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Wind Energy: Legal Issues and Legal Barriers

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by

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I. BACKGROUND

THE use of wind to do work for humans is ancient. Even today windmills are common sights in rural areas of America and in many foreign lands. Nevertheless, the study of the use of very large wind-driven machines, or large arrays of such machines, to produce power moved forward only in the 1930's in this country. Then, with the advent of rural electrification and low-priced oil and gas, it seems to have been largely forgotten until the current recognition of the energy crisis. With the sudden increased price of imported oil and the emphasis on seeking alternative domestic energy sources, an intelligent interest clearly exists in developing large wind machines or arrays of wind machines as major or auxiliary sources of power.[1] These suggestions are made more attractive by the belief that use of wind energy involves minimal environmental hazards, and that it taps a potentially permanent, non-exhaustible resource. In short, wind energy should be explored and developed to facilitate economizing our exhaustible petrochemical and carboniferous resources.

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1. Within the United States, the distribution of wind power has been and is being mapped. *See* Reed, *Wind Power Climatology of the United States*, 27 WEATHERWISE 236 (1974). Promising regions for tapping this source appear to be the New England, Mid-Atlantic, Northwest, and possibly the Aleutian coast lines, the Great Lakes, and the Great Plains from Montana to the Rio Grande valley. Hawaii is also an area of potential interest for wind energy. Windy mountain areas are not included here since present technology of transport and storage leaves many of these places impractical, although this may change. An estimated total energy of 1.15×10^{14} kwh per year exists in the winds over the Continental United States; if 1% of this energy could be tapped in electrical form by the year 2000, it would equal two-thirds of all the electrical energy generated in the United States in 1972. SOLAR ENERGY PANEL REPORT, NATIONAL SCIENCE FOUNDATION/NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, AN ASSESSMENT OF SOLAR ENERGY AS A NATIONAL ENERGY RESOURCE (Dec. 1972); R. Taubenfeld & H. Taubenfeld, Barriers to the Use of Wind Energy Machines: The Present Legal Regulatory Regime and a Preliminary Assessment of Some Legal/Political/Societal Problems 116 (report by Hal Watson, Jr., Wind Energy Development in the U.S.A.: Past, Present, and Future) (research funded by National Science Foundation Grant No. AER 75-18362). Obviously, in thinking in terms of siting large arrays, the existence of wind is not enough. If electrical energy is to be manufactured, given current storage and transfer technology, production must normally be near major consuming areas to be cost effective. Other factors, such as costs of fuels, are all of ultimate concern. This Article does not deal with these types of issues.

The small, isolated windmill commonly seen at work in rural areas causes little legal difficulty for the landowner, his neighbors, and the community. The new concepts of wind energy machines, however, present us with a strikingly new perspective. While as recently as three or four years ago, only two dozen or so firms and individuals were interested in this industry, there now are hundreds of interested parties. Research funding has risen to millions of dollars. Dr. William Heronomus, of the University of Massachusetts, talks of chains of mills involving several hundred thousand towers reaching from 700 to 850 feet in height and of structures on towers ranging from 300 to 400 feet above the oceans or the Great Lakes. Dr. H. Guyford Stever, the recently retired Director of the National Science Foundation, has discussed placing wind energy machines on skyscrapers in major cities. Others have suggested stretching chains of towers along and across highways, on the Great Plains, on the flatlands of New Jersey, on mountain chains and ridges on the mainland, the Hawaiian and the Aleutian Islands. Moreover, researchers are examining the feasibility of increasing blade size. Clearly, as wind machines increase in scale and frequency many legal issues will be raised. Some of these issues will arise with respect to the machines' noise, their ability to deflect wind from other machines or other arrays, the possible effects on local climate as wind speed and direction are altered, and the creation of a "visual pollution" problem. Additional legal issues are generated by the heightened risk of death and injury from the collapse of a large structure, or the failure and "flying off" of a large blade, particularly in densely populated areas. Researchers have suggested that large machines or arrays may also, among other things, cause signal reflections of TV signals or kill birds. If placed in the oceans or lakes, the structures may interfere with navigation, give rise to controversy with other nations over uses of the seas and seabed and with Canada over the Great Lakes. In short, troublesome legal and societal problems could be caused by the creation of large machines or large arrays. Indeed, there presently appears to be, in existent legal and regulatory regimes, potential impediments to the introduction of this technology, at least on a wide scale. This is particularly true in urban and suburban settings, in coastal zones, and near international borders. Environmentalists have in fact already argued that the use of large machines or large arrays would "pollute" the views of New England's mountains, and such complaints have not been ignored.[2]

II. THE PRESENT LEGAL REGIME

In so far as they receive any attention, the image of the small mill pumping water on a remote farm, or the mill in Holland on the bank of a canal, surrounded by tulips, seems to be the norm, rather than Don Quixote's vision of the looming, thrashing, multi-armed giant. Lawmakers in the United States have apparently accepted the image of windmills as one of

2. For a recent overview from the generalist's position see 148 NATIONAL GEOGRAPHIC 812 (1975).

legal inconsequence. In only four of the fifty states are windmills mentioned in the codes of laws and in these four, with one possible exception, the legislation refers to matters such as removing a windmill from mortgaged or encumbered property, to liens and claims connected with the windmills, and to their status as fixtures.[3] Nebraska does permit "second class cities and villages" to establish and regulate windmills.[4] The public also has had no serious problems with windmills. Cases are rare, although one, *Ward v. Norton*,[5] informs us that "[a] windmill is a machine in common use, well known in commerce, which is propelled by the wind."[6]

The lack of statutory and case law does not mean that the public, the legislators, and administrators have given a free hand to the builders and users of wind energy machines.[7] It simply suggests that, in historic uses, windmills have led to very few politically significant societal problems or conflicts. Legislative and judicial inattention is likely to continue unless some major changes occur in the technology or use of wind energy. Analysis must therefore be based on the implications of the expected changes: the newer sizes, shapes, and predicted numbers of machines; and in the increasingly vociferous pressure encouraging sacrifice to preservation of the environment. The pressure to produce non-polluting energy sources favors the development and use of wind energy. Wind Energy Conversion Systems (WECS) can be used to generate power for local, immediate use as well as to pump water and supply electrical energy to a utility net; the use in utility nets is nevertheless repeatedly cited as the best opportunity for large scale use.[8] WECS' utilization for these purposes would constitute a sufficiently major change in technology and use to require increased legislative and judicial attention.

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3. States in which some legislation refers to windmills, wind energy machines or the like: *California*: The Penal Code makes removal of a windmill from encumbered property the equivalent of larceny. No other references. CAL. PENAL CODE § 502-1/2 (West 1970). *Florida*: Windmills are referred to in § 713.63, but only concerning liens, distribution of assets to a surviving spouse, and escheat as to unclaimed funds. No other references. FLA. STAT. ANN. § 713.63 (West 1976). *North Dakota*: Windmills, pumps and fences are ordinary "fixtures" within the meaning of real property doctrines. Hasse v. Dewitz, 76 N.D. 108, 33 N.W.2d 625 (1948). *Texas*: Article 5462 refers to windmills in re mechanics' liens. No other references. TEX. REV. CIV. STAT. ANN. art. 5462 (Vernon Supp. 1976-77).

4. *See* NEB. REV. STAT. § 17-529 (1974).

5. 86 Kan. 906, 122 P. 881 (1912).

6. 122 P. at 882.

7. Some have already noted the diversity of the considerations which must be coped with in planning large numbers of installations. For example, it has been pointed out that in seeking sites for a wind energy conversion system to assist in the transport of water in the California aqueduct system, account would have to be taken of "present land use and probable use restrictions," since "[n]ational forests, privately owned grazing lands, and the California Condor Refuge cannot be considered equally available for wind machines and electrical transmission lines. Existing transmission lines, airports, flight lanes, visual impact and effects on neighboring mountain-top microwave links will also be considered." C. Lindley, Wind Machines for the California Aqueduct 2 (paper submitted for presentation at the 1975 Wind Energy Workshop).

8. *See generally* M. Dubrey & U. Coty, The Economic Potential for Wind Energy Conversion (paper presented at the Greater Los Angeles Area Energy Symposium, Los Angeles Council of Engineers and Scientists, April 3, 1975); R. Zimmer, C. Justus, R. Mason, S. Robinette, P. Sassone & W. Schaffer, Benefit-Cost Methodology Study with Example Application of the Use of Wind Generators (contractor report prepared for NASA, Report No. NASA CR-134864, July 1975).

III. PROBLEMS OF TOWERS OR GENERATORS IN VARIOUS SETTINGS

It is useful initially to divide the analysis of barriers and potential problems which may accompany the introduction of WECS by geographic areas. While increased numbers of systems presumably multiply problems in any locale, potential problems and impacts can be expected to differ in various physical settings. The locational partition presently most useful divides activities into those in sparsely populated regions (rural, mountainous, etc.), suburban and urban settings, coastal areas, and international lakes and oceans.

A. *Sparsely Populated Regions*

As noted above, there presently is no effective regime in federal law or in the law of any state dealing with WECS as such. Some minimal regulation, however, can be expected to exist already which, although not created for the purpose of controlling WECS, will nonetheless have that effect. For instance, if government owned lands prove to be potentially desirable sites for WECS, federal regulation of the use of forests, grazing lands, etc., already exists, and, thus, must be accommodated.

B. *Suburban and Urban Settings*

In urban and suburban settings even a single modern wind energy conversion machine may raise problems with height restrictions, structural regulation, zoning requirements, the law of nuisance, noise considerations, aesthetic considerations, and "wind robbing" by depriving a neighbor of the "natural" wind energy which might be expected at his generator site. Of particular significance here are the site, use, and construction restrictions which may be imposed by statute and regulation, as well as private covenants restricting land use in various ways. Analogous problems which have been encountered by solar energy collectors and with weather modification activities are examined for guidance.[9]

Height Restrictions. American cities tend to regulate routinely the height of structures within their jurisdiction. In part, this may be done by absolute bar at some stated height; in similar fashion, Federal Aviation Agency regulation limits heights of structures within established air lanes and glide paths. Moreover, height regulations may be affected by safety standards imposed by law, which as in the case of Occupational Safety and Health Administration (OSHA) regulations may intensify with added height. Height limitations

9. Eventually, the net societal desirability of any new technology has to be demonstrated. Regarding WECS, society will have to come to terms with the ultimate environmental choice. What is to be preserved of the present and past? What is to be allowed to evolve or to be induced to change? These appear to be the ultimate questions involved in the development of larger WECS in the large numbers called for by the requirements of major energy output in rural areas. Of course, even this ultimate policy choice is inherently temporary; new groups, new tastes, advances in technology, and more experience will require rethinking of the basic social policy assumptions applied to WECS and, therefore, will engender further innovation. In the end, even for sparsely populated areas, compromise and a temporary strategy towards this innovation seem called for.

are also enforced on the basis of the ground area to be used for the structure and with the imposition of setback restrictions as the structure reaches higher levels. Some limitations will be directly applicable to WECS, since tower heights of 200-300 feet and more are being examined by technologists. Presumably regions with relatively greater tolerance for high structures would offer some modest advantage to the establishment of WECS. It is likely, however, that cities would be quick to act if windmills began to appear in numbers, and that strict and specific regulation would be expected.

Zoning. A principal potential barrier to the introduction of WECS into urban and suburban settings is the existence of zoning ordinances. Zoning is already cited by present manufacturers as the most frequent problem encountered.[10] At the present time, all fifty states have zoning enabling acts for cities and nearly forty have enabling acts for counties. The basic constitutionality of such ordinances was definitively upheld by the United States Supreme Court in 1926 in *Village of Euclid v. Ambler Realty Co.*[11]

During the nineteenth and early twentieth centuries growth of cities in the United States was largely unplanned and uncontrolled, although some cases of early planning, for example, of Philadelphia and Washington, D.C., did exist. Early efforts at what we would call zoning include an 1889 Wisconsin statute which authorized cities to designate zones with various regulations as to buildings and structures, depending on fire risks involved, and an 1889 rule creating height restrictions in Washington, D.C. In 1909 height restrictions in Boston were held to be constitutional in *Welch v. Swasey*.[12] New York City was the first, in 1916, to adopt a comprehensive system of building control for an entire city.[13] The scheme covered use, height, and

10. Letter from Donald Mayer, North Wind Power Co., Warren, Vermont, to Howard J. Taubenfeld (July 29, 1975) (notes 35' height limit in Mt. Pleasant, Racine County, Wisconsin). In a brief survey of restrictions in law in and around Dallas, Texas, for example, it was found that in a residential neighborhood the maximum height of a structure is limited to 24 feet unless the lot size is one-half to one acre, in which case the structure may rise to 36 feet. In one satellite suburb, a general height limit of 35 feet exists but this can be extended if setback restrictions are complied with. In another, the only currently applicable height limit appears to be 99 feet, the limit now placed on antennas and antenna towers. These figures are not offered as definitive of anything; they do suggest on the one hand, a wide variance in existing possibilities without the need for a variance and, on the other, that height restrictions have become typical rather than the exception, even in small communities.

11. 272 U.S. 365 (1926). The court noted:

> There is no serious difference of opinion in respect of the validity of laws and regulations fixing the height of buildings within reasonable limits, the character of materials and methods of construction, and the adjoining area which must be left open . . . and excluding from residential sections offensive . . . industries and structures likely to create nuisances.

Id. at 388 (citations omitted). All of this has relevance for WECS in urban and suburban settings.

12. 214 U.S. 91 (1909).

13. *See* S. TOLL, ZONED AMERICA 174-87 (1969). While newer concepts of "spot" zoning and "floating zones" are entering into the property lawyer's daily language, the standard or "Euclidean" zoning is so widespread that familiarity with its meaning is useful. In the *Euclid* case, the United States Supreme Court held that the zoning rules adopted by the village were constitutionally permissible. Although the rules involved were not abnormal, they were extremely complicated. For example, the rules divided the village into six classes of use districts, three classes of height districts, and four classes of area districts; in great detail, the rules then set out which type of building, business, etc. could be built in each district.

land coverage. These rules were based broadly on the notion of "public nuisance" and the governmental right to deal with such nuisances under the police power and the duty to protect the public from harm.

Zoning is carried out under the police power for purposes of public health, safety, and the general welfare. Use, density, height, bulk, placement on a lot, and even aesthetic values, are among the dimensions controlled. Note that, in addition to zoning into industrial, commercial, residential, agricultural, and other uses, cities also normally include setback lines, side yard and rear yard lines, height limits, and area limits per lot.[14] Most zoning acts do permit a variance, but procedures tend to be cumbersome and often costly; a property owner must ordinarily show unnecessary hardship in the operation of the law.[15] Existing zoning rules may therefore inhibit or prevent the development or use of wind energy, as well as solar energy, in the urban-suburban setting. Or, alternatively, zoning laws could be used to encourage the development of wind energy systems.[16]

In any case, Euclidean zoning restrictions raise significant questions which require attention from those who intend to innovate WECS in urban and suburban settings. To the question, "can most pieces of urban and suburban land be used to generate electric power?," the appropriate answer currently appears to be that some effective restrictions and barriers are implied wherever there are zoning regulations. Thus, for example, as to the possible locations of WECS, present height limits may prevent their use on top of an existing structure, or their being used at all at an effective height. Other rules may bar WECS from a front yard, from within some number of feet from the building, or from side lines or a back line, or from attachment to other structures on the lot. Therefore, whether urban or suburban land can be used to generate electric power will depend upon the ordinances which regulate individual pieces of land.

In addition to height, some ordinances may limit the number of structures which may exist on a lot; a wind energy tower may be one structure too many. A tower might be required to be placed some distance from a residence; even the twenty-five- to forty-foot towers offered by one manufacturer must be sited at least fifty feet from residential buildings, and it is also suggested that they should be away from trees and other structures.[17] None of these are necessarily insuperable barriers to innovation. But variances will probably be widely necessary and for some time may be difficult to obtain in the more selective localities.

Of great importance are the aesthetic considerations which exist to some degree in zoning controls in these areas. WECS may or may not be accept-

14. *See* Goreib v. Fox, 274 U.S. 603 (1927) (sustaining such limitations). *See also* F. HORACK & V. NOLAN, LAND USE CONTROLS (1955).

15. *See* Otto v. Steinhilber, 282 N.Y. 71, 24 N.E.2d 851, 16 N.Y.S.2d 27 (1939). *See generally* R. ANDERSON, AMERICAN LAW OF ZONING (1968).

16. *See generally* American Bar Foundation, Proceedings of the Workshop on Solar Energy and the Law, Feb. 10, 1975 (an Interim Report submitted to the National Science Foundation, RANN Serial No. NSF-RA-575-004 (March 1975)) [hereinafter cited as Solar Energy and the Law].

17. Grumman Aerospace Corporation, Windstream 25 Electrical Generator (1975 brochure) [hereinafter cited as Grumman, Windstream 25].

able to regulatory boards in urban and suburban settings, but industrial and landscape designers and the landscape promoters could cooperate in designing aesthetically pleasing structures and sites. These considerations may imply additional design constraints and costs for WECS in certain regions. Many groups concerned with the future of urban living in the United States have stressed that requirements for the aesthetic impact of new facilities should be carefully considered. Such structures should add to rather than deteriorate the quality of urban living. There appears no reason why such a requirement should become a major barrier if controls are applied even-handedly by a city to all competitors. Moreover, the environmental problems created by alternative power sources and the requirement for environmental impact statements favors the more rapid development of aesthetically pleasing WECS as presently one of the best energy resource alternatives.

Aesthetics. Even if the WECS in fact produce little long-run or long-range effect on the environment, the issue of visual pollution is likely to remain and may become an important National Environmental Protection Agency factor. Siting of any potential major systems will have to be done with this in mind in any event. The Dutch have taught us, however, that there are alternative ways to cope with "eyesores." Since beauty is in part, at least in the eye of the beholder, the promotor, and the publicist, a well-maintained windmill may well be regarded as a charming and picturesque addition to a dull landscape rather than as a pollutant. Furthermore, newer designs have already transformed the windmill. The sleek vertical axis design which takes up less view and light may be as pleasing as a soaring church spire to many.

It is also true that important power transmission lines on giant towers already stalk across the United States. Where power is essential, many may *prefer* a modern mountainscape with these powerful giants bringing access to modern technology to hitherto unfavored regions. Many may feel, with Carl Sandburg, that there is beauty in technology and the power it brings humanity. A WECS which harnesses directly a source of power in nature which humans can feel and touch may have special attractiveness to environmentalists, especially in comparison to alternative sources of power. In all, considering the likely impact generated by alternative power sources, the requirement for an environmental impact statement may, on balance, hasten the development of WECS.

Building Codes and Restrictions on Building Design and Materials. As part of the urban and suburban legislative programs, restrictions are normally placed on building design and materials. Such building codes can impede technological innovation, but they are here to stay[18] since they primarily benefit society. A major problem in planning large WECS, or arrays of WECS, is not that such codes exist but that they vary from place to place.[19]

18. *See, e.g.*, C. FIELD & S. RIVKEN, BUILDING CODE BURDEN (1975); Rivkin, *Courting Change: Using Litigation to Reform Local Building Codes*, 26 RUTGERS L. REV. 774 (1973).

19. The fact of wide variation was immediately evident even in our informal field check in the metropolitan Dallas area. *See* note 10 *supra*. In Dallas, all structures must adhere to the

If WECS were used to any great extent, federal product standards would probably be expected for some of the parts—*i.e.*, the blades, towers, and turbines—but a federal building code or a uniform code adopted fully by all fifty states cannot be anticipated soon.

A Special Problem in the Urban Setting. The effects of wind changes in urban settings will require some engineering analysis as well, even if all the other obstacles to placing WECS in such environments are overcome. The upper parts of structures are, of course, normally subjected to more wind stress than exists at street levels. Tall buildings do, however, sometimes tend to cause accelerated wind speeds. If WECS increase wind speeds at street levels, and if humans or property are damaged by high winds, claims of liability seem certain.[20] It is known that varying building configurations can force high speed winds to ground level, resulting in "head height wind speeds two to six times higher" than normal.[21] This is not meant to suggest that the existence of a WECS in an urban environment will increase wind speeds at ground level or that these effects could not be minimized by architectural innovation. Rather, it suggests that before instituting an urban WECS program developers should estimate the potential overall "climatic" effects, and, considering the physical setting, should construct the most suitable type of structure for neutralizing any such negative effects.

A Special Problem for All. In addition to local zoning, building codes, and other controls a number of states now have innovative legislation giving the state a direct role in certain land use changes.[22] In part, this has resulted from the obvious widespread "externalized" effects of many major building developments; "a shopping center or a power plant can mean a healthy addition to [one] community's tax base, but the environmental effects (not the taxes) are shared by the entire region."[23] The legislation varies from

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Uniform Building Code, a body of regulations setting forth the strength requirements of any structure. But the Code is not in force in all cities. Of immediate relevance, table 23-F of chapter 23 of that Code provides, with respect to wind that:

Structure Height	Must be able to withstand lb/square foot wind pressure
up to 30 feet	20
30-49 feet	25
50-99 feet	30
100-499 feet	40

Dallas Building Code (2d ed. 1973). Other localities surveyed varied from no laws at all to the demand for city approval of the design of each structure, with requirements for an engineer's certification of the structural soundness of any innovative buildings.

20. Letter from Dr. T.I. McLaren, Weather Dynamics, Arlington, Mass., to Howard J. Taubenfeld (July 30, 1975); an NSF funded study by this firm is designed to establish "target guidelines for acceptable wind speeds in the urban environment." Harold C. Larsen has also warned of the possibility of speeded-up winds in some circumstances and of "downslope" effects. *See* Letter from Harold C. Larsen, Professor and Director of AFIT Aerospace Design Center, Wright-Patterson AFB, Ohio, to Howard J. Taubenfeld (July 30, 1975).

21. Weather Dynamics Division, Mt. Auburn Research Associates, Inc., Weather Dynamics (brochure).

22. *See Resources for the Future*, RESOURCES No. 50, Oct. 1975, at 1.

23. *Id.* at 2.

controls requiring permits to build in specially delimited areas, such as coasts and marshlands, to total barring of certain types of construction in certain areas in order to insure the preservation of wilderness areas. The state controls have not superseded local regulation; they tend, where permits and the like are required, to create another bureaucratic layer to deal with on the road to construction of anything in the controlled area.[24] Unless regulatory processes can be streamlined, this is likely to impose a great burden in any complex situation. A major local political commitment or legislation to foster wind energy would appear to be the best counterbalance.

The problems faced by promoters seeking permits for an innovative land use or a use that some might find aesthetically displeasing on a coastline, for example, are already reflected in the number of controlling government bodies. There are some 3000 county governments in the United States, some 18,000 municipalities, and some 17,000 townships. At least 14,000 of these exercise some form of land use control.[25] To minimize delay and disappointment in obtaining land use permits, a favorable climate of opinion and preferably some local political commitment to the innovation seem to be necessary. In addition, however, there would have to be a comparable commitment on the part of the WECS innovators to assure that only attractive facilities are built and that no unnecessary negative impacts are produced. However, persuasion based on widely shared local benefits, and assured compensation for unavoidable losses, should be relied on rather than resort to questionable political activities or other compromising action. The more layers of regulation there are, the more likely innovations will be hamstrung, and the greater the danger of political corruption. Promoters and innovators of WECS should be forewarned to search for regulatory strategies to minimize both of these serious dangers.

C. *Coastal Areas*

The area closest to the oceans is increasingly one in which government regulation will present difficulties for any kind of installation. Since the last century, for example, section 10 of the Rivers and Harbors Act of 1898, as amended,[26] has prohibited "the creation of any obstruction not affirmatively authorized by Congress, to the navigable capacity of any of the waters of the United States." The Act also prohibits the excavation and filling "of any navigable water of the United States, unless the work has been recommended by the Chief of Engineers and authorized by the Secretary of the Army prior to the beginning of the same." Courts have already decided cases on the filling of tidelands and the need for the Secretary to consider all ecological factors before issuing a permit.[27] In 1972 Congress increased the regulation of coastal areas by enacting the Coastal Zone Management Act.[28]

24. Clearing the papers needed to construct an entirely acceptable structure on the southern California coast, with no hitches at all, is said to require about 18 months.
25. *See* note 22 *supra*.
26. 33 U.S.C. §§ 403, 407 (1970).
27. *See, e.g.*, Zabel v. Tabb, 430 F.2d 199 (5th Cir. 1970), *cert. denied*, 401 U.S. 910 (1971).
28. 16 U.S.C. § 1451 (Supp. V 1975).

More recent statutes at the state level require additional permits and emphasize the need for consideration of environmental factors inasmuch as marshes, estuaries, tidelands, coasts, and even internal waters have increasingly been subjected to state controls. Massachusetts, for example, places limits on the dredging, filling of and other activities in the "wetlands."[29]

D. *The Seas*

A number of suggestions to date call for investigation of the use of arrays of wind energy machines off the coasts of the United States, or at least off the East Coast and in the Great Lakes.[30] The legal problems involved in innovating WECS will vary with distance from the shore as well as with the form of "attaching" the machines—by tower or anchored float. In addition, legal considerations will be affected by the fact that sea installations involve relations with foreign governments. We must be forewarned. The history of sharing "international resources" has typically been marked by a great deal of conflict. Fresh evidence on this matter has come from the ongoing conflict over a seabed regime. Since scientific suggestions include arrays as much as 200-300 miles or more off the coast, a brief review of each contingency is included.

Internal Waters. The internal waters of a nation are those waters lying landward of the line from which the territorial sea is measured (called the baseline)[31] and are of the same status as the land of that nation; they are

29. MASS. ANN. LAWS ch. 130, § 27A (Michie/Law. Co-op 1972); *see* Golden v. Board of Selectmen, 358 Mass. 519, 265 N.E.2d 573 (1970); MacGibbon v. Board of Appeals, 356 Mass. 635, 255 N.E.2d 347 (1970); Commissioner of Natural Resources v. S. Volpe & Co., 349 Mass. 104, 206 N.E.2d 666 (1965). Maine has a similar statute: the Wetlands Act, ME. REV. STAT. tit. 38, §§ 471-478 (West Supp. 1977-78). Wisconsin's Shoreland Zoning Law provides for limits on activities in areas within 1,000 feet of lakes and 300 feet of rivers. WIS. STAT. ANN. §§ 59.971, 144.26 (West Supp. 1977-78). Delaware regulates all new industrial development within a one- to six-mile strip along the Delaware Bay coast; heavy industry is barred. DEL. CODE tit. 7, §§ 7001-7013 (1975). California requires permits for any development within 1,000 yards of the Pacific coastline; there is a California Coastal Zone Commission authorized to issue such permits. CAL. PUB. RES. CODE §§ 30,000-,900 (West 1976). Note, too, that other states with some controls include Georgia, New Jersey, North Carolina, and Connecticut, while Washington has a very extensive Shoreline Management Act, WASH. REV. CODE ANN. § 90.58 (Supp. 1976). Many states, including California, have environmental quality acts as well. CAL. PUB. RES. CODE §§ 21,060-,176 (West 1972). Note that in addition to all state controls, most work in these areas requires United States Corps of Engineers approval under the Rivers and Harbors Act. *See* Note, *The Public Trust in Tidal Areas: A Sometimes Submerged Traditional Doctrine*, 79 YALE L.J. 762 (1970).

30. For example, Dr. Heronomus, in one suggestion, has proposed a series of machines, perhaps 65,000 in number, some 10-15 miles at sea off New England, or the New York Shoals, Nantucket, the Georges Bank, or in the Great Lakes. The machines would produce hydrogen through electrolysis of seawater; the hydrogen would be stored in tanks and pipelined to shore. PRODUCT ENGINEERING, Oct. 1973, at 25. The machines would be on towers up to 300 feet high and float or be on "Texas towers." Heronomus has also indicated that the arrays might well be 200 or 300 miles from shore. For an artist's rendition see Hamilton, *Can We Harness the Wind?*, 148 NATIONAL GEOGRAPHIC 812, 813 (1975). Regions observed by others to have high wind energy output include such offshore regions of the United States as the west coast from northern California to Washington, the northeast coast from Virginia to Maine, and the Texas Gulf Coast, all at 50-200 miles offshore. R. Taubenfeld & H. Taubenfeld, *supra* note 1, at 31.

31. The baseline generally follows the low water mark along the coast. While the nomenclature is obvious for internal lakes, rivers, and similar bodies of water, "internal" waters include those coastal areas which are considered "historical bays" (those historically accepted as under the authority of the adjacent state) and bays and rivers whose distance across ("closing line") at the mouth is 24 miles or less. Convention on the Territorial Sea, art. 7, ¶ 4, 516 U.N.T.S. 210. For example, Chesapeake Bay is an "historic" bay. On the other hand, Santa Monica Bay has

subject to that nation's unquestioned sovereignty and control.[32] Thus, *all* United States federal laws applicable to the land territory of the nation are applicable to activities in, on, or under these waters.

State sovereignty over submerged lands rests on the Submerged Lands Act of 1953.[33] The Alaska Statehood Act of July 7, 1958, for example, provides that the Submerged Lands Act "shall be applicable to the State of Alaska and the said State shall have the same rights as do existing States thereunder."[34] Section 3(a) of the Submerged Lands Act provides:

> [I]t is determined and declared to be in the public interest that (1) title to and ownership of the lands beneath navigable waters within the boundaries of the respective States, and the natural resources within such lands and waters, and (2) the right and power to manage, administer, lease, develop, and use the said lands and natural resources all in accordance with applicable State law be, and they are, subject to the provisions hereof, recognized, confirmed, established, and vested in and assigned to the respective States.[35]

In general, all federal and state laws apply to internal waters as they do to land. *All* federal law and certain state law is also similarly applicable in the so-called "territorial sea" of the United States and would apply to WECS installations located therein.

The Territorial Sea. For most of its history, the United States has claimed sovereignty, that is, complete control and ownership, over the oceans around it to a distance of three nautical miles from its coasts. It now claims those three miles, plus an exclusive fishing right for nine more, plus special rights in fish and other resources to a distance of 200 miles. Other nations have made greater claims. We expect that an international conference on the seas may, in the next few years, propose a treaty extending the territorial sea to a distance of twelve miles.

In these so-called territorial waters, the nation has all the rights over its territory that it has over its land mass; this is subject, however, to the right of "innocent passage" which grants the right of ships of all nations to pass through those waters on peaceable missions. Within territorial waters, all state and federal laws apply. The rule of the United States over its territorial sea is accepted as exclusive; assuming that proper warnings were issued and safety precautions adopted, *some* obstructions to shipping, even permanent obstructions, placed in these waters would not appear to give rise to claims

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been declared by the United States Supreme Court to be "territorial waters" rather than an historic bay. Under the Submerged Lands Act of 1953, if it were an historic bay, and hence internal waters, California's control under that Act would have extended to a point three nautical miles beyond the closing line. 43 U.S.C. §§ 1301-1303, 1311-1315 (1970). As territorial waters, California's rights went out only three miles from the low water mark. United States v. California, 381 U.S. 139 (1965), *supplemental decree*, 382 U.S. 448 (1966). *See also* 43 U.S.C. § 1301 (1970).

32. *See, e.g.*, Convention on the Territorial Sea and the Contiguous Zone, [1964] 2 U.S.T. 16-6, T.I.A.S. No. 5639, 516 U.N.T.S. 205.

33. *See* United States v. Maine, 420 U.S. 515 (1975).

34. *See* 48 U.S.C. §§ 21-486 (1970).

35. 43 U.S.C. § 1311(a) (1970). In United States v. California, 381 U.S. 139, 161 (1965), *supplemental decree*, 382 U.S. 448 (1966), the Supreme Court concluded that where appropriate for determining jurisdiction, the definitions in the international Convention on the Territorial Sea and the Contiguous Zone should also be used for purposes of the Submerged Lands Act.

by other nations. Of course, the kinds of obstructions so placed to date, such as lightships, and oil drilling towers, tend to be isolated units. Several thousand such obstructions, grouped in one area, might well close off, or make very hazardous, the use of the territorial sea in some area.[36] This, in turn, may improperly impinge on the right of innocent passage.

State authorities and the United States Coast Guard have primary law enforcement responsibilities concerning criminal and civil wrongs occurring in the territorial sea, while the Navy is charged with national defense in all areas of the ocean, including internal and territorial waters. This responsibility includes the obligation to protect United States citizens and their property in offshore areas in accordance with international law. Thus, protection of WECS would devolve upon all of these groups.

Are there likely to be problems in addition to the possible obstructions to fishing and navigation if large arrays in the seas prove desirable? There will be obvious local disturbance to the seabed and the seas during construction. It is predicted that even large arrays will neither substantially raise barometric pressures and cause shifts in wind direction, nor will there be significant atmospheric effects.[37] In any case, federal environmental impact statements will be required if there is any federal involvement in a project affecting the air or sea environment. An environmental impact statement may also be required in order to obtain certain necessary federal licenses. Indeed, WECS developers are likely to have to file such statements.

The Contiguous Zone. The contiguous zone is the area of the oceans, of indeterminate, or, at least, of not-yet-agreed breadth over which adjacent states can exercise special jurisdiction. Traditionally, this area has been subject to the jurisdiction of governmental agencies for such purposes as customs, narcotics, alcohol control, and the like, although, increasingly, the demand has been for control over fisheries. Internationally, such zones have been claimed as "one hour's sailing time" from the coasts, or twelve miles, or 200 miles. The United States has usually limited its claim to twelve miles as it did, for example, for Prohibition purposes, but a claim to sixty miles has been asserted for customs purposes. Moreover, Congress has enacted legislation creating and extending a United States "economic zone" to 200 miles in which the United States will initially claim special fishing rights, with mining and other rights, no doubt, to come. A 200-mile zone would seem to include all or at least the overwhelming bulk of the areas which might be suitable for WECS.

Internationally, the present limit embodied in the Geneva Convention on the Territorial Sea and the Contiguous Zones is twelve sea miles. Present drafts of a new international treaty suggest increasing this to twenty-four

36. *See generally* Convention on the Territorial Sea and the Contiguous Zone, note 32 *supra*.

37. Dr. Heronomus predicts that it is unlikely that even large arrays will substantially raise barometric pressures and cause shifts in wind direction or that there will be significant atmospheric effects. *See* AUDUBON, May 1974, at 87. Studying these effects through modeling and computer simulation would determine more precisely the degree and nature of these risks before any such large scale venture is actively considered.

miles. In this zone the coastal state may exercise the control necessary to: (a) prevent infringement of its customs, fiscal, immigration, or sanitary regulations within its territory or territorial sea; (b) punish infringement of the above regulations committed within its territory or territorial sea. Even though the zone may remain formally part of the high seas, the United States has greater rights of control and regulation over towers, superports, power plants, and WECS installations in the contiguous zone than it could exercise if they were in or on the high seas proper. Moreover, the United States legislation of 1976 appears to make United States claims to an "economic zone" likely, and, hence, property in this zone would be subject to the jurisdiction of United States courts for a 200-mile distance.

The High Seas. The area beyond the contiguous zone, wherever that ends, is high seas. Traditionally the high seas have been free for the peaceful use of all nations. Temporary preemptive uses, such as those for fleet maneuvers, or missile ranges, or space splashdowns are accepted; permanent obstructions of limited size are also tolerated internationally. This too may well change if technology alters significantly and creates undesirable results, or if some concept of an international control of deep ocean resources becomes part of international concern. These aspects should remain under review as the technology of WECS progresses.

Since all nations may freely use the seas for peaceful purposes, there is little doubt that an installation constructed and maintained to supply power is legal so long as such usage does not unreasonably interfere with the use of these areas of the oceans by others. Large numbers of major permanent obstructions, however, would present problems of legality under international law since their presence might constitute a "shutting off" of this "free" area. Claims to such permanent preempting uses have on occasion been made, but if navigation, fishing, and other activities were in fact seriously interfered with, other nations could be expected to question this preempting use of the high seas. Such questions would be especially likely to originate from countries with rights to traditional fishing grounds, or with other threatened vested interests. In time, there may also be created some form of international licensing authority with the right to control certain uses of the high seas and seabed, thus creating another potential complication to the placement of WECS in far offshore locations.

If structures are built in or on the high seas, the structures do not, obviously, become "international." Not only is ownership continued, but, under 14 U.S.C. §§ 2 and 89, the United States Coast Guard shall "enforce or assist the enforcement of all applicable Federal laws on or under the ***high seas*** and waters subject to the jurisdiction of the United States; [and] shall administer laws and promulgate and enforce regulations for the promotion of safety of life and property on and under the ***high seas*** and waters subject to the jurisdiction of the United States." WECS in the seas would seem to fit under this control and protection of United States owned structures. As noted, they might also in time be subject to the jurisdiction of an international seabed authority as an alternative or in addition to the United States rules.

Considerations Based on the Nature of the Seabed.

The Continental Shelf and the Outer Continental Shelf. Geophysically, the continental shelf is that portion of the land mass "pedestal" which moves downward into the ocean abyss. The United States, in its claim to the shelf first made in 1945, used a 600-foot depth of superjacent waters as the outer limit. Article I of the widely adopted Convention on the Continental Shelf of 1958,[38] however, used both a depth limit, 200 meters, *and*, even beyond 200 meters, "to where the depths of the superjacent waters admits of the exploitation." This has led to potentially vast and conflicting claims to the deep seabed since technology has increased the capability to work at ever increasing depths.

Under the Convention the coastal state has the right to explore and exploit natural resources of the seabed and subsoil of the submarine areas. If an offshore facility were located beyond the territorial sea or contiguous zone or the new economic zone, but on the United States continental shelf, or pipelines were laid on or under the shelf, the United States could claim the right to construct, operate, and protect the installations despite the fact that the waters above are high seas. Article 2(1) of the Convention provides that "[t]he coastal State exercises over the continental shelf sovereign rights for the purposes of exploring it and exploiting its natural resources." Thus, WECS located in such areas would be within the protective jurisdiction of the United States. Additional grounds for extending United States protection this far are found in the United States Outer Continental Shelf Lands Act.[39] Under that Act the United States includes all submerged lands lying seaward and outside of the area of lands beneath navigable waters as defined in Section 2 of the Submerged Lands Act, and of which the subsoil and seabed appertain to the United States and are subject to its jurisdiction. The Act provides:

> [Section 1332 of title 43, section 3 of the Submerged Lands Act] (a) It is hereby declared to be the policy of the United States that the subsoil and seabed of the outer Continental Shelf appertain to the United States and are subject to its jurisdiction, control, and power of disposition as provided in this Act.
> (b) This Act shall be construed in such manner that the character as high seas of the waters above the outer Continental Shelf and the right to navigation and fishing therein shall not be affected.
> [Section 1333 of title 43, section 4 of the Submerged Lands Act] Sec. 4. Laws applicable to outer continental shelf. (a)(1) The Constitution and laws and civil and political jurisdiction of the United States are hereby extended to the subsoil and seabed of the Outer Continental Shelf and to all artificial islands and fixed structures which may be erected thereon for the purpose of exploring for, developing, removing, and transporting resources therefrom, to the same extent as if the outer Continental Shelf were an area of exclusive Federal jurisdiction located within a state . . . .

Thus, even though the waters over the continental shelf or continental margin remain high seas, the United States has sought to establish juris-

38. 15 U.S.T. 471, 499 U.N.T.S. 311.
39. 43 U.S.C. §§ 1331-1343 (1970).

diction over certain structures in these waters which are attached to the shelf. This jurisdiction and these structures must be subject to the prohibition against unreasonable interference with the high seas. Nevertheless, reasonable measures taken to regulate such structures under general principles of international law appear to be permissible.

While the states have the Congress-given right in submerged lands to the three-mile mark, the federal government has control over the rest. The Federal government also has control over United States navigable waters. The Rivers and Harbors Act prohibits construction in navigable waters of the United States unless "recommended by the Chief of Engineers and authorized by the Secretary of the Army."[40] This prohibition was made applicable to the outer continental shelf by section 1333(f) of the Outer Continental Shelf Lands Act,[41] which provides: "The authority of the Secretary of the Army to prevent obstruction to navigation in navigable waters of the United States is extended to artificial islands and fixed structures located on the Outer Continental Shelf."[42]

The Sea Bed. At the present time, there has been no formal international agreement on the status of the seabed beyond the continental shelf. There appears to be a consensus that, despite the technologically based definition of the shelf contained in the Shelf Convention of 1958, there is some major area which is deep seabed and that some sort of international interest exists. In time, there will no doubt be mining (or scooping) and drilling operations, with or without international leasing, supervision, or regulation. It is preferable, however, to have a broadly recognized regime and widely recognized property rights. Current United States proposals for the deep seabed would accord special rights to an "adjacent" state. Together with an international seabed authority, if one can be created, this would satisfy the preferences of the United States and most other states and assure them that their common and special interests, as they see them, will be protected.

Existing and evolving United States and international law indicates the eventual creation of special rights in an adjacent state for an economic zone 200 miles wide offshore, including an exclusive right to develop energy resources such as wind energy; the United States and the states of the Union, to a degree, will without doubt claim the right to regulate the construction and operation of any WECS in the territorial sea, the present contiguous zone, the new "economic zone," on the United States continental shelf, and even in or on the adjacent high seas.

40. 33 U.S.C. § 403 (1970).
41. 43 U.S.C. § 1333(f) (1970).
42. This statute was construed in United States v. Ray, 423 F.2d 16 (5th Cir. 1970). Some entrepreneurs claimed ownership of two coral reefs 4-1/2 miles off Florida and planned to set up their own tiny empires. The Court found, however, that the reefs were part of the continental shelf and were part of the seabed and subsoil of the United States, as defined by Congress; as part of the outer shelf, the reefs were within the Outer Continental Shelf Lands Act of 1953 which applies to "artificial islands and fixed structures . . . erected . . . for the purpose of . . . developing" the reef. 43 U.S.C. § 1333(a)(1) (1970). The prior authorization of the Secretary of the Army was absolutely necessary for any construction; it was not given and dreams of empire vanished. WECS installations would seem clearly to have to meet the same requirements.

Several federal agencies already are concerned with towers in the waters. For instance, the Department of Defense prevents obstructions to navigation and protects American property; the Department of Transportation (Coast Guard) marks obstructions, issues safety regulations, and also protects United States public and privately-owned property; the Department of Labor, and especially OSHA regulate, in the interests of worker safety, the building and maintenance of towers and other structures; the Department of the Interior through its Bureau of Land Management, presently arranges leases for oil exploration and development and might be called on to do the same for wind energy installations; and the Environmental Protection Agency will require impact statements because federal funding or interests or licensing are likely to be involved. There will, no doubt, be other regulating agencies which may assert authority over WECS.[43]

Existing law presents many obstacles to the development of massive arrays in the seas, as it does to any major, permanent, wide-scale obstructions in the waters. Again, the issue must be presented and won politically, both internally and internationally. A very convincing case can be made for seeking to meet a high priority national need, a secure source of energy, with relatively modest environmental costs. The benefits of using the energy capacity of the sea winds, compared to alternative sources, seems, from society's viewpoint, to outweigh the relatively modest increased costs to fishing, shipping, and the potential additional burdens to international relations. If ways to compensate the private interests specifically burdened are developed, widescale WECS operations in the oceans may become acceptable both in the United States and abroad notwithstanding the inevitable extension of United States claims to control over the waters. A special problem, that of determining national boundaries in the oceans and seabed, also grows worse as the distance of WECS from shore increase and the possibility of conflicting national claims is enhanced.

IV. PROBLEMS OF LIABILITIES AND REMEDIES

A. *Nuisance*

The law of private nuisance has been developed in part from the maxim *sic utere tuo ut alienum nonlaedas*, use your land so as not to injure your neighbor.[44] The law, said Justice Sutherland, does not follow abstract con-

43. For a comparable survey regarding oil see D. KASH, ENERGY UNDER THE OCEANS 100-10 (1973). There is already an ongoing debate over the relatively isolated petroleum towers in the seas, quite apart from the oil spill or leakage issue: some see the platforms as useful places for fish life; others think them detrimental. Commercial fishermen argue that they are impediments. The Florida Audubon Society has protested their existence off Florida's coasts. *See generally id.* at 147. Even aside from the potential regulatory conflicts and burdens, the cost of operations, especially in deep water, may prove prohibitive. In the seas, a very demanding isolated environment, it may well be efficient to use WECS on towers already created for oil and gas production, presumably leaving the WECS to continue to function when the other fuels have been exhausted at the site; but sites and arrays chosen and designed for oil production may not be optimal for wind energy production. In addition, economic problems remain regarding how best to store or transfer the energy produced in what may often be a very small scale. Clearly also, if "floats" rather than towers are used, interesting problems of definition would arise: are they "ships" or "islands"? Are they to be manned by seafaring union members, or members of the Teamsters ("vehicles"), or by whom?

44. *See* Village of Euclid v. Ambler Realty Co., 272 U.S. 365, 387 (1926).

siderations of the building or of the thing considered apart, but by considering it in connection with the circumstances and the locality.[45] "A nuisance may be merely a right thing in the wrong place,—like a pig in the parlor instead of the barnyard."[46]

As a general rule, a property owner is free to use his property as he sees fit, without objection or interference from his neighbor, provided the use does not violate a statute or other local law. If, however, a neighbor's use unreasonably lessens the enjoyment of life or property, it may be stopped; the term usually used is that the unreasonable use constitutes a "private nuisance" to the aggrieved party. At the same time, courts have recognized that "not every annoyance . . . will be enjoined." In some instances, the interference is found to be so trifling that no remedy exists at all. In other cases, collection for damages, if any can be proven, will be allowed, but the activity will not be stopped. The closer the activity comes to being one considered necessary to the life of the community the less likely it is that a court will enjoin it.[47] Furthermore, where an activity is permitted by zoning or other laws, courts are very reluctant to override the legislative judgment, so far as they find it expressed. Legislative approval of WECS for particular areas would clearly help in avoiding claims of private nuisance. This would be aided by the tendency of some courts, where there is clear damage but the interest to be served by permitting the nuisance to continue is great, to permit "inverse condemnation" by assessing permanent damages in favor of the aggrieved while not enjoining the activity, thus giving the wrongdoer a permanent license to continue the activity without further complaint by the injured party.[48]

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45. *Id.* at 388 (citing Sturgis v. Bridgeman, L.R. 11 Ch. 852, 865).

46. *Id.* at 388.

47. *See* Boomer v. Atlantic Cement Co., 26 N.Y.2d 219, 257 N.E.2d 870, 309 N.Y.S.2d 312 (1970). In an earlier case, Bove v. Donner-Hanna Coke Corp., 236 App. Div. 37, 258 N.Y.S. 229, 232 (1932), the court set out a form of "community interest" approach:

> Congested centers are seldom free from smoke, odors, and other pollution from houses, shops, and factories, and one who moves into such a region cannot hope to find the air of the village or outlying district. A person who prefers the advantages of community life must expect to experience some of the resulting inconveniences. Residents of industrial centers must endure without redress a certain amount of annoyance and discomfiture which is incident to life in such a locality. Such inconvenience is of minor importance compared with the general good of the community . . . .
>
> Whether the particular use to which one puts his property constitutes a nuisance or not is generally a question of fact, and depends upon whether such use is reasonable under all the surrounding circumstances. What would distress and annoy one person would have little or no effect upon another; what would be deemed a disturbance and a torment in one locality would be unnoticed in some other place; a condition which would cause little or no vexation in a business, manufacturing, or industrial district might be extremely tantalizing to those living in a restricted and beautiful residential zone; what would be unreasonable under one set of circumstances would be deemed fair and just under another. Each case is unique. No hard and fast rule can be laid down which will apply in all instances. . . .
>
> The inconvenience, if such it be, must not be fanciful, slight or theoretical, but certain and substantial, and must interfere with the physical comfort of the ordinarily reasonable person.

48. *See* text accompanying notes 53-55 *infra* for discussion on inverse condemnation. *See generally* W. PROSSER, TORTS, §§ 82-91 (4th ed. 1971); Beuscher & Morrison, *Judicial Zoning Through Recent Nuisance Cases*, 1955 WIS. L. REV. 440; Juergensmeyer, *Control of Air Pollution Through the Assertion of Private Rights*, 1967 DUKE L.J. 1126.

Excessive noise has been one of the traditional bases for claims of nuisance and cannot be discounted for WECS. A number of commentators have suggested that, based on observations of the few large units now in operation, noise will not be a real problem.[49] The rotor of one type of windmill, however, makes some noise in high winds as the blade tips may beat at 100 to 200 miles per hour, and the generator makes a high frequency whine. The whine, however, is stated to be inaudible at fifty feet. Note however, that significant amounts of infrasound vibrations from moving WECS are inevitable.[50] Cumulatively, these factors may be destructive to property or life; this will have to be studied immediately if the innovation of large numbers of WECS systems is to be rationalized. Very little is now known about these effects, though it is known that such vibrations are a cause of carsickness in some people, and that under some circumstances they may cause physiological damage.[51] The EPA has not issued regulations on infrasound to date.

Thus, when WECS are used in an area with neighbors, the possibility of a claim of nuisance can never be totally discounted; the cases suggest, however, that each landowner has an individual right to use his land in his own best interests, so that interference, where there is no physical invasion of the neighbor's land, must be substantial before it will be barred. Where large systems are contemplated, it may also be necessary to consider the purchase (or condemnation) of a substantially larger area than is physically necessary for the specific location of the machines themselves, so that there exists a form of neutral zone, owned as part of the WECS complex, in which all potentially adverse effects on neighbors will be dissipated, eliminating any claims of nuisance or trespass.[52]

B. *Inverse Condemnation*

One approach to de jure authorization of the continuance of an otherwise harmful or enjoinable wrong, is through the relatively new doctrine of inverse condemnation. While the United States Constitution prohibits the government from any arbitrary taking of private property, it does permit a government, for a public purpose, to take private property when just, prompt, and adequate compensation is paid. This is called the right of

49. MITRE, Proceedings on the Second Workshop on Wind Energy Conversion Systems (RANN Serial No. NSF-RA-N-75-050 MTR-6970); R. Ramakumar, W. Hughes & H. Allison, Economic and Technical Aspects of Wind Generation Systems (paper reported in the Proceedings of the 1974 Internation Conference on Systems, Man and Cybernetics, Dallas, Texas, IEEE Catalog No. 74 CHO 908-4 SMC, at 88-92) (Oct. 1974) [hereinafter cited as Ramakumar, Proceedings].

50. It is reported that infrasonic waves are intolerable to worms and that this has been exploited by Florida native fishermen to drive them out of the ground and into the open. This is the so-called "grunting for worms" activity. Vibrations are induced by means of driving a hardwood stake into the ground and rubbing the stake head with a section of auto leaf spring.

51. Some French scientists were reported to have been fatally hurt while exploring infrasonic wave technology several years ago.

52. For example, noise, visual pollution, and wind robbing. Presently neutral zones exist in the creation of large facilities for other purposes. The Dallas-Fort Worth airport, for example, used this technique of extensive purchase to assure it would have a very large area in which it controlled the land and its use, with the intention of keeping developers and others so far from the central facility, its glidepaths, operations, and related areas, that no claims of noise, vibration or the like could ever be successfully maintained.

eminent domain. To use the airport and air way analogy, when a governmental agency decides, on a fair basis, that an airport is essential to the public welfare in a particular area, it is legally authorized to purchase the land needed for the airport. When the owner is unwilling to sell, the government may acquire the land by condemning it under the power of eminent domain. Land can be taken similarly under proper conditions for such public purposes as the creation of a utility system. To return to the analogy of airspace and airports, it was decided in the 1940's by the United States Supreme Court that reasonable use of airspace for aviation purposes was permissible, under federal preemption of regulation and control, and that each landowner over whose land an aircraft passed had no right, in general, to bar the passage of an airplane or seek damages on some theory of trespass or nuisance.[53] Some time later, however, the Supreme Court went on to rule that where the operation of an airport, through the need for very low approaches or take-offs over private property, caused a demonstrable loss in the value of that property, the owner was entitled to compensation for the loss, even though the government did not in fact want his land. The government, or other taker, was thus required to pay for the loss in value; although it did not acquire the land, it did nevertheless acquire the permanent right to overfly this land and do whatever normal reasonable damage the overflight occasioned.

Courts may tend to analogize treatment for WECS to that given airplanes. Indeed, since WECS may generate more continuously disruptive effects than jets, it seems likely that a government or utility using a large array which causes continuous "damage" may expect claims for compensation on the basis that the interference constitutes a taking, although perhaps unwitting, of a property interest. Analysis of case law indicates that payment typically has meant that the damaging acts can be continued in the public interest, the right to continue them vis-à-vis the inversely condemned property being thus assured.

In passing, it may also be briefly noted that efforts on behalf of airport authorities to bar residential uses near airports have been struck down by the courts when, for example, severe height restrictions were not strictly necessary for safe operations;[54] yet, at the same time, density controls and large lot zoning have been upheld[55] even though they may limit the property value of the land affected. Presumably the airports are not liable for foreseeable nuisance damages on properties built after the airports are in place. Clearly, as with airport development, if large scale WECS installations become economically attractive, and if they prove to have undesirable features such as noise, vibration, or local environmental or climatic effects, the cooperation of local government authorities will be essential to fit the WECS into a relatively benign, threat-free accommodation with existing systems of other potential land uses and land users.

53. United States v. Causby, 328 U.S. 256 (1945).

54. *See, e.g.*, Indiana Toll Road Comm'n v. Jankovich, 244 Ind. 574, 193 N.E.2d 237 (1963), *cert. dismissed*, 379 U.S. 487 (1965).

55. *See* Morse v. County of San Luis Obispo, 247 Cal. App. 2d 600, 55 Cal. Rptr. 710 (1967).

C. *Wind Robbing*

The field of intentional weather modification has produced a number of examples of how even the fear of losing one's natural weather due to experimental or commercial cloud seeding ventures, whether or not such fears are scientifically valid, can lead to law suits and, of greater importance, to legislation and administrative proceedings which can bar the activity totally or limit its development.[56] While courts have rarely attempted to deal with it or define it, a landowner appears to have some kind of property interest in not being deprived of the normal benefits of what moisture nature would bring. This is not unreasonable given that the value of land takes into account the typical natural weather enjoyed thereon. Weather robbing, or wind robbing, might well impose a serious loss in capital value of the properties affected.

Courts have rejected the notion, for purposes of solar energy collectors as well as all other purposes, that, absent a statute or individual agreement or limitation in a deed, a property owner has a right to a view or to sunlight coming to his property from across another's property. As one commentator reports, "the law in the United States is well established that a surface owner has a right to receive light from that area of the sky directly above his property but not to receive it across the land of his neighbors."[57] If this interpretation prevails, shadowing or wind robbing by a WECS tower would not invade the property rights of affected neighbors. However, the possibility of affected parties seeking legislative relief if deprivations were serious always exists.

Although we do not yet know all of the environmental, noise, and other effects of WECS in single units and in larger arrays, we do know that a WECS does in fact, of necessity, diminish the wind energy potential in its immediate area. This diminution appears to persist for about ten diameters (the distance from tip to tip of the blades of a traditional windmill) depthwise, and three diameters perpendicular to the wind,[58] and this deprivation may cause compensable damages on any of various legal rationales. Furthermore, the effect of hundreds or thousands of systems in a given locale is not yet known, but it is clearly possible that one WECS system could adversely affect the performance and energy extraction of another.[59] This might lead to conflicts between neighboring towns, jurisdictions, or energy districts.

Given these facts, what can we say about wind robbing? First, it may well be that, if the engineering estimates noted above are correct and wind energy recovers fairly rapidly, proper siting of small units or large single units, or use of large properties for relatively small arrays of WECS, will minimize the problem by permitting a restoration of wind energy to its

56. *See, e.g.*, CONTROLLING THE WEATHER (H. Taubenfeld ed. 1970).
57. Thomas, *Access to Sunlight,* in Solar Energy and the Law, *supra* note 16, at 8.
58. Ramakumar, Proceedings, *supra* note 49.
59. Letter from Harold C. Larsen, Dir., AFIT Aerospace Design Center, to Howard J. Taubenfeld (July 30, 1975).

momentary normal by the time it reaches a jurisdictional boundary. This could be a reasonable type of local regulation to explore.

Secondly, if the existence of a WECS on one property interferes with the operations of a WECS on an adjacent property, the courts will, absent a statute, probably decide on the basis of an analogy. If the analogy is water law, the United States is divided between states which use either (1) a theory of prior appropriation, in which a first user obtains a vested right in what he uses, or (2) a theory of riparian rights which, while authorizing an upstream user to fulfill his own reasonable needs, prevents him from interfering with reasonable use by others, thus forcing a sharing. In states where the theory of prior appropriation is used, WECS operators would have a vested right in the wind they appropriate and would not be subject to liability for depriving their neighbors of wind power; WECS operators in states which follow the theory of riparian rights, however, would be legally obligated to share the wind as well as being liable for interference with reasonable wind use by others. If the analogy chosen is that of earlier court-developed United States oil and gas law (derived, in turn, from the old Roman law concerning wild animals), then the first claimant to possess the source will prevail. Another type of law to which courts might analogize is the later oil and gas law which developed the idea of correlative rights and sharing in a common resource. If, on the other hand, the analogy is the modest amount of case law in the field of weather modification, then there is a support for the idea that each property owner has a right to what nature sends to his property undiminished. Note, however, that if the analogy takes off from the courts' treatment of light and views in the United States, there will be little protection for the first WECS in the area. The importance of choosing the wind dominating site could become crucial to the intelligent investor who might otherwise find his land's value diminished by a later, better sited array.

Obviously, none of these analogies presents a perfect model for regulation by the public through legislation or court action of wind as an energy source. If the wind is treated as a weather flow, a property owner has an embryonic right to have its use as nature forms it—but only in a limited sense. His neighbor can erect a building, or alter a grade, or remove a building, or other wind screen, or do many other things which will affect the wind, without normally incurring liability. There may, however, presently be exceptions to this insulation from liability. A landowner cannot redirect waters on his land in such a way as to damage a neighbor. By analogy to this common law rule, one could argue that a landowner may not be permitted to redirect wind speed or direction in a manner which will harm a neighbor's land. Nevertheless, as with solar collectors, it seems doubtful that courts today, absent protective legislation, will prevent a landowner from using his land in any normal way, even though this interferes with one or more WECS on other properties. Present law does not seem to create any rights in the owner of the WECS which would override the right of his neighbor to use his land as he sees fit. The present law probably equally protects the rights of a landowner who erects a WECS which shadows and diminishes the normally

available wind energy to an adjacent WECS system;[60] the second WECS operator, too, would have a right to use his land as he sees fit.

D. *Other Bases of Legal Liability*

Although not an entirely new technology, present proposals for use of WECS add at least a new, intensive scale to this old technology; this new scale could generate problems. In the absence of substantial weather effects generated by WECS, or infrasonic wave problems developing, there does not appear to exist a clear-cut basis for radically new liabilities. Nevertheless, it would be helpful to review the additional bases of legal liability other than nuisance, together with an indication of who would traditionally bear potential liability for damages caused in conflicts emanating from WECS.

Under the law of negligence, a person is not normally legally responsible for injuries to others unless he has behaved in a way which an ordinarily prudent person would have avoided. Certain actions, however, are dubbed "negligence per se" and, in these cases, broadly speaking, no other proof than that the violation occurred and that it led to the injury is necessary. Assuming the law of negligence will be applicable, several conclusions are foreseeable.

The manufacturer of a WECS can expect to be held liable to anyone who is placed in foreseeable risk by the negligent manufacture of the system, as for example, from the damages of infrasonic vibrations without warnings or other controls. He is also likely to be held liable to persons to whom a specific guarantee (warranty) has been made and to those closely associated with them (their family, for example). He may also be held liable to anyone to whom, although not in privity, the courts will assume an implied warranty of fitness of use has been made. Finally, if, under the circumstances (*e.g.*, in a crowded city), the system is considered to be inherently dangerous, then liability could be based on a strict liability theory. Similar liability would extend to manufacturers of component parts of WECS. Similarly, a seller of a WECS would be held liable under express or implied guarantees made when injury follows as a result of a breach of the guarantee.

The operator of a WECS will be held liable to anyone injured by his negligent operation, when the injury occurs within the range of foreseeable risk. He would also be liable to anyone injured where the operation of the machine, array, storage system, or combination is deemed ultrahazardous, whether or not negligence is involved.[61]

Perhaps the infrasonic or the vibration or other problems will cause some systems to be labeled ultrahazardous in some environments. In any event, injured persons are also often aided by legal presumptions that certain

60. If the use of this resource is encouraged, protective legislation, such as that created for zoning purposes, can be readily written or appropriately modified.

61. While the terms "ultrahazardous activity" and "strict liability" are not truly synonymous, they both imply a situation in which the risk to life and property created by the mere existence of an activity is rated by the law as so high that liability will be imposed on any party creating the risk when damage is caused, even if the activity is performed in the most careful manner known. With a new technology, those involved must be aware of the increasing tendency to hold manufacturers strictly or absolutely liable where their product is considered to be one unreasonably dangerous to the public.

injuries would not normally occur unless someone was in fact negligent (*e.g.*, the doctrine of res ipsa loquitur). Such presumptions might be applicable if, for instance, a wind energy device disintegrated and caused injury, thus suggesting inadequate maintenance even though the injured party had difficulty pointing to a specific act of negligence.

E. *Interference*

Electronic Transmissions. In considering siting of WECS, the possibility of interference exists with microwave beams or radar beams from Doppler effects (frequency shifting), if the WECS is located in the main lobe or side lobes of a microwave beam or radar beam. TV signals might oscillate on home receivers in synchronization with some harmonic of the fundamental frequency of the rotating blades. There has been some evidence of interference in a Dutch project where a windmill, fitted with metal blades, did cause interference with local TV and, as a result, was shut down during broadcast hours.[62] It has been suggested that the problem can be solved by using electronic filters for radar or microwave systems, or by the use of blades of fiber-reinforced composite materials such as Apoxy-boron, rather than of metal.[63]

A prior use of an area for transmissions might preempt the use of a WECS without proper safeguards because of the possibility of conflicting uses.[64] There are, however, a number of cases dealing with interference with television transmissions which are more favorable to a late-coming WECS. For example, in *People v. Sears, Roebuck & Co.*[65] the state courts held that the completion of a 110-story building would not be enjoined even though it interfered with television reception in certain adjacent areas because a landowner has the right to construct a building on his property to any desired height, so long as he is not barred by legislation. The courts held that this would not constitute a nuisance. The issue eventually might turn on whether the costs of avoiding interference by use of other materials for building windmills were low or could be lowered by use of innovative technology in relation to the widespread damages caused to others. In all such cases, the issue: "Who shall bear the costs?" also must be faced.

The recent evidence from cases seems to suggest that, as is typical, the status quo is to be relatively favored by the courts. The new building or innovation generally can be expected to bear much of the burden, by absorbing the added costs, if any, of efforts to reduce interference with already established usages of property. This politically inevitable bias is indeed implicit in the EPA Act. Thus, it is new projects which must produce environmental impact statements. This has not, however, uniformly been the courts' attitude; for example, in the already cited instance of skyscraper interference with sun, view, and even television the innovation was not dealt with prejudicially.

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62. MITRE, *supra* note 49, at 482.
63. *See id.* at 390 (general discussion of radio frequency interference).
64. *Compare* text following note 59 *supra*.
65. 52 Ill. 2d 301, 287 N.E.2d 677, *cert. denied*, 409 U.S. 1001 (1972); *see* Annot., 58 A.L.R.3d 1136 (1974).

In sum, the issue of who should bear the costs of progress is intrinsically normative and, in practice, is decided politically in the political-legal system. In the progress of social policy creation on any particular instance, the legislative and court systems may, at times, make different attributions of these costs. An innovator, however, should expect that, if recent practice is not reversed, the innovator will be expected to bear the costs of change from the status quo.

Birds. Towers inevitably present some hazard to birds. Possible effects of WECS and systems of WECS on migratory birds are also under investigation. Alternatively, WECS towers may provide good nesting places for some species, but birds may present some hazards to WECS generators. The questions raised by these problems involve value conflicts similar to those discussed above, but this time it is the purported needs of birds and those who derive joy from watching them or sharing the world with them which are to be added into the calculation of the costs and benefits to all humans. This again is not an isolated phenomenon. The necessity to make such value trade-offs is typical of the ecological dimensions of this type of innovation.[66]

Aircraft. While even the tallest towers proposed would not normally pose a hazard to aircraft in regular flight, towers used in certain geographic situations could be hazardous. This would occur in the normal course of events if the towers were placed near an airport in a take-off or landing path or if the towers, placed, for example, on a hill or mountain simply increased the hazards to flight already posed by the hill. For these reasons selection of major sites for WECS directly adjacent to airports seems an unlikely probability.

Towers in any location, under present regulations of the Federal Aviation Agency, require identifying lights to warn aircraft and apparently the tips of the whirling blades may have to be lighted, making them a possible attraction for armed vandals and hunters. Consider, however, that while utility companies and others relying on towers have become adept at camouflage and other techniques available to avoid offending aesthetic sensitivities, these very techniques make the objects less visible and hence more of a hazard to aircraft. A dilemma is implied once again. This is not atypical of the unavoidable conflicts of interest now posed by the regulation of change and innovation by society.

In addition to requiring lights, FAA regulations limit the height of obstructions in the flightpath or glidepath of aircraft. Where it becomes critically necessary to install an array of wind energy machines in an existing or

66. Indeed, an early ecology-environmental issue of the modern era, the question of the continued production and use of DDT in world-wide health programs, posed this specific issue and spokesmen from developing countries were reported as asking: "Will you save your birds or our people?" Even in the United States, the decision has thus far gone in favor of United States health programs in cases where insecticides threatened the environment, but where no other insecticide was available. The World Health Organization programs against malaria and tropical diseases likewise have been exempted from a United States ban on DDT export and use. *See* R. Taubenfeld, *DDT: The United States and the Developing Countries*, in MAN'S IMPACT ON THE OCEANS AND BIOSPHERE 499 (1971).

proposed glide path, a re-routing of aircraft would appear to be essential. Thus, an issue of a public policy choice would arise and costs, social as well as economic, would have to be estimated so that choice could be properly rationalized. Since landing and take-off patterns are also wind dependent, an irreducible conflict in interests is possible. Where the airfield is an established one, permission to create a WECS installation which could affect air traffic would normally not be granted.[67] Again, however, that may depend on the intensity of the need for conflicting services and the array of practical alternatives.

F. *Storage*

There are several legal problems associated with use of WECS in interface with or as part of a major utility network, but such a network would also provide one means of storing any excess power generated. Excess power would simply enter the network and become unidentifiable with power from other sources, the production of which would be adjusted downward if necessary. In so far as this involved fuel savings because alternative sources of power were not used, the savings could be considered as a form of storage.

Suggestions for other storage possibilities range from present or to be developed batteries, the creation of hydrogen fuel by electrolysis, storage of compressed air, hot water storage, magnetic, hydroelectric, and flywheel storage. The risks of all tend to be conventional; new technology is not really involved. Each possibility has technological assets and liabilities; each presents risks which differ from the others. In fact, none of these alternatives is revolutionary or unknown to practitioners in other fields; the only novel idea, that of use of an existing utility net as storage, will be noted further in the discussion of "Utilities" below. Of the remainder, only the possibility of stored hydrogen seems to offer a special risk, that of explosion. This risk, however, is associated with this form of energy storage, not one created by WECS. Storage of hydrogen is quite possibly a system which presents more risks than the energy generators themselves. The problems of extra risk, ultrahazardous activities, and the like which were discussed above would be applicable to analysis of liability as regards storage systems. Storing a potentially explosive gas in any environment in which high risk of injury or death existed would itself presumably be ultrahazardous, but even if this form of storage were adopted in some areas, only the actual patterns of development of WECS technology will indicate whether such storage would have to be in close proximity to the generator. If so, the entire operation might, in such instances, be classed as creating such an intolerably high risk that it would either be prohibited, or it would be classed as ultrahazardous. If it is ultrahazardous then liability would be imposed without regard to fault. Moreover, storage of hydrogen in a cryogenic liquid form or entrained in hydrides of FeTi, rather than as a gas, might well sufficiently reduce the risk element. In any case, if storage is in the form of

67. *See generally* Objects Affecting Navigable Airspace, 14 C.F.R. § 77 (1977).

hydrogen, or other potentially dangerous form, this set of issues will, indeed, require careful attention from the legal advisors of the innovating companies.

Collection of data on the costs of minimizing all unnecessary risks from operation, storage, or use of WECS energy output would be relevant to an analysis of the broader energy policy issues involved, and WECS' place in that policy. All energy producers could be required to maintain records of such data so that the appropriate comparative data bases for rational environmental decision-making could be collected. In the past, such a data base has rarely been available. One important outcome of the recent stress on assessment of environmental and other effects should be to require that at least federally aided or sponsored research be designed to produce the data required for an ultimately more rational choice by society. Then we can hope to improve decision-making on complex innovation issues. In the past, without such a specific policy, the essential data has not been produced even in federal projects.

V. A Brief Look at Environmental and Other Regulations

A. *Climate and Environment*

WECS, even in large arrays, are currently predicted by some to have little or no effect on large scale climate,[68] but research into such possibilities is just beginning and there is little data to support that contention.

Ramakumar, indeed, has suggested a very interesting possible *benefit* from using WECS; they may help in reducing evaporation of lakes in arid and semi-arid areas.[69] Since it is unclear whether benefits, or at least no disadvantages to climate, will result from arrays of hundreds or even thousands of units in one geographical locale, before large scale innovation is likely to be acceptable, the results of computer modeling on these issues will surely be required for scrutiny by those groups which give great weight to environmental factors, and by the regulatory community as well.

Moreover, as noted elsewhere, micro-climatology may well be more readily and significantly affected by large arrays than has been experienced in the past with solitary units.[70] It is already clear that much more research must be done to assess possible environmental impacts before major innovations are undertaken.[71] Otherwise, indeed, law suits by individuals fearing negative results to their own interests as well as the environment seem

68. A 1975 workshop concluded, for example, that:

> An array should have negligible impact on the climate. Although energy is extracted out of a thin air stream, the downward momentum flux in the atmosphere is such that no trace of the turbine should be experienced more than 10 times the rotor height downstream. This would also apply to rotor created turbulence transported downstream.

M. Changery, Initial Wind Energy Data Assessment Study 10 (RANN Serial No. NSF-RA-N-75-020) (May 1975).

69. Ramakumar, Proceedings, *supra* note 49.

70. S. Rogers, M. Duffy, J. Jefferis, P. Sticksel, D. Tolle, Evaluation of the Potential Environmental Effects of Wind Energy System Development 375 (Interim Final Report, Serial No. ERDA-NSF-07378-75-1) (August 1976) [hereinafter cited as Rogers]. *See also* note 68 *supra*.

71. Ramakumar, Proceedings, *supra* note 49.

likely. Environmental authorities, federal and state, may also be expected to intervene.

One interesting point has been made by Rogers in discussing the effects of tall trees, which like wind turbine generators, could be expected to affect wind speeds. She has pointed out that, while research is still in progress, there seem to be both positive and negative effects. "[V]ery often, the productivity of crops planted directly behind the wind breaks of the Dust Bowl era would drop significantly; but across the field, as the wind speed increased, and turbulence was smoothed out, the productivity would increase substantially."[72] Current studies are seeking to identify possible microclimatic variations including effects on pest species, spores, and other organisms since "just a minor change in the wind speed might cause them to . . . drop out."[73]

Ongoing studies through aerodynamic analysis include some designed to project the behavior of "flying organisms (birds, insects, and bats) within the zone of influence of the rotor, specifically the potential for entrainment of these organisms at operational wind speeds, organism maneuverability or avoidance potential, and collision probability. In addition to these investigations there is a field study of bird kills on [a] 200-foot meteorological tower during spring migration."[74] Large arrays on major migratory bird flyways would be a potential problem for some species in some areas. For example, one major American flyway is over the Great Plains, a region of substantial wind energy potential. The results of all these types of studies could become important if WECS lead to major changes in microclimate or other aspects of the environment, which in turn engender significant ecological changes. This, in itself, would not necessarily be an overwhelmingly negative phenomenon, but the relevant environmental authorities would be required to monitor and evaluate such events. This also can be counted on to heighten the attention paid to such innovation and, as such, to give these environmental issues a salience which may be disproportionate. Nevertheless, it is necessary to discuss briefly some of the major legal and institutional vehicles for environmental protection in the United States, and their policy implications for WECS.

B. *Federal Regulation: NEPA*

Two special areas of federal regulation are of concern for any large unit or sizeable installation designed to harness energy. The most obvious is the regulation of the environment provided by the National Environmental Policy Act of 1969 (NEPA).[75] This Act applies to all agencies and to all effects of federal or federally-assisted programs. The protection of the

72. Rogers, *supra* note 70, at 376.

73. *Id.* at 378. Soil nutrient and moisture demands of the trees reduce crop productivity near them, an effect not likely with WECS towers. Both trees and towers, however, may keep crop dusting aircraft flying at some distance from the obstacle, leaving the ground less well treated. Other possible long term ecological studies could include effects on the "structure and composition of vegetation and insect communities, measures of productivity and/or migration and changes in frost occurrence or snow depth."

74. *Id.* at 376.

75. 42 U.S.C. §§ 4331-4347 (1970 & Supp. V 1975).

environment is said to be the duty of all agencies. The other major area of federal control, discussed below, is the regulation of power. This field has been subject to the jurisdiction of both the Atomic Energy Agency and Federal Power Commission.[76]

NEPA established a national policy for protecting the environment and, indeed, for restoring lost quality to many areas of human interface with the environment.[77] The principal section of interest requires agencies to "include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment," a detailed statement by the responsible official on what the probable environmental impacts will be.[78] Clearly, and by intention, the development and introduction of new technology is slowed by the need to prepare reports, to have them reviewed, to have the process opened to court delays through suits and injunctive relief, even to the extent of barring implementation of a new technology entirely if it is deemed, on balance, undesirable. The Act requires vigorous exploration and description not only of the proposed activity, but of alternative courses of action, an analysis of their costs, impact on the environment, and a comparison which balances the net worth of the proposed project with the environmental and other risks and costs implied by alternative courses of action.[79] In view of the energy producing alternatives available, the requirement that credible alternatives be surveyed may give an advantage to the development of WECS federal programs since comparisons are likely to favor WECS.[80] Note, however, that while all agencies must comply with the Act and even a single structure can call the Act into play,[81] not all courts have been equally severe in finding the major effect requiring compliance.

In addition to the federal laws, there are similar laws in half of the states. Where a government permit is needed, even a private construction can be obliged to meet state and federal law requiring an impact statement.[82]

For WECS the laws mean that experimental projects involving federal agencies and support are presumptively subject to the NEPA requirements if they have or are likely to have meaningful environmental impacts. In time, large arrays anywhere, or arrays which are not well camouflaged, or beautiful, or are still felt to pollute the visual environment will need to be justified and examined under federal and, where appropriate, state environmental protection acts; this seems to be well understood by the federal agencies involved.

If noise, in one form or another, including infrasonic noise waves, should prove to be an important consequence of the use of large WECS, or WECS in massive arrays, the Environmental Protection Agency (EPA) must act.

76. *See, e.g.*, Calvert Cliffs' Coordinating Comm., Inc. v. United States Atomic Energy Comm'n, 449 F.2d 1109 (D.C. Cir. 1971).
77. *See* Air Quality Act of 1967, 42 U.S.C. §§ 1857-1858a (1970 & Supp. V 1975); National Environmental Policy Act of 1969, 42 U.S.C. §§ 4331-4347 (1970 & Supp. V 1975).
78. 42 U.S.C. § 4332(2)(C) (1970).
79. Natural Resources Defense Council, Inc. v. Morton, 458 F.2d 827 (D.C. Cir. 1972).
80. In general, on construction of NEPA see 17 A.L.R. Fed. 33 (1973).
81. *See* Goose Hollow Foothills League v. Romney, 334 F. Supp. 877 (D. Ore. 1971).
82. *See, e.g.*, Dulles v. Volpe, 344 F. Supp. 573 (E.D. Va. 1971).

Under the Noise Control Act of 1972, the EPA is to regulate noise injurious to public health and welfare. There has to date been little research and, to the best of our knowledge, no quantifiable data produced, much less meaningful criteria by which to judge how much noise from a WECS would be too much. In time, research will determine whether WECS in fact present any form of substantial noise hazard and also, how, if at all, they affect other valued environmental and other dimensions. Surely it is possible that some alternatives could have even worse defects than noise problems. We would assume that the EPA has, or will have, a policy which would handle such trade-offs so that society would be enabled to make the optimal compromise. Note that any absolute bar to environmental deterioration in any one dimension arising from noise, air pollution, or other activities, may serve to bar a rational choice by society. This should not be allowed to happen. Society must preserve its capacity to make even painful trade-offs rationally.

C. *Some Federal Regulation: OSHA*

In recent years, the question of the safety of workers has received renewed federal interest, culminating in the creation, in the Department of Labor, of the Occupational Safety and Health Administration. Title 29 of the Code of Federal Regulations now includes, in great detail, standards for materials, equipment, workplaces, etc., which must be met for the creation of less hazardous work conditions. Increasingly in the last few years, OSHA has engaged in vigorous campaigns of enforcement, as many employers have been discovering. Moreover, in general, OSHA will note and endorse state standards which are more rigorous than its own, and apparently will cite violators of standards which are thereby incorporated into its rules.

For wind energy systems, the principal concern of OSHA appears to be the towers; construction involving ladders, towers, scaffolding, and the like all come under OSHA's standards,[83] and compliance will doubtless influence the costs of the systems. Again, the towers will tend to be tall under most current major proposals and will obviously be placed in areas of substantial wind. They will have to be designated to withstand high wind speeds, perhaps 130 miles an hour or more.[84] The blades, it is estimated, should clear the ground by perhaps ten meters or more for large systems, pointing once again to tall towers.[85] Such towers and the generators will in fact be subject to routine access for inspection, repair, replacement of parts, and so forth. OSHA's interest and legal concern will go beyond the original construction, lasting through the structure's life. Moreover, if a tower is located in or near a continuing workplace, as, for example, on or close to a factory or other establishment, OSHA will insist on its safe construction and maintenance in order to protect those who work in its vicinity.[86]

83. *See* OSHA, Occupational Safety and Health Standards, 29 C.F.R. §§ 1910.1-.1500 (1976).

84. Grumman, Windstream 25, *supra* note 17, at 25 (notes that their 25-foot diameter wind generator systems are designed to withstand hurricane force winds of 130 mph).

85. A. Stodhardt, Selection of Tower Height for a Wind Driven Plant, in MITRE, *supra* note 49, at 122.

86. Interview, OSHA staff, Dallas, Texas (June 1975).

Where heights of structures are twenty feet or more, specific requirements for landing platforms for every twenty or thirty feet of additional height, for railings, for strength, and other safety features as well as for maintenance and regular inspection are thus already in the national law, and, if state requirements are higher, the latter will normally be the ones enforced. Meeting such standards adds both to safety and to the explicit cost of WECS. To the extent that this is a barrier, it is unlikely to be unique to WECS; other energy producing technologies will no doubt have to conform to relevant comparable regulatory requirements. At least this suggests that such regulation is likely not to distort the energy technology choice unfairly since all the alternative energy technologies are likely to be subject to it. It may be regarded as useful by an innovator that this regulatory structure and the costs likely to be engendered are already in place so that the order of magnitude of the attendant regulatory costs is roughly foreseeable and calculable.

VI. UTILITY COMPANY INTERFACE

Most of the predictions for the eventual use of wind energy systems seem to focus on an increase in the number of small units and on an eventual use in large utility systems. Although social impact prediction technology is in its infancy, it is fitting to summarize briefly, from our current vantage point, the potential legal and regulatory problems which seem to lie in these areas.

A. *The Small Unit*

Current rate systems tend to punish the small or infrequent user of power. Thus, a family installing a private WECS system for use as their primary power source but which would also be serviced by a utility company would often today pay a relatively higher rate for the utility company service it continued to require. The problem is the same whether the primary source be a WECS or a solar energy collector, or a combination thereof, an idea which may prove promising.[87] Flat rates for all users do seem increasingly in fashion, in any event, since the country's focus is on conservation rather than on the encouragement of consumption through lower rates for mass users. It should be noted, on the other hand, that utility company costs rise as existing plants are used at less than minimally efficient capacity, something which might occur in some cases if home use of WECS became common. This seems unlikely in most cases, however, since total energy consumption in the nation is expected to continue to increase. Nevertheless, in some instances, regulatory rate makers may wish to consider this aspect, too, at least as a transitional economic problem for the utility companies.

As noted above, the storage problem is real inasmuch as battery technology awaits a much-needed major breakthrough and other alternatives are not yet feasible. The concept of storage of electric power by feeding excess power produced by WECS into an existing utility company net presents technological difficulties, including safety problems which could no doubt

87. *See, e.g.*, Solar Energy and the Law, *supra* note 16, at 11-15.

be overcome. The effects on energy industry structure and on rate-making and regulation might be substantial but this does not seem at all inevitable. Major utility companies could be required to absorb excess capacity into their grids; this might indeed minimize energy resource waste. Rate-making policies obviously could be adjusted by regulators under a social policy not to disfavor such potentially complementary as well as competitive efforts at energy self-help, or alternatively, to aid efforts at self-help. Such grouping into a single common pool with innumerable outlets would be more efficient and easier to regulate fairly than attempts to convey excess energy, when produced, to neighboring households. Presumably, at present such pooling is likely to minimize the negative effects of such conflicts of interest by minimizing negative effects of such requirements on the industry, where possible, without adversely affecting efficiency. Other techniques of storage may be innovated and the problems may vanish.

State regulation and control of the right to enter into the utility business normally applies only to public systems; a purely private system for a home, factory, or the like should presently be acceptable. If, however, such systems need to tie in at all to a public system, or to sell to other parties, they may well come under the jurisdiction and regulatory control of a state or federal agency. The interplay of small private systems with a large regulated monopoly system will need careful analysis to protect all involved, consumers as well as producers; this must be done before widespread implementation is carried very far and the die is cast. Increasingly, one hears about the possibility of neighborhood or community windmills, as is the present case with ownership and maintenance of water towers. The political impact of private or small scale enterprise compared to major regulated public utilities merits exploration. Regulatory protection within the present legal framework may not suffice to protect the small individual entrepreneuer reliably, particularly if an aware power industry decided to oppose such nuisance competition. More self-sustaining, potentially politically acceptable WECS units could quite possibly be established, ranging in form from partnerships to corporations specializing in management of supplementary WECS.

Some suggestive models might be provided by organization in the television field which is structured variously from the community antennae for apartment houses to towns, to the kinds of regulated local private business entity suggested by locally franchised cable TV. The potential exploitation of local cooperatives, or even of community ownership and management, to facilitate the growth of supplementary solar and wind energy systems also need exploration. Special solar energy districts might also be possible for development and regulation, but they would need to be on very good terms with the local utilities, especially the conventional firm. Presumably, ways can be explored to organize individual interests so that they cooperate to counterbalance, at least to some extent, the bargaining power of the giant utilities. Nevertheless, despite the problems, legislative innovation of new ways to regulate and monitor such new, smaller scale business or cooperative ventures in the energy field and their conflict with the large power

companies may well prove necessary for efficiency and for the general welfare.

B. *Large Arrays*

Where large arrays are proposed, rather than the common single unit WECS, additional problems will inevitably arise.

Rate Structure. Rates of power companies are normally regulated at the local or state level. In calculating rates, the regulator is normally concerned with the source of the energy only as a factor in rate structure. As noted above, one coordination problem of the use of large arrays of WECS might be that of feedback from major system to major system as well as that of interacting systems. This is not unique to WECS and has perhaps already been resolved by the existing utility companies. Consequently, WECS present the need to explore and evaluate the performance of past coordination solutions.

Safety and Interstate Regulation. There are problems beyond rate structure. One often cited is that of assuring safety as systems feed back and forth, the need to have systems both interlocked and sufficiently isolatable technically so that safety to both can be assured.[88] These and other problems do not seem unique to WECS. For example, it may well be that plants or arrays will be in one state with transmission lines carrying the energy to another state. This is frequently the case today; there will be problems with sets of regulations and possible rate controls but, lacking a true national grid at this time, the issue of the need for federal preemption does not hang on wind energy use.

Reliability. Regulators usually have required that a system provide reliable power. For most locations, wind energy may be relatively unreliable overall within this concept as construed in law, and it may also, or alternatively, be unable to meet peak demands. If major storage facilities can be coupled with a large WECS system, a utility company may be able to consider relying primarily on WECS, coupling, where needed, with other energy generating methods or with other companies relying on other energy systems.

Siting. In addition to the major land use and environmental impact control problems noted above, there are numerous states, now about twenty, which have rules dealing specifically with the siting of power plants and transmission facilities. Clearing additional regulators means added expense. In Minnesota a plant which produces over fifty megawatts is equated with the locational safety requirements for nuclear plants in crowded areas. Such rules do not really seem to have contemplated a WECS array, but their present language, if applied, as it well might be, would cost time and raise costs. Connecticut and Massachusetts also have rigorous site requirements

88. Letter from John A. Clark, Director of Engineering at Winco, Division of Dyna Technology, Inc., to Howard J. Taubenfeld (Aug. 6, 1975).

laws as do many other states. It seems worth suggesting the possibility of a legislative enactment to exempt WECS from any such genuinely irrelevant requirements. In any case, the siting rules, which typically call for public hearings combined with environmental impact statement laws, if they are enforced strictly, imply unavoidable cost and, often, delays which are likely to provide hurdles to the easy installation of large arrays in this environmentally sensitized area.

The Regulatory Strategy. Questions have also been raised concerning the issue of the level of government which should regulate energy produced by WECS. Such questions, by implication, raise the issue of the appropriate overall regulatory strategy for WECS and, indeed, for the energy section of the United States economy as a whole.

We cannot delve deeply in this overview study into the broad issues of overall energy policy for the United States in the decades ahead, but there are some special aspects of wind energy use which require some comment on the nature of an appropriate regulatory regime. WECS, unlike nuclear facilities, do not seem to create dramatically new natural or physical problems requiring, on their account alone, a shift from the present regulatory regime, now primarily state and locally controlled, to overall federal regulation.

The appropriate regulatory jurisdiction should be a compromise which will, in some sense, assure the proper allocation of costs and risks and assure that the regions most importantly impacted by the utility will be able to do effectively most of the necessary primary regulating. Other external interests may, however, exercise some residual or complementary parallel controls in their own jurisdictions or, in the case of the federal interest, through a federal agency when, for instance, power flow crosses state lines. Perhaps use of grants imposing federal standards will be the technique for achieving conformity. The various possibilities of regulatory strategy suggest that control of WECS, and, indeed any other major new sources of power, should be explored to see if they present a new opportunity to improve the competitive or at least the internally self-regulating structure of the energy industry.

If, as WECS technology develops, it becomes apparent that, in some regions, WECS will be effective sources of power only if systems are created on a vast new scale, a TVA-type regional approach might be forthcoming in such areas. WECS may, however, be owned or operated as just one more facet of the present multi-fueled electric company systems which use coal, oil, natural gas, nuclear energy, and other energy sources. This may be the result of conscious social choice as the efficient compromise, or because the development of competitive units is successfully barred by existent interests. If this occurs, patterns of regulation probably will not be radically altered except insofar as new methods of defending the interests of individual generating systems and small size firms are needed.[89] These

89. *See* G. Jorgensen, M. Lotker, R. Meier & D. Brierley, Design, Economic and System Considerations of Large Wind-Driven Generators (paper submitted to IEEE/Power Engineering Society, Jan. 1976).

issues, which potentially involve some very important political-economic opportunities, are urgent and should be studied now. On the national scale, the issues go far beyond WECS and include *inter alia*, such questions as: What is the appropriate structure for a technologically complex United States energy industry from the point of view of establishing a substantially self-regulating, efficient, dynamic industry? How should new power sources be organized for development to achieve this optimum? Because the energy hunt now offers the United States an unusual opportunity to rationalize the structure of a major industrial sector, the energy producing potential of a WECS industry as well as creative regulation thereof should, at minimum, be explored soon.

VII. INCENTIVES

Clearly, if Congress, one or more states, or local governments believe that WECS are desirable in their jurisdictions, the introduction of WECS can be encouraged by the removal or mitigation of barriers as well as by the use of positive incentives, particularly financial incentives. Such incentives can include a wide range of approaches.

Among the incentives which can be offered are tax concessions, particularly in the property tax area, for those who use WECS in various ways. Sales taxes and use taxes on components could be waived. Real estate transfer taxes could be waived in areas where land costs for WECS are an important factor. Depreciation rates could be made favorable. Some of these ideas have been put into practice in Denmark where a system of tax incentives exists for WECS installations.[90] Furthermore, some states reportedly are introducing tax exemptions for property taxes for solar energy installations and the same could be done for WECS installations.[91] Tax credits could also be offered to encourage WECS development.[92] Under the present tax structure, innovators of WECS face tax problems for a business because of their high installation costs. These costs are normally treated as capital costs that result in a tax savings only over a few years through depreciation deductions. On the other hand, WECS generate low fuel costs.

90. MITRE, *supra* note 49, at 475.

91. Oregon is such a state and similar treatment for WECS was considered briefly but apparently considered premature. *Id.* Others include Indiana, Arizona, and Florida.

92. On tax impediments and inducements in the related field of solar collectors see Solar Energy and the Law, *supra* note 16, at 11-15, and on all state legislation to date in the solar field see ENERGY TASK FORCE, NATIONAL CONFERENCE OF STATE LEGISLATURES, 1 TURNING TOWARD THE SUN (abstracts of legislative enactments of 1974 and 1975 regarding solar energy). On the validity of statutes or ordinances allowing tax exemptions for property used in pollution control see 65 A.L.R.3d 434 (1975). The Texas weather modification statute, one rough purpose of which was to increase the difficulty of maintaining a successful claim for damages against a duly licensed modifier by declaring the activity to be *not* ultrahazardous, is an example. Little publicity was given to the enactment. Even if it had been widely publicized, those whose potential rights were thus made more difficult to assert at law would not yet have been even an "inchoate large group" until they gradually became aware of their possible need for protection from the application of this new technology and its potential impacts after it was used. M. OLSEN, THE LOGIC OF COLLECTIVE ACTION (1965). Only then could a reasonable political opposition group hope to coalesce enough to mount a counteroffensive campaign to assure that the legal parameters were adequately responsive to *their* needs and interests as well. This experience does *not* seem to us to be atypical for innovations of new and often poorly understood technologies.

This is highly desirable for society but it does not mean that the company gets increased deductions for fuel as an operating cost. More appropriate tax incentives are needed. Already investment tax credits exist which range in amount from four percent to ten percent. The need for further special investment tax credits to help equalize the specially disadvantageous tax regime should be carefully explored by Congress and the states.

Governments can and do also manipulate the availability of government made or guaranteed low interest loans to homeowners, building owners, and even utility companies who introduce WECS installations. Moreover, certain federal and state agencies can even facilitate entry into some aspects of manufacturing; this could be done, perhaps, through the Small Business Administration, or, if desirable, through a program specially created for the purpose of encouraging investment. Denmark, again, is reported to be encouraging WECS through low interest rates on loans used to create and install WECS. Interest costs are typically deductible business costs. This, in itself, provides an incentive to borrow for investment in potentially fruitful and innovative business undertakings. Federal financial assistance, either facilitating or making new capital directly available, as in the old rural electrification campaigns of the 1930's, could provide highly important support for innovation in this capital intensive, publicly regulated field of enterprises, especially if inflation persists.[93]

If decision-makers desire to encourage the development of such innovative technology, this could be done, for example, through a newly designed permissive regulatory regime. Indeed, as with subsidies of various other types, concessionary legislation of various types which manipulates the legal parameters, purportedly in favor of the innovation in question, is often possible to encourage entrepreneurship in the private sector. Such legislation has frequently been used to subsidize a socially desirable investment which would otherwise not take place. For example, direct assistance can be defended when offered to regulated industry to provide necessary social overhead capital or subsidized energy inputs which are necessary to achieve the efficient level of development, or maintain full employment in the economic system. A politically necessary subsidy to energy-intensive development may also be viewed as sensible given the needs and preferences of the political community in question for this type of development, even at a special cost. Obviously the optimal mix of various types and scales of all concessions, subventions, and other incentives is again dependent on the

93. We have elsewhere suggested various strategies for minimizing the negative results of socially funded assessments in such an assessment climate. The most important ones are: First, include diverse interest in the assessment process itself. This can be attempted most economically by using personnel of different interests and ideological committments in the principal funded assessment and by having alternative assessment teams representing as many viewpoints as possible even among the scientists and social scientists. Secondly, reassess a technology for its societal impacts regularly, at least every five years. *See* R. Taubenfeld, *DDT: The United States and the Developing Countries*, in MAN'S IMPACT ON THE OCEANS AND BIOSPHERE (1971); R. Taubenfeld, *Weather Modification, Technology Assessment and the Social Control of "Progress,"* in WEATHER MODIFICATION IN SERVICE OF SOCIETY (1974); R. Taubenfeld, Some Aspects of the Prospects for the Assessment of Societal Implications of Innovation (NCAR Study 1973); R. Taubenfeld & H. Taubenfeld, Technology Assessment: Snowpack and the Colorado River—A Critique (NSF Study Nov. 1974).

tastes, values, and objectives as well as the political judgments and institutions of the effective decision-makers in any society.

In addition to specific financial and legal concessions, which are frankly political, one of the most important legislative options is to manipulate the legal parameters with respect to property rights and liability obligations as these affect the new technology. Clearly, within a political jurisdiction, the opportunity to write favorable basic "rules of the game" of fair competition always exists. But this does not obviate the difficult questions as to selection of the cases in which this should be done and those in which it should not. Thus, again, the choice of determinative legal boundaries is a very important ethical and political choice.

Legislation could, of course, be introduced to manipulate property rights and liability burdens in favor of the innovations of WECS, *e.g.*, by creating "wind rights" as has been done with respect to "solar rights" in Oregon. Legislation could also be used to create the presumption that WECS are not ultrahazardous in nature as, for example, Texas legislation has done with respect to intentional weather modification activities.

Other types of concessionary legislation have been historically popular in the United States and could be used again. Examples of such legislation are federal, state, local grants, grants to the railroads which gave right-to-way easements, and the creation of new or added powers of eminent domain as, for instance, have often been given to utility companies and other regulated non-governmental entities.

Changes induced by these incentives will no doubt have a burdensome influence on some, unless truly adequate compensation is provided, and they will also affect the type and the structure of energy industry which subsequently evolves. Thus, each alternative political manipulation which negatively affects competition is very important and no alternative should be undertaken without careful, well balanced study of the changes it might cause in the distribution of rights and responsibilities.[94] Important redistributions of rights and duties can be expected to have non-neutral incidence on population subgroups, that is, to benefit some and to damage others. Historically, these political decisions concerning technological innovations have not been made on the basis of a program of analytical studies. Typically, favorable terms of competition, credit, and other politically given favors have been obtained from legislatures and from administration bureaucrats as a result of the political efforts of the benefitted, with little concern for the impact on other groups. Indeed, given the nature of political processes, normally some politically weak group such as the aged, women, blacks, the unorganized, or some other political minority, has had to bear in their entirety the burdens created by innovation, or has had to bear them dispro-

94. As we have already stressed, ultimate choice among the possible legal/regulatory regimes is highly political. This is because the choice of regime largely determines the distribution of impacts. The process of technological choice is unduly biased, however, if, as seems typical in the past, decisions are made primarily based on information as to implications of alternatives which comes primarily from the richest, best organized, interested parties, and if these decisions are "set in concrete" very early while the interests of the diffuse, unidentified *future* losers remain inchoate and the interests of the politically weak are ignored.

portionately, without compensation.[95] It would seem more just if the producers and consumers of new technology were induced by legally imposed responsibilities and the political system to divide these burdens between them. Failing this, or in the event some greater social purpose is involved, it would seem reasonable that society as a whole and not just its politically weak groups, should share the costs and burdens of innovation fairly. Society could perhaps finance the costs and burdens through a fair tax and public revenue system.

Experience shows that, for new technology, the likely impacts are only partly foreseeable even by the experts. Thus, no adequate political effort by the as yet unorganized potentially damaged interests can be reasonably expected to counterbalance the activities of the innovators in seeking to obtain subsidies or to shift possible liabilities. Nevertheless, to minimize, in this case, the current tendency of the popular backlash against all new technology and innovation, the property rights and security threatened by unforeseeable dangers imposed by others on these diffuse interests must be regularly identified. Protection of the interests must be adequately championed in the political processes, and the impact costs of innovation must be equitably shared.

In brief, before enacting enabling legislation to aid large-scale innovation of WECS or any other important technological innovation, early, careful technical impact analysis should be supplemented by comprehensive appraisal of the effects of alternative property rights and liability regimes. Not only impacts within the current or assumed social structure, but implications of at least the more likely set of alternative social structures should be explored before legislatures create new rights and responsibilities. Moreover, analysis should be repeated at intervals as the property rights, liabilities, and technology evolve so that actual performance, its implications, and its incidence can be monitored.

The combination of being highly political and very important to the parties and poorly or incompletely predictable purely on the basis of technical foresight is a dangerous one with respect to WECS legislation. Historically, under such circumstances, the politically and economically powerful have been able to manipulate both the experts and the politicians, and, therefore, to dominate the formulation of the social choice on technology issues. The environmentally wasteful, cumulative results of this strategy have influenced the development of attempts to rationalize social choice processes concerning the technology choice. Technology policy remains a major challenge for a democratic, decentralized political-economic choice system: how to succeed without either falling back to a much more permissive innovation policy or so impeding choice that all technological change, all progress, all growth, all hope for fuller human emancipation is stalemated.

One more important point must be made: the timing and pacing of regulation must be considered. Normally, lawyers from the pragmatic Anglo-

95. For a more developed description of this see R. Taubenfeld, *Weather Modification, Technology Assessment and the Social Control of "Progress,"* in WEATHER MODIFICATION IN SERVICE OF SOCIETY (1974).

American tradition have called for delay in choosing a legal regulatory system until more of the actual implications of the new situation work themselves out in practice, until the problems mature. As far as technology is concerned, this advice may create serious problems. Total postponement is not, in fact, typically among the available social options.

First, political favor-seekers have no incentives to heed this call; they can be expected, as, for instance, was the case with weather modification legislation in Texas, to press politically for interpretations of property rights and shifts in liability favorable to themselves and, more generally, for a favorable regulatory climate. Second, in any case, society does not start out at the birth of a new technology legally naked, without a regulatory regime. If there is no directly applicable law, the courts, in the Anglo-American tradition which requires a decision for all cases, will find applicable law by analogy and manipulation of the traditional rules. Yet it is also true that the evolutionary application of concepts which evolved out of past and often completely irrelevant conditions, are often viewed as dysfunctional, biased, or antisocial by the innovators, the parties burdened or displaced by the threatened innovation, or by society. A quest for the appropriate legal or regulatory principles most consistent with the public interest is unavoidable and cannot be postponed without potentially creating entrenched vested interests which compromise the future possibilities for a socially desirable solution. Thus, the legislative incentives which may be offered to encourage WECS development must be viewed from the beginning in the light of the likely political and social effects on various groups as well as from a philosophical perspective of policy choices in the best interests of American society as a whole.

The entire federal wind energy program, and other publicly financed related research, are the major current sources of incentive to development of WECS. Increased research in product development, siting, wind surveys, technological safety, storage and conversion technology, and other areas while perhaps obvious in this context, must be noted here. Without publicly financed research and development there seems little evidence that large scale use of WECS will be tested, although relatively expensive, small-scale, home-type units are already being marketed, and even their efficiency might well be improved over time.

The net incentive impact on innovation caused by the granting of patents, which are, in effect, monopoly privileges granted to reward and hence to encourage investment in research, is unclear. With respect to WECS, it is likely to remain exceedingly difficult to know whether or not, if one had the choice, development would be encouraged or discouraged by policies requiring licensing of the patents to others or by policies protecting the monopoly of a developer. A generous patent and licensing policy for WECS innovations developed with federal funding might encourage widespread production of WECS and is likely to be demanded, especially since there is a field in which federal funding supports so much of the research and development, but the results cannot be predicted with assurance. Some modest, positive payout to an inventor of a major breakthrough innovation would be

viewed as fair, however, even from federally funded research, and would tend to suffice to assure high personal motivation to create inventions. This would be consistent with a policy of relatively generous licensing and other encouragement of a competitive manufacturing sector.

Restrictive Legislation. While various classes of existing legislation in general have been broadly analyzed above, primarily for their possible facilitation of WECS innovation, restrictive legislation is also possible. In time, as wind energy technology advances and becomes clearly more cost effective, and, particularly, as larger machines and arrays become the norm, it may be necessary to resort to other types of evolving legislative intervention at the federal level. Initially, at least, this would be necessary for some clear-cut national regulation, for example, to standardize safety and material requirements, to specially license large scale installations or arrays such as those at sea or, indeed, which extend across city, county, and even state lines. The achievement of other objectives, such as the protection of consumers or the small producer from fraudulent claims, or from the coercive market power of large scale, and inadequately regulated, public utilities may also be more effectively undertaken at the federal level. At lower levels, their economic power appears even more formidable.

Historically, in the field of real property, the suggestion of imposed uniform federal rules has typically been rejected as of doubtful constitutionality since it has generally been assumed that the states have the prime right to regulate real property within the state. Nevertheless, even where federal lands and interstate issues are not involved, federal standards, safety guidelines, and the like are both persuasive and can often be imposed on local officials by regulatory, or cost sharing, or incentive techniques.

Developing fifty or more very different technical standards on the state level, or 50,000 or more such standards at the local level, would tend to be counter-productive and costly to the consumers. Such regulations would tend to increase the costs of obtaining credentials and of regulation, while allowing a range of standards wider than justified and imposing restrictions on entry and, therefore, on competition. In any case, federal legislation regulating the risk of dangerous installations and shoddy construction in inherently multi-jurisdictional facilities may well be required in the not distant future.

In sum, while certain of the present WECS developers have already expressed traditional fears of new restrictive legislation, a new public sensitivity has replaced much of the old quiescent acceptance of unidentified and uncompensated negative impact from the innovation of new large scale technologies. Increasingly, new technology is accepted without major opposition or political protest by the public only if some evidence that the public interest, which often means the interests of the politically articulate and effective groups, the public safety, and even the politically dominant groups' quality of life have been considered and safeguarded. Witness, for instance, the long controversy over the introduction of nuclear power plants. This change of style or taste for innovation seems justifiable in a

maturing society. The interests of recently politically activized subgroups which exist outside the business community, and to whom these issues are especially salient, are growing and will probably continue to grow. Pressed on by the new public consciousness, both the President and Congress have expressed the hope that an era of more rational and socially responsible innovation policy can be attained. There is no way back to the simple "good old days" when unfettered technology was widely believed to be the American destiny. Creative, responsible innovation will probably be favored, even at some extra cost. On balance, this new context of technology policy seems, if anything, favorable to the future development of WECS.

VIII. CONCLUSIONS

Without attempting to forecast precisely the speed of the development of wind energy conversion systems, but viewing the mid-1980's as a feasible target for introducing some major production of energy through such systems, a preliminary overview of likely legal and administrative barriers to innovation is encouraging for many of the foreseeable major uses of WECS in various geographic areas. Use of isolated units presents few if any new and special problems and probably can be expected to spread slowly as its cost efficiency increases. With a normal utility company innovation or investment lead time of ten or more years, rational planning for innovation of WECS even on a large scale seems plausible. The acceptance of the technical feasibility of the use of large arrays and a believable scientific finding that there are no major environmental and atmospheric perturbations should make it possible to find sites, comply with environmental and siting laws in many less populated areas of the country, and, where the winds are right, do so within reasonable range of some urban complexes. The use of large arrays in the oceans appears beset with more complex environmental and legal problems, but these too may prove to be equally manageable, especially in a broadly extended United States "economic zone." Surely these barriers are not insuperable, especially if national self-sufficiency really becomes a major United States goal. Yet, despite the relative reliability of the ocean winds, the high cost of ocean installations suggests that this is a less likely probability in the near future except, perhaps, in conjunction with other ocean installations such as pumping oil stations or towers.

The use of large arrays in urban and suburban areas in the near term also seems much less likely than in the open country, unless noise and vibration problems which have been associated with large systems could be reduced. Progress is reported on these problems; there is likely to be further innovation in solving them if the prospects appear financially attractive. Then, one could imagine the development of attractive urban windmill parks and, potentially, indeed, even windmill tower apartments in their extensive mandatory gardens. If the technology is developed to facilitate these multiple uses, even large units could be integrated into urban and suburban buildings and sites. We do not expect that there would be insuperable legal barriers, even without major amendments of zoning and other laws.

We do not here suggest that there are no presently foreseeable barriers; cost may be substantial to meet space, environmental, and other social requirements. We do suggest, however, that all United States energy production is scheduled to assume gradually parallel expensive burdens vis-à-vis the environment and other societal concerns. There do not seem to be overwhelming legal societal barriers to innovating cost-effective WECS either as a supplemental energy system or, at windy, remote, or underdeveloped places, even, perhaps as the primary energy system, with secondary back-up systems.

In a world increasingly concerned about the consumption of limited, readily accessible resources, a technology for producing energy out of the non-depletable natural endowment of wind of many remote regions laden with still unplumbed resources, and of the endless seas, seems itself worth remembering and studying on these scores alone.

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