SOLAR RIGHTS AND THEIR EFFECT ON SOLAR HEATING AND COOLING*

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Reprinted from

natural resources journal

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INTRODUCTION

The recent energy shortage has stimulated solar energy research along two distinct paths. The first is concerned with large-scale conversion of solar energy to electrical or chemical energy. Schemes for converting from solar to electrical energy include the use of solid state solar cells,[1] steam generating plants,[2] and power generating satellites.[3] The solar-to-chemical conversions include using solar energy to dissociate water and thus produce hydrogen[4] and using solar energy to aid in the gasification of coal.[5] In all these large-scale conversion processes, solar energy would be converted to another energy form at a central plant and then be sold to the consumer.

The second path taken by solar researchers has been concerned with the heating and cooling of living and working areas.[6] A number

*This work was funded by a grant from the Board of Educational Finance of the State of New Mexico. The funds are a (small) part of a two million dollar appropriation made by the legislature of the State of New Mexico for energy research. The writers would like to thank the State of New Mexico and the Board of Educational Finance for funding this work. Thanks go to Mr. Bruce Beakley, a student in the Mechanical Engineering Department, for writing several computer programs that were required and for preparing the figures used. Thanks also go to Mr. Forest Steely, a mechanical engineering student, for his help with writing the computer programs.

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1. Spakowski and Shure, *Estimated Cost of Large Scale Power Generation Using Solar Cells,* 9th IEEE Photovoltaic Specialists Conference (1972).

2. Hildebrandt et al., *Large Scale Concentration and Conversion of Solar Energy,* 53 Transactions of the American Geophysical Union 684 (1972), and A. Meinel and M. Meinel, *Is it Time for a New Look at Solar Energy,* 27 Bull. Atomic Sci. 32 (1971) are typical of the proposed steam generating plants.

3. Glaser, *Satellite Solar Power Station: An Option for Power Generation,* 7th Intersociety Energy Conversion Engineering Conference 507 (1972).

4. Eisenstadt and Cox, *Hydrogen Production from Solar Energy,* 17 Solar Energy 59 (1975).

5. Hildebrandt and Vant-Hull, *A Tower Top Focus Solar Energy Collector,* Am. Soc'y Mech. Eng'rs [hereinafter cited as ASME], Paper No. 73-WA/Sol-7 (1973).

6. Among the papers on solar heating and cooling are: LaPlante, San-Martin and Smith, *A Competitively Priced Residence for Utilization of Solar Energy,* ASME Paper No. 73-WA/Sol-3 (1973); and Eisenstadt, Flanigan, and Farber, *Tests Prove Feasibility of Solar Air Conditioning,* 32 Heating, Piping and Air Conditioning 120 (1960).

of homes using solar heating and cooling are currently in operation. Some of these buildings are sophisticated research structures[7] while some are the residences of private citizens who feel that the solar age has arrived.[8] Solar heating and cooling is also being applied to commercial and institutional buildings. Public schools in Georgia[9] and Massachusetts will soon be heated and cooled by solar technology, and university buildings in New Mexico and Colorado will be similarly treated.[10]

The technology required for solar heating and cooling of homes is presently available although the price is prohibitive for most applications.[11] This economic problem can be alleviated by our legal institutions as well as by engineering progress, and this paper will discuss one aspect of how legal institutions can encourage solar energy use for home heating and cooling.

One group of legal institutions that has recognized the need and desirability for encouraging solar heating and cooling is the state legislatures. This recognition has come during the past two years. Four states have passed laws which deduct the assessed valuation of solar heating and cooling equipment from the assessed valuation of real property,[12] thereby eliminating property taxes on solar equipment. Bills providing economic incentives were introduced into the legislatures of 18 states during their 1975 legislative sessions.[13] These bills included provisions exempting solar equipment from property taxes, giving advantageous treatment to solar equipment purchasers for income tax purposes, eliminating sales and use tax on solar equipment, and aiding citizens in financing the purchase of solar equipment.[14]

Legislation has been passed,[15] and more proposed in 1975 sessions,[16] authorizing creation of state agencies to encourage solar energy use or allocating that task to an existing agency. A number of states have proposed legislation defining standards to be used for solar heating systems,[17] and Florida has gone so far as to legislate that "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."[18] State legislatures are also beginning to allocate money for solar energy research and demonstration projects. For example, a number of bills were introduced in various legislatures for solar research and development during their 1975 sessions.[19]

STATEMENT OF THE PROBLEM

The problem treated in this paper is simple to comprehend but difficult to solve. Suppose that a homeowner decides to equip his home with a solar energy system. Such a system is capital intensive and the homeowner will invest a significant sum in solar collectors. These will probably be located on his roof. Suppose that a neighbor builds a two-story home next door or grows a stately tree, thereby shading the collector. What can the homeowner do? This problem has not been considered by any legislature, possibly because it has not yet come up. Most of the solar buildings now in existence belong

7. The "Extended Abstracts" of the 1975 meeting of the International Solar Energy Association lists 31 papers concerning heating and cooling of experimental homes. These papers are listed in Sections 41 and 42 of the abstracts. The meeting was held in Los Angeles, California, July 28-August 1, 1975.

8. Windes, *Solar Energy Heats Two Houses,* N.M. Mag., Feb., 1975, at 6.

9. Duncan, *Solar Energy Will Cool and Heat Atlanta School,* Am. Soc'y of Heating, Refrigeration and Air Conditioning Eng'rs J. Sept., 1974, at 47 [hereinafter cited as ASHRAE J.].

10. Bridgers, *Applying Solar Energy for Cooling and Heating Institutional Buildings,* ASHRAE J., Sept., 1974, at 29.

11. For example, consider a home having 1,500 square feet of heated area, which we wish to heat with solar energy. A cost comparison using solar and conventional heating can be estimated, though costs will vary in different geographical locations. Since the authors live and work in Albuquerque and Albuquerque has favorable solar conditions, all geographically dependent numerical values in this paper will be taken for the Albuquerque area. Under typical Albuquerque conditions, the house will require between 500 and 700 square feet of solar collectors, at a price now ranging from $5. to $10. per square foot. This price includes energy storage. Thus, the capital investment required for a solar heating system lies between $2500 and $7000. In the present money market this capital can be obtained for about 8½%. The cost of servicing the loan for the solar system is between $213. and $595. per year. Assuming that the lifetime of the equipment is 25 years, and using straight line depreciation, the depreciation cost lies between $100. and $280. per year. From these figures, the average cost of heating the 1,500 square foot home is $594. per year, using solar energy. The yearly cost of gas for heating a "typical" 1,500 square foot Albuquerque home is about $150. per year. The analysis shows that solar heating is a capital intensive enterprise that is not *presently* competitive with natural gas. Anticipated increases in natural gas prices combined with lower prices for solar collectors will probably change this competitive outlook. The situation for solar cooling is worse than that for solar heating.

12. Ind. Code § 6-1-9.5 (Repealed 1975); Ariz. Rev. Stat. Ann., § 43-123.37 (1956); S.D. Compiled Laws § § 10-6-35.5-.7 (Additional Supp. 1975); N.D. Bill 5.2439 passed in 1975.

13. The letters and numbers following each state are the number of the bill introduced during the 1975 legislative session: Ariz. 51011; Calif. S215, S218, SCA13; Conn. H5048, H5236, H5873, H7666, H7667, S348, S412, S414, S441, S448; Md. H506, S520; Mass. S1366, S1385; Mich. H4137, H4138, H4139, H1820; Minn. H85, S281; N.J., A2303; N.Y., A659; N.D., S2439, H1527; Ore. H2201, H2202, H2203, S209, S2046; Pa. H262; Tex., H429; Vt. H206; Wash. S2375; W.V. H1138; Wis. A268.

14. N.M. Stat. Ann. § 72-15A-11.3 (Supp. 1975) provides an income tax credit for solar equipment.

15. Ariz. Rev. Stat., § 30-123(c) (Supp. 1975); Va. Bill H1809 passed in 1975.

16. Mass. H3517; N.Y. S672; Ore. HJR3.

17. Calif. A774, S428; N.M. S18; N.Y. S896; Vt. S88.

18. Fla. Stat. Ann. § 553.065 (Supp. 1974).

19. Calif. S429; Colo. S37; Conn. H7563, S347; Iowa H65; N.Y. A3342; Ore. H2200; Va. HJR268. *See generally State Responses to the Energy Crises* (1974).

to institutions such as universities, which own large land areas surrounding the solar heated buildings. This control of the surrounding land precludes the shading of collectors. If solar heating and cooling is to be widely used, however, a serious collector shading problem will arise in our urban areas.

At least three pertinent questions arise from this problem. 1) Does the homeowner have a right to the sunshine that is blocked by his neighbor's building or tree? 2) If he doesn't have a right to the solar energy, should such a right be given to him? 3) If such a right is given to him, how should it be done?

Section III of this paper answers the first question, concluding that present law gives the homeowner no right to the solar energy. Energy and environmental considerations dictate that some sort of right to the solar energy should be given to the homeowner on the basis of public policy. Public policy arguments alone, however, are seldom satisfying, and should be in accord with existing law. Sections IV, VI, and VII discuss the present state of the law with respect to easements for light and air, property rights in airspace, and zoning regulations for light and air. These topics are then combined and a right to solar energy emerges based upon the developed law in these three areas and the public policy consideration of encouraging solar energy use. This answers the second question. Sections VIII and IX discuss methods of minimizing the impact of the newly defined solar rights on our traditionally accepted property rights. This is done by trading off some of a landowner's solar rights in deference to his neighbor's traditional property rights, and a sensible answer to the third question posed above requires reconciling the conflicting interests.

DOCTRINE OF ANCIENT LIGHTS

The doctrine of ancient lights came to the American colonies as part of the English common law. It stated that if a person had the uninterrupted use of light and air through a window for 20 years, an adjoining landowner could not cause the light to be blocked. In effect, the person with the window acquired a prescriptive easement for light and air across his neighbor's land. This doctrine was part of the English common law at least as far back as the 17th century.[20]

The treatment of the doctrine by American courts follows the development of the country to some extent. During the first half of the 19th century the doctrine was generally upheld. The earliest

20. For an early case involving the doctrine, *see* Aldred's Case, 5 Coke's Reports (1826 ed.) 102 (K.B. 1611).

American case involving the doctrine was the 1815 Massachusetts case of *Story v. Odin.*[21] There, the City of Boston owned a building and an adjacent lot. Story bought the building, after which Odin bought the lot and erected a structure which blocked the light from Story's windows. The Court said that after selling the building to Story, the City of Boston could not block light to Story's windows since such blocking would be an act by the grantor (City of Boston) in derogation of the grant, and such derogation of a grant was prohibited by the common law.[22] Since the City of Boston had no right to stop Story's lights, it could not convey that right to Odin when it sold the lot to Odin.

New York was the first state to reject the doctrine of ancient lights. In the 1838 case of *Parker v. Foote,*[23] the New York court stated that the doctrine was "not adapted to the circumstances or existing state of things in this country." The court also stated that "It may do well in England . . . but it cannot be applied to the growing cities and villages of this country without working the most mischievous consequences."[24] In other words, the doctrine was rejected on the grounds of public policy. *Parker* correctly predicted the demise of the doctrine, and it has been consistently rejected by American courts since the middle of the 19th century.[25]

When the country was rural, the doctrine of ancient lights was acceptable. It was rejected when our cities began to grow, and the usual grounds for rejection was the public policy argument given in *Parker.* It is interesting to note that both England and some parts of the English speaking world still accept a modified form of the doctrine of ancient lights,[26] and that a party may still claim a prescriptive easement for sufficient light rather than for all of the light previously acquired.[27] Maintaining the doctrine does not appear to have inhibited urban growth in the country that gave us the Industrial Revolution.

21. 12 Mass. 157 (1815).
22. *Id.* at 159.
23. 19 Wendell 309, 317 (N.Y. 1838).
24. *Id.* at 317.
25. A somewhat more complete history of the doctrine of ancient lights is given by Eisenstadt and Utton, *Solar Rights and Their Effect on Solar Heating and Cooling,* Tech. Rept. ME-66(75) ERB-360-1, U. of N.M. College of Eng'r 7-10 (1975).
26. The doctrine of ancient lights has been modified somewhat by the Rights of Light Act of 1959. That act is discussed in two articles by Wilkerson, *Let There be More Light,* 118 New L. J. 7 (1968) and *Right to Light,* 112 Sol. J. 675 (1968), and two articles by Greene, *Rights of Light,* 110 New L. J. 362 (1960), and *Securing Rights of Light,* 112 New L. J. 744 (1962). The doctrine is also alive and well in New Zealand according to Adams, *Easements of Light and Air,* 21 N.Z. L.J. 231 (1945).
27. Colls v. Home and Colonial Stores, Ltd., [1904] A.C. 179.

Despite the 19th century rejection of the doctrine of ancient lights, it still arises occasionally in a 20th century context. It often appears in cases involving the blocking of views since an easement for light and air is assumed to include protection of views.[28] The 20th century case that is perhaps the leading one for the doctrine of ancient light is *Fontainbleu Hotel Corporation v. Forty-Five Twenty-Five, Incorporated.*[29] The case involved two luxury beachfront hotels in Miami Beach, the Fontainbleu and the Eden Roc. The Fontainbleu, located to the south of the Eden Roc, built an addition onto its existing structure. This addition shaded the swimming pool of the Eden Roc after about 2 p.m. in the winter. The winter, of course, is the lucrative tourist season in Miami Beach, and since the tourists come for the sun, the situation was quite detrimental to the Eden Roc. In dismissing an argument by the Eden Roc based on the doctrine of ancient lights, the court said:

> No American decision has been cited, and independent research has revealed none, in which it has been held that—in the absence of some contractual or statutory obligation—a landowner has a legal right to the free flow of light and air across the adjoining land of his neighbor.[30]

The court did, however, offer a suggestion to prevent this situation from arising again. It said,

> If public policy demands that a landowner . . . refrain from constructing buildings upon his premises that will cast a shadow on the adjoining premises, an amendment of [the city's] comprehensive *planning and zoning ordinance,* applicable to the public as a whole, is the means by which such purpose should be achieved.[31]

It would appear that the public policy in favor of solar heating and cooling systems is at least as strong as that for unshaded resort hotels, and that zoning ordinances should be available for the former as for the latter.

EASEMENTS FOR LIGHT AND AIR

Rejection of the doctrine of ancient lights by the American courts has eliminated prescriptive easements for light and air. It is possible,

28. *See, e.g.,* Katcher v. Home Savings and Loan Assn., 53 Cal. Rptr. 923 (Cal App. 1966).

29. 114 So.2d 357 (Fla. App. 1959). This case is also discussed in Comment, 34 Tul. L. Rev. 599 (1960).

30. 114 So.2d 357, 359 (Fla. App. 1959).

31. *Id.* at 360.

however, to obtain express or implied easements for light and air. It is of interest to investigate how the law treats these easements since the problem of creating access to solar energy has facets that are analagous to the problem of access to light and air.

Implied Easements for Light and Air

All states recognize that property abutting a public street has an easement for light, air, and view from the street and an easement for access to the street. Since this easement is not an expressed one, and is not given by statute, it must be implied. Even the California courts which stated "It is well settled in California that easements for light and air cannot be created by implication. . . ."[32] recognize this particular implied easement.[33]

Implied easement cases concerning public streets first arose when portions of city streets were used by urban railroads, both ground level and elevated.[34] The elevated railroad cases were finally decided by the Supreme Court,[35] and in *Muhlker v. New York and Harlem Railroad Company,* Justice McKenna said, ". . . established beyond question the existence of these *rights,* or easements, of light, air, and access as appurtenant to abutting lots, *and they are as much property as the lots themselves.*"[36] Thus, the Supreme Court defined these easements for light, air, and access as property. State courts have upheld the implied easement for light and air for land abutting roads and streets in cases involving individuals as parties.[37] The elevated railroad in the Supreme Court cases had been authorized by the state legislature and had a different status than a private individual.

Litigation concerning implied easements has come up frequently in eminent domain cases.[38] In a typical case involving an easement for light, air, and view, there is often a partial taking of the landowner's land for public use with the remainder of his land being deprived of light, air, access, or view, usually because of the nature of the use for which the land is condemned.[39] This deprivation of light

32. Taliaferro v. Salyer, 162 Cal. App.2d 685, 687, 328 P.2d 799, 801 (1958).

33. Sacramento and San Joaquin Drainage Dist. v. Reed, 215 Cal. App.2d 49, 29 Cal. Rptr. 847 (1963).

34. Dooley Block v. Salt Lake Rapid Transit Co., 9 Utah 31, 33 P. 229 (1893); Southern Traction Co. v. Fears, 199 S.W. 856 (Tex. App. 1918).

35. Mulker v. N.Y. & Harlem R.R. Co., 197 U.S. 544 (1905); Birrell v. N.Y. & Harlem R.R. Co., 198 U.S. 390 (1905); Roberts v. N.Y. City, 295 U.S. 264 (1935).

36. Muhlker v, N.Y. & Harlem R.R. Co., 197 U.S. 544, 571 (1905) (emphasis added).

37. Brzozowski v. Boutinger, 180 Misc. 52, 43 N.Y.S.2d 57 (1943); Wall v. Eisenstadt, 51 R.I. 322, 154 A. 651 (1931).

38. Annot., 84 A.L.R.2d 348 (1962).

39. State Road Comm. v. Rozzelle, 101 Utah 464, 120 P.2d 276 (1941); Okla. v. Allison, 372 P.2d 850 (Okla. 1962).

and air is compensable. In *Okla. v. Allison,* the court said that loss of an abutter's right of access, light, air, or view should be considered in determining condemnation damages.[40] A 1944 California case held "property which an abutting owner has in a street in front of his land is the right of access and light and air, *and for infringement of such right he is entitled to compensation.*"[41] In discussing the compensation for partial taking of a piece of land under eminent domain, a 1973 New Mexico court said "loss of view, impaired ingress and egress . . . were compensable consequential elements. . . ."[42] Although compensation for light and air was not specifically discussed in that case, they would probably be included with view. In addition, the New Mexico statute which defines the measure of compensation for partial taking of land under eminent domain makes it clear that loss of light and air is to be compensated.[43] *Liddick v. City of Council Bluffs*[44] involved interference with light, air, and view caused by the city building a viaduct across the street from the plaintiff's house. The court held that property abutting the street has a right to light, air, and view. These rights are property rights, "whether the bare fee of the street is in the owner or the city."[45] They went on to find that depriving the owner of his light, air, and view was taking of private property within the purview of the Iowa Constitution.[46] These cases conclude that an easement for light and air is property. As property rights to light and air have a money value, the owner of the rights can be required to convey them, for just compensation under the power of eminent domain.

We have so far determined three characteristics of the implied easement for light, air, view, and access which applies to property abutting public roads and highways. These are:

1. The easement is a property right and/or property.
2. The easement has a determinable money value.
3. The property or property right which constitutes the easement can be sold and conveyed in cases of condemnation under the power of eminent domain.

40. 372 P.2d 850, 852 (Okla. 1962). In *Okla. v. Allison,* the condemnation involved 19 acres of a 300 acre farm. By condemning the 19 acres for highway use, the remaining 281 acres were denied direct access to the highway.

41. Beckham v. Calif., 64 Cal. App.2d 487, 149 P.2d 296 (1944) (emphasis added).

42. N.M. ex. rel. State Highway Comm. v. Hesselden Investment Co., 84 N.M. 424, 427, 504 P.2d 634, 637 (1972).

43. N.M. Stat. Ann. § 22-9-9.1 (Supp. 1975).

44. 232 Iowa 197, 5 N.W.2d 361 (1942).

45. *Id.* at 209, 5 N.W.2d at 373, quoting 3 Dillion, Municipal Corporations § 1123 (5th ed.).

46. Iowa Const. Art. I, § 18.

Subsections which follow will address the question of whether rights to light and air are conveyable in situations other than eminent domain condemnation.

Express Easement for Light and Air

Like most easements, those for light and air can be created by grant, convenant, or reservation.[47] They can be created for the benefit of particular buildings or for the benefit of parcels of land. If the easement is for the benefit of a building, it is lost when the building is destroyed unless another building is constructed with windows in the same location.[48] Usually, however, the dominant estate is a parcel of land, and an easement which enhances the value of land to which it relates becomes appurtenant to that land and passes with it. This is illustrated by the 1960 Virginia case of *First National Trust and Savings Bank v. Raphael.*[49] There, two parties entered into an agreement. The first party gave the second the use of a wall, which became a party wall, while the second party granted to the first an easement for light and air. The grant was broad, and bound "the heirs and assigns" of the second party. Over the years, the nature of the property changed from residential to commercial and the windows of the dominant tenement had not been used for years. In a suit to determine whether or not the easement had been lost by abandonment, the court held that the easement was still valid. The easement had been granted for the benefit of the property and ran with it. Thus, one private party can convey his property right in an easement for light and air to another private party in return for consideration. The property transferred when such an easement is conveyed is an inheritable incorporeal hereditament.

Rights to light and air can be created in land developments by means of the developer defining in the conveyance the burden which each lot has to others and the benefit which it receives from the others. This is usually done by covenant.[50] In an 1890 Massachusetts case,[51] the City of Boston erected buildings on part of a tract of 64 lots. Each lot in the tract had convenants concerning heights of houses, locations of streets, etc. The city's buildings violated the covenants, and the owner of one of the tract lots sued the city for

47. Annot., 142 A.L.R. 467 (1943).

48. Annot., 25 A.L.R.2d 1265, 1321 (1952); City Nat'l Bank of Salem v. van Meter, 59 N.J. Eq. 32, 45 A 280 (1899).

49. 201 Va. 718, 113 S.E.2d 683 (1960).

50. The privity of estate requirement for covenants is met in these cases since the privity exists at the time of conveyance.

51. Ladd v. City of Boston, 151 Mass. 585, 24 NE 858 (1890).

the taking of an easement for light and air. The court held that reciprocal easements were created by the convenants, that they ran with the land, and that the city had to compensate the landowner. This was not an eminent domaint proceeding, but simply involved compensation for property taken by one party from another.

Cases involving tract restrictions on the height of fences and hedges usually fare the same as the Boston case. *Mock v. Shulman* is typical of these.[52] There, the court said that mutual property rights had been created by the height restrictions and treated these as equitable servitudes. The right to receive light and air was found to be appurtenant to the land and was defined as a property right. Thus, light and air rights can be created over areas of land having many owners, either by covenants in the deeds from the single owner of the tract to the subsequent purchasers of the lots, or by mutual grants between the owners of the various lots. Access to solar energy can be readily guaranteed by convenants in newly developed tracts, but a mutual grant arrangement covering a developed neighborhood is very cumbersome at best.

Leasing and Taxing Easements for Light and Air

There is little case law concerning leases of easements for light and air, but that which does exist treats the easements as property which can be leased. *Irving Trust Company v. Anahma Realty Corporation*[53] concerned two buildings in New York City. A four-story building was surrounded on three sides by a large office building. The large office building wanted to secure its access to light and air. To accomplish this, the owner of the four-story building granted an easement of light and air to the owner of the office building in return for $8,500 annually. The grant was for a term of years with a right to extend the time period. The right of the owner of the small building to lease an easement for light and air was not questioned by the court.

A similar situation with two buildings caused litigation in the recent case of *Macht v. Department of Assessment of Baltimore City*.[54] The facts of the case, as given by the court, are:

> In 1961, Charles Street Development Corporation (the Blaustein Building) determined to erect a multi-storied office building on property immediately to the west of that now owned by the Machts. Apparently aware that the doctrine of ancient lights had been rejected by our predecessors, *Cherry v. Stein*, 11 Md 1, 21-22 (1857), some positive assurance that the building's eastern face would have unimpeded access to light and air was a problem of immediate concern. To that end, the Blaustein Building opened negotiations with the Macht's predecessor in title. These culminated in an agreement under which the Macht's predecessor leased to the Blaustein Building the airspace over 11-13 East Fayette Street above an altitude of 124 feet. The lease term was 98 years and nine months from 1 April 1961, without provision for extension or renewal. The rent from and after 1 January 1962 was fixed at twice the annual real estate taxes imposed on the "entire property" at 11-13 East Fayette Street, (land, improvements and airspace) less any increase in taxes attributable to improvements made by the Macht's predecessor, but not more than $8,000.00 or less than $2,000.00 in each of the calendar years 1962 through 1970.[55]

52. 226 Cal. App.2d 263, 38 Cal. Rptr. 39 (1964).
53. 285 N.Y. 416, 35 N.E.2d 21 (1941).
54. 266 Md. 602, 296 A.2d 162, 56 A.L.R.3d 1285 (1972).

No problem arose until the tax assessor placed a value of $50,700 on the airspace and proceeded to increase the assessed value of the property by this amount for tax purposes. This assessment was upheld.[56] While the court discussed the case in terms of air rights, it recognized that the purpose of the lease was to guarantee access to light and air to the Blaustein Building.[57] The relationship between easements for light and air and rights to airspace will be explored in depth below.

It is now evident 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 can also be taxed.

ARE EASEMENTS FOR UNOBSTRUCTED LIGHT SOLAR RIGHTS?

This section will be concerned only with the easement for light. An easement for light usually gives the dominant estate the right to the light coming directly from the sun or sky; *i.e.*, the servient estate is prohibited from obstructing any light coming from the sky to the dominant estate. This is called an easement for unobstructed light to distinguish it from an easement which gives only sufficient light to the dominant estate. The sufficient light need not be unobstructed, but may be reflected or diffuse. Most easements for light give the dominant estate the right to unobstructed light. A piece of land

55. *Id.* at 164.
56. Annot., 56 A.L.R.3d 1300 (1974).
57. The question of whether the interest assessed and taxed was a lease of airspace or an easement appurtenant to the Blaustein Building is discussed in Notes and Comments *Taxation of Easements in Airspace*, 33 Md. L. Rev. 159, 164 (1973). The commentator there argues that the interest involved was an easement. The easement was right of access to light and air across Macht's airspace.

having an easement for unobstructed light appurtenant to it has the right to receive the light coming across an adjacent piece of land. We wish to show that this right includes or implies that the dominant estate has the right to the solar energy coming across the servient estate. The right to the solar energy will be called a *solar right.*

It is necessary to introduce two scientific principles that are needed for the discussion. Figure 1 is a diagram of the electromagnetic spectrum.[58] The spectrum is made up of electromagnetic waves, and the single characteristic of these waves dealt with here is the wavelength. As an aid in orienting the reader, the radio broadcast band is shaded in Figure 1 and the radio waves therein have wavelengths in the neighborhood of 100 meters. The part of the electromagnetic spectrum of interest here is the region containing infrared, visible, and ultraviolet light. In previous sections of this paper, the word light has been used in its ordinary sense; *i.e.,* electromagnetic radiation which acts as a stimulus to the eye. The shaded region in the diagram labeled visible corresponds to this definition. In terms of wavelength, the visible band of the electromagnetic spectrum covers the wavelength region from about 0.4 millionths of a meter (4×10^{-7} m) to 0.8 millionths of a meter (8×10^{-7} m). The wavelength band of the solar energy arriving at the earth's surface is wider than the visible light band, as shown in the figure.[59] This band goes from 0.2 millionths of a meter (2×10^{-7}m) to 2.0 millionths of a meter (2×10^{-6}m). The solar energy band includes the visible light band, but also contains some infrared and ultraviolet radiation. Although modern vocabularies include terms such as "infrared light" and "ultraviolet light," it is not at all clear that the word light as used in the preceding sections includes anything other than visible light, and it is assumed that the word light means only visible light. Two more terms require defining. *Solar energy* will mean all of the energy in the solar wavelength band, as shown in Figure 1, while *solar light* will mean that part of the solar energy that is within the visible light band. When the terms solar energy or solar light are used, reference is made only to the energy or light coming from the sun in a straight line, and striking the earth. Reflected or diffuse radiation is not included in these terms, because such radiation is of minor usefulness to solar heating and cooling systems. With this background, the following argument will attempt to show that an easement for light is a solar right.

58. This particular diagram comes from Weidner and Sells, Elementary Modern Physics, 23 (1960).

59. The solar energy spectrum can be found in J. P. Holman, Heat Transfer, 262 (2d ed. 1968).

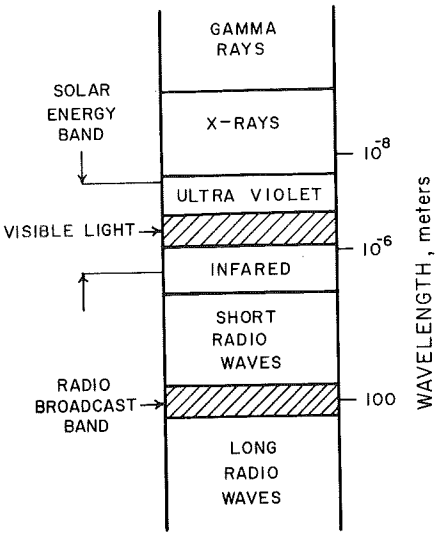

FIGURE 1.
Schematic diagram of the electromagnetic spectrum showing that the solar energy band includes visible, ultraviolet and infrared light.

If a piece of land has an easement for unobstructed light, included in that easement is a right to the solar light. If it can be shown that the easement for unobstructed light should include the solar energy rather than the solar light, then the easement becomes a solar right. The argument for this consists of showing that if rights to solar light are not expanded to include rights to solar energy, the results are illogical, socially wasteful, and against the energy policy of the nation. Assume that a piece of land has an easement for light across an abutting servient estate, and that solar energy flows across the servient estate to the dominant one. The owner of the servient estate is only required to let the solar light pass; he has no obligation to pass the solar energy.[60]

In addition, it would be socially wasteful and contrary to national energy policy to permit the servient estate to block the infrared and ultraviolet portions of the solar energy band while attempting to

60. While he might be legally entitled to block the infrared and the ultraviolet light, it is not technically feasible to do so. It may, in fact, be technically impossible. If, for example, the owner of the servient estate attempted to use a light filter to block the infrared and ultraviolet, he would need a filter that would block none of the solar light since the dominant estate is entitled to all of the solar light by virtue of the easement. An optical filter that blocks radiation in one wavelength band but passes absolutely all of the radiation in another wavelength band has never been made and may be physically impossible to fabricate.

transmit all of the visible portion. Such an arrangement would hinder solar development, and is probably impossible to achieve. This part of the argument rests on strong public policy considerations.

We are now at the point of equating an easement for unobstructed light with a solar right and classifying the solar right as property with an ascertainable money value that can be conveyed, bought, sold, traded, leased, rented, and taxed.

PROPERTY RIGHTS TO AIRSPACE

Easements for light and air can be granted because the grantor has property rights in the airspace above the land; the right to grant the easement is only one of the incidents of ownership of the airspace. This section is concerned with the rights of a landowner in the airspace above his own land. It will be shown that a party can sell or trade his airspace rights, and it is therefore possible for a landowner to trade part of his airspace property rights in return for some of his neighbor's airspace rights. Such a trade could create solar rights for both parties.

The right of property owners to the airspace above their land was expressed at least as long ago as Blackstone's time. His opinion was that "to whomsoever the soil belongs, he also owns to the sky and to the depths."[61] The advent of aviation required that the doctrine be modified, since the infinite upward extent of an estate in land would create a problem of airplane trespass. Congress passed the Civil Aeronautics Act of 1938 which gave a right of public transit in navigable airspace, which is the airspace above the minimum safe altitude of flight prescribed by the Civil Aeronautics Authority.[62] The minimum safe altitude becomes quite low when aircraft take off or land, giving rise to the problem treated in *U.S. v. Causby*.[63] There, a property owner's real estate was directly under the landing pattern of a military airport, and the issue concerned how low the planes could fly before there was a taking of Causby's property by eminent domain. The court held that a "landowner owns at least as much of the airspace above the ground as he can occupy or use in connection with the land, and the fact that he does not occupy it in a physical sense by erection of buildings and the like is not material."[64] This case defines the extent of the estate in airspace.

61. Blackstone, Commentaries, 18 (8th ed. 1778).
62. 49 U.S.C. § 403 (1953), repealed (1958), now included in 49 U.S.C. 1304 (1970).
63. 328 U.S. 256 (1946). The extensions of the holding in Causby are discussed by Hays, *U.S. v. Causby: An Extension Thereof*, 3 Wm. & Mary L. Rev. 36 (1961).
64. 328 U.S. 256, 264 (1946).

The nature of the airspace estate is such that it can be severed from the surface estate and conveyed. A number of substantial buildings have been constructed with the owner having a fee interest in airspace and an interest only in that part of the surface estate that was necessary for the support of his building.[65] Among these airspace buildings are the Grand Central Terminal in New York, the Merchandise Center of Marshall Field in Chicago, and the Chicago Daily News building.

The description of the "air-lot" conveyed to the Chicago Daily News by the Union Station reads as follows:

> All the land, property, and space at and above a horizontal plane twenty-three feet above Chicago City Datum bounded on the East by Wells St., on the North by Kinzie St., on the West by the Franklin-Orleans Viaduct, and on the South by the Chicago River.[66]

These buildings were constructed in the 1920's. More recently, the emphasis has been on the purchase of airspace over roads and freeways. For example, in 1960 the City of New York granted the volume of air above one of the approaches to the George Washington Bridge to the Bridge Site Building Corporation.[67] The grant was in fee simple and included easements necessary for the support structures. A large apartment building has been constructed on the site.

There is a fair amount of case law concerning airspace estates, which has been discussed by Wright[68] and others.[69] Rather than discuss case law, this article will consider the Model Airspace Act, and the characteristics of airspace estates as defined therein.[70] Sections 3, 4A, and 4B of the Act leave no doubt that airspace estates are property.

> Section 3. Legal Nature of Airspace
>
> Airspace as defined herein is real property, and until title thereto or rights, interests or estates therein are separately transferred, airspace is the property of the person or persons holding title to the land surface beneath it.

65. Bell, *Air Rights*, 23 Ill. L. Rev. 250 (1928); Ball, *Division into Horizontal Strata of the Landscape Above the Surface*, 39 Yale L.J. 616 (1930); Comment *The Interest of the Occupier of Land in Superjacent Space–the New York View*, 4 N.Y.L.F. 350 (1958).
66. 39 Yale L.J. 616, 654 (1930).
67. Comment Conveyance and Taxation of Air Rights, 64 Colum. L. Rev. 338 (1964).
68. R. Wright, The Law of Airspace (1968); and R. Wright, *Development of Policy for Use of Airspace*, in Legal, Economic, and Energy Considerations in the Use of Underground Space (1974).
69. Annot., 76 A.L.R.2d 896 (1961).
70. The final draft of the Model Airspace Act can be found in 7 Real Property, Probate and Trust J. 353 (1972).

Section 4. Purposes and Application of the Act

(A) It is the purpose of this Act that airspace shall be subject to being acquired, held, enjoyed, possessed, alienated, granted, sold, conveyed, exchanged, transferred, partitioned, assigned, demised, leased, released, charged, mortgaged, encumbered, assessed, devised, condemned, *zoned,* platted, divided, subdivided, and otherwise utilized and manipulated in the same manner, upon the same conditions and for the same uses and purposes as other real property; and airspace shall be subject to the same statutes, rules of law, and common law as other real property.

(B) All of the rights, privileges, immunities, incidents, powers, remedies, *burdens, servitudes,* duties, liabilities, limitations and restrictions which apply to titles, estates, rights and interests in other real property shall apply to airspace.

The Model Airspace Act defines the airspace estate as property in a very general sense. Consider two property owners, *A* and *B,* owning adjacent lots. Each owner has a fee interest in the airspace above his land. *B,* for example, can grant all or part of his fee interest to another party. If he grants a solar right to *A,* he is granting part of his airspace estate to *A.* The right to make this grant is one of the incidents of a fee interest. *B* can grant the solar right to *A* for money or in exchange for some other form of consideration. This consideration could be receiving a solar right from *A.* If this were the case, *A* and *B* would each have solar rights across each other's land by virtue of each granting part of his airspace estate to the other. Thus, in an exchange of solar rights by *A* and *B* each of them gives up one property right and gains another. Each conveys part of his airspace estate and receives a solar right.

The concept of exchanging solar rights can be extended to entire neighborhoods. Each landowner would grant solar rights across his airspace to all of his neighbors. This would set up a group of equitable servitudes and everyone would have access to solar energy. The main problem with acquiring solar rights in this manner is that voluntary action is required from each landowner, and it may not always be obtainable.

Section 6 of the Model Airspace Act may help. It says:

Section 6. Power of Governmental Bodies and Private Persons

(A) The State and all of its departments, commissions, agencies, instrumentalities, divisions, subdivisions, and authorities, including all counties, municipal corporations and governmental units of any kind, shall have the same powers, rights and duties with respect to airspace as are possessed with respect to other real property.

(B) All private individuals, partnerships, corporations, foundations, trustees, fiduciaries, and all other private persons whatever their legal status, shall have the same powers, rights and duties with respect to airspace as are possessed with respect to other real property.

Thus, airspace is to be treated in the same manner as other real property and is subject to zoning regulations.[71] Zoning control over airspace does not depend upon Section 6 of the Model Airspace Act, which is a codification of previous case law. The creation of solar rights by means of zoning regulations rather than by mutual grants eliminates the problem of requiring the entire neighborhood unanimously to be in favor of the creation of solar rights.

CREATION OF SOLAR RIGHTS BY ZONING

The zoning power has never been used to create solar rights because there has not been a need for such rights in the past. This section of the paper will investigate the problems that arise when solar rights are subjected to the zoning power. The constitutional limits of the zoning power and their effect on the creation of solar rights will be studied first. The manner in which light and air have been traditionally treated in zoning laws will be discussed briefly. Then, some of the newer zoning concepts will be noted, and the manner in which solar rights fit into the zoning system should become clear.

Constitutional Limits of the Zoning Power

The Constitution places three basic requirements on a zoning ordinance:[72] (a) the ordinance must bear a rational relationship to the health, morals, or general welfare of the community so as to comply with the due process requirements of the fourteenth amendment,[73] (b) it must not be so arbitrary and discriminatory that its restrictions are a denial of equal protection of the laws under the fourteenth amendment, and (c) it must not so reduce the value of the land as to constitute a taking without just compensation in violation of the fifth amendment.

Fourteenth amendment requirements were first tested in the land-

71. Zoning of airspace estates approximates potential zoning for solar rights. *See, e.g.,* Comm. on Public Regulation of Land Use, *Zoning: Air Lot Regulation/Title Insurance,* 5 Real Property, Probate and Trust J. 260 (1970).

72. These requirements are specified by Hill, *Environmental Considerations: New Arguments for Large-Lot Zoning,* 7 Urban L. Annual 370 (1974).

73. The requirement that the ordinance relate to health, morals, or general welfare means that the authority for the ordinance comes from the police power of the state.

mark case of *Village of Euclid v. Ambler Realty Co.*[74] In that case, a general zoning regulation reduced the value of a piece of land to about one-third of its former value. Despite the diminution in value, the U.S. Supreme Court upheld the authority of the municipality to legislate general zoning regulations as a proper exercise of the police power. The court stated that the ordinance must be "clearly arbitrary and unreasonable and without substantial relation to public health, safety, morals, or general welfare before it can be declared unconstitutional."[75]

Modern fourteenth amendment limits of the zoning power were defined by the recent Supreme Court case of *Village of Belle Terre v. Boraas.*[76] In that case, a village containing about one square mile restricted its land use to one family dwellings. A family was defined as a group related by blood, adoption, or marriage or two or less people not related by blood, marriage, or adoption but living and cooking together as a single housekeeping unit. The dicta of the Court of Appeals for the Second Circuit in this case was quite similar to the language used in *Euclid.* That court said, "where zoning regulations represent a valid exercise of delegated state police power and are designed to promote or protect the public health, safety or welfare, the individual's right must give way to the particular concern of the community."[77] However, the Second Circuit went on to strike down the zoning ordinance on the equal protection grounds that the legislative classification (*i.e.,* only families as defined in the ordinance could occupy houses) was not substantially related to the object of the statute.

The equal protection clause of the Fourteenth Amendment has recently been undergoing extensive changes in interpretation.[78] At present, the criteria which a court will apply to determine whether or not an ordinance complies with the equal protection requirement are difficult to predict with certainty. In *Belle Terre,* for example, the Court of Appeals for the Second Circuit required that a substantial relationship exist between the object of the zoning ordinance and the class of people whom the ordinance permitted to live in Belle Terre, *i.e.,* single families as defined in the statute. The Court of Appeals held that the required substantial relationship did not exist between the object and the class, and that the ordinance was therefore in violation of the equal protection clause.

74. 272 U.S. 365 (1926).
75. *Id.* at 395.
76. 416 U.S. 1 (1974).
77. Boraas v. Village of Belle Terre, 476 F.2d 806, 812 (1973).
78. These recent changes are demonstrated in G. Gunther and N. Dowling, Constitutional Law Ch. 14 (9th ed. 1975).

The decision of the Court of Appeals was reversed by the Supreme Court; however the Supreme Court used a different criterion. It required that only a minimum rational basis need exist between the object of the ordinance and the class of people it defined. By changing the criterion, the equal protection clause was satisfied and the zoning ordinance upheld. Some confusion exists as to exactly which equal protection criterion was used[79] but it is evident that whichever criterion was actually used, *Belle Terre* sets a low equal protection barrier to zoning ordinances.[80]

This discussion of the Fourteenth Amendment limits on zoning power is brief and covers only the first (1926) and the last (1974) cases decided by the Supreme Court. The Fourteenth Amendment question is a difficult and uncertain one. With respect to zoning, wide latitude has usually been given to the communities and it is reasonable to expect this policy to continue.

Consider how the Fourteenth Amendment due process requirements would apply to a situation in which solar rights were created by ordinance in an entire neighborhood, and all land in that neighborhood had the same zoning restrictions. The purpose of the zoning ordinance would be to encourage the use of solar energy for heating and cooling of buildings, thereby reducing consumption of fossil fuels and reducing the outflow of American dollars to the OPEC countries. Such a purpose directly affects the health and welfare of individuals, the municipality, the state and the nation. Thus, the purpose of a solar zoning ordinance could arguably provide a legitimate reason for exercise of the police power. The means selected bear a direct relationship to the purpose of the ordinance. Creating solar rights encourages solar energy utilization, which is the purpose of the ordinance. Whether the test used is that of a substantial relation or a minimum rational basis between the means and the end, or a balancing test, the nexus between the creation of solar rights and the encouragement of solar energy utilization is sufficient to satisfy the due process clause of the Fourteenth Amendment.

The group affected by the ordinance creating the solar rights is neither overly broad nor overly narrow, but is a group of people who are similarly situated with respect to zoning regulations. Selecting a group on the basis of each member of the group owning property

79. Note, *Village of Belle Terre v. Boraas: A Sanctuary for the People,* 9 U. of S. Fran. L. Rev. 391 (1974); Note, *Boraas v. Village of Belle Terre: The New Equal Protection,* 72 Mich. L. Rev. 508 (1974); Recent Developments, *Equal Protection and Exclusionary Zoning: Boraas v. Village of Belle Terre,* 60 Va. L. Rev. 163 (1974).
80. Margolis, *Exclusionary Zoning: For Whom Does Belle Terre Toll?* 11 Calif. W. L. Rev. 85 (1974); Note, *Zoning: Village of Belle Terre v. Boraas–A Reaffirmation and Strengthening of the Police Power,* 4 Capital U. L. Rev. 156 (1974).

subject to the same zoning restrictions results in neither an invidious classification nor a suspect category. Therefore, creating solar rights among the member of such a group should not violate the equal protection clause of the Fourteenth Amendment.

A third constitutional problem is whether creation of solar rights is a taking of property without just compensation in violation of the fifth amendment.[81] The question of taking is really one of determining where the police power of the state ends and the power of eminent domain begins. Eminent domain requires just compensation while regulations which represent an exercise of the police power do not. The problems involved in distinguishing the two were summarized in *Harris v. U.S.*, in which the Tenth Circuit said, "A compensable taking under the federal constitution . . . is not capable of precise definition, and the adjudicated cases have steered a rather uneven course. . . ."[82]

Various tests have been suggested for distinguishing between regulation and taking. These range from "diminution of value."[83] to "fairness between the parties,"[84] but none of the theories has been able clearly to draw the line between the two. For example, consider diminution of value. In *Pennsylvania Coal Co. v. Mahon,*[85] Justice Holmes' opinion recognized that property values could be diminished by regulations that were valid exercises of the police power. In this particular case, the value of Pennsylvania Coal Co.'s mineral estate was reduced to zero by the regulation in question and such an extreme property value reduction was held to be a taking. In *Euclid*[86] however, a property value reduction of about 2/3 was upheld. The extent of the diminution in property values that will be tolerated under the police power seems to vary with time, place and circumstances.

Bosselmann, Callies, and Banta[87] have investigated the problem of taking. They discuss the wave of state land use legislation brought about by heightened ecological awareness on the part of the public and the legislature. It is evident from their discussion that the bounds

81. Note that the fifth amendment is a limitation on the federal government but can be used as a limitation on state government through the 14th amendment.

82. 205 F.2d 765, 767 (1953).

83. Michaelman, *Property, Utility, and Fairness: Comments on the Ethical Foundations of "Just Compensation" Law,* 80 Harv. L. Rev. 1165 (1967).

84. Olson, *The Role of "Fairness" in Establishing a Constitutional Theory of Taking,* 3 Urban Lawyer 440 (1971).

85. 260 U.S. 393 (1922).

86. 272 U.S. 365 (1926).

87. F. Bosselman, D. Callies, and J. Banta, *The Taking Issue,* Council on Environmental Quality, U.S. Govt. Print. Off., No. 4111-00017 (1973).

of regulation have been broadened when ecological issues are involved. The following quote aptly states the current trend:

> . . . Basically, we are drawing away from the nineteenth century idea that land's only function is to enable its owner to make money.
>
> This concern over the interrelatedness of land uses had led to a recognition of the need to deal with entire ecological systems rather than small segments of them. . . . Increasingly the question being asked is not only "Will this reduce the value of the surrounding land?" but "Will this make the best use of our land resources?"[88]

This statement advocates a systems analysis approach to land use planning which could provide the same benefits here as it has in the many scientific and technical fields to which it has been applied.

Consider how the creation of solar rights by means of zoning ordinances fits into the framework of the taking issue. Michaelman[89] has suggested four judicial theories that might be used for determining whether a particular limitation on property constitutes a taking of the property. These theories are: (A) physical invasion, (B) diminution of value, (C) balancing social gain against social loss and (D) private fault and public benefit. These theories provide a good starting point for analysis of the taking issue as applied to solar rights. Creation of solar rights results in no physical invasion of property, therefore theory A does not apply. Theory B deals with diminution of the value of the estate as a result of regulation. Solar rights zoning would require that a property owner give up part of his airspace estate, but he would receive a solar right in return. Solar rights are property, are similar to easements for light and air, and have value. Whether this trade enhances or diminishes the value of the property may be a matter of opinion at present, but any diminution of value that might occur as a result of such a trade is unlikely to be sufficient to permit classifying the trade as a taking. This is particularly true in light of the broad permissible regulation of matters affecting the ecology, and solar energy utilization has definite ecological consequences.

Theory C requires balancing social gain against social loss. The social gain takes two forms. First, solar energy is a pollution-free substitute for fossil fuels, and reduces the amount of oil and gas drilling, coal mining and fuel transportation required on a nationwide basis. In addition, solar energy utilization might decrease the need for gasification of coal from Western coal fields. Coal gasification

88. F. Bosselman and D. Callies, *The Quiet Revolution in Land Use Control,* Council on Environmental Quality (1971).

89. *Supra* note 83, at 1184, 1190, 1193, and 1196.

requires water as a chemical feedstock, and the water-poor Western states have little water to spare without taking it from agricultural use.[90] The second social gain is a potential reduction in the cost of keeping the populace warm and healthy in winter and cool and productive in summer, using a pollution-free energy source. The social loss consists of preventing a property owner from using his land in a manner that causes shading of his neighbor's collector. Surely the social gain is greater than the social loss. Theory D does not apply. If we use fairness between the parties as our test, no problem arises since creation of solar rights gives to and takes the same thing from each person. Each gives up part of his airspace estate in return for a solar right. This appears to be the fairest method possible for creation of solar rights.

Thus, using the zoning power to create solar rights is arguably within the police power of states and municipalities, and does not appear to constitute a taking. The government would be regulating the use of private property for the benefit of the community and the nation; it would not be taking private property for public use. Creation of solar rights by means of the zoning power does not appear to violate either the fifth nor the fourteenth amendment, though future case law in this area cannot be predicted with certainty.

Traditional Zoning Treatment of Light and Air

States usually delegate the zoning power to municipalities by means of legislation. Much of the zoning enabling legislation that has been passed specifically states that one of the purposes of zoning ordinances is to provide adequate light and air.[91] In *Euclid* the Court spoke of apartment houses ". . . interfering by their bulk with the free circulation of air and monopolizing the rays of the sun. . . ."[92] One of the purposes of zoning was still to provide adequate light and air in *Belle Terre* where the Court of Appeals said, "Traditionally, [a zoning ordinance] may be justified by showing that it is related to such matters as . . . adequacy of light and air. . . ."[93]

Despite the fact that adequate light and air is one generally

90. This problem has already come up with the coal gasification plant proposed by El Paso Natural Gas Co. in the Four Corners region of New Mexico (near Farmington). The Navajo Tribe is hesitant to divert water from agricultural use for coal gasification.

91. Examples of zoning enabling statutes that specify adequate light and air include: N.M. Stat. Ann. § 14-20-3(4) (Repl. 1968); Conn. Gen. Stat. Ann. § 8-2 (1958); Ga. Code Ann. § 69-802 (1933); Ill. Ann. Stat. ch. 24, § 11-13-1 (1961); Mass. Gen. Laws Ann. ch. 40A, § 3 (1968); N.Y. Gen. City Law, art. 2A, § 20-24; Texas Rev. Civ. Stat. art. 1011C (1963), etc.

92. 272 U.S. at 394 (1926).

93. 476 F.2d at 812 (1973).

accepted reason for zoning regulations, zoning litigation dealing directly with adequate light and air is rare. Usually, light and air requirements are used as part of the justification for zoning regulations specifying maximum building heights,[94] building setbacks[95] or lot frontage.[96] For this reason, litigation over light and air usually involves violation of a height or setback regulation.[97] The situation was well stated by the court in *Taliafero v. Salyer,* "in the exercise of police power, a local government can impose restrictions on the maximum height of buildings for the purpose of securing adequate sunlight to promote public health in general."[98]

The American public is accustomed to zoning for light and air; however, creation of solar rights goes much further than traditional light and air zoning regulations. The traditional concern over light has been associated with visual and esthetic considerations. We are concerned with solar rights for heating and cooling. The purpose of this discussion is not to place solar rights in the same position in the zoning hierarchy as light and air but to demonstrate that there is established precedent for light and air zoning which should serve as a precursor for acceptance of the concept of solar rights.

Solar Rights and the Newer Land Use Tools

In a recent talk on land use law and its effect on solar energy, Prof. Haar stated that,

> . . . there's going to be a tremendous need for revision of the legal system soon. That is, if we are serious about the economy and the need to find new forms of energy such as solar, the legal policies and institutions are going to have to be considerably reshaped and revamped. . . .[99]

Some work has been done on defining legal and governmental areas in which change is necessary if solar energy use is to increase,[100] and the problem of solar rights is included among the problem areas.

The previous discussion showed that solar rights are similar to

94. Annot., 8 A.L.R. 963 (1949).

95. Annot., 93 A.L.R.2d 1223 (1964).

96. Annot., 96 A.L.R.2d 1367 (1964).

97. *See, e.g.,* City of Cleveland Mississippi v. Young, 236 Miss. 632, 111 So.2d 29 (1959); San Lan Builders Inc. v. Baxendale, 28 N.J. 148, 145 A.2d 457 (1958); LaSalle Nat'l. Bank of Chicago v. City of Chicago, 5 Ill.2d 344, 125 N.E.2d 609 (1955).

98. 162 Cal. App.2d 685, 328 P.2d 799, 802 (1958).

99. C. Haar, *Innovative Land Use Laws,* Proceedings of the Workshop on Solar Energy and the Law 22 (1975).

100. W. Thomas and R. Robbins, *Solar Energy and the Law,* Extended Abstracts of the 1975 Meeting of the International Solar Energy Society 25 (1975).

rights to light and air, but are not identical. There are similarities between solar rights and some new land use tools such as zoning with compensation, contract zoning, and transferable development rights.

Zoning with compensation combines the police power with eminent domain and provides compensation to landowners who have been damaged by land use restrictions.[101] This type of zoning has generally been upheld,[102] and is most useful when the question of regulation or taking is a close one. Since creation of solar rights by zoning is not a taking, zoning with compensation is not particularly relevant to our discussion. If special situations arise in which creation of solar rights begins to look like a taking, zoning with compensation may provide a valid solution to the problem.

Contract zoning describes a situation in which the landowner enters into a contract with another party (often the municipality) and promises to place certain restrictions upon the use of his land in return for a promise that is of benefit to him, such as rezoning of the land by the municipality.[103] Contract zoning generally arises when a landowner gives consideration to the municipality in return for rezoning of the landowner's land. The consideration given may be land for a school[104] or a park,[105] or a promise to limit the use to which the rezoned land will be put.[106] When a municipality was a party to a contract, the contract has been held void for the reason stated in *Hartnett v. Austin;* "[A] municipality has no authority to enter into a private contract with a property owner for amendment of a zoning ordinance. . . . A municipality cannot contract away exercise of its police power."[107]

A zoning contract to which a governmental unit is not party is generally held valid. *State ex rel Zupancic v. Schimenz* illustrates this premise.[108] There building developers were trying to get a zoning change in order to construct a shopping center. The residents of the area were in favor of the developers building a bowling alley, but not

101. Annot., 41 A.L.R.3d 636 (1972).

102. City of Kansas City v. Kindle, 446 S.W.2d 807 (Mo. 1969); Williams v. Parker, 188 U.S. 491 (1903); State v. Houghton, 144 Minn. 1, 176 N.W. 159 (1920).

103. S. Fishman, *The Contract Zoning Method and Public Policy,* 1972 Urban L. Annual 219; Note, *Contract and Conditional Zoning, A Tool for Zoning Flexibility,* 23 Hastings L.J. 825 (1972).

104. Midtown Properties Inc. v. Madison Township, 68 N.J. Super. 197, 172 A.2d 40 (1961).

105. City of Knoxville v. Ambrister, 196 Tenn. 1, 263 S.W.2d 528 (1953).

106. Oury v. Greany, 107 R.I. 427, 267 A.2d 700 (1970); Baylis v. City of Baltimore, 219 Md. 164, 148 A.2d 429 (1959); Cederberg v. City of Rockford, 8 Ill. App.3d 984, 291 N.E.2d 249 (1973).

107. 93 So.2d 86, 89 (Fla. 1956).

108. 46 Wis.2d 22, 174 N.W.2d 533 (1970).

a complete shopping center. The builder agreed to this and placed a limitation in his deed that the property not be used for businesses other than a bowling alley. The neighbors stopped objecting, and the city zoned the land for neighborhood business. Business use of the land was limited to a bowling alley by virtue of the private agreement between the builder and the neighbors. Enforcement of the agreement was up to the city.[109]

The creation of solar rights is similar to the situation in this case. Under a solar rights zoning regulation, each landowner would give up certain property rights in return for others, with enforcement by the municipality. There would be no written agreement between the parties since the parties involved would be given no choice. If solar rights were created by contract between private parties, there would exist mutual easements or equitable servitudes, enforceable by the courts and not by an administrative arm of the local government. Thus, while solar rights are analagous to some present legal doctrines, they do not fit any of them exactly. The solar right would be a new creature of the law.

The necessity of providing access to solar energy is being recognized by some progressive municipal planning departments. The Comprehensive Zoning Plan for the City of Albuquerque and Bernalillo County, New Mexico, states:

> Tall or massive structures which would dominate their environment shall be located in urban centers to provide visual variety and functional diversity while preserving pleasing vistas and *solar access.*[110]

Implementing access to solar energy is a difficult matter, and as a start the Albuquerque Planning Department will use height regulations. Among changes to the zoning code recommended by the Planning Commission is the following for high density residential, office, and commercial zones:

> Height. Structure height up to 26 feet is permitted at any legal location. The height and width of the structure over 26 feet shall fall within 45-degree-angle planes drawn from the horizontal at the mean grade along each internal boundary of the premises and each adjacent public right-of-way centerline. *To protect solar access,* a structure over 26 feet may not exceed the northern boundary of these

109. The agreement was held valid by the court which said: "We do not consider the declaration of restrictions, which only the city can enforce, makes the city a party to the contract; at most, the city is a third-party beneficiary protecting the public interest." 174 N.W.2d at 539.

110. Albuquerque/Bernalillo County Comprehensive Plan; Policies Plan, Dec., 1974. Adopted in 1975 by the City and County Planning Department. Available from the Planning Dept., City of Albuquerque, P.O. Box 1293 (emphasis added).

45-degree planes drawn at a 60-degree angle from the same boundaries or centerline.[111]

Figure 2 illustrates the locations of the planes defined above.

This approach is conventional in that regulating the height of buildings by zoning ordinances has long been acceptable. It is new in its recognition of the necessity for access to solar energy. The solar rights concept is a more effective way of guaranteeing access to solar energy, but is probably less acceptable to the public at present than a plan based on height regulation. The Albuquerque Planning Department recognizes that height regulation is merely the first step in ensuring a landowner's access to solar energy.[112]

Summary and Conclusions

Neither our zoning tradition nor our modern land use concepts exclude solar rights; instead they indicate a conceptual accord with such rights. Environmental considerations dictate zoning ordinances favoring solar energy utilization.

While zoning appears to provide a valid means for creating solar rights, this should be done in such a manner as to minimize social and political opposition. The next two sections of the paper deal with these problems.

DESIRED CHARACTERISTICS OF SOLAR RIGHTS

Zoning is a desirable and legally appropriate tool for creating solar rights. These rights must be created in such a way that they are acceptable to society, or they may become meaningless in a practical sense. Acceptability lies in minimizing the inconvenience to the neighbors of a solar collector owner, while guaranteeing the collector owner all of the solar energy he can use.

Up to now solar rights have been defined as simply the right to the solar energy that would fall on one's property if the path of the sunshine were not impeded by one's neighbors. That definition must be limited to gain greater social acceptability for the solar rights concept. Several practical limitations that can be placed on solar rights will now be discussed. Those presented in this section are based on public policy and law. Those in the following section are based on engineering and technical considerations.

Even countries which recognize the doctrine of ancient lights no

111. Changes to the Comprehensive Zoning Code recommended by the City of Albuquerque Planning Commission, Aug. 14, 1975, p. 5 (emphasis added).

112. Personal communication with Mr. Don Peterson of the Albuquerque Planning Department.

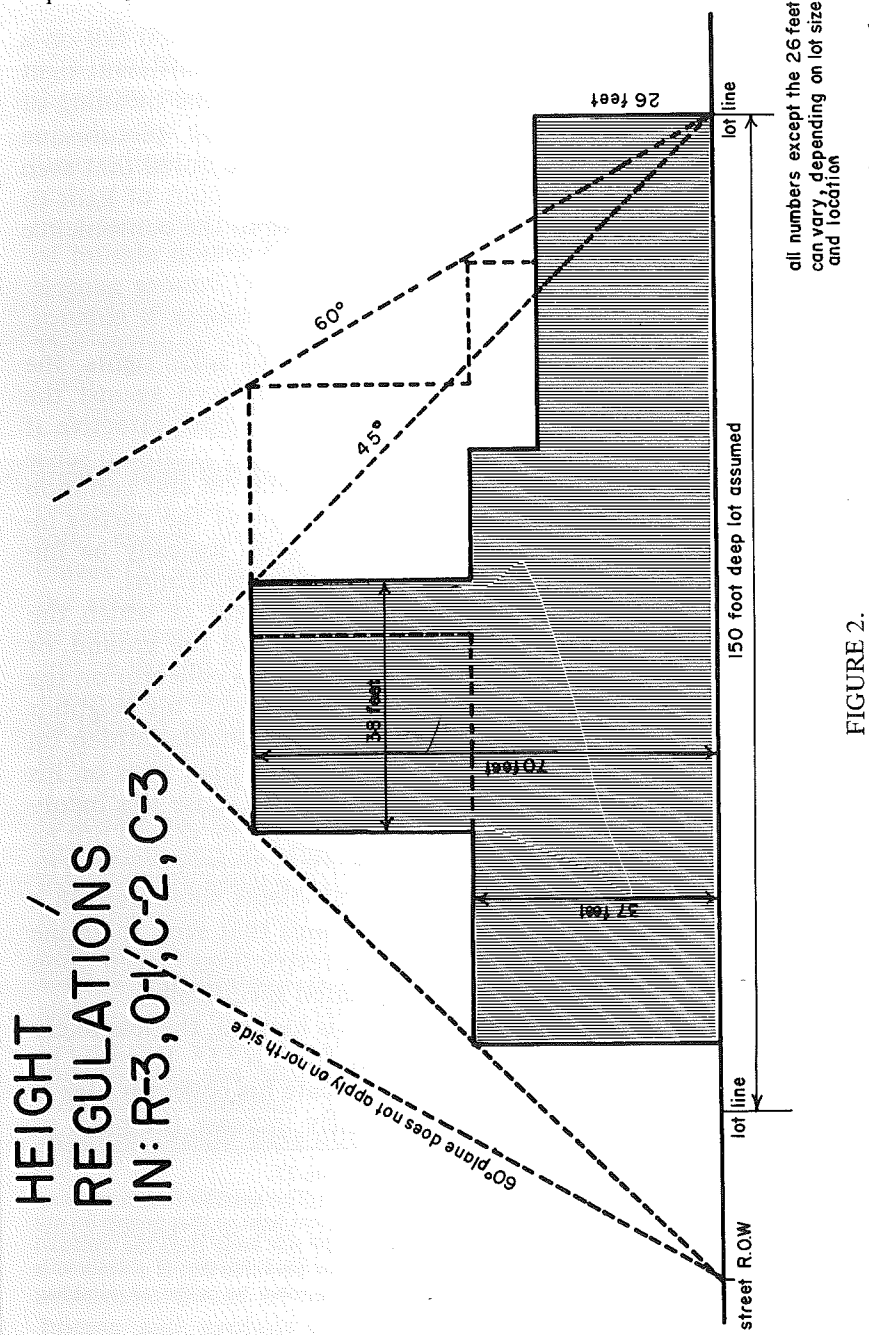

FIGURE 2.
Sketch showing the height regulations recommended by the Albuquerque Planning Dept. for protection of access to solar energy.

longer give an absolute right to all of the light that would fall on a window. In modern England the doctrine guarantees sufficient light in only part of the room under consideration.[113] The meaning of sufficient has been questioned, resulting in some picturesque tests.[114] For purposes of this paper, it only need be noted that even where the doctrine of ancient lights is law, the amount of light to which a person is entitled is limited in deference to the convenience of his neighbors.

The Requirement of Reasonableness

To gain social acceptability for the creation of solar rights, the need of one party for solar energy must be balanced against the inconvenience to his neighbor. This balancing is more effective if both parties act in a spirit of cooperation and apply common sense to their mutual problem. Unfortunately, cooperation and common sense do not always characterize the relationships of the parties involved. Therefore, those limitations which should logically be imposed on solar rights should be included in zoning regulations.

The first consideration has to do with the height at which the collector is located. It can be placed on the roof, on the ground, or anywhere in between. If a collector owner places his collector on the ground near his south property boundary and expects his neighbor not to shade the collector, he is placing an unreasonable burden on his neighbor, since the collector owner could find other sites on his property that would accommodate a collector but cause less inconvenience. The right of the collector owner to sunshine should not be protected if the site selected for the collector is unreasonable. The words reasonable and unreasonable create problems when used in a legal sense, as evidenced by the number of cases that seek to define the mythical reasonable man. Therefore, the restrictions placed upon solar rights in the name of reason must be stated specifically.

Generally speaking, the higher a collector is located, the less likely it is that a neighbor will block solar energy from it.[115] It would be reasonable to expect a collector owner to locate his collector high if this did not inconvenience him or significantly increase the price of

113. For a discussion of the modern doctrine see *supra,* note 27.

114. The "grumble line" test is discussed *supra,* note 27. The grumble line is an imaginary line in a room. On one side of that line, there is sufficient light so that people do not grumble about a lack of light. On the other side of the line (the side away from the window) people grumble about the lack of light. At present, the law provides that if a window is protected by the doctrine of ancient lights, at least half the room be in the ungrumbling category.

115. For example, if a collector is located at an elevation higher than the neighbor's trees, it cannot be shaded by those trees.

his collector. The logical high location for a collector is on the roof of a building. The zoning ordinance creating the solar right should therefore provide that the lowest point of the flat plate collector for which solar energy is guaranteed is 10 feet above the level of the highest floor in the house. Provisions should also be made to have this restriction subject to a variance process since the restriction may not be reasonable in a limited number of cases. For example, in the case of hillside homes it may be reasonable to place the collector on the sloping ground. Also, the 10-foot height restriction may be unreasonable if applied to buildings having unconventional architecture. The variance procedure would provide some recourse in unusual cases.

Collectors should be placed on the south facing part of the roof for practical reasons, and the area of this part of the roof may be greater than the collector area. If it is, the collector owner should be required to locate his collector so that he receives the quantity of solar energy consistent with his need which simultaneously minimizes the inconvenience to his neighbors. In areas developed before the creation of solar rights, the question of collector placement can be important. It is possible that some south facing areas of the roof will be shaded by a neighbor's building or trees, while others will not. From the point of view of the collector owner, the collector should be located so the length of the pipes going to and from the collector is at a minimum. If the neighbor happens to shade the collector when it is in this optimum location, the collector owner should be required to locate his collector at an unshaded site on his roof provided such a site exists and locating the collector there does not cause the collector owner substantial additional expense. Thus, when the collector is being sited initially, if a neighbor can be accommodated at a reasonable cost, the collector owner should be required to do so, since such a requirement is reasonable. After the collector has been installed, however, the collector owner should be protected from shading by the neighbor. If the neighbor causes shading subsequent to installation, the shading source would have to be removed at the neighbor's expense. This is a reasonable requirement since the neighbor would have notice of the collector location prior to shading it.

Newly developing areas could use the same limitations, though it is anticipated that less disagreement will be generated in these areas by creation of solar rights. People building or landscaping in new areas would be aware of solar rights and would presumably arrange their homes and gardens so they would not interfere with a neighbor's solar rights. In new areas, all homeowners would have notice of their

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neighbor's solar rights before any structure was built, unlike areas developed before the creation of solar rights.

Areas in Which Solar Rights are Not Created

Some areas of municipalities are not amenable to the solar rights concept. The prime example would be a downtown area zoned for high rise buildings. While it might be possible to guarantee solar rights for collectors located at or above the maximum building height permitted for the area, the roof area available for solar collectors in a high rise building is small compared to the volume of the building to be heated or cooled. And while the south vertical wall of a high rise might be utilized as a solar collector, guaranteeing such use where the neighboring property is also zoned for high rise buildings is not only unreasonable but probably amounts to taking of property without compensation.

Areas in which solar rights cannot or should not be created will differ from one municipality to another. Lack of solar zoning in a high rise area does not prevent a building owner from obtaining a solar guarantee by acquiring easements for light and air or by means of legal tools discussed earlier.

Structures in Existence Before the Solar Rights were Created

When an area is zoned for the first time, there are property parcels whose use does not conform to the zoning ordinance. Such a prior nonconforming use has been defined as a "use which not only does not conform to the general regulation or restriction governing a zoned area but which lawfully existed at the time that the regulation or restriction went into effect and has continued to exist without legal abandonment since that time."[116] Passage of the zoning ordinance does not mean that owners having property with prior nonconforming uses must immediately comply with the ordinance. Such a requirement would amount to a taking of property without compensation. At the same time, a nonconforming use is not expected to last forever but is expected to conform with the ordinance.[117] The length of time for which the nonconforming use will be permitted is often determined by the zoning board.

Permitting a prior nonconforming use to exist for a predetermined period of time is called amortization of a nonconforming use. The majority of jurisdictions have held the concept of amortization of

116. Kirsch Holding Co. v. Borough of Manasquan, 111 N.J. Super. 359, 682 A.2d 333, 338 (1970).

117. *See* City of Los Angeles v. Gage, 127 Cal. App.2d 442, 274, P.2d 34, 44 (1954).

nonconforming uses constitutional,[118] although at least three states consider it a taking.[119] Amortization situations must be considered individually to determine whether the length of time permitted before conformance is required is long enough to prevent conformance from being a taking. A number of recent cases have formulated tests to determine whether an amortization is a taking. In *HFH Ltd. v. Superior Court for County of Los Angeles,*[120] it was determined that the amortization period should be commensurate with the investment involved. *State v. Joyner*[121] required that the time allowed for nonconforming use be reasonable, while several cases have balanced public gain against private loss.[122]

The tests developed for handling prior nonconforming uses can readily be applied to solar rights which are created by a zoning ordinance. Consider the case where a building shades its neighbor for all or part of the day. A solar zoning ordinance is passed creating solar rights for both the building owner and the shaded neighbor. Applying past zoning practices, the building causing the shading would be granted a nonconforming use and the owner of the shaded lot would be denied his solar right. For how long should the nonconforming use last? Using the test that requires the time period to be commensurate with the investment, the nonconforming use would have to be perpetual since the party whose land is shaded has made no investment in solar equipment. However, a perpetual nonconforming use defeats the purpose of zoning. The tests of reasonableness and weighing public gain against private loss are more appropriately applied to solar rights. Under either test, the financial burden of tearing down the nonconforming building can be weighed against the financial benefit of the solar right.

118. The question of amortization of nonconforming uses has stimulated a number of law review articles. Among the recent ones are Comment, *Amortization of Nonconforming Uses in Pennsylvania: A Possible Remedy for a Zoning Headache,* 79 Dick. L. Rev. 235 (1974); Smith, *A Survey: The Nonconforming Use in North Carolina,* 10 Wake Forest L. Rev. 597 (1974); Comment, *Amortization of Nonconforming Uses,* 7 Wake Forest L. Rev. 255 (1971); Note, *Nonconforming Uses in Iowa, The Amortization Answer,* 55 Iowa L. Rev. 998 (1970). These consider amortization as constitutional.

119. Michigan held that amortization was a taking in Demull v. City of Lowell, 368 Mich. 242, 118 N.W.2d 232 (1962). Ohio has so held in City of Akron v. Chapman, 160 Ohio St. 382, 116 N.E.2d 697 (1953), and Missouri followed in Hoffman v. Kinealy, 389 S.W.2d 745 (Mo. 1965).

120. 41 Cal. App.3d 908, 116 Cal. Rptr. 436 (1974).

121. 286 N.C. 366, 211 S.E.2d 320, 325 (1975).

122. Gough v. Board of Zoning Appeals for Calvert City, 21 Md. App. 697, 321 A.2d 315 (1974); City of Los Angeles v. Gage, 127 Cal. App.2d 442, 274 P.2d (1954); City of University Park v. Benners, 485 S.W.2d 773 (Tex. 1972); Grant v. Mayor and City Council of Baltimore, 212 Md. 301, 129 A.2d 363, 369 (1957). A number of cases on this subject have been summarized in Annot., 22 A.L.R.3d 1134 (1968).

The value of a solar right depends upon the price of energy. On the present energy market in Albuquerque, solar rights in areas which have natural gas service are practically worthless, since gas heating is cheaper. In some suburban and rural areas where natural gas is not available, heating must be done by liquified petroleum gases or electricity, and solar rights have value since solar energy is competitive with these energy forms.[123] Thus, the value of a solar right depends upon both time and location. In order to determine the longevity of the nonconforming use, the value of the solar right must be compared with the loss sustained by the owner of a nonconforming building. In areas where solar rights are practically valueless, a nonconforming building would be permitted to block the sun until the building could no longer be used. When the nonconforming building was replaced, however, the replacement building would have to conform with the solar zoning ordinance. In this way, all nonconforming uses would eventually be eliminated. In areas where solar energy is competitive with other types of energy, a nonconforming building might remain for a shorter period of time. In the near future, it would appear that the loss entailed by removal of all or part of a structure will be far more than the value of the solar right, and the nonconforming buildings will probably remain for at least the next twenty years.

Necessity for Determining the Value of Solar Rights

The discussion of prior nonconforming uses shows that the value of a solar right must be considered in determining the duration of a nonconforming use. Other situations arise in which the solar right will be severed from the rest of the property and sold.

To illustrate when a solar right might be sold, suppose that a building is blocking the sun from a neighbor and the building owner wishes to enlarge his building. The addition would be such that if the original building were removed, the addition would continue to block the sun. The general rule in zoning cases is that a landowner who has a nonconforming use cannot extend or expand that nonconforming use.[124] In the present case, the neighbor would receive her solar right either when the nonconforming use had been amortized or when the original building was no longer usable. If the

123. Private communication with Mr. Steve Baer, president of Zomeworks, Inc., of Albuquerque, New Mexico.

124. Smith, *A Survey: The Nonconforming Use in N.C.*, 10 Wake Forest L. Rev. 597, 609 (1974); Note, *Nonconforming Uses in Iowa: The Amortization Answer*, 55 Iowa L. Rev. 998, 1007 (1970); Werner v. Board of Appeals of Harwich, 318 N.E.2d 483 (Mass. App. 1974).

building owner is permitted to expand his nonconforming use, the date on which the neighbor will receive her solar right is pushed back since the building owner would be entitled to a longer amortization period by virtue of his added investment. Adding to the nonconforming period in this manner would not be unreasonable, and the general rule of not permitting expansion of nonconforming uses should be applied to solar rights. The building owner, however, has an option. He could purchase his neighbor's solar right. By so doing, his use would cease to be nonconforming since the neighbor no longer would have a right to the solar energy. He could then construct his building addition. This example shows an important difference between a nonconforming building where only solar rights are involved and a building that does not conform to a more general zoning ordinance. In the case of solar rights, nonconformance occurs only if the collector of a neighbor is shaded. This two-party problem can be resolved by one party buying the solar rights of the other. The party being shaded is not obligated to sell his solar rights, but if meaningful negotiations are to take place between the parties each must have some idea of the value of a solar right.

It is not the purpose of this paper to investigate methods for evaluating solar rights. This value will depend upon time and place among other things.[125]

Possible Effect of Zoning Variance on Solar Rights

Zoning ordinances usually provide that the zoning board can permit some parties to use their property in a manner not consistent with the ordinance. This is called a variance. Grounds for obtaining a variance generally are based upon unusual or unnecessary hardship, some condition peculiar to the land, or a showing that the proposed use will benefit the neighborhood.[126] The variance process is one method used to introduce flexibility into zoning plans and has been found to be necessary to those plans. The subject of zoning variances is an extensive one, but only a relatively narrow area in which zoning variances and solar rights interact is of interest here.

Assume that a variance has been granted to a party. In the course of exercising the variance, she shades a neighbor's solar collector. The collector owner is entitled to compensation for both the value of his solar right and the loss that he sustained in his investment for solar

125. Methods of evaluating solar rights is a topic that is ripe for investigation.

126. Grounds for granting variances are listed in Note, *Variance Administration in Indiana—Problems and Remedies*, 48 Ind. L.J. 240, 242 (1972). The manner in which a comprehensive area plan becomes a consideration in granting a variance is discussed in Annot., 40 A.L.R.3d 372 (1971).

equipment. If the neighbor being shaded has no collectors, he is still entitled to compensation for the value of his solar right.

The more difficult question is whether the party being shaded can prevent the variance owner from exercising the variance if such an exercise would diminish his solar right. In granting a zoning variance the relevant administrative body (or the court, if the administrative decision is appealed) considers the advantages and disadvantages of the variance. One disadvantage to be considered is the fact that exercise of the variance would diminish a neighbor's solar right. The shaded neighbor should not be permitted to prevent the exercise of the variance after it has been properly granted. If he could prevent exercise of the variance, much of the flexibility that comes from the variance process would be lost and general zoning plans might become too rigid.

The fact that a solar right is being diminished by allowing a variance would be accounted for in two ways. First, it would become one of the factors considered in determining whether or not to grant the variance. In addition, it would make the variance less valuable since the owner of the variance would have to compensate any neighbors whose solar rights were diminished. Compensation would be limited to the extent that the solar rights were diminished plus any losses due to unusable solar equipment. Thus, the injured party would receive monetary compensation but he could not obtain an injunction. If the shader and shadee could not agree on the value of the solar right and equipment, the value determination would have to be made by an administrative agency or a court. Once again it becomes important to have a sound method for determining the value of solar rights.

Trees and Shrubbery

Shading of solar collectors by trees and shrubbery may be the problem most frequently encountered when solar heating and cooling becomes widespread. A landowner may do his best to accommodate his neighbor and be in full compliance with the requirement of reasonableness, yet have no reasonable site for his collector that is not shaded by his neighbor's trees. If the trees were in existence before the solar zoning ordinance was passed, they are prior nonconforming uses.

The test for prior nonconforming uses can be applied here, with results that are bleak for maintaining the trees. If the investment of a neighbor in his tree is considered, it is generally not large enough to justify loss of a solar right. If public gain is weighed against private loss, the public is gaining a reduction in fossil fuel use at the cost of

the loss of a tree to an individual. On the other hand, the removal of a tree results in an esthetic loss to the public and the individual. This test balances a reduction in the consumption of a nonreplacable natural resource (fossil fuel) against the removal of a replacable resource. Usually another tree can be planted in a location that does not interfere with a neighbor's collector. While the authors are not insensitive to esthetic and ecological arguments in favor of trees, the need for an ecologically sound energy source dominates this question.

The question of whether destruction of trees is a taking was treated by the Supreme Court in the case of *Miller v. Schoene*.[127] That case involved two diseased cedar trees which officials ordered destroyed under the Cedar Rust Act of Virginia. While this rust did not adversely affect the cedar trees, it damaged the fruit and foliage of apple trees. The State saw fit to protect the apple crop at the expense of the cedar trees. The Court held that the Cedar Rust Act was within the regulatory power of the State and the State was not required to compensate the owners of the cedar trees. The State was required to pay the cost of removing the trees, however. By analogy to *Miller v. Schoene*, it would seem reasonable to expect the solar collector owner to pay for removal of any of his neighbor's trees that shade his collector, since the collector owner derives a benefit from the removal while the neighbor does not.

TRADEOFFS

In previous sections of this paper, a solar right has been defined as giving a landowner the right to all of the solar energy that falls upon his land. The requirement of reasonableness modified this definition so that the landowner had a right only to the solar energy that he could use beneficially without unduly burdening a neighbor. In the present section, the possibility of reducing the solar right even further will be examined. As the amount of solar energy guaranteed diminishes, the law concerning solar rights comes closer to present property law concepts and public resistance to the new concept diminishes. Perhaps an example can clarify this. Suppose *A* has three trees on his land which shade the solar collector of *B*. Assume that tree 1 shades part of the collector for only 20 minutes in the morning (near sunrise) while trees 2 and 3 shade most of the collector for most of the day. Obviously trees 2 and 3 must be removed if *B's* collector is to function, but should *A* be required to cut down tree

127. 276 U.S. 272 (1928).

1? If *A* is not required to cut tree 1, he may find the solar right concept more agreeable than if he had to cut down all three trees. If the solar zoning ordinance is written so that *A* is not required to cut tree 1, the ordinance is trading off a small part of *B's* solar right in return for *A's* approval (or diminished approval) of the solar right concept.

The classical problem of a tradeoff situation is to determine how much of one desirable thing to trade for another. Here part of a solar right is being traded for public approval. Enough of the solar right must be traded to ensure that the required ordinances will be enacted, but not so much that the cost of solar heating and cooling systems becomes prohibitive. Addressing the tradeoff problem requires leaving the realm of concepts and applying a quantitative treatment to the problem. The requirement of reasonableness does not cause a landowner to part with any of the solar energy he can use and is therefore not a tradeoff device. That requirement is concerned only with siting the solar collectors. In this section, solar energy will be traded for public approval.

Solar Heating Systems

The starting point for the tradeoff analysis is a discussion of some technical aspects of solar heating. The dashed line in Figure 3 labeled "Average Temperature" shows the average outside temperature in Albuquerque for each day of the year.[128] The greatest heating requirement occurs during the first week of January.

The amount of solar energy that strikes a square foot of collector surface depends upon the collector angle, the time of day, and the time of year. The sketch at the top of Figure 3, defines the collector angle as the angle between the collector and the horizontal. Several other terms that will be used are also defined in Figure 4. In the winter at Albuquerque the sun will rise in the southeast and set in the southwest. The points of sunrise and sunset, as well as the path followed by the sun between sunrise and sunset, will change slightly from day to day. The collector in Figure 4 is shown facing due south, and the maximum solar intensity would be expected at noon. The figure shows it would be advantageous to have the collector move so that its surface would always be perpendicular to the sun's rays. Though devices are available for doing this, their cost is prohibitive, so this article will deal only with flat plate collectors having a fixed position.

The family of solid curves in Figure 3 shows the amount of solar

128. This data came from the Albuquerque Office of the U.S. Weather Bureau.

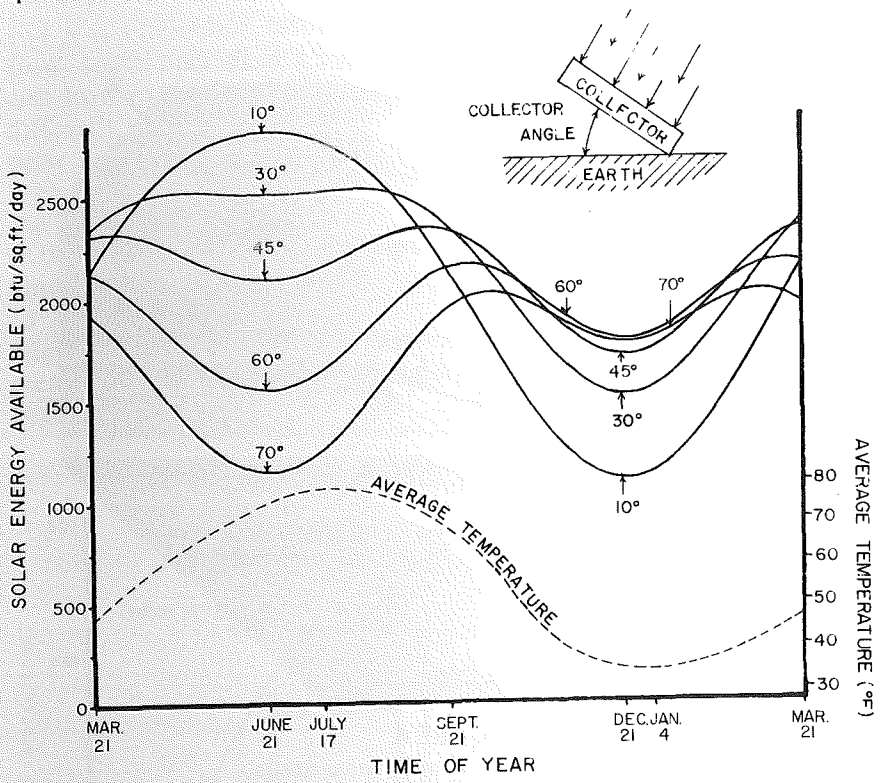

FIGURE 3.

Relationship between solar energy availability, collector angle, and time of year. The average temperature curve indicates that the design day for heating is January 4 while the cooling design day is July 17.

energy striking a square foot of collector surface during a full day. This is the quantity of solar energy available to the collector and depends upon the collector angle. The figure shows that the available solar energy varies considerably with the seasons.[129] The design heating day is January 4. The best collector angle on that day is 60 degrees, according to Figure 3, which also shows that this is a reasonable angle during the entire heating season. Thus, we will assume that we are dealing with a collector having a design collector angle of 60 degrees.

129. The data of Figure 3 is valid only at the latitude of Albuquerque, New Mexico. A similar set of curves can be generated from other latitudes. It is stressed that the data given in this section is applicable only to local conditions in Albuquerque. The same methods, however, are applicable to any terrestrial location. The data in Figure 3 assumes that no clouds block the solar energy, and that the transmissivity of one atmosphere is 0.8 under local conditions (low concentration of water vapor in the air and no smog).

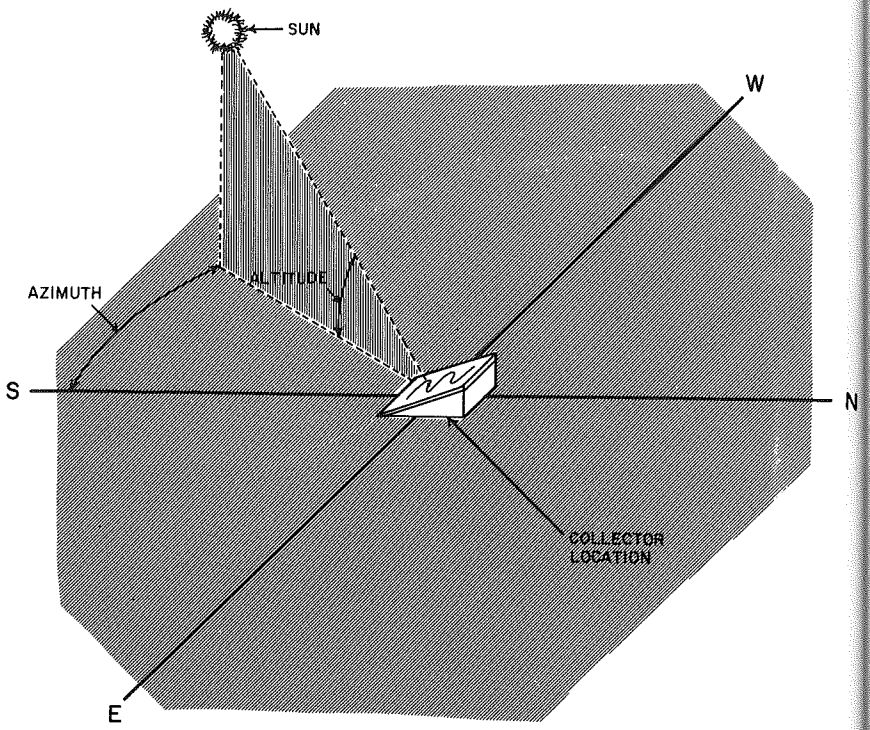

FIGURE 4.
Sketch defining azimuth and altitude.

Figure 5 shows the solar energy available to a collector with a 60-degree collector angle on January 4, as a function of the time of day. Azimuth and altitude are also shown (these are defined in Figure 4). Note that the azimuth angle is zero when the sun is due south of the collector. This occurs at noon. The total amount of energy available during the entire day is measured by the area under the curve in Figure 5. This area has been divided into a number of smaller areas, each representing five per cent of the total area. An understanding of Figures 3, 4, and 5 permits discussion of the first possible tradeoff. Figure 5 shows that the first five per cent of the energy striking the collector in the morning takes one hour and 23 minutes, during which time the sun travels through an azimuth angle of 13.9 degrees. The same is true of the last five per cent in the evening since Figure 5 is symmetric. By contrast, around noontime five per cent of the energy arrives in the 17 minutes during which the sun moves through an azimuth angle of 4.15 degrees.

In accordance with the tradeoff concept, if A is a collector owner

and B is a neighbor, assume that B will be permitted to block the sun from some part of A's collector. Where should the blockage occur and how extensive should it be? The interests of A and B are quite different. A has made an investment which enables him to collect solar energy. If B is permitted to block part of A's collector, the logical measure of how much B is blocking, from A's point of view, is the amount of energy that A is losing due to B's blocking. Thus, if B is to be permitted to block part of A's sunshine, the measure of the amount blocked should be some fraction of the total energy available to A. On the other hand, B may want to block as large an azimuth angle as possible, since the inconvenience to him can reasonably be measured by the azimuth angle he is prohibited from blocking. Figure 5 shows a large angle can be blocked with small resulting

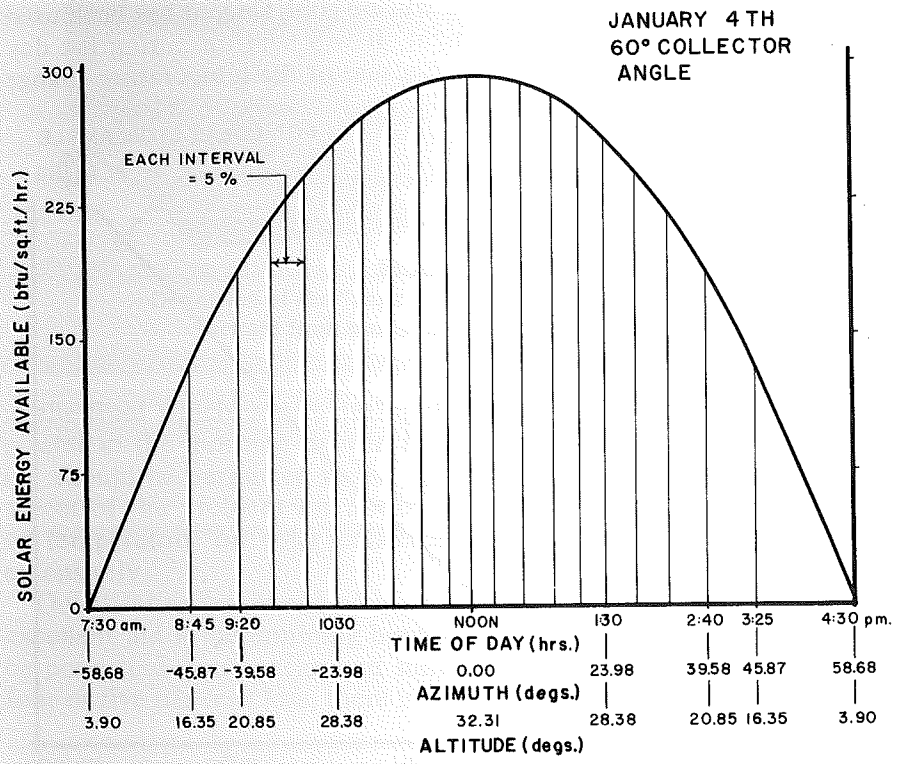

FIGURE 5.
Relationship between the amount of solar energy striking a collector and the time of day. This figure assumes a 60° collector angle, and is valid only for the heating design day. Each area division represents 5% of the total solar energy available.

energy loss if the collector is blocked shortly after sunrise or shortly before sunset. This effect is shown quantitatively in Figure 6. The quantity called "angle shaded" is defined in Figure 7. This angle is measured from sunrise. Because of the symmetry of the solar day, the curve of Figure 6 would be the same if the angle shaded were measured from sunset (see Figure 7). The data in Figure 6 show that if *A* is deprived of 10 per cent of his available solar energy (five per cent immediately after sunrise and five per cent immediately before sunset), *B* will be permitted to block a total angle of 27.8 degrees. On January 4 the total angular travel of the sun is 117.36 degrees, therefore a 10 per cent energy loss permits blocking during 23.6 per cent of the total azimuth angle traversed by the sun.

This discussion implies that shading after sunrise and before sunset have the same effect. This is not strictly true. In the morning the working fluid of the solar system will be cool, since it has been used to heat a building through the night. It will heat up during the day and be hottest just before sunset. Because of the temperature change

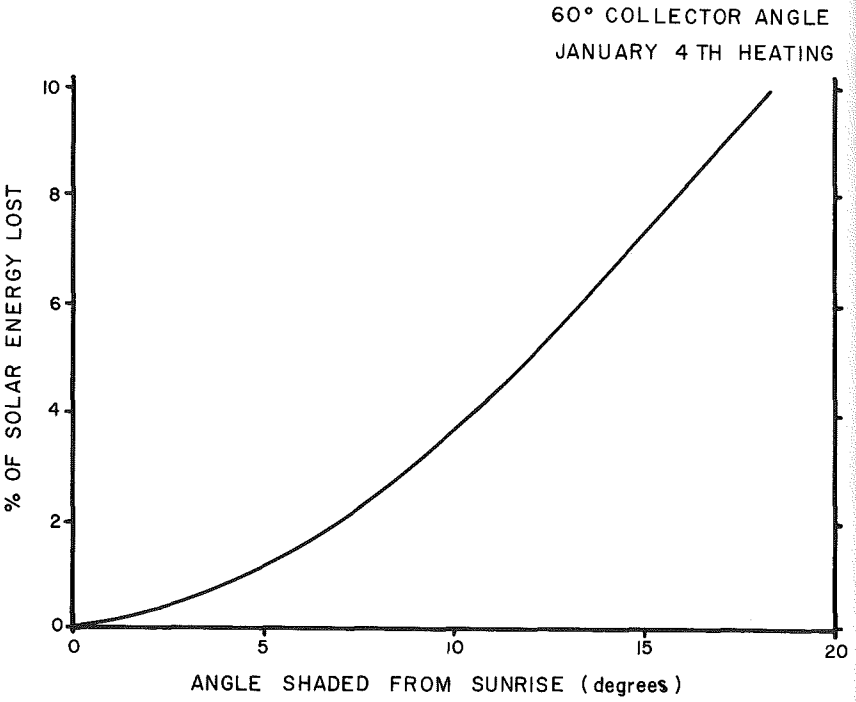

FIGURE 6.
The relationship between the amount of solar energy lost and the size of the angle shaded.

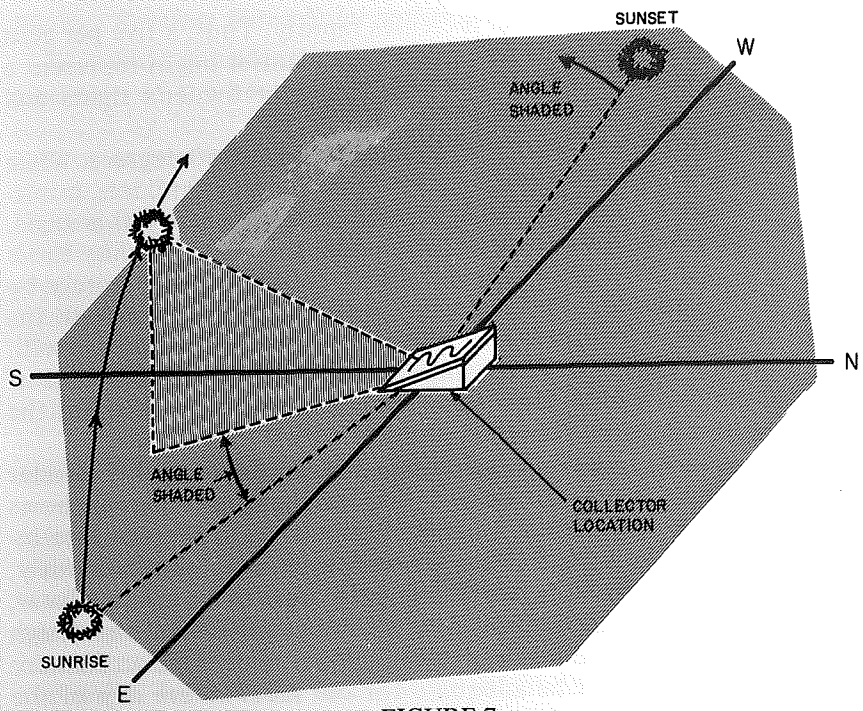

FIGURE 7.
Definition of the "angle shaded." The angle is measured forward from sunrise or backward from sunset.

in the fluid which occurs during the day, collector efficiency will be greater in the morning than in the afternoon.[130] Thus, more blocking should be permitted in the afternoon than in the morning. This aspect of the problem will not be pursued further, because the effect of temperature on solar collector efficiency has been investigated extensively.[131]

Quantitative treatment of the tradeoff problem makes Figure 6 an excellent aid in determining how much solar energy blocking should be permitted near sunrise and sunset. The figure shows that below a four or five per cent loss, there is a large shaded angle for a small loss,

130. This change in efficiency is one of the consequences of the Second Law of Thermodynamics. The theory of the Second Law will not be discussed here, and readers lacking a technical background will have to accept the efficiency change on faith.

131. *See, e.g.*, Tester, Mayer, and Fraas, *Comparative Performance Characteristics of Cylindrical Parabolic and Flat Plate Solar Energy Collectors*, ASME Paper No. 74-WA/Ener-3 (1974), Figure 8. Extensive discussion is also given in Extended Abstracts of the 1975 International Solar Energy Society Meeting, § § 32 and 33 (1975).

though the loss rate thereafter increases rapidly. Thus, a five per cent loss near sunrise and the same amount near sunset might represent a reasonable tradeoff between the solar collector owner's rights and those of his neighbors.

Figures 5 and 6 are based on a collector angle of 60 degrees. While this represents the optimum angle on the design day, builders, homeowners, and architects may not wish to be confined by this angle. Other angles can be used by sacrificing efficiency. Curves like those of Figures 5 and 6 can be found for any collector angle merely by changing the angle in the computer program used to generate the curves. Although the curves in Figures 5 and 6 will change with collector angle changes, permitting the blocking of five per cent of the total energy near sunrise and five per cent near sunset on the design day still remains a sensible tradeoff.

This analysis is based on the design day of January 4. Consider what occurs on other days during the heating season. Figure 3 shows that by moving away from January 4, the average temperature increases and the amount of heat required decreases. Simultaneously, the amount of solar energy available increases. In an average year, there will be a surplus of solar energy for days other than the design day. The solar collector area is determined by conditions on January 4. Since the design will be adequate for the most severe day of the heating season, it will be more than adequate for other days of the heating season. Thus, if the system is designed for the most severe heating day, it is overdesigned for the remainder of the heating season. There is no need to protect all of the overdesign capacity, since the collector owner is collecting more energy than he needs. Yet some fraction of the overdesign should be protected, since terms like design day and overdesign are based on weather data averaged over a period of years. In a given year, heating conditions may be more severe than the average conditions. A fair compromise might be to gaurantee the collector owner 30 per cent of his overdesign capacity. His neighbor should then be permitted to shade the remaining 70 per cent of the overdesign collector area. If this scheme is used, the amount of shading permitted will vary during the year. The minimum 10 per cent of the total collector area could be shaded on the most severe heating day, to be increased by 70 per cent of the overdesign area on other days. The overdesign area increases as the average temperature becomes hotter.

Overdesign factors can readily be calculated from weather data since methods are available for determining the percentage day by which the collector is overdesigned on any particular day.

Heating Systems Using Solar and Fossil Fuel Energy

Economic considerations may dictate that solar energy be used for a portion of the heating requirement of a home with the remainder supplied by fossil fuel.[132] Such an arrangement permits high utilization of expensive solar equipment with fossil fuel being used only on the colder days. The solar system is thus underdesigned on the design heating day and remains underdesigned throughout some part of the heating season. During the milder parts of the heating season, however, the system will be overdesigned and this overdesign should be treated as discussed above. During the undersigned period, however, the neighbor would be permitted to shade only 10 per cent of the collector area.

Administration of a scheme such as this requires a knowledge of what percentage of the heating is to be supplied by solar energy. This can be readily ascertained by determining the ratio of collector area to floor area required for 100 per cent solar heating. Methods for calculating this ratio are available and present no problems.[133] The ratio depends upon two factors; local weather conditions and the insulating properties of the building in question which vary from building to building. If insulation factors are accounted for, administration of the solar zoning ordinance will become cumbersome and expensive. Instead, the ratio can be calculated for an average building in the locality, which can then be used for all overdesign determinations. Using a single ratio would penalize poorly insulated homes and provide a boon to those whose homes were well insulated, thereby furthering the expressed national policy of encouraging better home insulation.

An example might help clarify how these principles would be applied. Assume that in a particular locality the ratio of collector area to floor area is 0.4 for 100 per cent solar heating on the most severe winter day. A homeowner erects a 1,000 square foot home having 300 square feet of collector area. His collector area is thus 75 per cent of that needed for complete solar heating. Further assume that the most severe heating day is on January 1 and that on December 1 and February 10, the heating load has fallen to 75 per cent of the load on January 1. The solar heating system is underdesigned for

132. Several papers which include this problem can be found in Extended Abstracts of the 1975 International Solar Energy Society Meeting, § 12 at 28 (1975).

133. As examples of the methods used, *see* the following articles in Extended Abstracts of the 1975 International Solar Energy Society Meeting (1975); C. Barnaby and B. Wilcox, *Predicting Loads and Performance of Solar Heating Systems*, at 284, and *Models for Solar Heating and Cooling Systems and Buildings*, at 276.

the period from December 1 to February 10, and a neighbor would be permitted to block only 10 per cent of the homeowner's solar energy during this period. Prior to December 1 and after February 10, however, the collector is overdesigned and a neighbor would be permitted to shade 70 per cent of the overdesign area in addition to the permitted 10 per cent.

Trees

Solar collectors and trees can coexist only by careful placement of both. In the development of housing tracts, the developers and the buyers can arrange the locations of solar collectors and trees so that shading of collectors does not occur. Thus, the problem can be avoided by advance planning in areas developed after solar zoning ordinances are in effect. Problems arise in areas already developed, particularly where lot sizes are small.

Previous sections argued that neighbors should be permitted to block 10 per cent of the energy falling on a collector. If the neighbors do not block this 10 per cent near sunrise or sunset, when it is most advantageous to them, perhaps they should be permitted to block 10 per cent at any time during the day. This might alleviate the tree shading problem but does not present a solution. Further alleviation of the problem may be possible by a compensatory arrangement. Consider a case in which a homeowner has placed his collector to best accommodate his neighbor, but the neighbor's tree still partially shades the collector. The neighbor should be permitted to compensate the collector owner for the fraction of the energy blocked beyond the allowed 10 per cent. The measure of compensation should be the amount the collector owner requires to increase his unobstructed collector area to make up for the area blocked by the tree. This solution is available only when the homeowner can place additional collectors on his roof. If all other roof sites are shaded, the compensatory scheme cannot be used. Since the first site chosen for the collector must comply with the requirement of reasonableness, other available sites will be at least partially shaded and the additional collector area required may be quite large. If the neighbor elects not to use a compensation scheme the tree must be removed. Upon whom does the cost of removal fall? If the tree was in place before the zoning ordinance was passed and before the collector owner installed his collector, the costs of the changes should fall upon him. Removal of trees planted before the creation of solar rights should be at the expense of the collector owner; trees planted after the solar rights are created should be removed at the expense of the planter.

Deciduous trees can block large areas in the summer but only small ones in winter. This fact may be useful in providing some relief for tree owners. Consider a home with a solar system designed to provide winter heating and year around domestic hot water. Assume that neighbor *A* has a deciduous tree which blocks 25 per cent of *B's* collector on the winter design day, but blocks 65 per cent of the collector during the summer. *A* wishes to keep the tree and is willing to compensate *B*, but the measure of compensation must be determined. On the heating design day, the tree is blocking 25 per cent of the energy, which is 15 per cent more than the allowed amount. Thus, *A* must pay *B* sufficient money so that *B* can increase his unshaded collector area by 15 per cent. During the summer, when the tree has leaves, the blockage is 65 per cent. Must *A* compensate *B* for this? The only function of the collector during that part of the year when the tree has leaves is to provide domestic hot water. If the 35 per cent of the collector which is not shaded will provide the required domestic hot water for *B*, *A* should not have to pay compensation. Thus, summer shading should be permitted in this situation, but sufficient unshaded area must be left to produce hot water. This permits *B* to obtain full advantage from his collectors and permits *A*, *B*, and the community to enjoy the advantage of the tree.

This example is a special case of the more general principle already applied to the shading problem. Solar collector systems usually perform more than one function. The amount of collector area is usually based on some design condition; for example, it may be designed to supply 80 per cent of the heat required on the most severe heating day as well as provide hot water throughout the year. On days of the year that are not the design day the system is overdesigned. Solar rights should be guaranteed only to the extent that the energy collected is usable. In accordance with this principle, a collector owner should be guaranteed a fixed maximum percentage (say 90 per cent) of the available solar energy on the days for which the system was designed. On the days for which the system is overdesigned, the homeowner should be guaranteed 90 per cent of the available solar energy minus 70 per cent of the overdesign. This will be called the design day principle.

Cooling Systems

Domestic hot water and house heating are now the most commonly used forms of solar energy, followed by solar cooling. A

number of methods are available for solar cooling,[134] and solar cooling is currently an active research area. If solar collectors are used for heating, cooling, and hot water, there is a triple use system for which to consider tradeoffs.

The first step is to find whether the collector area will be determined by the heating function or the cooling function. (It is assumed that the amount of solar heat required for domestic hot water is approximately constant during the year.) Fortunately, some data on the heating and cooling requirements of an average Albuquerque home are available. La Plante estimates that a 1700 square foot house of frame construction with an attic in Albuquerque, has a design day heating load of 28,836 BTU/hr, and a cooling load on the design cooling day of 13,600 BTU/hr.[135] All solar energy collected for heating will be used to heat the house, but this is not true for the cooling function. The solar energy collected for cooling is used to drive an absorption refrigeration cycle. In a typical installation using a lithium bromide-water absorption refrigeration system,[136] 0.8 BTU of cooling effect is obtained for each BTU of solar energy collected.[137] Using these figures, cooling requires 13,600/0.8 = 17,000 BTU/hr and heating requires 28,837 BTU/hr. Thus, a typical frame house in Albuquerque requires 1.7 times as much solar energy on the heating design day as on the cooling design day.[138] Figure 3 shows that the cooling design day occurs on July 17. The figure of 1.7 will be used in this section as the ratio of energy required for heating to energy required for cooling. In many regions of the U.S. more solar energy is required for cooling than for heating, although this is not the situation in Albuquerque. Miami provides an example of a locality where the cooling load is greater than the heating load.

The next aspect of the cooling problem to be considered is the collector angle. Figure 3 shows that the optimum collector angle for cooling is 10 degrees on July 17, which is the cooling design day. The optimum collector angle for heating was 60 degrees. The significance

134. Swartman, Ha, and Newton, *Survey of Solar Powered Refrigeration,* ASME Paper No. 73-WA/Sol-6 (1973). A collection of 14 solar cooling papers are included in the Extended Abstracts of the 1975 International Solar Energy Society Meeting, § 44 at 389 (1975).

135. LaPlante, San Martin & Smith, *A Competitively Priced Residence for Utilization of Solar Energy,* ASME Paper No. 73-WA/Sol-3 (1973).

136. Farber, Morrison, and Ingley, *Selection and Evaluation of the University of Florida's Solar Powered Absorption Air Conditioning System,* ASME Paper No. 74-WA/Sol-6 (1974).

137. In engineering terminology, it would be said that the coefficient of performance of the refrigeration system is 0.8.

138. The Figure of 1.7 is the ratio of the heating load to the cooling load, or 28,837/17,000 = 1.7.

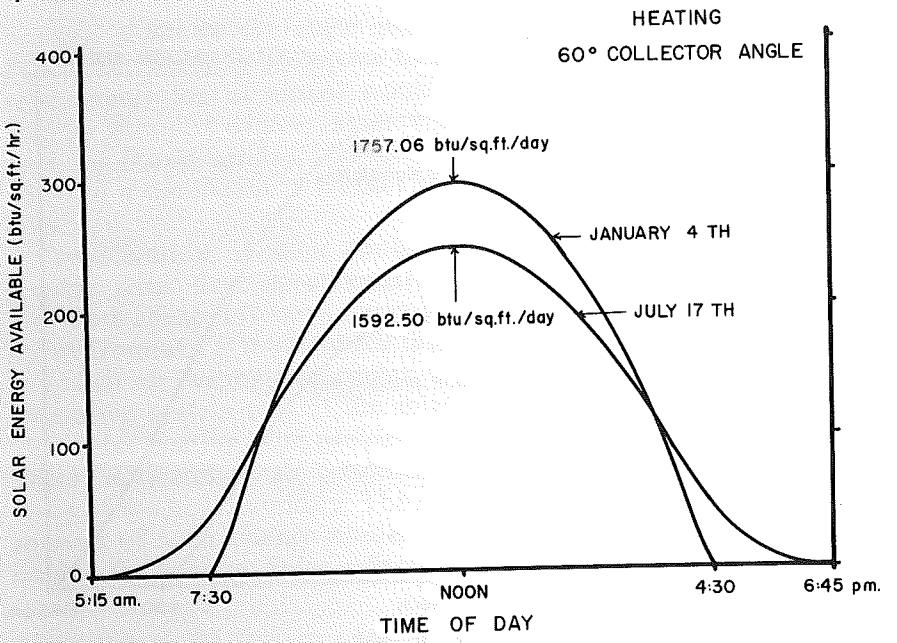

FIGURE 8.
Solar energy available on the heating and cooling design days in Albuquerque. The collector angle is 60°

of these angles is demonstrated more clearly in Figures 8 and 9. Figure 8 shows the solar energy available on January 4 and July 17 with the collector angle at 60 degrees. The total amount of solar energy striking a square foot of collector surface during the entire day is equal to the area under each curve. Note that for a 60-degree collector angle, 1757 BTU/square foot will strike the collector on January 4, and 1592 BTU/square foot will fall on July 17. Since heating requires 1.7 times as much collector area as cooling, Figure 8 indicates that if a 60-degree collector angle is used, the January 4 heating requirements should be used to determine the collector area. This area will be more than that required for cooling on July 17. In fact, it will provide 136% of the area required for cooling. Figure 9 shows that by using a 10-degree collector angle, the overdesign for cooling is even more extreme. If a collector with a 10-degree collector angle was sized for the January 4 heating load, it would collect 470% of the solar energy required for cooling.

The design day principle indicates that a solar collector owner who is using his solar system for both heating and cooling should be guaranteed 90 per cent of the solar energy available to him on

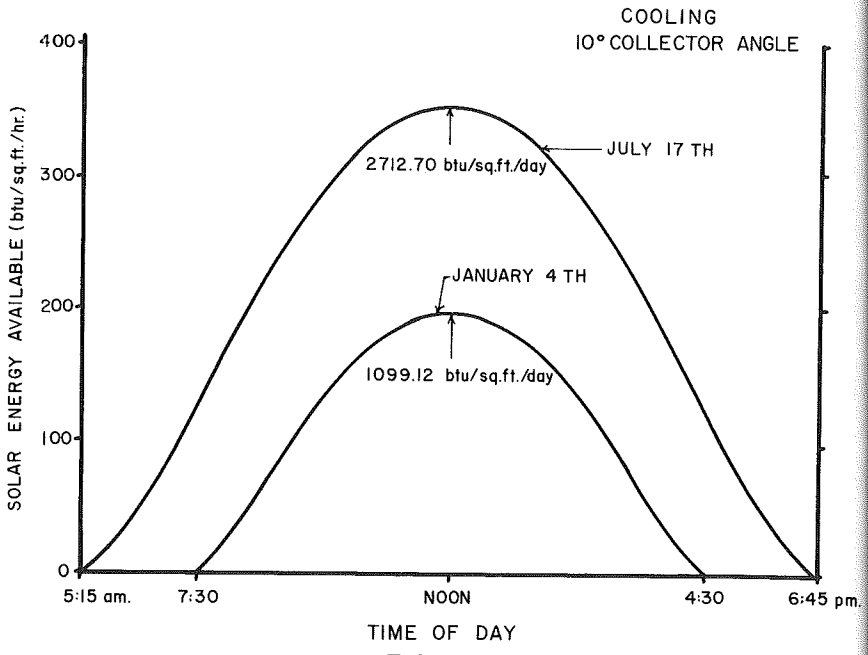

FIGURE 9.
Solar energy available on the heating and cooling design days in Albuquerque, with a 10° collector angle.

January 4, but should not be guaranteed the solar energy he cannot utilize for cooling during the summer. For example, suppose a homeowner has a solar energy system with a 60-degree collector angle which is used for heating and cooling. On the cooling design day, he receives 130 per cent of the solar energy that he needs. His solar right should guarantee him at least 100 per cent of what he needs, and perhaps 30 per cent of the overdesign. The remaining 70 per cent of the overdesign can then be blocked by neighbors. This permitted blockage has at least two salutory effects. First, it allows some blocking of solar collectors in the summer when the deciduous trees have leaves. Second, it reduces the azimuth angle that must be kept open for solar energy during the summer. The total azimuth angle traversed by the sun on January 4 is 117 degrees; however, this increases to 227 degrees on July 17. This means that some obstacles which would not block the winter sun, which sits low in the southern sky, from the collector might block the summer sun, which has a higher altitude angle, as defined in Figure 3. By permitting greater solar energy blockage in the summer, the azimuth angle which the solar right guarantees the collector owner can be reduced and

brought closer to the angle guaranteed on the heating design day. Figure 10, which is analogous to Figure 6, shows that a 10 per cent solar energy loss at sunrise would reduce the azimuth angle guaranteed by about 30 degrees, assuming a 60-degree collector angle. Thus, applying the design day principle to the summer cooling function can result in a significant reduction in the burden placed upon the neighbors.

Consideration of solar cooling makes more sense in some geographic areas than in others. In Albuquerque, evaporative coolers provide a cheap, effective means of space cooling, but a low humidity environment is required for this to be effective. It may be cheaper to install an evaporative cooler than to purchase an absorption refrigeration system even if the solar collector is already on the house for winter heating. The problem would be quite different in Miami. There, refrigeration air conditioning is required in the summer because of the high humidity. The mild South Florida winter causes the amount of solar energy needed for cooling to be greater than that needed for heating. Solar collector areas there would be based on the

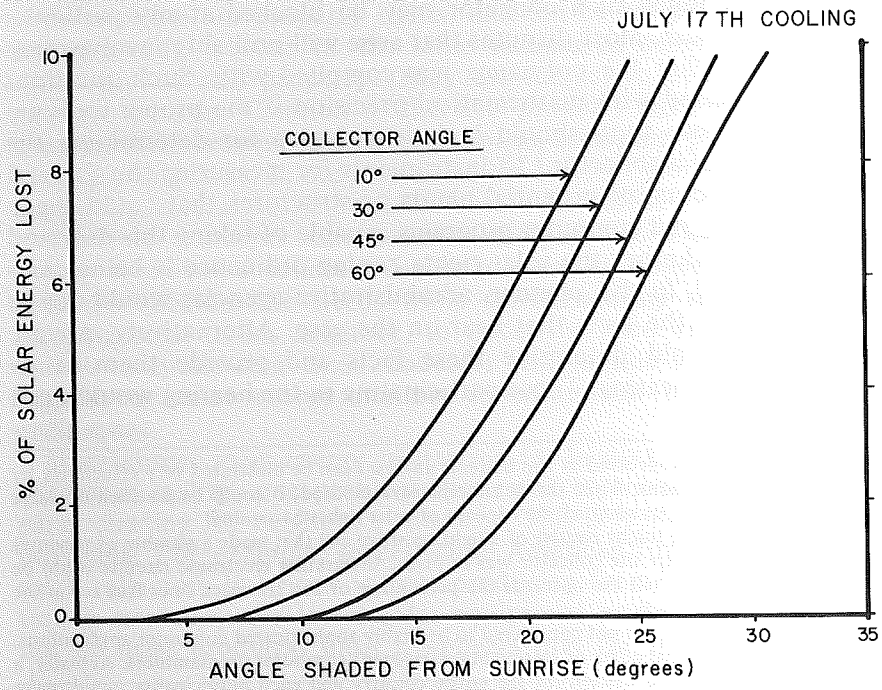

FIGURE 10.
Energy lost as a function of the angle shaded for solar cooling applications, under Albuquerque conditions.

cooling requirement and the design day principle would permit blocking part of the collector during the heating season.

Need for a Solar Administrator or Master

The discussion of tradeoffs employs fundamental and conceptually easy principles of solar engineering and technology. If solar rights are to be created by zoning ordinances, and tradeoffs are included as part of the ordinances, it is essential that the laymen affected by these ordinances understand them in detail. It is through understanding that disputes and litigations can be minimized.

One sound method for communicating the necessary information and resolving disputes would be a solar administrator or a solar agency. The administrator would be expected to disseminate information by normal channels; *e.g.*, community meetings and the mass media.[139]

In disputes between collector owners and neighbors, an administrative hearing should be the first level of dispute resolution. The tradeoff discussion shows that ordinances will be quite specific in stating how much of a collector may be blocked at any particular time of the year. Most disputes that arise will probably involve questions of whether the ordinance was complied with. Such questions can be answered with mathematical precision if the proper tools are available. These tools should include a device for determining the shaded area of a collector,[140] instruments for measuring the size and position of actual or potential plants or structures that could shade the collector, and computer programs capable of taking this data and determining whether the solar rights zoning ordinance is being complied with.[141] In this manner, administrative agencies would act to bring together the facts that bear on the case. Alternatively, private contractors could determine these facts and provide them at an administrative hearing. Those participating in the hearing would need

139. The concepts involved in the tradeoff analyses can be illustrated very effectively by means of movie cartoons. While this is an expensive method, it could be justified if a large number of municipalities adopted the concept of solar rights by zoning.

140. Such a device might consist of a light sensitive cell that made a number of traverses across a collector when the collector was in place. Integrating electronic circuits could be included which would tell the operator the percentage of the traversed lines that are in the sun and shade respectively.

141. Such programs are not considered to be highly sophisticated computer applications, but are within the capabilities of reasonably competent computer programmers. Actually, a single program could be written for the entire country and each municipality could make minor changes to account for local conditions. It should be noted that the computer programs which supplied the data for Figures 4, 6, 7, 10, 11, and 12 were written by engineering students.

a reasonable knowledge of solar technology involved in order to adjudicate the cases. There would be recourse to the courts, as is currently the case with zoning board decisions.

If a solar case were appealed to the court, it would be advisable to use a Master to aid the court in resolving the dispute. Again, the dispute would probably be a factual one, and a Master who understood the facts of the case within the framework of solar technology could be a great aid to the court. Use of a knowledgable Master might eliminate the need to use expensive expert witnesses in many solar rights disputes.

SUMMARY AND CONCLUSIONS

Legal analysis shows that the creation of solar rights is within the zoning power of municipalities. Access to solar energy can be obtained by means of easements and mutual covenants. However, zoning provides the most practical method, particularly in established neighborhoods. Most of the problems concerning shading of solar collectors will come from these established neighborhoods.

Solar rights are property rights, and can be bought, sold, leased, and generally treated in the same manner as other incidents of ownership of real property. They are subject to both zoning and eminent domain. Creation of this new property right may be problematic, since creating a solar right for an individual places a burden upon his neighbors. In order to make the concept more acceptable to the public, several possible tradeoffs were discussed.

Tradeoff concepts can become complicated. They vary from simply requiring a collector owner to place his collector so that he gets the sunshine he needs while simultaneously minimizing the inconvenience to his neighbor, to tradeoffs based upon solar technology. Adjudicating these tradeoffs will require a person knowledgable in solar energy matters to administer the solar zoning ordinances.

If extensive solar energy utilization for heating and cooling is to become a reality, one problem that must be solved is that of one party shading his neighbor's collector. This is related to other solar problems. For example, several large American firms are producing solar collectors but none is mass producing them.[142] Mass production is necessary for lower solar equipment prices. Equipment will not be mass produced until it appears that the market can absorb

142. Included among the companies exhibiting solar equipment at the 1975 meeting of the International Solar Energy Society were Owens-Illinois Glass Co., Revere Copper, and General Electric.

such quantities. A lawsuit involving shading of a collector would have a dramatic effect on the demand for solar equipment if the owner of the shaded collector lost the case, and precedent indicates that he should lose unless a zoning ordinance were in effect or the owner had an easement. Such a case would probably bring solar energy utilization for home heating and cooling to a standstill until adequate legal protection was given to the collector owner. Zoning ordinances which treat the problem before the lawsuit arises would be instrumental in encouraging solar use and would also eliminate the delay in solar development that could arise as a result of the first collector shading lawsuit.