business concerns. [DSE-76-2, p. 11]

There are two weaknesses in this program. First, although there is to be at least 50 percent small-business participation in teams, it is possible for the amount of money going to small-business concerns to be as little as 20 percent of 50 percent, under priority (3), which is only 10 percent. The ERDA Division of Solar Energy has remedied this by setting an overall goal of 40 percent of its funds going to small businesses. Second, even if small-business concerns get their fair share of the money spent, their participation tends to be primarily as suppliers of hardware. Small-business concerns should have the same quality of opportunity as large firms to do research and development work, which will lead to a stronger future position, not just the same or a greater quantity of participation.[12]

This mandatory subcontracting program is useful, but its limitations must be recognized. The required realistic and adequate opportunities for small-business concerns to participate in the programs to the maximum extent possible (under 42 U.S.C. § 5512) call for equal quality of opportunity for small businesses.

Aid in Procurement. The SBA can aid small-business concerns in various ways in procurement. The SBA can provide technical and managerial aids by advising on matters relating to procurement and practices of good management, using any means deemed appropriate (15 U.S.C. § 637(b)). The SBA can inventory all productive facilities of small-business concerns or arrange for another agency to do so (15 U.S.C. § 637(b)(2)). In the past, a directory of solar manufacturers was prepared, but the directory is now out of date and it reportedly will not be revised. A current directory should be prepared including information on capabilities of

small-business facilities, updated semiannually. It would be useful, for example, as a basis for improved communications with small business, for notices of upcoming opportunities for research and development work, and active soliciation of small-business participation in such work. It could also be used to notify potential contractors of ERDA's policies on contract terms, such as ERDA patent policy (see the chapter on ERDA patent policy). The SBA can determine the way that the productive capacity of small-business concerns can be most effectively used (15 U.S.C. § 637(b)(3)).

The SBA can consult with other agencies and cooperate in setting up appropriate small-business programs in them. This would include certifying which businesses within a particular industry are entitled to small-business treatment. The SBA can suggest who should receive contracts in the interest of maintaining or mobilizing the nation's full productive capacity or to assure that a fair proportion of total contracts are placed with small-business concerns. This can be done for individual contracts or for classes of contracts. Whenever the SBA and the contracting officers fail to agree, the matter is submitted to the head of the procuring agency (15 U.S.C. § 644).

In the case of ERDA, an employee of the SBA works in the ERDA Division of Procurement to review each proposed procurement before publication to suggest the appropriate steps for small-business participation. The form of small-business participation, if any, is decided after negotiation between the officials in the ERDA Small Business Office and the officials responsible for the particular program.[13] This is essentially a cooperative effort to see that the small-business participation goals set can be met through the means chosen. To strengthen the position of small-business representation in this process, small-business set-asides could be mandated by Congress. There have been proposals to require that at least 50 percent of solar program money be given to small businesses. Although present Division of Solar Energy policy is to grant 40 percent to small businesses, there are advantages to mandatory set-asides. The current policy could be changed at any time. The 25 percent increase may be justified. Also, the negotiating position of the Small Business Office for small-business participation in particular procurements or classes of procurements would be improved. The question whether the quantity and/or quality of small-business participation should be changed, is worth study. The SBA could do such a study and make recommendations under another of its programs.

Program studies and recommendations. The SBA is to study matters materially affecting the competitive strength of small business, and the effects on small business of federal laws, regulations, and programs; it is then to make recommendations to the appropriate agencies on how to adjust their regulations and programs to the needs of small business (15 U.S.C. § 637(c)). We suggest that the SBA should be funded to make such a study for the energy agencies to ascertain the needs of solar small business and recommend adjustments to regulations and programs. The mandate to the SBA should also include the recommendation of new legislation, where necessary. The various suggestions in this chapter, bills before Congress, and any other relevant matters could also be included in such a study.

Aid in research and development. Congress has recognized the competitive disadvantage of small-business concerns in research and development. It has also recognized the importance to a strong, competitive, free-enterprise system of adequate opportunity for small-business concerns to do research and development work at government expense. Thus, the SBA is to assist small-business concerns in obtaining government contracts and the benefits of the research and development work done. The SBA can provide technical assistance to accomplish this (15 U.S.C. § 638(a) and (b)). This would presumably include aid in preparing proposals and the like. Since SBA funds are limited, the SBA would not presently be able to help many potential contractors of the solar heating and cooling program. Special funding and staff for this purpose have been proposed. Again, the SBA is particularly authorized (under 15 U.S.C. § 638(c)) and qualified to consult and cooperate with other government agencies to do studies and make recommendations to the agencies on such matters.

Pooling agreements. The SBA can consult with representives of small-business concerns to assist such firms to undertake joint programs for research and development. This can be done to establish laboratories for basic and applied research; collect information for a particular industry, and disseminate it to participating members; do applied research for particular members or others on a protected, proprietary, and contractual basis; and make applications for patents, and negotiate and grant licenses under patents held in the program. After consultation with the attorney general and the chairman of the FTC, and with prior written permission of the attorney general, the SBA can approve agreements between small-business firms providing for joint programs of research and

development to strengthen the free-enterprise economy. No acts or omissions within the scope of an approved program are treated as a violation of the antitrust laws or the FTC Act (15 U.S.C. § 638(d)). Few approved pools have been in operation since World War II, however, when the exemption from antitrust law was broader.[14] Whether such agreements would be appropriate in the solar heating and cooling field, and, if so, what programs should be approved, is another matter worthy of SBA study.

Proposed aid for sales. In addition to the institutions already in place, there have been proposals to aid small businesses by providing direct, low-interest loans to homeowners and builders to help them purchase and install solar heating and cooling equipment. The loans would be administered by the SBA and would require the recipients to purchase their systems from small businesses, unless there were no small-business source within 250 miles of the residence. This proposal would put a large burden on the SBA that may not be balanced by benefits to small businesses. Although the SBA does not favor this proposal, it merits further study.

NOTES: ANTITRUST AND FOSTERING COMPETITION

1. See Conf. Rep't Amendment 71 to the Agriculture-Environmental and Consumer Protection Appropriation Act of 1974, Pub. L. No. 93-135.
2. Federal Nonnuclear Energy Research and Development Act of 1974, § 10, 42 U.S.C. § 5909 (Supp. IV 1974).
3. Solar Heating and Cooling Demonstration Act of 1974, § 14, 42 U.S.C. § 5512 (Supp. IV 1974). The Energy Reorganization Act of 1974 also calls for reasonable opportunity for small business participation and consultation by ERDA with the SBA. Energy Reorganization Act, § 2(d), 42 U.S.C. § 5801(d) (Supp. IV 1974).
4. These figures are for the last fiscal year, including the transition period (15 months total), according to Steve Morgan of ERDA's Division of Solar Energy.
5. Less than half a dozen large firms have participated in the demonstration program so far, according to HUD's David Engel.
6. Between them, they have sold 268 of the 437 completed or on-order nuclear reactors of the non-Communist world; that is over 60 percent. See Tom Stevenson, "Gloom on the Monongahela," Saturday Review 4 (22 Jan. 1977): 7.
7. See, e.g., Senator Nelson's remarks quoted in Investor Responsibility Research Center, News for Investors 3 (Sept. 1976): 179.
8. American Bar Association Journal 62 (1976): 1284.
9. Small-business concern for government procurement purposes is defined in 41 C.F.R. § 1.1-701, based on 13 C.F.R. § 121.3-8 (1976).
10. Such as that proposed in HR 13001, 94th Cong., 2d Sess. (1976).
11. See Energy Research and Development Administration, Program Opportunity Notice (DSE-76-2, Oct. 1976), p. 11.
12. See Harold R. Hay, "Solar Energy Opportunities for Small Business" (Paper presented at the Consumer Conference on Solar Energy Development, Albuquerque, N.M., Oct. 2-5, 1976), p. 6.
13. Each ERDA procurement office (field or operations office) also has an ERDA employee who is a small business specialist to assist in the administration of the small-business/minority-business programs. Energy Research and Development Administration, Selling To ERDA (May 1975), p. 4.
14. Small Business Mobilization Act of 1942, ch. 404, § 11, 56 Stat. 357 (no longer in force).

8

LABOR UNION RESISTANCE AND CONFLICTS

Installation of solar energy systems will require many different manual skills. Water circulation systems will require plumbers, while air systems will require the expertise of sheet metal workers and HVAC (heating, ventilation and air conditioning) contractors. Roofers may install integrated solar roof components. New technologies may require new types of skills, and there may be arguments over which traditional craft union should encompass these skills.

At least one union has already demonstrated an interest in protecting its future slice of the energy pie: the sheet metal workers commissioned a study of their role in the future energy delivery system, which noted the significant potential market for sheet metal workers created by air circulation solar technologies and urged the union to campaign actively for government funding of such systems.[1] This particular battle is likely to be fought in the halls of Congress, not in union halls, and does not, therefore, raise any legal problems.

Labor law issues could arise, however, in other ways: through union resistance to new technologies, through jurisdictional disputes, or through conflicts over work assignments. First, unions could oppose the use of solar technologies much as they did plastic pipe, by promoting discriminatory provisions in building codes. The use of building codes as a barrier to change is extensively discussed in the chapter on building codes. Unlike the use of plastic pipe, solar technologies are not an immediate threat to existing jobs. Opposition, therefore, should be less. A related problem is that construction unions may resist any plumbing or other solar system fabrication done in factories.

A second possible labor law problem is conflict among unions over the representation of new skills. Serious obstacles are not anticipated here as existing solar technologies rely primarily on very traditional skills. But this potential problem should not be overlooked, because if jurisdictional conflicts between craft unions do arise, they may seriously impede solar energy. Studies have documented the importance of labor groups in the utilization of new technologies:

> The [construction] industry is craft-based and operates through a series of individual craft unions that contribute separate skills and functions to the construction process. These unions have a great deal of control over acceptance of individual technological innovations.2/

The slow acceptance of plastic pipe, mentioned earlier, is often cited as an example of union opposition to work-saving products.[3] One survey of early solar uses found labor jurisdiction problems to be among the least significant constraints.[4] The AIA Research Corporation argues that the literature on innovation in buildings overstates many problems by focusing on standardized, cost reducing products. Since the building industry is highly decentralized, the AIA contends that any effort toward standardization will encounter great difficulty.[5] On the other hand, it is too soon to say that jurisdictional disputes will not be a problem in the solar industry, because labor unions are unlikely to haggle over the control of a new product until a real market exists. That stage has not yet been reached with solar energy.

A third area of possible labor disputes, conflicts over work assignments, deserves more attention. Work assignment disputes might arise if different unions claim responsibility for the same task, such as connecting solar components to existing heating and ventilating ducts. Unlike jurisdictional disputes the fight here is not over which union should represent new skills, but over which should represent the new application of old skills. The existence of such conflicts could interfere with the installation of solar equipment, discouraging builders who might otherwise be interested in solar alternatives.

The federal government has broad authority over labor disputes under the National Labor Relations Act of 1947 (also known as the Taft-Hartley Act).[6] The National Labor Relations Board (NLRB) was created by the act. The NLRB has no authority over work assignments prior to the existence of a dispute, but after a conflict exists, the NLRB can determine if a labor practice is unfair. For example, the board could investigate union efforts to force an employer to give particular

work to its members.[7] The NLRB also may settle work assignment disagreements that are the source of a strike or threatened strike.

Although the NLRB has no jurisdiction prior to a dispute, states may legislate in this area if their efforts do not in any way conflict with federal law. Thus, they may not ban strikes or require binding arbitration, but they can provide voluntary negotiating procedures.[8]

The most rational approach to labor questions may be federal support of early jurisdictional negotiations among affected unions. The study prepared for the sheet metal workers evidences some interest in timely resolution of jurisdictional questions:

> A solid understanding in advance of [technological] developments would help ensure that new areas logically falling within SMWIA jurisdiction would be so assigned. Early settlement of jurisdictional problems would benefit SMWIA. . .9/

Past experience suggests unions will cooperate to obtain mutual benefits.[10] The ABF study suggests the creation of a Solar Energy Labor Board to recommend appropriate regulations. To date, however, there is very little proof that any new organizations are necessary. Although problems could arise abruptly, for the immediate future it will probably be adequate to monitor experience in the demonstration program and support informal discussions with union officials.

NOTES: LABOR UNION RESISTANCE AND CONFLICTS

1. Arnold Cohen, Mary Harlow, Augustus Johnson, and Peter Spewak, Impact of Energy Developments on the Sheet Metal Industry (MITRE Corporation, M75-44, June 1975), p. 6-2.
2. Alan Hirshberg and Richard Schoen, "Barriers to the Widespread Utilization of Residential Solar Energy: The Prospects for Solar Energy in the U.S. Housing Industry," Policy Sciences 5 (1974): 459.
3. Ibid., p. 463.
4. AIA Research Corporation, Early Use of Solar Energy in Buildings, 2 vols. (Washington, D.C., Aug. 1976), 1: 14.
5. Ibid.
6. The analysis that follows relies heavily on a study by William Thomas, Alan Miller, and Richard Robbins, "Legal Issues Related to Use of Solar Energy Systems" (Aug. 1976 draft of forthcoming article in the American Bar Foundation Research Journal).
7. 29 U.S.C. § 158(b)(4) (1970).
8. Carey v. Westinghouse, 375 U.S. 261 (1964).
9. Cohen et al., Impact of Energy Developments on the Sheet Metal Industry, p. 6-2.
10. Solar Energy for Heating and Cooling: Hearings Before the Subcomm. on Energy of the House Comm. on Science and Astronautics, 93d Cong., 1st Sess. 216-17 (testimony of Robert G. Reines).

9

PROPERTY TAXES

This a field where it is very difficult to sort carrots from sticks. Although there are many tempting carrots, in the form of tax incentives in particular, this section will deal only with existing and proposed laws that may present special obstacles to solar-equipped buildings. Most of the action is on the state level, but it is an important area to explore because of the plethora of proposed and enacted legislation, and because of several overlooked potential legal problems.

Opinion seems unanimous that solar equipment will add to a structure's assessed value. From the owners' viewpoint, this is both good and bad. When they seek to sell their property, or to obtain financing on it, it is desirable to consider the added value. But to include this addition in assessments made to determine the amount of tax to be levied on a property may be unfair. Many states have passed, or are considering, legislation that addresses this problem. There are serious legal deficiencies in most bills, however. These shortcomings are detailed at the end of this chapter.

Property taxes are presently collected in all states. They may be levied at the county or municipal level, or at both. Most state governments themselves collect little revenue today from property taxes.[1] Homes, commercial properties and factories are all subject to property taxation. The business community contributes an estimated 40 percent of property taxes.[2]

Although the impact of property taxes is most heavily felt at the local level, there are many actions state governments can take that influence these taxes. State laws define what is and is not taxable; states may certify local assessors; conduct research for localities to use in determining assessment standards; prepare manuals to guide assessors; actually assess difficult-to-assess properties; etc.[3]

Historically, there has been great resistance to the federal government tampering with local property taxes. Federal authority over property taxes is severely limited by the Constitution. Article 1, section 9, clause 4 states that the federal government may only levy direct or capitation taxes in proportion to the census or enumeration. It is unlikely that the near future will see much federal involvement with property taxes (unless important constitutional rights are involved, such as in the school financing cases). In 1972, the Advisory Commission on Intergovernmental Relations studied what role the federal government should take in providing relief from property taxes. The conclusion reached was that "the interests of our federal system are best served when states retain primary responsibility for shaping policies dealing with general property tax relief."[4] There are, of course, indirect ways that the federal government affects property taxes. One way is through federal revenue sharing, as some states use their portion to relieve particular property taxpayers.

The American Bar Foundation (ABF) study includes a suggested statute that would have states exempt solar energy systems from property taxes.[5] It is reasoned that a solar system puts no additional burdens on a community: in fact, it reduces a community's financial burden by lessening air pollution, cutting the amount of energy needed to transport conventional fuels, etc. Exempting solar equipment from property taxes would therefore prevent local governments from getting an unjustified windfall, while encouraging owners to select the solar option.

Under the ABF statute, assessors would value a property as if it had a conventional system. If a solar system were an economic liability during its adjustment and testing stages, assessors could reduce its assessed value.

A statutory definition of real property (important because it determines what property will be subject to taxation) typically includes the words "structures," "fixtures," and "improvements." The term improvements actually encompasses the first two terms. Equipment to harness solar power for heating and cooling could be found to be either a structure, a fixture, or conceivably (in the case of a backyard "portable" collector) personal property. Passive systems would probably be found to be structural, as could collectors that substituted for roofing. But it is probable that most solar energy equipment would be defined as fixtures.[6] A fixture is often described as a thing which, although originally a movable chattel, is regarded as a part of the land because of its annexation to, or association in use with, the land.

The distinction is not a crucial one for our purposes, as fixtures are nearly always considered when assessments are made.

Either state statutes or state constitutions may tell assessors what to include. Usually they are directed to include all property that is not specifically exempted.[7] Oregon law, for example, defines real property as ". . . the land itself . . . all buildings, structures, improvements, machinery, equipment, or fixtures erected upon, under, above or affixed to the same . . . and all other rights and privileges appertaining to the land; and any estate, right, title or interest whatever in the land or real property, less than the fee simple."[8] Movable machinery is considered personal property[9] and is exempt from taxation.[10] In some states, however, personal property is also taxed.[11] Where a public interest is found, many items have been successfully exempted from taxation. These include fallout shelters, pollution control facilities, nuclear power plants, union halls, and homesteads for disabled veterans.[12]

Even if solar system components were specially exempted, if they served a second purpose as well (such as substitution for part of the roof) their value would probably have to be considered. This is the approach of the ABF suggested statute.[13]

A factor to be considered when designing legislation is that states use several systems to value real property: (1) by how much it would cost to construct it today, less depreciation or obsolence; (2) the income it generates; or (3) market data. The method used may depend, in part, on the type of property being assessed. The market data alternative is often used for private homes; the income approach may be used for shopping centers, apartments, and other income-generating properties.[14] A reduction in the assessment of solar equipment would not be effective where property is assessed according to the income it generates. Other devices must be used to aid these property owners.

There may be legal problems with exempting solar equipment from property tax assessments as the majority of states have what are known as "uniformity clauses" in their constitutions and/or in their tax laws. Oregon, for example, has such restrictions in both its constitution and tax laws.[15] Uniformity clauses say that all "similarly situated" property or the "same class of subjects" must be taxed at the same rates. The language and the interpretation of such clauses vary widely from state to state, making it very difficult to predict the success of an effort to

exempt solar heating and cooling equipment. In some states, constitutional changes may be needed.

Test cases will probably soon make their way to the courts. For example, Illinois, which has a constitutional uniformity clause, enacted legislation last year allowing special treatment by assessors of solar energy systems. No accompanying consititional change was made. If Illinois' new law survives challenge, other states may be encouraged to pass their own similar laws.[16]

To allow businesses to be taxed at higher rates than homes, some states with constitutional uniformity clauses "classify" properties according to their use and character, and assess only those within the same category at a uniform rate.[17] In 40 percent of the states, however, constitutional clauses prevent the classification of property. Even so, classification is often done extralegally by assessors.[18]

Legislation to exempt solar systems from property taxes is the most popular state solar incentive. Enacted laws typically say that solar equipment shall not cause an increase in the valuation of a building.[19] At least one study based on a complicated solar energy market simulation model concludes that such legislation would increase "the estimate of solar energy to 38.6 percent in the year 2000" with the increase concentrated in small, owner-occupied homes.[20] These figures suggest that exemption legislation is worthwhile.

Most existing and proposed legislation has several important flaws when viewed from a legal perspective. Ambiguities abound regarding the treatment of passive systems, backup systems, commercial property, and easements.

First, legislation is often vague on how backup heating systems should be assessed. In most climates, building and health codes require structures with residential occupancy to be equipped with heaters capable of warming habitable rooms to specified temperatures. Requirements vary greatly, but as massive solar storage systems capable of outlasting weeks of cloudy weather are not now cost-effective, solar homes will require backup systems. These backups may not be as expensive as ordinary heating systems because solar homes will presumably be better insulated, and because less durable systems may be utilized (since they will have lighter demands). Nevertheless, backup systems will exist and laws must deal with them.

One popular type of state legislation says solar homes shall be assessed as if equipped with a conventional system[21] or "at no more than" the value of a

conventional system.[22] Such laws could be interpreted as requiring a "double assessment," i.e., the value of the backup system plus the adjusted value of the solar system.

Even legislation that simply exempts solar systems from taxation should be precise about the tax treatment of backup systems.

Second, a similar precision should be sought in statutory definitions of "solar energy system" and like terms. Not only should the exclusion (or inclusion) of legally required backup systems be specified, but it should be made clear whether passive solar systems are also to receive preferential tax treatment.

Third, state legislation should be cognizant of the fact that some assessments are made on the basis of a property's income production, a problem mentioned earlier. We found no examples of legislation reflecting an awareness of this reality.

The ABF has raised another consideration. Their suggested statute would do more than just protect solar heating and cooling systems from higher assessed value. It would also exempt entirely from taxation the value of a solar landowner's solar easement, but recognize the decrease in the value of the servient estate over which the easement passed. This approach should encourage adjacent property owners to grant easements.[23]

Yet another frequently overlooked issue is when tax exemptions should begin. Property under construction may be taxed, and is not usually exempt merely because its prospective use would make it exempt.[24] The few samples we found that dealt with this topic said the exemption would begin after the system was installed.[25] The authors of the ABF study were aware of this potential ambiguity, but decided to acquiesce to existing law.

A final aspect that has been generally ignored is whether solar units that qualify as taxable personal property (as a portable yard collector may) should also be exempt.

In summary, laws that protect solar systems from high assessments are worthwhile, but a well-designed piece of legislation should take clear positions on the following:

1. How backup heating systems are to be assessed.
2. A clear definition of "solar energy system."
3. Whether passive solar systems are eligible for exemption.

4. If the state values any property according to its income production, such property should either be given another type of incentive tailored to it, or specifically excluded from the exemption.

5. The treatment of solar easements in assessments.

6. Whether solar systems under construction are eligible for an exemption.

NOTES: PROPERTY TAXES

1. Robert R. Statham, A Review of the Property Tax and Its Impact on Business (Washington, D.C.: U.S. Chamber of Commerce, 1973), p. 14.
2. Ibid., p. v.
3. Ibid., p. 14.
4. Ibid., p. 15.
5. William Thomas, Alan Miller, and Richard Robbins, "Legal Issues Related to Use of Solar Energy Systems" (Aug. 1976 draft of forthcoming article in the American Bar Foundation Research Journal).
6. Ibid.
7. Ibid.
8. Or. Rev. Stat. § 307.010.
9. Ibid., § 307.020(3).
10. Ibid., § 307.190.
11. Statham, A Review of the Property Tax and Its Impact on Business, p. 14.
12. Ibid., pp. 79-80.
13. Thomas, Miller, and Robbins, "Legal Issues Related to Use of Solar Energy Systems."
14. Statham, A Review of the Property Tax and Its Impact on Business, p. 38.
15. Or. Const. art. 1, § 32; Or. Rev. Stat. § 305.090.
16. Thomas, Miller, and Robbins, "Legal Issues Related to Use of Solar Energy Systems."
17. Statham, A Review of the Property Tax and Its Impact on Business, p. 113.
18. Ibid., p. 122.
19. H. Craig Peterson, The Impact of Tax Incentives and Auxiliary Fuel Prices on the Utilization Rate of Solar Energy Space Conditioning (Logan, Utah: Utah State University, 1976), p. 10.
20. Ibid., p. 77. It was assumed that "consumers discount future property taxes at the same rate as they can borrow to finance solar energy equipment." Without this assumption, the exemption would have a somewhat smaller impact. Ibid., p. 82.
21. Ill. H.B. 164 (1975).
22. Md. H.B. 1604, 1975 Md. Laws ch. 509.
23. Thomas, Miller, and Robbins, "Legal Issues Related to Use of Solar Energy Systems."
24. Ibid.
25. Iowa H.F. 719 (1975).

10

MOBILE HOMES

Pursuant to the National Mobile Home Construction and Safety Act of 1974,[1] the Department of Housing and Urban Development (HUD) promulgated the Mobile Home Construction and Safety Standards (Mobile Home Standards), effective June 15, 1976. These nationwide standards apply to all mobile home manufacturers, and control "all equipment and installations in the design, construction, fire safety, plumbing, heat-producing, and electrical systems of mobile homes designed to be dwelling units."[2] The standards preempt state laws that deal with anything covered by the standards, unless the state law is identical to, or more stringent than, the federal standards. Therefore, any successful effort to produce a mobile home equipped with solar heating, cooling, and/or hot water systems would be dependent upon compliance with HUD's regulations. It is, then, essential to examine these regulations and identify and try to eliminate any barriers to use of solar energy in mobile homes.

Over a quarter of new houses have wheels. The great potential for widespread use of solar systems on mobile homes makes it important to overcome existing impediments and provide all possible incentives for the development of an economically feasible system. According to statistics compiled by the Manufactured Housing Institiute, mobile homes accounted for 94 percent of all single-family housing starts under $20,000 and 28 percent of all single-family starts in 1975.[3] (These figures do not include owner-built homes or homes that were built to rent—only new homes that were sold during 1975.) Moreover, a generous percentage of mobile homes are located in states with high insolation.

In addition to providing a large potential market for solar heating, cooling, and hot water systems, the potential for mass production means that great opportunities exist for cutting the price of solar systems for manufactured housing.[4]

The purpose of the Mobile Home Standards, as set forth in the Mobile Home Act, is to protect the public from injuries caused by faulty construction and design. It is possible that solar systems will be safer than conventional ones, and that their encouragement will thus dovetail with the purpose of the act. An amendment to the act, broadening its purpose to include energy conservation, may be wise.

Encouraging innovation. Nevertheless, the mere existence of uniform standards facilitates the future development of solar-equipped mobile homes. The process of introducing innovative designs, like solar-equipped units, is greatly simplified by a nationwide uniform code, because manufacturers only have to deal with one authoritative source rather than a multitude of state and local regulations (as is the situation with conventional housing). Although the Mobile Home Standards designate specific materials to be used in mobile home construction, they do not prohibit introduction of new materials; in fact, innovative designs are expected and provided for.[5] Alternative materials may be used if they perform as well or better than the specified materials. Therefore, solar heating, cooling, and hot water systems may be substituted. A greater burden is put on the manufacturer's shoulders, however, as he must prove that the alternative devices he wishes to use are truly equivalent. Required testing procedures are set out in the standards.[6] Unless the new material or method of contruction is based on "accepted engineering design for the use indicated,"[7] the burden is put on the manufacturer of developing and conducting tests to show the structural properties and significant characteristics of the alternative.[8] It is questionable whether solar systems for mobile homes could be based on accepted engineering design. Although the "burden of proof" lies rightfully with the manufacturer, this provision could impose significant administrative and economic burdens. As manufacturers must already invest a great deal of time and capital in developing new designs, this extra burden would discourage innovation.

Cost--the major obstacle. Government agencies have already recognized the potential for solar development in the mobile home industry and are funding experimental projects. But the major problem, the high cost of solar mobile homes,

remains unsolved. The Los Alamos Scientific Laboratory, with funds from ERDA's Division of Solar Energy, has completed one of four planned solar-heated mobile/modular homes. The laboratory estimates that the cost of one such unit, if produced at the rate of one unit per week, would be $25,000. A similar mass-produced unit without solar heat would cost $20,000.[9]

One of the major problems in establishing a secure market for solar-equipped mobile homes lies in the nature of the market. Mobile home buyers are seldom affluent, so a 20 percent increase in the initial cost of a unit may be crucial to their buying decisions. Mobile homes provide inexpensive housing to low- and moderate-income families. Arguments about life-cycle costing are pointless if a family simply cannot make a larger down payment. Because of this, the potential for widespread use of solar systems is greatly reduced.

Even with low-interest, long-term financing, most mobile home owners may not be interested in such an investment. This, again, is due to the nature of the market. The majority of mobile home owners are young couples or older retired couples. Young couples regard living in a mobile home as a temporary situation while they save for a real house. They would not be interested in the long-term cost benefits of solar heating, cooling, and hot water systems. Retired couples who purchase mobile homes usually have fixed incomes. As they tend to be conservative about expenditures, they may be discouraged by a large down payment. On the other hand, people with fixed incomes might be more concerned about rising fuel prices, and the idea of amortizing their energy costs as part of their mortgage may appeal to them.

Planning now for retrofits. Although it appears that solar energy will not be economically feasible for mobile home use until the cost is lower, there is still a great opportunity to increase the future market through retrofits. The Mobile Home Standards establish roof load requirements.[10] If HUD were to determine the anticipated weight of solar collectors, and increase, if necessary, the roof load requirements to accomodate collectors, many more mobile homes would be able to convert to solar systems in the future. Present mobile homes may be structurally strong enough to support a small solar collector, because of the broad distribution of the weight of collectors, but it is doubtful that their roofs could withstand installation weights, such as the pressure of workmen.[11]

In addition to improving the structural strength provisions, plumbing standards should be examined and changed, where necessary, to facilitate future solar retrofits.

Ground collectors. One alternative to roof collectors is the Solar Furnace manufactured by Champion Homes Inc. This controversial furnace can only be used for space heating, but Champion Homes is currently attempting to develop a cooling system as well. Designed to be placed on the ground, this unit is particularly adaptable to mobile homes. But, while roof load problems are no longer a concern, new problems are presented by zoning ordinances.

Roughly half of all mobile homes are in mobile home parks,[12] and mobile home parks provide only minimally sized lots. Because of this, ground space is limited and precious. A survey of density regulations where mobile homes are most abundant (the southeastern states and California), reveals that the minimum lot size ranges from between 2,000 to 3,000 square feet per mobile home. An average mobile home (720 square feet) occupies from 24 to 34 percent of this space.[13] Although there is technically room for a solar furnace in the remaining space, it would further reduce an already too small yard.

Connecticut, on the other hand, requires a generous 10,000 square feet of land for each mobile home, and New York subjects both mobile and conventional homes to the same lot requirements.[14] If the minimum lot size requirements of all mobile homes were increased to provide a reasonable amount of yard space, as in Connecticut and New York, more mobile home owners might consider the Solar Furnace type of alternative. In addition to being more compatible with the structure of existing mobile homes and more easily retrofitted to any forced air system, the Solar Furnace costs less than other units with comparable performances. Its price ranges from $2,500 to $3,500, excluding installation.

A third, more distant, possibility are thermic diode panels used as structural, vertical wall elements. Such panels are now being tested. Their overall structure is based on a stiff paper honeycomb core, a material already used in mobile homes.[15]

Communal solar systems. Another possibility, since so many mobile homes are close together in mobile home parks, is collective solar systems. The most attractive aspect of collective systems is that they lower the barriers previously discussed. A collective system could be located on an empty lot so individual yards would not be shrunk. It would not require stronger roofs. It also removes the necessity for large consumer investment, a very important factor. If the owners of mobile home parks would provide the necessary space for a joint collector (and this

should be more palatable to them than increasing each lot's size), this could be a feasible solution. Joint heat storage units may also be useful in a trailer park setting. (See the Utilities chapter for further discussion of joint systems.)

Tax breaks overlook mobile homes. Another barrier to the use of solar energy in mobile homes is tax policies. In some areas, mobile homes are taxed as personal property; in other areas they are taxed as real property. Mobile homes that are taxed as personal property are not eligible for the solar tax exemptions being considered by state legislatures, and tax incentives are now the most popular form of economic incentive for solar energy. At least three-fifths of the states have introduced legislation providing income tax deductions or exemptions from sales, use, or property taxes for the cost of purchasing and installing solar heating and cooling systems. These incentives are offered for both residential and commercial properties. However, mobile homes are not specifically included. Either all mobile homes should be taxed as real property, or, where applicable, present tax laws should be amended to include personal property tax exemptions for purchasers of solar equipment for mobile homes.

Better financing terms are needed. The way solar homes are financed also discourages solar energy utilization. The larger, more expensive mobile home units are treated as conventional housing and thus are eligible for long-term financing, while smaller units are not. Because of this practice, it would be harder for purchasers of the smaller units to bear the additional costs of a solar-equipped mobile home. The same irony found in many credit situations is present here: only the least favorable credit terms are available to the higher risk applicant who could most benefit from longer-term, lower-interest loans. Because there is a strong public purpose in encouraging solar heating and cooling, it may be wise to accept the risk of defaults. Accordingly, state and local institutions that affect the lending laws could be required to treat all solar-equipped mobile homes as conventional housing. In response to arguments that the owners of small units are more likely to default, it can be said that those small-trailer owners who invest in solar equipment must be planning to keep their trailers long enough to recoup their investment. It is even possible that as fuel bills rise, the buyers of solar mobile homes would be less likely to default as their total monthly expenditures on energy and housing may be lower.

HUD now provides mobile home loan insurance, and facilitates a secondary market (through the Government National Mortgage Association) for some

government-insured or guaranteed mobile home loans. HUD should review its programs to see how its considerable influence in this market could be used to encourage solar mobile homes. One possibility would be to raise the maximum amounts of loans that can be insured when the increase in the price of a mobile home is due to solar equipment.

NOTES: MOBILE HOMES

1. 42 U.S.C. § 5401 et seq. (Supp. IV 1974).
2. 24 C.F.R. § 280.1(a) (1976). Emphasis added.
3. Manufactured Housing Institute, "Quick Facts" (Chantilly, Va., 1975), p. 7.
4. J. Douglas Balcomb, "Solar Energy Systems for Manufactured Housing," (Paper presented at the Consumer Conference on Solar Energy Development, Albuquerque, N.M., 2-5 Oct. 1976), p. 4.
5. See 24 C.F.R. Part 280 (1976).
6. Ibid., § 280.301(g).
7. Ibid., § 280.301(e)(2).
8. Ibid., § 280.301(e)(2) and (f).
9. See Balcomb, "Solar Energy Systems for Manufactured Housing," p. 12.
10. 24 C.F.R. §§ 280.305(3) and 280.401-02 (1976).
11. According to Alan Jacobson, program manager for a General Electric project funded by the National Science Foundation entitled, "Exploration, Design, Construction, and Evaluation of Solar Energy Systems for the Heating and Cooling of Mobile Homes."
12. See Balcomb, "Solar Energy Systems for Manufactured Housing."
13. See Norman Williams, Jr., "The Special Problem of Mobile Homes," in American Land Planning Law, 5 vols. (Chicago: Callaghan & Co., 1974-75), 2: chap. 57.
14. See ibid., § 57.31.
15. Solar Energy Digest 8, no. 1 (Jan. 1977): 5.

11

TORT LIABILITY, INSURANCE, AND WARRANTIES

Even the most wildly enthusiastic supporters of solar heating and cooling would admit that someone or something is bound to be injured at some time by this new technology. Solar systems may be less dangerous and more reliable than conventional furnaces. Nevertheless, it is possible that solar equipment will pose special hazards like glare, broken glass, or leakage of dangerous chemicals, or that they will simply not function as promised. Persons seeking compensation for injuries caused by such hazards will turn to the well-developed tort laws that deal with the duties of landowners to persons on and off their property.[1] A related area of tort law deals with "product liability" laws determining who pays when a person or property is damaged by a product. Relief will also be sought from insurance companies and under warranties.

Although solar devices will present slightly new factual situations, courts have had a lot of practice applying liability laws to new circumstances. It is not possible to predict the outcome of all solar equipment cases, but it is interesting to sketch out the broad principles that shape court decisions. We will look first at the legal duties of the landowner and then at the duties under tort law of equipment manufacturers, retailers, and installers. Insurance and warranty options will then be examined.

Tort Liability of Solar Property Owners

As the use of solar equipment becomes more popular, questions may arise about the liability of equipment owners to persons accidentally injured by their systems. The potential dangers most frequently cited are broken glass or leaking

chemicals; whether a ground collector would be an "attractive nuisance" to a child; and whether glare from collector surfaces may momentarily blind auto drivers and cause accidents.

The liability of a landowner will hinge, in part, on the legal status of the injured plaintiff with regard to the property (trespassor, licensee, invitee); the age of the plaintiff; and on whether the injury occurred on the property. If a child trespasses and is injured while climbing on a ground collector, the landowner may be liable if it can be proved that the collector was a "dangerous condition" with a risk children would not be able to appreciate, if the owner knew that children frequently came into the yard, and if it would be very difficult to make the collector "childproof." Thus, if a child climbed to the top of a tent-shaped collector and fell off, the owner would probably not be liable because children can usually appreciate the risks associated with height. But if the child broke the collector and was injured by a chemical leaking from it, liability may attach. It is hard to imagine a situation, however, where a fence could not easily be put around ground collectors, thus avoiding this problem.

If an adult trespasses on land, and the owner does not know of his presence, the owner has no responsibility for accidental injury. Once the owner is informed of the intruder, a responsibility exists to warn him of, or make safe, any concealed artificial conditions that could seriously harm the trespasser. On the other hand, if there is <u>any</u> risk of harm from <u>active</u> operations, the owner must provide adequate warnings. If a trespassor is anticipated, he is usually treated as a discovered trespasser.

Someone with permission to come on land, either for their own benefit or for business purposes, is called a licensee. (Social guests are licensees.) Licensees are entitled to warnings regarding any dangerous conditions they are unlikely to discover. The owner need not make repairs or make safety inspections. But, if a solar system could be termed an "active operation," the owner must exercise reasonable care in running it.

Another category of persons are "invitees"—those invited to come on the premises for the owner's benefit. Customers at a store or worshippers in a church fall into this group. Property owners owe a rather high duty of care to such people. They must make safety inspections of their property and make safe (a warning may be sufficient) dangerous conditions, as well as warn of concealed dangers.

Glare off some collector surfaces may be an irritant or even a danger to motorists. The general rule is that landowners are only liable to persons off their premises if the injury was caused by unreasonably dangerous, artificial conditions on the property. A court would probably ask whether a simple, inexpensive solution to the glare existed.

Although we did not find any very analogous cases, a glare that creates a danger on a public highway could possibly be dealt with as either a public nuisance or as a case of negligence. The most similar cases we found involved instances where a landowner diverted water onto a sidewalk.[2] In these cases, property owners had to pay for damage resulting from their negligence. Reflecting sunlight could be found analogous to diverting water.

Nearly all homeowners have liability insurance that protects them if they are sued by a third party. When a Washington, D.C., insurance agent was asked whether a typical homeowner's policy would cover the glare situation, she replied that legal expenses would be paid, and the homeowner reimbursed, if the suit was lost. She thought it very unlikely, however, that the homeowner would lose the suit if the jurisdiction allowed the type of solar device that caused the glare. (She thought the jurisdiction would be liable.)[3]

Liability insurance would, of course, also cover the situations where a person coming on property is injured by a solar device.

Tort Product Liability

If a solar device is defective and malfunctions or harms someone, it may not be the landowner who is liable. The law has shown an amazing ability to stretch itself to reach into deep pockets. Thus, the manufacturers, retailers, or installers of a product may find themselves defendants. Utility companies in the business of selling or leasing solar equipment could also be sued, even in jurisdictions that have not abolished municipal immunity from tort suits, since utilities serve a proprietary, as opposed to a governmental, function. Whether pockets in the new solar industry are shallow or deep is questionable. The liability, theoretically, is the same.

Three theories may apply: strict liability, breach of implied warranty, and negligence.

Strict liability. Most jurisdictions have adopted section 402 A of the Restatement of Torts Second. This model code says that if you are in the business

of selling a particular product, and if the product is expected to reach the consumer in essentially the same condition it was in when it left your hands, then you are liable for any physical harm caused by an unreasonably dangerous defect in your product.[4] How much care you used in making and selling the product is irrelevant (hence the term strict liability).

Breach of implied warranty. Another type of strict liability is provided in section 2-314 of the Uniform Commercial Code. Under this section, sellers of goods warrant that their products are fit for the ordinary purposes for which they are used. Some courts use this approach.

Negligence. To prove negligence, a plaintiff must show that a manufacturer, retailer, or installer failed to exercise as much care as a reasonable person would under the same circumstances. For example, a manufacturer need not make the best possible product, but if a competitor makes a similar product[5]—and makes it safer—that fact will be evidence against the defendant manufacturer.[6] When the negligence approach is used, plaintiffs may recover for almost any expenses associated with personal injuries or damage to their property. Actual, substantial harm or injury must be shown. Attorneys fees and punitive damages are not available, and the plaintiff always has a duty to mitigate damages.

For any of the above theories, it makes no difference whether the defendant had included a disclaimer in the sale. Even if a bill of sale said "manufacturer is absolutely not liable under any circumstances," the maker would still be liable for personal injuries. A defendant could be anyone in the distribution chain. Mass producers of new homes, used-product sellers, and commercial lessors have been found liable under these theories. Thus a "solar subdivision" developer or lessor of solar equipment may not escape liability. If a person other than the owner is injured, it is still probable that they could recover, if injury to persons in their situation was foreseeable.

Defenses available to a manufacturer or retailer defendant being sued under any of the above theories are that the plaintiff voluntarily and unreasonably assumed the risk, or that the plaintiff was contributorily negligent. To prove the former, it would have to be shown that the plaintiff knew of the defect and the danger it presented, but continued to use the product the same way, and was therefore injured. Contributory negligence could be shown by proving the plaintiff's injuries were caused by plaintiff's misuse of the product.

Some courts allow the above theories to be used only where bodily or property damage (as opposed to purely economic harm) can be shown. Because safety is the key concern, it would sometimes be necessary to show that the product caused harm to a person or to property. A collector that leaked, damaging walls and floors, would fit into this category. So would a poorly insulated set of collectors if their repeated heating and cooling degraded the cellular structure in a house's wood frame, making it vulnerable to fires. The cost of replacing or repairing the damaged system itself could also probably be recovered under these circumstances. The major limitation of a negligence or strict liability in tort approach, therefore, is that it would not help the buyer of a solar system that was not dangerous but did not adequately heat his home:

> There is no doubt whatever that the manufacturer is under a duty to use reasonable care to design a product that is reasonably safe for its intended use . . . The maker is not required to design the best possible product, or one as good as others make, or a better product than the one he has, so long as it is reasonably safe. 7/

Manufacturers and others may also be held liable for intentional or negligent misrepresentation; where an express warranty exists; or where there is an implied warranty of fitness for a particular purpose (and the seller knows what the buyer intends to do with the product, and the buyer relied on the seller's "expert" advice). In these situations, the seller is promising more than the mere safety of the product, and purely economic losses on the bargain are always recoverable.[8]

Obtaining Insurance on Solar Homes

The major potential problem with insuring solar homes is the lack of data on the risk involved. We did not, however, find any strictly legal barriers. At present, there is no explicit exclusion of solar systems for heating and cooling in the standard homeowner's contract. The value a solar energy system adds to a structure may mean slightly more insurance must be purchased, but this is not a "legal" barrier. Clauses in some insurance contracts apply to "infrequent risks." Individual companies may choose to apply these clauses to solar homes.[9] But the insurance company would have to be able to convince a state insurance department that an extra and substantial risk of exposure was involved in order to make a major departure from the basic contract, or to collect a special surcharge. Evidence of extra risk exists, since nearly all solar homes are required to have

backup conventional heating systems. Thus the known risk of conventional systems is added to the unknown risks of solar. Antifreeze in a domestic hot water system may cause insurance problems, as may the degeneration of a structure's wood roof frame from repeated heating and cooling of collectors.[10]

New technologies are examined by the Insurance Services Office (ISO) to find if enough additional risk is involved to justify special rates.[11] As yet, the ISO does not have enough data on solar systems to make a decision. They could find solar homes to be less risky than conventional ones. If they do determine that solar homes are in a special category, the ISO may either spread the greater (or lower) risk among all homes, so all would pay the same rates, or may issue special policies for solar homes.[12] This could only be considered a legal barrier if the ISO decides solar homes are more risky and that they should bear the full cost of the additional risk, and if state insurance departments act on such a recommendation.

Should insurance companies decide solar homes are so risk-laden as to be uninsurable, most states have some sort of "fair plans." These work much like the car insurance assigned risk pools.[13]

From the lenders' point of view, securing insurance is not a problem. If it should prove to be one, they would just require the homebuyer to obtain insurance as a financing precondition.[14] Some members of the insurance industry have said they would insure solar-heated homes, but may charge higher premiums or require the homeowner to assume more risk.[15]

Warranties

One commonly expressed concern is that poorly designed, manufactured, or installed solar devices will give the solar industry a bad reputation and slow the growth of this new market. This fear has some basis. In Florida, for example, tank failures and leakages eroded consumer confidence in solar water heaters, contributing to the demise of this once-popular piece of equipment.[16] Similarly, an AIA study found:

> At present, performance warranties are offered with few solar products. Most of those which have been obtained by early users have been the result of negotiations before finalizing a sale, rather than a standard practice.
>
> Even in those cases where warranties are available, there is reluctance to rely on those offered by newly-formed companies. As a result, solar subsidiaries of large, established companies have an advantage in [a] market which increasingly requires warranties. 17/

Before consumers invest a large sum of money in solar heating and cooling systems, they need information to determine the risk and ascertain that the risk is manageable. First, they need to know what to expect in terms of system performance and durability. Second, they need to know who will pay for repairs if the system malfunctions—the designer, manufacturer, architect, plumber, or themselves.

Private Remedies are Inadequate. It is best to clearly allocate the cost of repairs in advance by means of comprehensive warranties of performance, or service contracts for maintenance and repair. Although these private mechanisms for allocating responsibility are the most obvious ways to overcome consumer doubts about using solar equipment, they are not now being offered. According to attorney Steven Rivkin, in a report prepared for the AIA Research Corporation, manufacturers are not offering comprehensive warranties because they are caught in a circular problem. Until manufacturers install enough solar systems to know what problems can be expected, they cannot prudently offer broad warranties; meanwhile, consumers hesitate to buy unwarranted systems, thus retarding the collection of information on which warranties are necessarily based.

A similar problem exists with the development of comprehensive service contracts for maintenance and repair. Such contracts are really a form of insurance policy. A combination of poorly defined risks and potentially large repair bills, in the event of malfunction, makes the costs of such insurance too great to be widely utilized. Because of the circular nature of this problem, the AIA Research Corporation recommends a structural approach — i.e., a public policy to underwrite the development of the market as a whole.[18]

Governmental Approaches

Develop performance standards. Almost everyone will agree that the importance of developing performance-based standards for solar heating and cooling cannot be overemphasized. Such standards allow for further development of a new technology, grant flexibility to the builder or designer who uses the new technology, and give the consumer a clear idea of what to expect from solar equipment. In the long run, performance-based standards can provide the necessary underpinning for comprehensive warranties.

A first attempt to set federal solar standards was completed in January 1975, when HUD published the Interim Performance Criteria for Solar Heating and Combined Heating/Cooling Systems and Dwellings. Developed by the National Bureau of Standards, these criteria established standards for federal procurement and demonstration projects. A more recent set of federal standards, the draft Intermediate Minimum Property Standards for Solar Heating and Domestic Hot Water Systems, was prepared by the NBS and released by HUD for public comment in July 1976. Finally, in the private sector the American National Standards Institute (ANSI), the American Society for Testing and Materials (ASTM), and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) are working to develop "voluntary consensus" standards, which are probably two to three years in the future.[19]

Use demonstration projects. Federal solar demonstration projects that are underway can be used extensively to develop permanent standards of performance, inform consumers of what can be expected from solar equipment, and build consumer confidence in solar systems.

Federal underwriting of service contracts. As noted above, comprehensive service contracts offer one way to reduce the consumer's risk of getting stuck with costly repairs, but such contracts are not currently offered due to the difficulty of establishing the risk of malfunction and the potential cost of repairs. The federal government could choose to underwrite service contracts, at least temporarily, to allow these service contracts to be offered by private manufacturers.[20] Such support would have far-reaching implications by inspiring public confidence in solar energy. It would also have the immediate effect of allowing manufacturers to offer comprehensive service contracts without fear of financial ruin, and would tell consumers exactly what risks they would assume with the purchase of solar equipment.

Government insurance for solar system builders. It has been suggested that the federal or state governments could provide insurance to solar system builders, under which the government would pay for the cost of repairs if the builder filed complete information about why the system malfunctioned or failed.[21] This program would encourage builders to experiment with new technologies, would insure consumer satisfaction, and would provide the government with useful data. On the other hand, it may also encourage slipshod work on solar systems. Because

of this possibility, we do not recommend it. As the manufacturer or installer who offers a good warranty will have a tremendous competitive advantage, it can be anticipated that warranties will be available as soon as enough data is collected on which to base them.

Summary

We found no important legal barriers to solar heating and cooling in either tort or insurance law. Nor do we recommend that the federal government take any new action at this time with regard to warranties. Present tort laws will adequately and fairly handle situations where children or adults are injured by solar devices. Insurance will usually reimburse the property owner for any judgments against him and for associated legal fees. Solar homeowners may have to pay slightly more for insurance if their homes are found to present more risks.

If a solar device damages property, it may sometimes be possible to collect under tort theory. However, the more important situation, where a solar device does no injury to person or property but simply malfunctions or fails to perform well, is not covered. A few states with strong consumer laws may provide partial solutions, but it is clear that product standards are the best remedy. Standards would also reassure insurance companies that worry about the diversity of solar systems and their unknown risks. Through the use of standards, many problems can be kept from arising.

It is not possible to draft reasonable laws to fill all the gaps related to product warranties. For instance, because many solar systems are experimental, and because structures vary so greatly in their design and insulation, manufacturers will sometimes not be able to expressly guarantee that their systems will be adequate for a particular structure. The builder or homeowner must assume the risk. An architect who has designed many solar buildings points out: "Right now the solar industry has a lot of blue suede shoe operators, and it's really a case of 'buyer beware.' "[22]

NOTES: TORT LIABILITY, INSURANCE, AND WARRANTIES

1. William L. Prosser, who was widely regarded as "the king of torts," defines the term "tort": "Broadly speaking, a tort is a civil wrong, other than a breach of contract, for which the court will provide a remedy in the form of an action for damages." Prosser, The Law of Torts, 4th ed. (St. Paul: West Publishing Co., 1971), § 1, p. 2. The following discussion draws heavily from Prosser, particularly chapter 10, "Owners and Occupiers of Land," and chapter 17, "Products Liability." Another fine, detailed examination of these same issues, but in relation to wind energy systems, can be found in Louis H. Mayo, Legal-Institutional Implications of Wind Energy Conversion Systems (Washington, D.C.: George Washington University, Program of Policy Studies in Science and Technology, NSF Grant APR 75-19137, May 1976 preliminary draft). (Readers wishing to obtain the forthcoming final report should contact the Program of Policy Studies in Science and Technology, (202) 676-7382.)

2. See Leahan v. Cochran, 178 Mass. 566, 60 N.E . 382 (1901); Adlington v. City of Viroqua, 155 Wis. 472, 144 N.W. 1130 (1914); Tremblay v. Harmony Mills, 171 N.Y. 598, 64 N.E. 501 (1902).

3. Conversation with agent at Charles Boteler, Jr. & Associates, Inc. (Dec. 7, 1976).

4. The term "defect" as used under any of the three theories encompasses anything wrong in the design, materials selection, manufacture, advertising, etc., of a product.

5. See, e.g., Brown v. General Motors Corp., 355 F.2d 814 (4th Cir.), cert. denied, 386 U.S. 1036 (1966).

6. See Garbutt v. Schechter, 167 Cal. App. 2d 396, 334 P.2d 225 (1959).

7. See Prosser, Law of Torts, § 96, p. 645.

8. See ibid., § 102, p. 667.

9. Larry L. Forrester, vice-president and general manager of the National Association of Mutual Insurance Companies, says premium increases for solar homes are a possibility: "Any time there is something unique or different which appears to increase the danger of loss, standard premiums may not be appropriate." He added that some member companies that were insuring solar homes were concerned about the diversity of the units. Solar Energy Intelligence Report 3 (Jan. 17, 1977): 15.

10. Ibid. Forrester notes that this destruction of wood's cellular structure could lower its ignition point to room temperature.

11. The ISO is a nonprofit organization based in New York and owned by 1,200 property and casualty companies. It is the major national rating service for the insurance industry and works closely with state insurance departments in setting contract terms and underwriting criteria.

12. David Barrett, Peter Epstein, and Charles M. Haar, Financing the Solar Home: Understanding and Improving Mortgage Market Receptivity to Energy Conservation and Housing Innovation (Cambridge, Mass.: Regional and Urban Planning Implementation, Inc., 1976), p. 86.

13. Ibid., p. 87.

14. Ibid., p. 85.

15. Ibid.

16. Almost half the respondents of a New Mexico survey said that issuing strong warranties for solar heating and cooling systems is very important. Craig R.

Lundahl, An Investigation of the Acceptance of Solar Heating and Cooling in the Housing Industry in New Mexico, prepared under a grant from the National Aeronautics and Space Administration to Western New Mexico University (Silver City, N.M., NASA Grant No. NS6-902, 1976), p. 70.

17. AIA Research Corporation, Early Use of Solar Energy in Buildings, 2 vols. (Washington, D.C., Aug. 1976), 1: 62.

18. Ibid., 2: 40

19. Elizabeth C. Moore, "No News Is Bad News," Solar Age 1 (Dec. 1976): 12.

20. This possibility is mentioned in the report by the AIA Research Corporation, Early Use of Solar Energy in Buildings, 2: 39.

21. Memorandum from Steven R. Rivkin to Charles Masterson (Dec. 31, 1975), p. 8.

22. Richard P. Rittelman, "Experts Agree: Solar Energy Can Pay Off Now, But Builders Proceed with Caution," Professional Builder, June 1976, p. 103.

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Legal Barriers to the Utilization of Solar Energy for Heating and Cooling

The Environmental Law Institute
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Note: Entries are grouped according to the type of legal barrier to which they relate.

AIR POLLUTION

American Bar Foundation. Legal Issues Related to Use of Solar Energy. Chicago: American Bar Foundation. August 1976 draft. This comprehensive work of over 200 pages should be a useful source for persons researching nearly any legal issue in this field. Because it is so extensive -- a "cafeteria style" plethora of suggested statutes with accompanying legal analysis--relevant sections will be discussed under the appropriate heading rather than in one massive entry. The study is sponsored by the National Science Foundation.

Very broad conclusions include a statement that the real cause of our inability to quickly respond to our energy needs is not legal, but cultural, and that the only true traditionally legal issue is guaranteeing access to sunlight for solar collectors.

Air pollution is not directly discussed as a relevant legal issue. It is, however, suggested that one of the regulatory actions the federal government could take is to impose the full cost of exploration, production and use of oil and gas on their ultimate users. Air pollution is an externalized cost of these fuels.

Kraemer, Sandy F.; Felt, James G. "Solar Rights--New Law for a New Technology." Draft of a proposed article for publication. February 1976. The authors' stated goal is to evaluate proposed solutions to the solar access problem in light of their political, economic and social impact. The suggestions are intended to complement, but not replace, existing tools like private solar easements, covenants, etc. Kraemer says the usefulness of covenants is limited as they affect only a few houses, are prospective only, and may not always run with the land. Easements are proscriptive and dependent on cooperation between neighbors. Additional measures are therefore needed. The use of eminent domain is discussed, and the question of whether a solar easement is a "public" use, not merely a public interest. Kraemer concludes that the use of eminent domain is currently feasible under the laws of most states. Private nuisance actions are not viewed as a viable option; the issue is raised whether shadows could be declared a public nuisance. He predicts it could be a reasonable regulation to preserve the public health, safety, order and welfare. Useful possibilities in zoning to prevent shadows are also foreseen. Air pollution is noted as a potential problem, and Kramer points out that current laws do not provide for private suits in this area.

ANTITRUST

American Bar Foundation. Legal Issues Related to Use of Solar Energy. (See entry under AIR POLLUTION.) Antitrust issues are touched only indirectly. For instance, joint private and public utility use of solar energy systems are encouraged (p. 181); joint systems would be allowed unless they had an undue economic effect on the utility. It is termed questionable whether public utilities have the authority to supply solar energy systems for use by the general public.

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Hay, Harold R. "Solar Energy Opportunities for Small Business." Paper for the Consumer Conference on Solar Energy Development, Albuquerque, New Mexico, October 1976. The author suggests ways that demonstration programs could enhance small businesses' role in solar development, and points out why small businesses should play a major part in developing solar energy.

Howe, Everett D. "Public Utilities Consider Solar Energy." Sunworld 1 (1960): 10-11. This short article discusses the solar energy application efforts of the Electric Power Research Institute, Pennsylvania Power and Light, San Diego Gas and Electric, Pacific Gas and Electric, and the Southern California Gas Company. The author states it would "considerably accelerate" the adoption of solar water heating equipment if customers paid a monthly fee to a utility for hot water service, or a lease and maintenance fee for the use of equipment.

Wilson, Jones, Morton & Lynch. The Sun: A Municipal Utility Energy Source. This San Mateo, California law firm is doing research for the City of Santa Clara, California. ERDA has supported this work. This study says that solar energy may be a financial threat to established utilities, but that it will have no abrupt impact on them. Analyses are made of conditions under which the contract clause of the U.S. Constitution would be violated, when takings would occur, and of the application of federal antitrust law when a city decides to generate electricity from a central solar plant and sell it in competition with a franchised utility. It is concluded that the interests of existing privately-owned utilities are not significant obstructions to the ownership and operation of a solar utility by a municipal corporation. The authors say that a finding of public purpose is almost compelled by the benefits of solar energy, and that the public purpose and benefit of solar energy will grow even stronger as the prices of conventional fuels rise. The possibility of both mandatory and discretionary utilization of solar energy are discussed, including the familiar issues of utility

rates, financial incentives, zoning and other land use techniques, condemnation of airspace, and various forms of governmental financing. A state-by-state look at the possibility of using revenue bonds to finance solar facilities is included. It is found that, in general, most forms of local governmental financing are legally adaptable to financing solar facilities, and that government financing is a necessity.

Knauer, Virginia H. Speech to the Pennsylvania Electric Association. Pittsburgh: 18 September 1975. Knauer, special assistant to President Ford, urges that utilities be allowed to participate in the rental or sale of solar units for homes to help overcome the problem of initial costs. She does not however, believe utilities should be given a monopoly of supply or distribution. The New England Electric System plans to have 100 consumers participate in a hot water demonstration program are mentioned, as is Southern California Gas Company's "Project Sage."

Moore, J. Glen. "Solar Energy Legislation in the 94th Congress: A Compilation of Bills through August 3, 1976." Washington, D. C.: The Congressional Research Service of the Library of Congress. Mr. Moore is an analyst in the Science Policy Research Division. Many of the Proposed laws deal with tax credits, deduction and other financial incentives. A few would help small businesses capture a share of the solar pie.

Rosenberg, Laurence C. "Three Problem Areas Affecting the Future of Solar Energy." Paper delivered at the annual AAAS meeting in Boston: 21 February 1976. Rosenberg is program manager for the National Science Foundation. The three problem areas he pinpoints as having the potential to "generate tremendous barriers to the widespread use "of solar energy for residential and commercial water heating and space heating and cooling are: 1) the relationship between solar energy and electric utility rates; 2) the industrial organization of new solar energies (who owns them and the terms of competition) and 3) the building industries' adoption of new solar technologies (including finance, land use and technology transfer issues). Brief descriptions of thirteen NSF solar and geothermal research projects are in the appendix.

Scott, Jerome E.; Melicher, Ronald W.; Sciglimpaglia, Donald M. Demand Analysis Solar Heating and Cooling of Buildings. Washington: National Science Foundation RA-N-74-190, Government Printing Office, 1974. This investigation focused on why the use of solar energy to heat water in South Florida declined in the 1950's. Three primary forces were isolated: 1) a rapid decline in electricity prices but an increasing first cost of installing a solar unit; 2) tank failure and leakages; 3) the emergence of the large scale builder-developer, which largely removed the homeowner's choice of hot water systems. Insufficient capacity was another frequent complaint. The future, in the authors' opinions, is brighter. They point out that, unlike space heating and cooling, water heating has a huge potential retrofit market.

U.S. Congress, Senate Select Committee on Small Business. Interim Report on the Role of Small Businesses in Solar Energy Research, Development, and Demonstration. 94th Cong., 1st sess., 7 October 1975. Charges that ERDA has not given sufficient attention to the role of small business in developing solar energy. Includes suggestion that HUD's Minimum Property Standards should be amended to include standards for solar space-heating, air-conditioning, and water-heating equipment. Tax incentives, educational programs, model codes, and decentralized applications of solar energy are also called for.

U.S., Congress, Senate, Select Committee on Small Business. Hearing on Energy Research and Development and Small Business, Part I, Solar Energy: How Much? How Much from Small Business? How Soon? Why Not More? Why Not Sooner? 94th Cong., 1st sess., 13 and 14 May 1975. Part II, Solar Energy: The Small Business and Government Role. 94th Cong., 1st sess., 8 and 22 October and 18 November 1975.

von Hoffman, Nicholas. A commentary in The Washington Post, 7 May 1976. The author derides the Santa Clara County, California, effort to rent solar pool heaters at hefty installation and rental fees. He also criticizes a decision by the California PUC to allow Pacific Gas and Electric to charge customers with solar equipment on the basis of all the Btus they consume, not on the basis of the traditional forms of actually supplied by the utility.

BUILDING CODES

American Bar Foundation. Legal Issues Related to Use of Solar Energy. (See entry under AIR POLLUTION.) A discussion of building codes begins on page 136. The authors say that there are so many codes that "it is impossible here to devise standard amendments." Rapid developments would make specific standards unworkable anyway. Codes should be examined, however, for unreasonable interferences, and the FHA's minimum property guidelines should be altered to conform with state recommendations. Building codes are mentioned briefly in the discussion of comprehensive land use planning beginning on page 195.

American Institute of Architects Research Corporation. Early Use of Solar Energy in Buildings: A Study of Barrier and Incentives to the Widespread Use of Solar Heating and Cooling Systems. A review copy of a summary report to the National Science Foundation, May 1976. The principal finding is that there are no major barriers to the solar heating of buildings (this is particularly true with low-rise buildings, but no instance was found of any actual impediment). A lack of an energy conservation policy in the building industry was noted, as was the atmosphere of novelty surrounding solar installations, an erroneous view that the costs of equipment are the only significant costs, a crucial lack of climatic information, a lack of usable performance standards, a need for warranties until real world experience is gained, a need to know more about how sun rights affect land values, and energy trade-offs with increased transportation and communition needs. Early users report that first costs (for equipment, design and construction) are the greatest barrier.

Anderson, Bruce. "The Sun in a Drawer." Environment 17 (1975): 36-41. A maze of bureaucratic, economic and legal barriers threatens to bottle up the use of solar energy for heating and cooling. This article is based on Anderson's Solar Energy in Building Design book which was written under a contract with Arthur D. Little. It is available from Total Environmental Action, Church Hill, Harresville, New Hampshire 03450. Chapter 5, "Solar Energy: Obstacles and Outlook" is the most relevant to our needs. Anderson argues for life cycle costing and that property taxes should be lower rather than higher for solar-equipped homes. He discusses the slowness of the building industry in adapting to change, its fragmentation, and the obstacle of 30,000 frequently incompatible building codes (no great detail is given). He feels that the fire code is the most likely to affect solar use because, for example, of the flammability of paraffin, the glass collector cover plates, and the combustion and smoke problems from insulation. Health code problems are mentioned, as is a need for sun rights. Ways to protect collectors from vandalism are looked at as are the problems of reflection from tilted collectors.

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Hillhouse, Karin H. (principal investigator). "Solar Energy and Land Use in Colorado: Legal, Institutional and Policy Perspectives," Washington, D. C.: Environmental Law Institute, April 1976. Interim report to the National Science Foundation. This case study in Colorado included interviews with energy decision makers and others. Topics discussed include energy demand and supply in Colorado, environmental constraints, utility regulation and energy planning, how PUC regulations could encourage solar energy utilization. Suggests that creation of a state solar energy agency is necessary to ensure that solar energy receives serious consideration soon. The use of federal lands for nonfederal energy projects, is covered as a solar land use planning and zoning. It was found that the

shading of roofs is not a real problem in Colorado Springs for single family residences. The use of easements, solar zoning and various procedures are analyzed. The study concludes that a condemnation program related to airspace may be upheld. The issues of discriminatory rates, regulation of end-use energy by the PUC, monopoly franchise restrictions, and whether communal collectors would be subject to PUC regulation are also studied.

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Morris, David. "Solar Energy is Really Power for the People." Planning, September 1976: 16-20. The author is codirector of the Institute for Local Self-Reliance, and this article emphasizes the decentralization potential of solar power. Many subjects are touched upon and interrelated: passive systems, building codes, sun

rights, the pros and cons of life cycle costing, the leasing of solar collectors by utilities, peak pricing, and land use planning.

National Conference of State Legislatures, Turning Toward the Sun, Vol. 1, Washington, D. C. The NCSL Energy Task Force and NCSL Renewable Energy Project. Abstracts of state legislative enactments of 1974 and 1975 regarding solar energy. Publication made possible by a National Science Foundation grant. Legislation summarized here covers property, income and sales tax incentives; state-financed energy research and development; life cycle cost analysis; solar provisions in state building codes; access to incident solar energy; informational and promotional activities; and state-financed solar buildings.

Phillips, James D. "Assessment of a Single Family Residence Solar Heating System in a Suburban Development Setting." Prepared under a National Science Foundation grant to the City of Colorado Springs, Colorado: July 1975. A shortage of natural gas motivated officials in Colorado Springs to investigate the possibility of using solar heating and cooling. A legal research committee comprised of lawyers, engineers, zoning and building officials reviewed numerous issues related to solar use, including zoning building codes, covenants and easements, condemnation, transfer of development rights, and nusiance actions. Using aerial photographs of the city the committee concluded that "Residential zones in Colorado Springs do not pose problems for roof top collectors." However, the committee also recognized that problems were likely to arise due to the use of ground type collectors, tree growth, and future development. Several new legal systems for protecting access to sunlight were considered but rejected for two reasons. First, a legal challenge was considered likely and an adverse outcome from such a suit would threaten the future development of solar law, and second, the threat of a lawsuit was viewed as a serious obstacle to the political acceptance of legislative proposals. A more limited approach was recommended whereby the City would facilitate the creation of "solar easements" among adjoining property owners. In areas of future development the use of the planned unit development concept was suggested as a way to allow for use of solar collectors. The authors say the best approach is retro-fitting, which should be handled on an ad hoc basis as cases arise, because providing generalized legislative protection for retrofitted systems would now create more costs than benefits. Legal goals discussed to guarantee sunlight access include civil nuisance suits, public nuisance (both approaches were found impracticable), private nuisance ("possibly a more sustainable alternative"), private ways of necessity (may work in Colorado), transfer of development rights, and solar easements. Public attitudes were

surveyed on private versus public utility ownership of collectors, acceptable costs, and the need for protection from shading. Results: higher income people who own homes prefer private ownership of collectors; those earning under $5,000 and renting are much more likely to favor municipal ownership. Among other findings: all income groups saw the high initial cost for installation as a disadvantage; 68 percent felt homes heated with solar energy would have a higher resale value. If cost considerations were equal, 53 percent of all heads of households would choose solar heating. A randomly selected example of 400 was used for this survey.

Rivkin, Steven R. "Courting Change: Using Litigation to Reform Local Building Codes." Rutgers Law Review 26 (1973): 774-802.

Rivkin, Steven R. Draft research reports for the American Institute of Architects project. We have several pieces of information from Rivkin. One is in the form of a memorandum; others appear to be draft sections of the AIA report. See also entry above under "American Institute of Architects. The memorandum, dated 31 December 1975, is to Charles Masterson, and entitled "Summary of Legal, Regulatory and Consumer Considerations in Developing a National Market for Solar Heating and Coding of Buildings." Whether there is a right to energy is discussed, particularly Jackson v. Metropolitan Edison Co. where the Supreme Court allowed a lower company to cut off a customer without fair procedures. Cases holding private utilities are not immune from antitrust laws are also analyzed. No actual impediments were ascertained with regard to sun rights and land use; options that other writers have suggested are in a footnote. The author concludes that solutions will emerge naturally in response to need if the property rights in need of protection grow. Rivkin does not feel that the development of standards for amending building codes is a legal question. As to the need for warranties and consumer protection, a structural approach for public policy (to underwite the development of the market as a whole) is suggested. The importance of performance based standards is stressed. Until the National Bureau of Standards has finalized its standards, Rivkin suggests the following: 1) solar collector component guarantees, detailed manufacturer manuals, an extensive information-generating government demonstration project, and state or federal insurance of solar system builders. Utilities, he says, should be encouraged now to view solar power as part of their conservation programs. Incentives to structural evolution should recognize the important but nonexclusive role of utilities. Credit should be made available, utility bonds guaranteed, tax incentives granted. Finally, all the above should be done in a framework that emphasizes nonpolluting forms of energy.

Robbins, Richard L. "Building Codes, Land Use Controls and Other Regulations to Encourage Solar Energy Use." Robbins is executive director of the Lake Michigan Federation in Chicago. Paper prepared for the Consumer Conference on Solar Energy Development, Albuquerque, New Mexico, October 1976. Robbins concludes that governments and the construction industry will be much more

enthusiastic about solar energy when unnecessary barriers, the remnants of other regulatory objectives, are overcome. He specifically addresses utility rate structures, tax laws, building codes, skyspace protection, comprehensive planning, land use, zoning, and the required use of solar energy.

Robbins, Richard. "Law and Solar Energy Systems: Legal Impediments and Inducements to Solar Energy Systems." Robbins, then deputy director and counsel to the Lake Michigan Federation in Chicago, presented this 25-page paper at the University of Wisconsin and the International Solar Energy Society meeting in July 1975. The author explains what he views as the eight major issues affecting the use of solar technology for heating and cooling: improving access to solar insulation, optimizing the location of solar energy collectors, improving the public economies of solar systems, improving the operation of solar systems through new utility backup conflicts, revision of the banking laws to account for the higher initial building costs of solar systems, increasing the number of solar systems to reflect the nation's desire for energy independence, and allocating rights to solar insulation.

Schiflett, Mary. "State and Municipal Legal Impediments and Incentives to the Use of Solar Energy." Background paper prepared for a conference at the University of Houston in September 1976. An annotated bibliography is included. Legal impediments found include building codes, zoning and land use regulations, utility regulations and rate structures, banking laws, tax laws, labor laws and work regulations. A competent overview, its comprehensiveness is limited to 55 pages. Rather than reach her own conclusions the author summarizes the positions of others.

Schoen, Richard; Hirshberg, Alan S.; Weingart, Jerome M. New Energy Technologies for Buildings: A Report to the Energy Policy Project of the Ford Foundation. Edited by Jane Stein. Cambridge, Mass.: Ballinger, 1975. This book examines ways new energy conserving technologies might be encouraged to be widely used in buildings. The authors find abundant evidence that the use of available design techniques, technologies, and management practices can reduce the energy demand for new buildings up to 40 percent. Technologies discussed include total energy systems and fuel cells. Barriers seen include the higher initial cost of solar equipment and the issue of who will bear this cost; determining who is responsible for installation and maintenance; who will run and operate decentralized generating facilities, and whether new zoning laws will be needed to enable the effective use of solar collectors.
An outline structure is included for the diffusion of innovation in the construction industry. It suggests that if a new product or process is compatible with the local form of expression of laws and regulations, professional practices and relationships, skilled labor jurisdictional agreements, building department approval processes, etc., it can be more easily incorporated. Strategies for overcoming barriers are analyzed,

and the benefits and disadvantages of a regulation/specification approach are weighed. It is concluded that specification codes deter energy-conserving innovation. Performance codes are found preferable. Utility considerations and solar access questions are briefly covered. Appendix C deals extensively with building codes.

Shaw, Robert W., Jr., principal investigator; Shantzis, Steven B.; Fischer, Steven C. The Effectiveness of Solar Energy Incentives at the State and Local Level: An Overview for the Federal Energy Administration. Bethesda, Md.: Booz, Allen and Hamilton, Inc., 1976. The biggest barrier to commercialization of solar technology found by the researchers is the high first cost. They say that large government expenditures are needed to overcome this. Removal of disincentives may have great psychological importance, however. Incentives should address the market directly (rather than go to manufacturers or builders). Tax incentives and low-cost loan incentives are discussed, and the latter found preferable. The role of utilities is analyzed and the authors say that case-by-case studies are needed to determine whether solar energy will benefit or harm utilities financially. Rate inversion may be desirable; peak-off-peak pricing may also help; both depend on individual utility conditions. Utility ownership and leasing of solar electric systems to consumers is seen as benefitting both utilities and consumers. The authors find it unlikely that easing gas curtailments or providing new connections for users of solar energy (as backup) will happen, as gas supplies are too small and there is no financial incentive for gas companies to do this. Legal disincentives discussed induce the need for equipment standards (independent state efforts to produce codes are likely to be expensive and cost-ineffective, the authors say. Zoning and land use issues should be resolved on a local scale as they arise, it is concluded, as there is a danger of both overreaction and underreaction. Other incentives dealt with include grant and subsidy programs, government insurance programs, and development and information programs. The latter are thought very worthwhile. NOTE: An analysis of the above report is published by the FEA in Analysis of State Solar Energy Policy Options, written by the National Conference of State Legislatures.

Schurcliff. Solar Heated Buildings: A Brief Survey. 12th ed. 1976. A survey of houses, schools and commercial structures -- 163 buildings in all. A typical entry gives the location of a building a description of it, its collector and storage system, the percentages of heat and cooling supplied by the solar system, and the relevant costs.

Thomas, William A., editor. "Proceedings of the Workshop on Solar Energy and the Law." An interim report to the National Science Foundation in March 1975. NSF-RA-575-004. This workshop in February 1975 brought together approximately 40 lawyers and other solar energy professionals to discuss legal issues related to solar

use. It was moderated by Thomas, of the American Bar Foundation. Presentations were made by Steven Rivkin on building code restrictions, William Thomas on solar access, Richard Robbins on fiscal impediments and inducements and on zoning, John Costonis on transferable development rights, and Charles Haar on innovative land use laws.

U.S., Congress, House, Committee on Public Works and Transportation, Subcommittee on Public Buildings and Grounds. Hearings on bills relating to energy conservation in public buildings. 94th Cong., 1st sess., 4 and 5 Nov. 1975.

Yellott, John I. "Retrofit -- a Major Solar Opportunity." Paper for the Consumer Conference on Solar Energy Development, Albuquerque, New Mexico, October 1976. Yellott is a visiting professor in architecture at Arizona State University. The author foresees a tremendous market for retrofitting. He notes that virtually all streets in cities west of meridian 100 run north-south and east-west, implying that virtually all dwelling units have substantial south-facing areas (enough, at the very least, for a solar domestic hot water heater). He looks at present retrofit activity in the U. S. and predicts retrofit activity for the remainder of this century.

ENVIRONMENTAL IMPACT ASSESSMENT

American Bar Foundation. Legal Issues Related to Use of Solar Energy. (See entry under AIR POLLUTION.) The vast amounts of energy required to produce a great many collectors is mentioned early in the report. Later, on page 206, a suggested ordinance dealing with energy use impact statements would require projects to describe their impact on the potential use of solar energy in areas within their shadow on December 22.

Anderson, Bruce. The Sun in a Drawer. See BUILDING CODES. Problem of reflections off tilted collectors is addressed.

Hillhouse, Karin H. "Solar Energy -- Its Environmental Dimensions." Paper for the Consumer Conference on Solar Energy Development, Albuquerque, New Mexico, October 1976. Hillhouse discusses ways to protect the environment from adverse impacts of solar development and environmental protection strategies that act as incentives for solar development.

EQUIPMENT STANDARDS

American Bar Foundation. Legal Issues Related to Use of Solar Energy. (See entry under AIR POLLUTION.) The possibility of federal certification and standards for solar energy systems is raised, as well as the option of requiring states to set standards within a certain time (an analogy is the Clean Air Act).

American Institute of Architects Research Corporation. Early Uses of Solar Energy in Buildings: A Study of Barriers and Incentives to the Widespread Use of Solar Heating and Cooling Systems. See BUILDING CODES. The lack of usable performance standards is noted.

Burke, Kenneth J. "Alternative Forms of Energy."
Mr. Burke, a member of the Denver and Fort Collins, Colorado, law firm of White and Burke, begins with a general discussion of the need for solar energy and of state and federal legislation in this area. He lists potential consumer and legal problems, including issues related to solar access, land use, consumer protection and equipment standards. He then lists possible incentives for producers, consumers and the centralized market.

Consumer Action Now. Survey on solar incentives. Washington, D. C., Summer 1976. Questionnaires were given twenty architects/builders and eight mortgage bankers. They were asked what incentives they would find most useful in residential and commercial projects. Tax credits were the clear winner among architects and builders, and were also popular with the bankers for residential projects. "Simplified systems for determining size of system needed" and maintenance contracts were bankers' major concerns for commercial projects.

Dawes, Daniel. "Allocation of Solar Energy -- Rights to Light." An unpublished manuscript written in 1973 when the author was in law school. He later joined the Los Angeles law firm of Spenseley, Horn, Jubas and Lubitz. The paper documents the evolution of American and English court attitudes towards rights to light and air. Possible judicial reaction to cases involving infringements upon the use of solar collectors are discussed. The conclusion, based on English experience, is that legislation will provide a better allocation of solar energy than would the courts. Traditional zoning approaches are criticized and the author advocates the use of performance standards as an alternative approach.

Dikkers, Robert D. "Development and Implementation of Standards for Solar Heating and Cooling Standards." Paper prepared for the Sharing the Sun conference in Winnipeg in August 1976. Dikkers is manager of the solar energy program, Center for Building Technology, IAT, National Bureau of Standards. He describes NBS efforts to develop performance criteria for solar systems; standards that can be used in conjunction with HUD's Minimum Property Standards; draft standards for materials; plans to establish a testing laboratory accreditation program; and cooperation with ASTM and ASHRAE.

Hillhouse, Karin H. "Solar Energy and Land Use in Colorado." See BUILDING CODES.

Hirshberg, Alan; Schoen, Richard. "Barriers to the Widespread Utilization tion of Residential Solar Energy." See BUILDING CODES. Problems of specification instead of performance-oriented codes are discussed.

Holton, John K. "Interfacing Building Design and Solar Energy Research and Standards." See BUILDING CODES.

Howe, Everett D. "Public Utilities Consider Solar Energy." See ANTITRUST. Relevant here as uniformity of product, and perhaps some quality control, would be achieved without standards if utilities supply the equipment.

Howell, John R. "The Implementation of Solar Energy Technology--The Next 25 Years." Howell, director of the Energy Institute at the University of Houston, contributed this paper to a conference held at the university in September 1976. Using a fresh approach, Howell pretends to be looking back from the year 2001. He first assumes that solar energy is playing a major role then, and examines the technological breakthroughs and social scenarios that allowed this to happen. Then he develops a pessimistic scenario. A summary of needed research to avoid the pessimistic scenario is included. Among the unfortunate possibilities foreseen are poor performance by many solar heating and cooling systems, leading to consumer disgust; the failure of complete systems to be manufactured by any one company, and the resulting confusion as to who was responsible when something failed to work. There is a litany of things that could go wrong with collectors.

National Conference of State Legislatures. Turning Toward the Sun. See ANTITRUST. Summary of state legislation through 1975.

Scott, Jerome E.; Melicher, Ronald W.; Sciglimpaglia, Donald M. Demand Analysis Solar Heating and Cooling of Buildings. See ANTITRUST. Faulty equipment was one cause of the demise of solar water heaters in south Florida.

Shaw, Robert W. Jr.; Shantzis, Steven B.; Fischer, Steven C. The Effectiveness of Solar Energy Incentives at the State and Local Level. This Booz, Allen & Hamilton report includes a discussion of the need for equipment standards. See BUILDING CODES.

U. S. Congress, Senate, Select Committee on Small Business. Interim report on the Role of Small Business in Solar Research, Development, and Demonstration. See ANTITRUST. Need for HUD to amend Minimum Property Standards to include standards for solar space-heating, air-conditining, and water-heating equipment is mentioned.

von Hoffman, Nicolas. Washington Post commentary 5 July 1976. See ANTITRUST. Expensive utility-supplied solar pool heaters are criticized.

American Bar Foundation. Legal Issues Related to Use of Solar Energy. See ANTITRUST. The need for federal fiscal incentives, methods of financing the acquisition of solar easements and financial and tax incentives in general are discussed (note particularly pages 155 to 175).

Anderson, Bruce. "The Sun in a Drawer." See BUILDING CODES. Anderson makes an argument for life-cycle costing.

Barrett, David; Epstein, Peter; Haar, Charles M. Financing the Solar Home: Understanding and Improving Mortgage Market Receptivity to Energy Conservation and Housing Innovation. Cambridge, Mass.: Regional and Urban Planning Implementation, Inc., 1976. Research supported by the NSF. Findings are based on interviews with 200 residential mortgage lenders, federal agency representatives, executives of secondary market entities and others. The authors found that lenders are uncertain as to the market value of solar properties, that loan amounts offered will tend to be a lower proportion of total costs, and that the borrower underwriting criteria used by many lenders are detrimental to conservation improvements. But the inclusion of solar domestic hot water heating in new homes will probably meet little resistance from lenders, and the retrofit of such systems can typically be financed with consumer or home improvement loans. Guidelines for action include the adjustment to ceilings in existing federal mortgage insurance programs to accommodate the higher costs of solar homes.

Consumer Action Now. Survey on solar incentives. Washington, D. C., See EQUIPMENT STANDARDS.

Costello, Dennis. "Midwest Research Institute Programs Dealing with Incentives and Barriers to the Commercialization of Solar Energy." Working paper for a conference at the University of Houston in September, 1976. One study described, done for ERDA, deals with economic and institutional factors surrounding the development of photovoltaic electric power systems. It evaluates the effectiveness of alternating federal government tax and other fiscal policies to stimulate private sector investment in on-site solar technologies. Life-cycle costing is used to measure effectiveness. Life cycle costs are also examined from the system owner's perspective. Areas for further government research are recommended.

Damon, Peter S. "Financing Solar System Costs." Paper for the Consumer Conference on Solar Energy Development. Damon is senior vice president of the Charlestown Savings Bank in Boston. Damon urges appraisal departments to note and assign values to energy-conserving design, and to consider low-cost, long-term second mortgages for retrofits.

Eisenhard, Robert M. Building Energy Authority and Regulations Survey: State Activity. See BUILDING CODES.

Foster, Harold D.; Sewell, W. R. Derrick. "Daedalophobia: Diagnosis and Prognosis." See BUILDING CODES. Need for a federal program of insurance of solar heated homes in Canada is explored as is the need for government financial support of large scale prefabrication.

Haar, Charles H. (principal investigator). "Evaluation of Alternative Incentives for Overcoming Mortgage Market Constraints on the Commercial Acceptance and Use of Residential Solar Heating and Cooling Technologies." Research for Regional and Urban Planning Implementation, Inc. in Cambridge, Massachusetts.

Hirshberg, Alan S. "Public Policy for Solar Heating and Cooling." Bulletin of the Atomic Scientists, October 1976: 37-45. See BUILDING CODES.

Mayo, Louis H. (principal investigator). A forthcoming study on legal and institutional implications of wind energy conversion resources. Washington, D. C.: Program of Policy Studies in Science and Technology at George Washington University. Many of the discussions are also relevant to solar heating and cooling. Sources of federal funding for wind energy conversion systems (WECS) or for small business concerns that make them, are analyzed, as are relevant tax laws. There is a lengthy discussion of products liability and theories of recovery (negligence, warranty, strict liability). For instance, the duties of system owners to protect persons coming on their property are discussed. Public and private nuisance law is examined for its application to WECS, including a few pages on aesthetic nuisances, and the cases holding that interference with electromagnetic transmission is not a public nuisance. An entire draft chapter (3) deals with utility regulatory concerns.

Morris, David. "Solar Energy is Really Power for the People." Planning, September 1976: 16-20. See BUILDING CODES.

National Conference of State Legislatures. Turning Toward the Sun. See BUILDING CODES. Proposed and enacted state legislation includes many financial incentives, and provisions for life-cycle costing.

Northcross, Mark. "Who will Own the Sun?" The Progressive, April 1976: 14-16. Northcross argues that a community-controlled solar utility is the best way to make a massive public investment (which he believes is essential) in solar energy.

Robbins, Richard L. "Building Codes, Land Use Controls and Other Regulations to Encourage Solar Energy." See BUILDING CODES.

Rosenberg, Laurence C. "Three Problem Areas Affecting the Future of Solar Energy." See ANTITRUST. Financial issues related to the utilization of solar power are mentioned.

Rivkin, Steven R. Draft research report for the American Institute of Architects. See BUILDING CODES. State or federal insurance of solar system builders is advocated.

Schiflett, Mary. "State and Municipal Legal Impediments and Incentives to the Use of Solar Energy." See BUILDING CODES.

Scholl, Martin M. "Economics of State-of-the-Art Solar Applications." Paper for the Consumer Conference on Solar Energy Development, Alburquerque, New Mexico, October 1976. Scholl is with the MITRE Corporation in McLean, Virginia. The author says that solar water heating and space heating is competitive today against electric resistive systems throughout most of the U. S. and against oil hot water heating and/or oil and electric heat pump space heating in many places.

Schulze, William; Ben-David, Shaul; Katson, Roberta, Roach, Fred. "An Economic Analysis of Solar Water and Space Heating." Paper for the Consumer Conference on Solar Energy Development, Albuquerque, New Mexico, October 1976. The authors are with the department of economics at the University of New Mexico.
the residential use of solar energy could be widespread by 1990 with energy price decontrols, but that the penetration of solar technologies beyond areas which are most favorable depends on interest rate policy. They suggest means to alleviate the adverse impact of price decontrol on poor persons.

Shaw, Robert W.; Shantzis, Steven B.; Fischer, Steven C. The Effectiveness of Solar Energy Incentives at the State and Local Level. See BUILDING CODES. The high first cost is found the greatest barrier to solar technology installation. Various incentives including government insurance programs are examined.

Wilson, Jones, Morton & Lynch. The Sun: A Municipal Utility Energy Source. See ANTITRUST.

FOREIGN TRADE

Szego, G. C., president of the InterTechnology Corporation, Warrenton, Virginia. In this letter of 15 August 1976 to President Ford (with copies to many other people) he protests what he feels is an unreasonably low ad valorem tax on the import of foreign solar equipment.

LABOR

American Bar Foundation. Legal Issues Related to Use of Solar Energy. See ANTITRUST. This study includes a fairly long discussion of labor relations issues, and suggests that a Solar Energy Labor Board could be created to report to the NBS and NLRB. Jurisdictional disputes among unions are foreseen as a possible problem.

Hirshberg, Alan; Schoen, Richard. "Barriers to the Widespread Utilization of Solar Energy." See BUILDING CODES.

Robbins, Richard. "Law and Solar Energy Systems." See BUILDING CODES. Trade union conflicts are mentioned as a potential major issue.

Schiflett, Mary. "State and Municipal Legal Impediments and Incentives to the Use of Solar Energy." See BUILDING CODES.

LAND USE

American Bar Foundation. Legal Issues Related to Use of Solar Energy. Issues related to land use crop up repeatedly in this study. The possibility is mentioned of conditioning federal assistance, such as that under the Housing and Community Development Act, upon state and local adoption of good planning laws and regulations. There is a detailed discussion of accessory uses and the ambiquities surrounding this concept. For instance, if separate collectors must be included in a structure's floor-to-area ratio, one may have to construct a smaller building on a given size of lot (page 84). Suggested statutes also deal with the problems that could arise over the aesthetics of collectors, set back requirements, requirements often found in large scale developments to plant and preserve trees, etc. A scheme for solar zoning is outlined that includes three types of districts; mandatory solar use districts; affirmative solar use districts, and other solar use districts (page 103). The study suggests that the use of eminent domain has advantages, and discusses the definition of a "public use". Transferable development rights are covered on page 145 as a workable possibility. Other suggested statutes let cities ensure solar access by restricting structure heights in zoning ordinances, and by acquiring skyspace easements by power of eminent domain. but these latter are all considered insufficient by themselves. The application of easements in gross or appurtenant, covenants, equitable conditions or restrictions are explored. An analysis of the way the variance process should be used is also included. Inclusion of a solar energy element in municipal comprehensive plans is covered, beginning on page 195.

American Institute of Architects Research Corporation. Early Use of Solar Energy in Buildings. See BUILDING CODES. The need to consider trade-offs in land use planning between the requirements of solar energy and transportation and communication needs is mentioned.

Bliss, Raymond W. "Direct Solar Heating: Why Not Just Let the Winter Sun Shine in the Windows?" See BUILDING CODES.

Bridgers, Frank H. "Solar Energy Applications to Large Buildings." See BUILDING CODES.

Burke, Kenneth J. "Alternative Forms of Energy." See EQUIPMENT STANDARDS.

Dawes, Daniel. "Allocation of Solar Energy -- Rights to Light." See EQUIPMENT STANDARDS. Criticism of traditional zoning approaches.

Eisenhard, Robert M. "A Survey of State Legislation Relating to Solar Energy." See BUILDING CODES.

Eisenstadt, Melvin M.; Utton, Albert E. "Solar Rights and Their Effect on Solar Heating and Cooling." Natural Resources Journal, vol. 16, No. 2 (1976): 363-410. With funding by the Board of Educational

Finance of New Mexico, professors Eisenstadt and Utton of the University of New Mexico Law-School have prepared a thorough, scholarly analysis of legal issues involved in protecting access to sunlight. They assume that a collector shading problem will arise in urban areas. Their discussion of the history of the right to light and air is excellent, and there is a brief rundown on state legislation. The questions they pose are: (1) Does a solar collector user have a right to the sunshine that is blocked by a neighbor's building or tree? (2) If he doesn't have such a right, should one be granted? (3) If such a right is granted, how should it be done so as to mitigate disruption of competing interests? It is concluded that no constitutional problems would block the creation of solar rights through zoning, i.e. that neither the fifth nor the fourteenth amendments are violated.

Problems likely to be encountered in the administration of such a system are considered, like the elimination of nonconforming uses and the handling of variances. The use of a solar administrator or agency to resolve conflicts is suggested.

Easements for unobstructed light are equated with a solar right, and the authors conclude that easements for light and air are property which has a determinable money value and can be bought, sold, leased, rented, traded, generally conveyed, and taxed. Airspace estates and the exchange of solar rights across airspaces by neighbors is covered, and such airspaces are found subject to zoning laws. They believe that roofs are the most reasonable location for flat plate collectors.

Among land use tools analyzed for their usefulness are zoning with compensation, contract zoning, and transferable development rights. The authors find that modern land use concepts "indicate a conceptual accord with solar rights." They feel it is important to apply zoning ordinances now to prevent adverse lawsuits that could discourage solar development.

Hillhouse, Karin H. "Solar Energy -- Its Environmental Dimensions." See ENVIRONMENTAL IMPACT.

Hillhouse, Karin H. "Solar Energy and Land Use in Colorado." See BUILDING CODES. The use of federal lands for nonfederal energy projects and solar land use planning and zoning are covered.

Holton, John K. "Interfacing Building Design and Solar Energy Research and Standards." See BUILDING CODES.

Kraemer, Sandy F.; Felt, James G. "Solar Rights--New Law For a New Technology". See AIR POLLUTION. The advantages and disadvantages of legal tools like solar covenants and easements, the use of eminent domain, zoning, and nuisance suits are weighed.

Kraemer, Sandy F. "Phoenix Project Legal Research Report." This document includes the 1975 drafts of several papers. The author is with the law firm of Asher, Kraemer and Kendall of Colorado Springs, Colorado. He proposes and offers a design guide for solar access overlay zones (SAO zones). The goal is to allow the collection surfaces of solar devices to receive direct sunlight from 10 a.m. apparent solar time (this term is defined in his proposed legislation) to 2 p.m. His scheme would involve certificates of reservation and abandonment and be enforced by government officials through the use of fines and imprisonment.

A piece on solar rights discusses one's right to the light above one's lot, with the conclusion that there is no satisfactory existing solution. Air pollution's effect on collectors is mentioned as is the right to light at an angle over adjoining lots, the application of nuisance law, easements, covenants, and zoning.

The zoning discussion is further broken down into problems related to spot zoning, uniformity, floating zones, public versus private purposes, vagueness issues, enforcement of an existing solar zone, and protection against future solar zone changes. Kraemer concludes that some governmental assurance of the right to continued access to direct sunlight should be made available through zoning. A "first in time, first in right" approach has been advocated by Kraemer.

A memorandum on the use of industrial revenue bonds in the solar energy industry is included in this document, as is a note on federal incentives to encourage the use of solar energy.

Morris, David. "Solar Energy is Really Power For the People." Planning September 1976: 16-20. See BUILDING CODES.

Phillips, James D. "Assessment of a Single Family Residence Solar Heating System in a Suburban Development Setting." See BUILDING CODES. Using aerial photography it was concluded that residential zones in Colorado Springs do not pose problems for roof top collectors. It is advocated that the city facilitate the creation of solar easements among neighbors. Planned unit developments are also advocated.

Rivkin, Steven R. Draft of research results for the American Institute of Architects project. See BUILDING CODES. Concludes that solutions to solar access property will naturally grow along with the value of the property rights in need of protection.

Robbins, Richard L. "Building Codes, Land Use Controls and Other Regulations to Encourage Solar Energy Use." See BUILDING CODES. Robbins advocates the creation of special districts where solar energy use would be required in new structures, and that local governments legislate to require the use of solar energy systems in older buildings.

Rosenberg, Laurence C. "Three Problem Areas Affecting the Future of Solar Energy." See ANTITRUST. Land use issues are briefly dealt with.

Schiflett, Mary. "State and Municipal Legal Impediments and Incentives to the Use of Solar Energy." See BUILDING CODES.

Schoen, Richard; Hirshberg, Alan S.; Weingart, Jerome M. New Energy Technologies for Buildings. Edited by Jane Stein. See BUILDING CODES. Although land use issues are not the central focus of this book the potential need to change zoning laws is discussed.

Shaw, Robert W., Jr.; Shantzis, Steven B.; Fischer, Steven C. The Effectiveness of Solar Energy Incentives at the State and Local Level. See BUILDING CODES. Authors say that zoning and land use issues should be resolved on a local scale as they arise.

Thomas, William A. "Proceedings of the Workshop on Solar Energy and the Law." See BUILDING CODES. Zoning, transferable development rights and comments by Charles Harr on innovative land use laws are part of this interim report.

White, Mary D. "The Allocation of Sunlight: Solar Rights and the Prior Appropriation Doctrine." University of Colorado Law Review 47 (1976) 421-47. White addresses the question "What right does the owner or user of a solar collector have to the continued use of the sun's rays that may cross the property of another before reaching his collection unit?" After examining the federal commerce clause she says that congressional regulation of activities affecting the use of solar energy seems constitutional, and finds that even free-flowing sunlight that has not yet been reduced to a usable form of energy may be subject to federal regulation. She also finds that the regulation of solar resources seems an appropriate exercise of the state police power. Noting that there is as yet no federal preemption of this area, White believes that state regulations would not put an undue burden on interstate commerce.

White notes that in the absence of legislation, courts will look to analogous areas of law. She anticipates that some areas courts may evaluate for possible application to solar allocations are oil and gas law (she finds these laws inappropriate); the Doctrine of Ancient Lights (not useful as repeatedly disavowed in the U.S.); solar easements; zoning; and water law. White includes a lengthy discussion of water law and concludes that the prior appropriation approach used in Western states is a hopeful potential solution to solar rights.

Wilson, Jones, Morton & Lynch. The Sun: A Municipal Utility Energy Source. See ANTITRUST.

MANDATORY INSTALLATION

Robbins, Richard L. "Building Codes, Land Use Controls and Other Regulations to Encourage Solar Energy Use." See BUILDING CODES. Robbins advocates the creation of special districts where solar energy use would be required in new structures, and that local governments legislate to require the use of solar energy systems in older buildings.

Wilson, Jones, Morton & Lynch. The Sun: A Municipal Utility Energy Source. See ANTITRUST.

MOBILE HOMES

Wilson, J.V. "Energy Usage and Conservation in Mobile Home Heating and Cooling." Report from the Oak Ridge National Laboratory. ORNL/ NSF/ EP-91.

MUNICIPAL FINANCING

Kramer, Sandy F. "Phoenix Project Legal Research Report." See LAND USE. Includes a memorandum on the use of industrial revenue bonds in the solar energy industry.

Wilson, Jones, Morton & Lynch. The Sun: A Municipal Utility Energy Source. See ANTITRUST.

PATENT LAW

American Bar Foundation. Legal Issues Related to Use of Solar Energy. See AIR POLLUTION. The authors say that the U.S. Congress could require compulsory licensing to encourage more rapid development, with equitable fees.

ERDA. The Patent Policies Affecting ERDA Energy Programs. ERDA-76-16, January 1976. A report to the President and Congress on ERDA's statutory patent policies. Covers allocating the rights in inventions under ERDA contracts, acquiring rights in contractors' background patents, licensing of ERDA-owned patents, and compulsory licensing. Has extensive appendices of background material including legislative history and public comments.

Hay, Harold R. "Solar Energy Opportunities for Small Business." See ANTITRUST. On pages 19 and 20 Hay argues that government agencies undermine the purpose of patents when they attempt exclusively to develop competition for an idea.

Sperber, Philip. "Government Contracting: Perpetuating the Energy Crisis." American Bar Association Journal, October 1976: 1301-4. The author argues contractors doing government-funded research should be given an exclusive right, for a limited period, to market a product. He argues that otherwise the contractors that produce a working prototype will be at an economic disadvantage if their competitors can underprice them.

American Bar Foundation. Legal Issues Related to Use of Solar Energy. See AIR POLLUTION. This study concludes that the only true legal issue in the traditional sense is guaranteeing access to sunlight for solar collectors, and that guaranteed access to sunlight is necessary to induce private investment in capital-intensive systems. One possibility mentioned is for the federal government to grant constitutional protection of unobstructed solar skyspace (using the commerce, national defense and other powers). The discussion under LAND USE is applicable here.

American Institute of Architects Research Corporation. Early Use of Solar Energy in Buildings. See BUILDING CODES. Cites a need to know more about how sun rights affect land values, transportation needs, etc.

Baer, Steve. "Solar Heating in Small Buildings." See BUILDING CODES.

Becker, Ralph E., Jr. "The Common Law--An Obstacle to Solar Heating and Cooling?" To appear in the winter 1976-1977 edition of the Journal of Contemporary Law. Becker agrees with most writers that the common law right to light, absent an express agreement, does not solve the solar access problem. He feels state and local legislation protecting solar rights will be necessary, but speculates that if there's another fuel crisis courts may recognize a nuisance remedy or grant some other form of judicial relief.

Bezdek, Roger H.; Maycock, Paul D. "Incentives and Barriers to the Development of Solar Energy." A paper prepared for the Sharing the Sun conference in Winnipeg, Canada, August 1976. Vol. 9, p. 64. The authors identify legal and regulatory problems as the third most serious barrier to the widespread adoption of solar energy (the high first cost of solar systems and their interface with utilities are seen as greater barriers).

Bliss, Raymond W. "Direct Solar Heating: Why Not Just Let the Winter Sun in the Windows?" See BUILDING CODES. An argument for passive solar structures that outlines some of their requirements.

Bridgers, Frank H. "Solar Energy Applications to Large Buildings." See BUILDING CODES. Not directly relevant to legal problems, but of interest because many researchers assume it is impractical to even try to use solar power in large buildings. Bridgers argues otherwise.

Burke, Kenneth J. "Alternative Forms of Energy." See EQUIPMENT STANDARDS. Solar access issues are among the potential legal problems mentioned.

Dawes, Daniel. "Allocation of Solar Energy--Rights to Light." See EQUIPMENT STANDARDS. History of right to light and air, possible judicial reaction to solar access cases, and the need for legislation are explored.

Eisenstadt, Melvin M.; Utton, Albert E. "Solar Rights and Their Effect on Solar Heating and Cooling." See LAND USE. This article is very relevant to solar access and well-researched.

Harris, William R. "Is the Right to Light a California Necessity?" A prepared statement submitted before the California State Assembly Committee on the Judiciary December 1975. The author is with the Rand Corporation in Santa Monica, California. He concludes that a statewide right to sunlight, even though transferable, would be likely to facilitate solar heating and possibly solar cooling systems. Legal impediments may be mitigated at a modest cost, he says, by some combination of transferable solar energy rights, transferable development rights, and land use plans, zones or contracts for solar system districts and high rise development districts. It is occasionally difficult to follow the reasoning in this article. Harris recommends that land and zoning decisions still be made at the local level. What he calls a "referant regime" includes the following: 1) a right to incident sunlight attaching to real property, established by state law; 2) transferability of rights to light by grant or reservation, eminent domain, administrative petition and valuation, or inverse condemnation; 3) an exemption of existing buildings from liability; and 4) delegation to municipalities or other local land use planning agencies of authority to establish high-rise districts and/or solar energy collection districts, to acquire by purchase or condemnation solar energy rights in such districts and tax exempt bonds to buy collection facilities.

Hillhouse, Karin H. "Solar Energy -- Its Environmental Dimensions." See ENVIRONMENTAL IMPACT. Land use considerations are extensively discussed.

Hillhouse, Karin H. "Solar Energy and Land Use in Colorado." See BUILDING CODES. Easements, solar zoning and variance procedures are discussed; it is argued that a condemnation program related to airspace may be upheld.

Hirshberg, Alan S. "Public Policy for Solar Heating and Cooling." Bulletin of Atomic Scientists, October 1976: 37-45. See BUILDING CODES.

Kraemer, Sandy F.; Felt, James G. "Solar Rights -- New Law for a New Technology." See AIR POLLUTION. The authors find solar covenants and easements to be of limited usefulness. They discuss the applicability of eminent domain and the possibility of declaring shadows a public nuisance. They find that zoning to prevent shadows is a potentially useful approach.

Kraemer, Sandy F. "Phoenix Project Legal Research Approach." See LAND USE. In this draft Kraemer outlines his concept for solar access overlay zones, and the need for some governmental protection of solar access.

Mayo, Louis H. (principal investigator). A forthcoming study on legal and institutional implications of wind energy conversion resources. Washington, D. C.: Program of Policy Studies in Science and Technology at George Washington University. See FINANCING.

Morris, David. "Solar Energy is Really Power For the People." Planning September 1976: 16-20. See BUILDING CODES.

National Conference of State Legislatures. Turning Toward the Sun. See BUILDING CODES. To date there has been little state action on guaranteeing access to sunlight.

Reitze, Arnold W., Jr.; Reitze, Glen L. "Protecting a Place in the Sun." Environment. Part one is in vol. 18, no. 5, pages 2-4. Part two is in vol. 18, no. 6, pages 4, 5, 44 (1976). Part one is a general discussion of English and American law as it pertains to solar access rights. It is concluded that aside from several small exceptions, there is no present legal right to sunlight in the U. S.

Part two deals with the access to sunlight laws in Oregon and Colorado, and other proposed solar access laws, including the American Bar Foundation's suggested statutes. The latter are criticized for the expense and burden that solar impact statements would put on builders. The Reitzes advocate "Solar Rights Zoning Guarantee Statutes" that would allow a property owner to certify a solar collector location by paying a fee to a designated state or local agency. Notice would be given to property owners within a 150 foot radius of the proposed collector. If changes having significant adverse effects on the collector occurred on nearby property during the life of the certification, the collector owner would get compensatory damages.

Rivkin, Steven R. Draft of AIA report. See BUILDING CODES. No actual impediment to sun rights was ascertained.

Robbins, Richard L. "The Right to Light--A Legal History." Sunworld 1 (1976):17. A reworking of other materials Robbins has published on this topic.

Robbins, Richard. "Legal Impediments and Inducements to Solar Energy Systems." See BUILDING CODES. Robbins views allocating rights to solar insolation as one of the eight major issues affecting the use of solar energy for heating and cooling.

Schiflett, Mary. "State and Municipal Legal Impediments and Incentives to the Use of Solar Energy." See BUILDING CODES.

Schoen, Richard; Hirshberg, Alan S.; Weingart, Jerome. New Energy Technologies for Buildings. Whether new zoning laws will be needed to allow the effective use of collectors is discussed.

Thomas, William A. "Proceedings of the Workshop on Solar Energy and the Law." See BUILDING CODES. Thomas' presentation on access to sunlight.

White, Mary D. "The Allocation of Sunlight: Solar Rights and the Prior Appropriation Doctrine." See LAND USE. The author analyzes and finds feasible the application of water law to solar rights.

Wilson, Jones, Morton & Lynch. The Sun: A Municipal Utility Energy Source. See ANTITRUST.

Yellott, John I. "Retrofit -- A Major Solar Opportunity." See BUILDING CODES. An optimistic argument for the practicability of retrofitting.

TAX LAW

American Bar Foundation. Legal Issues Related to Use of Solar Energy Systems. See AIR POLLUTION. A suggested statute to exempt the value added to a structure by solar equipment from real property taxes is on pages 155 to 175. Uniformity clauses in state constitution are probably not a barrier, it is said, but they do need examining.

Anderson, Bruce. "The Sun in a Drawer." See BUILDING CODES. Anderson argues that property taxes should be lower rather than higher for solar-equipped homes.

Consumer Action Now. Survey on solar incentives. Washington, D. C., Summer 1976. See EQUIPMENT STANDARDS.

Costello, Dennis. "Midwest Research Institute Program Dealing with Incentives and Barrier to the Commercialization of Solar Energy." See FINANCING/INSURANCE.

Eisenhard, Robert M. "A survey of State Legislation Relating to Solar Energy." There has been a lot of state legislation proposed and enacted that relates to taxes. SEE BUILDING CODES.

Halacy, Dan. "Federal Solar Legislation." Paper for the Consumer Conference on Solar Energy Development, Albuquerque, New Mexico, October 1976. Halacy is in Senator Paul Fannin's office. He reviews the history of federal solar legislation and gives summaries of what happened in the 93rd and 94th Congresses.

Hirshberg, Alan S. "Public Policy for Solar Heating and Cooling." Bulletin of the Atomic Scientists, October 1976: 37-45. See BUILDING CODES.

Mayo, Louis H. (principal investigator). A forthcoming study on legal and institutional implications of wind energy conversion resources. Washington, D. C.: Program of Policy Studies in Science and Technology at George Washington University. See FINANCING.

Moore, J. Glen. "Solar Energy Legislation in the 94th Congress," See ANTITRUST. Many of the bills deal with tax credits and deductions and other financial incentives.

National Conference of State Legislatures. Turning Toward the Sun. See BUILDING CODES. Various forms of tax incentives are a popular type of legislation.

Schiflett, Mary. "State and Municipal Legal Impediments and Incentives to the Use of Solar Energy." see BUILDING CODES.

Shaw, Robert W., Jr.; Shantzis, Steven B., Fischer, Steven C. "The Effectiveness of Solar Energy Incentives at the State and Local Level." See BUILDING CODES. Tax and other incentives aimed directly at the market (rather than at manufacturers or builders) are advocated.

Thomas, William A. "Proceedings of the Workshop on Solar Energy and the Law." See BUILDING CODES. Richard Robbins made a presentation on fiscal impediments and inducements.

von Hoffman, Nicholas. Commentary in The Washington Post 5 July 1976. Hoffman criticizes a proposal to put a state tax on solar collectors used to heat swimming pools.

TORT LIABILITY

Mayo, Louis H. (principal investigator). A forthcoming study on legal and institutional implications of wind energy conversion resources. Washington, D. C.: Program of Policy Studies in Science and Technology at George Washington University. See FINANCING. A long discussion of product liability and theories of recovery (negligence, warranty, strict liability) is included.

UTILITY REGULATION

American Bar Foundation. Legal Issues Related to Use of Solar Energy. See ANTITRUST. Ways to encourage public utility and joint private use of solar energy systems are included. Jointly owned solar energy systems would be allowed to supply energy to consumers unless they had an undue economic effect on the integrity of a public utility. It is termed "questionable" whether public utilities have the right to supply solar energy systems for use by individual members of the general public. The issue of whether states can license new utilities that use solar energy systems is raised, as are potential difficulties with giving eminent domain powers to private joint systems.

Anderson, Bruce; Feldman, Steven. "Utility Rate Structures and Solar Building Design." This NSF-funded paper describes a model developed to test various relationships in the interface between solar buildings and public utilities. Preliminary results indicate that solar buildings seem to mitigate peak demands for electricity when compared to conventional buildings.

Bezdek, Roger H., Maycock, Paul D. "Incentives and Barriers to the Development of Solar Energy." See SOLAR ACCESS. The interface of utilities with solar energy utilization is recognized as a major issue.

Feldman, Stephen L.; Anderson, Bruce. "Solar Energy--Public Utility Interface: An Assessment of Policy Options." A memorandum dated 24 September 1976 on the work the authors are doing for ERDA. Technology options examined in detail include (1) on-site building storage, (2) telemetry, (3) collector size, (4) active and passive building design and (5) utility storage. Research on market penetration will look at the impact of alternative utility gas and electric rate schedules, and the geographic distribution of free market and government subsidized buildings as associated with regional utility and energy characteristics. Yet another section will examine knowledge and acceptance of solar by utility managers. This is not a final report, but contains many useful ideas and facts.

Hirshberg, Alan; Schoen, Richard. "Barriers to the Widespread Utilization of Residential Solar Energy." See BUILDING CODES. The appendix examines the Southern California Gas Company's SAGE project (Solar Assisted Gas Energy). The authors see some advantages to such a system. For instance, it helps solve the high first costs and market fragmentation problems, and provides an established sales, distribution, and service network.

Howe, Everett D. "Public Utilities Consider Solar Energy." See ANTITRUST. The efforts of various utilities are briefly described. The author says allowing utilities to lease solar equipment to customers would greatly speed the adoption of solar water heating equipment.

Jardine, Douglas M. "Solar Penetration and the Utility Load Factor." Paper for the Consumer Conference on Solar Energy Development, Albuquerque, New Mexico, October 1976. The author is senior engineer with the Kaman Sciences Corporation.

Knauer, Virginia H. Speech to Pennsylvania Electric Association. See ANTITRUST. Knauer urges that utilities be allowed to participate in the rental or sale of residential solar units.

Mayo, Louis H. (principal investigator). A forthcoming study on legal and institutional implications of wind energy conversion resources. Washington, D. C.: Program of Policy Studies in Science and Technology at George Washington University. See FINANCING.

Morris, David. "Solar Energy is Really Power For the People." Planning September 1976: 16-20. See BUILDING CODES.

Northcross, Mark. "Who Will Own the Sun?" The Progressive April 1976: 14-16. See FINANCING.

Phillips, James D. "Assessment of a Single Family Residence Solar Heating System in a Suburban Development Setting." See BUILDING CODES. A survey of a randomly selected sample of 400 persons revealed that higher-income persons who own homes would prefer to own a solar collector; those earning under $5,000 a year and renting generally preferred leasing solar equipment.

Rivkin, Steven R. Draft of AIA report. See BUILDING CODES. The author urges that utilities be encouraged to view solar power as part of their conservation programs. Recent utility lawsuits about the right of utilities to cut off service to a customer without fair procedures, and on the applicability of antitrust law to utility provision of free light bulbs are discussed.

Robbins, Richard L. "Building Codes, Land Use Controls and Other Regulations to Encourage Solar Energy Use." See BUILDING CODES.

Robbins, Richard. "Legal Impediments and Inducements to Energy Systems." See BUILDING CODES. The improvement of solar system operatives through new utility backup arrangements is considered.

Roberson, J. Bob. "The Utility Role in Solar Commercialization." Paper for the Consumer Conference on Solar Energy Development, Albuquerque, New Mexico, October 1976. Roberson is manager of conservation for the Southern California Edison Company.

Rosenberg, Laurence C. "Three Problem Areas Affecting the Future of Solar Energy." See ANTITRUST. The author predicts that the relationship between solar energy and electric utility rates will generate barriers to the widespread use of solar energy.

Schiflett, Mary. "State and Municipal Legal Impediments and Incentives to the Use of Solar Energy." See BUILDING CODES.

Schoen, Richard; Hirshberg, Alan S.; Weingart, Jerome M. New Energy Technologies for Buildings. See BUILDING CODES. One question the authors ask is who will own and operate decentralized generating facilities. But utility considerations relevant to solar heating and cooling are given only brief consideration.

Shaw, Robert W., Jr.; Shantzis, Steven B.; Fischer, Steven C. "The Effectiveness of Solar Energy Incentives at the State and Local Level." See BUILDING CODES. Case-by-case studies are recommended to determine whether solar energy use would financially benefit or harm utilities. Rate inversion may be desirable, the author says, and peak pricing may also help. Both, however, depend upon individual utility conditions. Utility ownership and leasing to consumers of solar electric systems is viewed as benefitting both utilities and consumers. The authors find it unlikely that schemes to provide new gas hookups (as backup systems) for users of solar energy would work.

Summers, David K. "EPRI/SHAC." This paper for the Consumer Conference on Solar Energy Development in Albuquerque, New Mexico, October 1976, describes a project for five residential solar augmented homes, and the development of a model that will be able to forecast the impact of solar systems on a typical utility grid.

von Hoffman, Nicholas. A commentary in The Washington Post. See ANTITRUST. Hoffman is sharply critical of the Santa Clara Water and Sewer Department program of renting solar pool heaters at high fees.

Wilson, Jones, Morton & Lynch. The Sun: A Municipal Utility Energy Source. See ANTITRUST.

WARRANTIES

Consumer Action Now. Survey on solar incentives. Washington, D. C., Summer 1976. See EQUIPMENT STANDARDS.

Howell, John R. "The Implementation of Solar Energy Technology -- The Next 25 Years." See EQUIPMENT STANDARDS.

Mayo, Louis H. (principal investigator). A forthcoming study on legal and institutional implications of wind energy conversion resources. Washington, D. C.: Program of Policy Studies in Science and Technology at George Washington University. See FINANCING.

Rivkin, Steven R. Draft of AIA study. See BUILDING CODES. Rivkin feels there is a need to underwrite the development of the solar market as a whole, and to develop performance-based standards. He suggests component guarantees, detailed manufacturer manuals, an extensive information-generating government demonstration project, and state or federal insurance of solar system builders as interim measures.

Schoen, Richard; Hirshberg, Alan S., Weingart, Jerome M. New Energy Technologies for Buildings. See BUILDING CODES. Barriers anticipated by the authors include the question of who is responsible for the correct installation and maintenance of solar equipment. There is not an in-depth discussion of this issue.

Scott, Jerome E.; Melicher, Ronald W.; Sciglimpaglia, Donald M. Demand Analysis Solar Heating and Cooling of Buildings. See ANTITRUST. The project concludes that one of the reasons that the use of solar water heaters in Florida declined was because of tank failures and leakages (with an attendant decline in consumer confidence).

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