Legislative Developments in Solar Energy During 1980

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I.
INTRODUCTION

On June 20, 1979, President Carter committed the Nation to a goal of meeting one fifth of our energy needs with solar and renewable resources by the end of this century.[1] Since establishing that goal, the complexion of the energy scene in the United States has been changed by legislation and political events. Though the impact of Ronald Reagan's election cannot be minimized, it is difficult to assess in advance the ultimate affect it will have on the future of solar energy.[2] Rather than speculate, this article will instead examine legislative developments affecting solar energy since President Carter set the twenty-percent goal. Most of what is discussed concerns enactments that have a direct influence on solar energy development and utilization. It would, however, be inappropriate to examine energy legislation in 1980 without mention of Title I of the Energy Security Act (ESA).[3]

Title I of the Energy Security Act is composed of two acts, Part A, the Defense Production Act Amendments of 1980, and Part B, the United States Synthetic Fuels Corporation Act of 1980. Part B provides an initial authorization of $20 billion[4] to the Synthetic Fuels Corporation to initiate a program designed to meet produc-

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1. Jimmy Carter, Solar Energy Message to the Congress (June 20, 1979), *reprinted in* 15 WEEKLY COMP. OF PRES. DOC. 1097 (June 25, 1979).

2. Indeed, as this issue goes to press, it is apparent that many solar and energy conservation programs are not destined to get much support from the Reagan administration. In particular, the Solar Energy and Energy Conservation Bank has been targeted for elimination.

3. Energy Security Act of 1980, Pub. L. No. 96-294, 94 Stat. 611 (1980).

4. *Id.* § 152.

tion goals of 500 thousand barrels of synthetic fuel per day by 1987 and two million barrels per day by 1992.[5] Within four years, the Corporation must submit to Congress a comprehensive strategy for attaining these goals.[6] After Congress has approved this comprehensive strategy, the Act provides that a maximum of $68 billion is to be authorized,[7] in addition to the previously authorized $20 billion, to carry out the strategy. Throughout the life of the Synthetic Fuels Corporation the goals of the Act are to be promoted through loans, subsidized loans, purchase guarantees, price guarantees, and direct participation by the Corporation in synthetic fuels projects.

The mere size of the committment of funds to synthetic fuels in the ESA cannot help but influence appropriations for solar activities. As is discussed below, Congress, though sometimes generous with authorizations, has shown a reluctance to follow through with 1981 appropriations for solar projects. Considering President Reagan's campaign emphasis on conventional and nuclear energy sources, 1980 may prove to have been solar's best year.

This paper examines legislation in 1980 for six major solar technologies: direct thermal solar energy systems, solar thermal electric systems, photovoltaic systems, biomass, ocean thermal energy conversion systems ("OTEC"), and wind systems.

II.

DIRECT THERMAL SOLAR SYSTEMS

The most common devices available for transforming sunlight into useful energy are direct thermal solar energy systems. Direct thermal devices involve direct use of the energy of the sun for heating or cooling without an initial transformation into some other energy form. There are two general classifications of direct thermal devices: they are either active or passive. It is difficult to formulate precise definitions that will distinguish between the two, but generally, active systems absorb solar energy in a collector and transfer it mechanically for use at another point. Passive thermal devices, on the other hand, put the solar energy to work at the place of absorption or transfer it for use elsewhere through natural processes like convection.[8] The most common active system is a

5. *Id.* § 125.
6. *Id.* § 126(b)(2).
7. *Id.* § 126(c)(ll).
8. *See, e.g.*, 26 C.F.R. §§ 144C-2(f)(2) to -(3) (1980), which define active and passive systems for federal tax purposes.

solar hot water heater in which a remote collector, usually placed on the roof of a building, absorbs the sun's energy. This energy, now in the form of heat, is then drawn off the collector plate by a working fluid which circulates through a heat exchanger to heat the water.[9] If air is substituted for the working fluid and fans are substituted for pumps, then the active system can be used for heating or cooling buildings.

Passive solar applications are not so readily recognized. Because passive applications strive to use the sun's energy without an intermediate transfer, passive techniques focus primarily on building design. In a sense all buildings use passive solar energy because all buildings depend on the sun for some of their energy needs. The object of passive techniques is to maximize the use of the incident solar radiation in the heating or cooling of the building. The simplest passive design technique requires that buildings be oriented with the longest side facing south. In this way the sun will be incident on the outside wall with the greatest surface area. Passive techniques can be very simple. For example, using a pool cover to trap the sun's heat within the pool. They can also be very involved, as in placing a steel-lined water-filled wall behind a south facing window or providing glass only on the south side of the building and very little or no glass on the north, east, and west sides.[10]

A. Federal Programs

1. Windfall Profit Tax Act of 1980[11]

The cost effectiveness of a solar system is generally gauged by comparing the life cycle cost to the user of a conventional system with the life cycle cost to the user of the solar system.[12] Favorable tax credit treatment has substantially reduced the payback period

9. If an open loop system is used, the heat exchanger is eliminated and the working fluid is potable water. Swimming pool heaters often use this open loop active system design.

10. For an interesting description of a passive solar development in a cold climate, *see* Finneran, *Yes, Even in Buffalo*, SUN TIMES, Oct. 1980, at 6. SUN TIMES is a publication of the Solar Lobby.

11. Crude Oil Windfall Profit Tax Act of 1980, Pub. L. No. 96-223, 94 Stat. 229 (1980).

12. This "payback period" is not a realistic measure of the cost-effectiveness of a system unless it refers to the recovery of capital investment as discounted to reflect true cost. In other words, future savings must be computed in terms of actual value in current investment dollars. The costs of borrowing, operation, and maintenance must also be included. An example of this level of sophistication can be seen in California's SOLFIN 2 computer analysis prepared by the California Resource Conservation

of eligible systems making many direct thermal systems cost effective. The Crude Oil Windfall Profit Tax Act (WPTA) has increased and expanded the available tax credits for active systems by amending Internal Revenue Code section 44C(b)(2) to increase the tax credit for the first $10,000 of expenditures for renewable energy sources to 40 percent of that expenditure.[13] Previously the tax credit was 30 percent of the expenditures up to $2,000 and 20 percent of the expenditures from $2,000 to $10,000.[14] The tax credit is still only available for expenditures made by the owner of a dwelling unit which is used by that owner as his principal residence.

Solar system components do not obtain the benefit of the tax credit if a structural purpose is also served by the component.[15] Therefore, if a block wall serves as both the thermal sink in a passive heating system and as a structural wall within the building, no tax credit is available for the cost of building that wall. This rule eliminates most passive systems from the tax credit. Many consider this to be a flaw in the incentive scheme.[16] The Act does create an exception to this rule for active collectors which are installed as a component of the roof of a building.[17] However, this exception merely eliminates an absurd application of the rule, it does not change the rule.

The WPTA also permits adjoining property owners to claim the tax credit when purchasing solar equipment to be used jointly. Each property owner is allowed a tax credit on his portion of the cost of the system.[18]

Several bills have been introduced to provide a passive system tax credit to builders.[19] However, each bill died in committee. One of the difficulties with passive system tax credits is the definitional problem of distinguishing between a passive design feature and a normal component of the house. For example, one relatively simple passive design technique is to place large windows

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and Development Commission. *See* CALIFORNIA ENERGY COMMISSION, A USER'S GUIDE TO SOLAR FINANCE: SOLFIN 2 (1980).

13. *See* § 202(a).

14. 26 U.S.C. § 44C(c)(2) (Supp. III, 1979).

15. 26 C.F.R. § 1.44C-2(f)(4) (1980).

16. *See, e.g.*, Finneran, *Passive Solar: Tax Credit May Soon Be Here*, SUN TIMES, Oct. 1980, at 3.

17. Section 202(d).

18. *Id.* § 201(a).

19. H.R. REP. No. 7688, 96th Cong., 2d Sess. (1980); H.R. REP. No. 7690, 96th Cong., 2d Sess. (1980); H.R. REP. No. 8019, 96th Cong., 2d Sess. (1980). Each died in the House Ways and Means Committee.

on the south-facing wall to admit solar radiation during the winter when the sun is low in the sky and to construct overhangs to shade these windows during the summer when the sun is high in the sky. The summer shading can be increased, without impinging on the winter sunning, by planting deciduous trees in front of these windows. Congress has an understandable reluctance to subsidize landscaping costs or picture windows with overhanging sun decks.

The WPTA also prevents subsidy collectors from "double dipping." Section 44C(c)(10) will be added to the Internal Revenue Code to provide that "subsidized energy financing" may not be considered a renewable energy source expenditure for tax credit calculations.[20] Subsidized energy financing means financing provided under a federal, state, or local program the principal purpose of which is to provide subsidized financing for projects designed to conserve or produce energy.[21] This double dipping provision only applies to post 1980 taxable years and financing or grants made after December 31, 1980.[22]

The WPTA also increases the energy investment credit for solar or wind energy property from 10 percent to 15 percent.[23] This credit applies to commercial solar installations which generate electricity or heat, cool, or provide hot water for a structure. The 15 percent credit is available only on qualified investments made on or after January 1, 1980, and expires (as does the 40 percent residential credit) on December 31, 1985.[24] The 10 percent investment credit previously in effect was scheduled to expire in 1982.[25]

2. Solar Energy and the Energy Conservation Bank

The second major federal initiative to foster market development for direct solar thermal sytems is the Solar Energy and Energy Conservation Bank (SEECB) which will provide subsidized loans for solar energy projects.[26] The SEECB has an authorization of $525 million for solar purposes for fiscal years 1981 through 1983.[27] Payments will be made through the SEECB to those local financial institutions willing to provide loans below the

20. *Id.* § 203(a).
21. *Id.*
22. *Id.* § 203(c).
23. *Id.* § 221(a).
24. *Id.*
25. [1980] 1 FED. EX. TAX REP. (CCH) ¶ 531.
26. Solar Energy and Energy Conservation Act of 1980, Pub. L. No. 96-294, tit. V, 94 Stat. 719 (1980).
27. *Id.* § 522(b).

market rate or to provide principal reductions on loans to borrowers for solar improvements. The Bank will operate within the Department of Housing and Urban Development. The size of the loan available to a given borrower will be a function of the income of the owner relative to the area's median income, the cost of the solar component, and the type of building on which the installation will be made.[28] For example, if a borrower has an income of less than 80 percent of the area's median income, he or she can borrow 60 percent of the cost of the solar system up to a specified maximum amount which depends upon the type of building.[29] For existing commercial or agricultural buildings the maximum loan to the owner or purchaser would be 40 percent of the cost of the solar system up to a maximum of $100,000.[30] Builders are eligible for 40 percent loans with the maximum determined by the type of structure.[31] Congress appropriated $125 million for fiscal year 1981. This includes SEECB funds for both solar energy and conservation projects.[32]

For direct solar thermal devices the expanded tax credit and the SEECB are the most significant federal incentives to date. The anti-double dipping provision in the WPTA would preclude utilization of the income tax credit on those portions of the solar project funded through the solar bank. The solar bank is designed to act as an incentive primarily for those who cannot afford the initial installation or who may not have a sufficient tax liability to be affected by the tax credit incentives. However, loans would be available to owners with incomes as high as $32,000 per year.[33]

3. Other Actions

Aside from the federal tax credit and the Solar Energy and Energy Conservation Bank, several other federal programs have been designed to promote direct thermal solar energy systems. The Department of Energy has issued proposed building energy

28. *Id.* § 512.

29. *Id.* § 512(a)(1). The maximum amount is $5000 for a residential building with one unit, $7500 for a residential building with two units, and $10,000 for buildings with three or four units.

30. *Id.* § 512(c). These limits also apply to loans to purchasers of newly constructed or substantially rehabilitated commercial or agricultural buildings.

31. *Id.* § 512(a)(4). The maximums are the same as for an owner or purchaser. *Id.* § 512(a)(1).

32. Department of Housing and Urban Development—Independent Agencies Appropriations Act of 1981, Pub. L. No. 96-526, 94 Stat. 3044 (1980).

33. 126 CONG. REC. S7,407 (daily ed. June 19, 1980).

performance standards (BEPS) that require all new buildings to be designed to operate within specified energy budget (Design Energy Budget).[34] The Design Energy Budget encourages the use of a solar energy system because "energy supplied by solar energy systems is not included in the calculation of the Design Energy Consumption of a building. In effect, building designs receive a credit for the energy requirements supplied by solar energy systems."[35] Domestic hot water was specifically included within the Design Energy Budget to encourage the use of solar domestic hot water systems. Thus BEPS will force building designers to consider alternative forms of energy, particularly solar, if they want to retain design flexibility and still stay within the energy budget standards. Implementation of the proposed BEPS standards have been delayed until 1983 by the Housing and Community Development Act of 1980.[36]

There are several other ongoing federal programs to encourage the use of direct thermal systems. The following are a sampling of these programs: federally guaranteed loans to veterans for the purchase and installation of solar systems in the home;[37] funds under CETA;[38] research into the use of solar energy on farms, including crop drying;[39] federal programs requiring the use of solar heating and cooling systems in federal buildings;[40] legislation authorizing small business loans to solar businesses;[41] and the energy audit program under the National Energy Conservation Pol-

34. 44 Fed. Reg. 68,120 (1979). These proposed regulations were issued under the authority of the Energy Conservation Standards for Buildings Act of 1976, 42 U.S.C. §§ 6831-6840 (1976).

35. 44 Fed. Reg. 68,120, 68,142 (1979).

36. Pub. L. No. 96-399, § 326(a), 94 Stat. 1614 (1980). Section 326(a) delays the BEPS implementation date until April 1, 1981. Subsection (b) provides that the Department of Energy is to conduct a 12 month demonstration program in at least two different geographic regions of the country. This program is to begin August 1, 1981. When the demonstration period is over the Department is directed to deliver a report to Congress, within six months after which the regulations may become final. *Id.*

37. 38 U.S.C. § 1810(a)(7) (Supp. III, 1979).

38. 29 U.S.C. § 823(m) (Supp. III, 1979).

39. 7 U.S.C. §§ 427, 3241-3282 (Supp. III, 1979).

40. 40 U.S.C. § 175 (Supp. III, 1979); 22 U.S.C. § 292(a) (Supp. III, 1979). In May, 1980, the Department of Energy awarded $31 million to 16 federal agencies for construction of 843 solar projects under its building program. All of these projects were direct thermal projects and involved a combined installation of between 500,000 and 600,000 square feet of collectors. [1980] 356 EN. USERS REP. (BNA) 18. This report states that the "solar federal buildings program should expand the solar industry by 10%." *Id.*

41. 15 U.S.C. § 636(l) (Supp. III, 1979).

icy Act of 1978.[42]

B. State Programs

1. Financial Incentives

State and local governments have passed a multitude of laws, regulations, and ordinances designed to promote the increased utilization of solar energy.[43] Financial incentives include tax credits, tax deductions, property tax exemptions, sales tax exemptions, grants, and subsidized loans. Grants have been used primarily as part of demonstration programs, both to prove the technology and to provide data for future users. Direct thermal devices are past this stage of market development and as a consequence there are few grant programs still in effect.

Aside from direct grants, the most powerful financial incentive is the tax credit. As of mid-1978, thirteen states have instituted tax credits. These range from California's 55 percent credit to North Dakota's 5 percent credit.[44] Seven states have some form of income tax deduction; 27 states have some form of property tax exemption; one state has a property tax reimbursement; six states have sales tax exemptions; six states have use-tax exemptions; and six states provide subsidized loan programs.[45]

2. Institutional Incentives

Aside from financial incentives, there are many institutional incentives that states have employed to foster solar utilization. Several states have enacted some form of solar rights legislation. Colorado, for example, has passed legislation which permits neighboring land owners to negotiate solar access easements which can be recorded to run with the land.[46] California has passed a shade control law, although it is only concerned with

42. The National Energy Conservation Policy Act of 1978 (NECPA), Pub. L. No. 95-619, 92 Stat. 3206 (1978), is part of the National Energy Act of 1978. The regulations promulgated under NECPA provide for the preparation of state residential conservation service plans. *See* 44 Fed. Reg. 16,590 (1979). The state plans provide that utilities must offer energy audits to customers on request. *Id.* at 16,594. Among the energy audit features, an analysis of the potential for the use of renewable resources in a given building is required. *Id.*

43. *See* U.S. DEP'T OF HOUSING AND URBAN DEVELOPMENT, SOLAR LEGISLATION: STATE LEGISLATION (1980).

44. Ashworth, *Implementing Solar Financial Incentives: the Experience of Selected State Programs*, 1 SOLAR L. REP. 367 (1979).

45. *Id.*

46. COLO. REV. STAT. §§ 38-32.5-100.3 to -103 (Supp. 1979).

vegetation shading direct thermal solar devices.[47] An interesting part of the California law recognizes the possible conflict between passive shading techniques and active solar techniques used on adjacent lots:

> Any person who plans a passive or natural solar heating system or cooling system or heating and cooling system which would impact an adjacent active solar system may seek equitable relief in a court of competent jurisdiction to exempt such system from the provisions of this chapter. The court may grant such an exemption based on a finding that the passive or natural system would provide a demonstrably greater net energy savings than the active system which would be impacted.[48]

New Mexico has passed a Solar Rights Act designed to protect solar access on the basis of prior appropriation and beneficial use principles derived from water law. This has been a fairly controversial act. Essentially the law provides that the property upon which a solar collector is installed has an entitlement to the sunlight passing over adjacent lots to reach that collector.[49]

Local governments are also experimenting with innovative zoning concepts and subdivision controls to assure solar access. Los Angeles is studying the use of an envelope zoning technique which maximizes solar access within a discrete community. Envelope zoning is a form of bulk zoning by which the height limit is defined by angled planes which are low at the north end of the property and high at the south end of the property.[50] By requiring that all sunlight-obstructing vegetation or structures be close to the ground on the north side of a lot, envelope zoning insures that adjoining property to the north will have clear access to sunlight as the path of the sun in the United States is almost always such that the sunlight comes from the south.

Subdivision controls do not have to be quite so site specific. In San Diego County, as an adjunct to an ordinance requiring the use of solar hot water heaters in new construction, a solar access provision is required as a prerequisite for approval of subdivision maps. No specific method of insuring solar access is required. The law merely requires that each subdivision be laid out in a manner which assures solar access for at least 100 square feet of

47. CAL. PUB. RES. CODE §§ 25980-25986 (West Supp. 1980).

48. *Id.* § 25986.

49. N.M. Stat. Ann. §§ 47-3-4A to -4C (1978).

50. Knowles, *The Solar Envelope*, 2 SOLAR L. REP. 263 (1980).

suitable space. This can include dedication of solar easements.[51] Additionally, the State of California requires that any subdivision tentative map "shall provide, to the extent feasible, for future passive or natural heating or cooling opportunities in the subdivision."[52] In determining feasibility, economic, environmental, societal, and technical factors are to be taken into account. On the local level the City of Port Arthur, Texas, has adopted a subdivision ordinance which requires that new homes be oriented in a manner that will permit maximum utilization of solar energy.[53]

Because the federal residential tax credit is generally unavailable for any major passive design feature, much of the burden of encouraging the use of passive solar systems falls on state and local government. However, the cost of passive features in new construction can be recovered within a few years through savings in the energy costs of operating the building. Thus, finances are not really an obstacle to passive utilization. Though a tax credit would certainly be a substantial incentive for using passive designs, the financial incentive is actually already there for the new home buyer. What is required, perhaps even more than favorable tax treatment, are favorable attitudes towards passive designs by architects and builders.

Housing and building regulations can promote the use of passive designs in places where such designs would save energy. Active systems, for which the tax credit is available, also would profit from more favorable housing and building code regulations. The Council of American Building Officials, under the auspices of the Department of Energy, has developed a model document which provides guidelines for incorporating solar design into traditional building, plumbing, and electrical codes.[54] By adopting and implementing codes conducive to solar installation, incorporating passive design techniques into subdivision regulations, and eliminating barriers like subdivision covenants which may restrict solar installations,[55] local governments should be able to offset the tax

51. San Diego County, Cal., Ordinance No. 5589 (codified at County Code §§ 53.119, 81.401, 81.506) (1979).

52. CAL. GOV'T CODE § 66473.1 (West Supp. 1980).

53. *Port Arthur Mandates Solar Orientation*, 2 SOLAR L. REP. 13 (1980).

54. COUNCIL OF AMERICAN BUILDING OFFICIALS, RECOMMENDED REQUIREMENTS FOR CODE OFFICIALS FOR SOLAR HEATING, COOLING AND HOT WATER SYSTEMS (U.S. Dept. of Energy No. DOE/CS/34281-01, 1980) (known as the MODEL DOCUMENT FOR CODE OFFICIALS ON SOLAR HEATING AND COOLING OF BUILDINGS).

55. One way to cut back on such restrictions is to declare them void because con-

credit's failure to provide for passive systems.

III.
SOLAR THERMAL ELECTRIC

Solar thermal electric systems use mirrors to focus the sun's energy in order to obtain the high temperatures required to generate electricity efficiently. Three types of concentrating systems are now being researched. Two of these, the central and distributed receiver systems are discussed below. The third, a sytem using parabolic troughs to heat water flowing through pipes placed at the focus of the trough, has not been the subject of legislative attention.

A. Central Receiver

Perhaps the best known solar thermal electric system is the central receiver or power tower concept, in which hundreds, or even thousands of mirror assemblies called heliostats are combined to form an array in which all the mirrors focus on the top of a tower that faces the array. Each mirror individually tracks the sun in azimuth and elevation to keep the focused image of the sun steady on the receiver tower as the sun moves across the sky. The energy focused on the tower by the mirrors produces high temperatures which can be used to produce steam to run a conventional steam power plant.

1. Barstow

A pilot plant using this power tower concept is currently being constructed in Barstow, California. The estimate of required federal funds for this project is $146 million. A little less than $100 million had already been either spent or committed prior to fiscal year 1981. Of the additional funds required, $36.5 million was supposed to be provided to the Department of Energy by 1980 appropriations. However, the 1980 supplemental appropriations bill deferred $8 million of this $36.5 million to the 1981 fiscal year.[56] As it now stands, fiscal year 1981 appropriations, which

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trary to state policy. This has been done in California. *See* CAL. GOV'T CODE § 65850.5 (West Supp. 1980).

56. Supplemental Appropriations and Rescission Act of 1980, Pub. L. No. 96-304, 94 Stat. 857 (1980). The bill provides that "$8,000,000 are deferred pending submission to and approval by the cognizant committees of Congress an appropriate plan for utilization of [the 10 Megawatt plant] as a solar repowering test facility to meet repowering test facility objectives. . ." *Id.* at 869. This amount was then included in

were supposed to have provided the additional $10 million to complete the project, appropriate no additional funds beyond the $8 million deferred from the 1980 supplemental appropriation.[57] The conference report, however, permits the Department of Energy to transfer "to this project up to $10,000,000 from unobligated balances accruing from savings and slippages in the solar program."[58]

2. Repowering

Repowering is a commercial scale use of the power tower concept. There are two projected applications for repowering:

(1) In conjunction with electric utility power plants to conserve fuel when the solar facility can offset the energy demand on the power plant and, in some cases, to augment the available capacity of the power plant.

(2) To offset the use of existing fuel supplies and, in some cases, to cogenerate at existing industrial sites where onsite boilers are used.

The primary focus for the industrial applications will be to generate industrial process steam. Anticipated repowering projects are in the 60 to 110 megawatt range, using as many as 10,500 heliostats.[59] By comparison, the 10 megawatt Barstow plant, which should be on-line in 1982, will employ 1818 heliostats.[60] Repowering projects are not expected to be in operation until 1985 or 1986.

B. Distributed Receivers

The second general concept employed in solar thermal electric systems uses distributed receivers.[61] Rather than having a single receiver upon which all the mirrors focus, the distributed receiver concept uses a separate receiver for each mirror. In this way each

appropriations for fiscal year 1981 in the Energy and Water Development Appropriations Bill. *See* H.R. REP. No. 96-1093, 96th Cong., 2d Sess. 47 (1980).

57. Energy and Water Development Appropriations Act of 1981, Pub. L. No. 96-367, 94 Stat. 1331 (1980). *See also* H.R. REP. No. 1093, 96th Cong., 2d Sess. 47 (1980).

58. *See* H.R. REP. No. 1366, 96th Cong., 2d Sess. 22 (1980).

59. Conversation between Larry Prince, Program Analyst, Department of Energy (San Francisco Office), and Peter Hoffman (Dec. 19, 1980).

60. *Solar One, Transmission Tower Building Underway*, Sun*Up, Dec. 1980, at 24, col. 3.

61. For a general discussion of the concepts being considered, *see* Jet Propulsion Laboratory, SITING ISSUES FOR SOLAR THERMAL POWER PLANTS WITH SMALL COMMUNITY APPLICATIONS (1979).

mirror can be used as an independent power generation module. As currently being developed by the Jet Propulsion Laboratory, each module involves a two-axis tracking mirror with a receiver and an engine placed at the mirror's focus,[62] and will generate approximately 20 kilowatts.

A Department of Energy site selection process is currently underway for a one megawatt community power generation facility. Out of many applications, six sites were selected as candidates. These sites are: Burke, South Dakota; Cheny, Washington; Harbison, South Carolina; Molokai, Hawaii; Osage, Kansas; and Whitkinberg, Arizona. One of these candidate sites will be selected for the installation of approximately sixty 15 to 17 kilowatt modules for a total capacity of approximately one megawatt. The installation should be completed by 1984. The program as a whole is attempting to create systems competitive with conventional generating systems by 1985.[63] $3.75 million in funding was provided in conference by the 1981 appropriations bill.

IV.
PHOTOVOLTAICS

Photovoltaic devices produce electricity directly from sunlight by taking advantage of the absorption of photon energy by electrons at the PN junction of semiconductor devices. Most photovoltaic research involves silicon based devices, but cadmium sulfide and other semiconductor materials are also being investigated.[64] The primary difficulty with photovoltaic cells is their cost. A similar, but somewhat less frequently discussed difficulty with photovoltaics is their inefficiency.

Most legislative efforts have focused on the cost problem. The capacity of a photovoltaic system is measured in peak watts, which are the number of watts the system would supply when exposed to sunlight under ideal conditions:

> Currently, photovoltaics cells convert sunlight to electricity at a

62. The Jet Propulsion Laboratory prototype design uses a Brayton engine at the focus of the parabolic dish. Other designs use a Stirling engine. A recent Mitre Corporations Study indicates that "the most promising concepts are expected to use advanced heat engines such as the Stirling." THE MITRE CORP., SOLAR ENERGY SYSTEMS AND RESOURCES 16 (1980).

63. Conversation with Ab Davis, Jet Propulsion Laboratory (Dec. 20, 1980).

64. *See, e.g.*, In Review: A SERI Monthly Update, Aug. 1979, at 2, col. 1, which announces a request for proposals on gallium arsenide solar cells and research contracts for cadmium sufide/copper sulfide cells, and cadmium sulfide/cadmium telluride cells.

> cost ranging from $7 to $12 per peak watt . . . . [T]he [Energy] department's goal is to bring down solar cell costs to $2.80 per peak watt in 1982 and $.70 per peak watt in 1986.[65]

Conventional methods of generating electricity cost about one dollar per watt.

The federal government has established a two-prong program to help commercialize photovoltaics. This program is embodied in the Solar Photovoltaic Energy, Research, Development and Demonstration Act of 1978 and the Federal Photovoltaic Utilization Act.[66]

The Solar Photovoltaic Energy, Research, Development and Demonstration Act of 1978 declares a federal policy promoting the implementation of programs intended to help "reduce the average cost of installed photovoltaic energy systems to $1 per peak watt by fiscal year 1988."[67] The Act also sets out a federal policy favoring increased utilization of photovoltaics in the private sector.[68] Additionally, the Act authorizes the Secretary of Energy to procure photovoltaic systems and components and to arrange for their use in federal buildings.[69]

The Federal Photovoltaic Utilization Act establishes the Federal Photovoltaic Utilization Program (FPUP) which is designed, in more specific terms, to accelerate the procurement and installation of photovolaics for use in federal facilities.[70] The purpose of the purchase program is to stimulate the development of a manufacturing, marketing, and servicing infrastructure for the photovoltaic industry. A substantial part of this effort is being focused on the international market. United States photovoltaic manufacturers have a significant competitive advantage as far as the price of their product is concerned but a tremendous competitive disadvantage in marketing and servicing capability.[71]

The FPUP has been in existence for three years and the Department of Energy has selected about 3,000 projects to support under the Act. The total capacity of all of the projects is less than one megawatt and most are to be located in remote locations where photovoltaics are cost effective. Between 200 and 300 photovoltaic

65. [1980] 359 EN. USERS REP. (BNA) 15.
66. 42 U.S.C. §§ 5581-5594 (Supp. III, 1979).
67. *Id.* § 5581(b).
68. *Id.* § 5581(b)(1).
69. *Id.* § 5581(b)(3).
70. 42 U.S.C. §§ 8271-8278 (Supp. III, 1979).
71. Telephone conversation between John Hesse, Jet Propulsion Laboratory, and Peter Hoffman (July, 1980).

systems have already been installed under this program.[72]

Congressional funding has been about one-third of what was expected when the bill was passed.[73] The Department of Energy's project funding has focused primarily on research and technology development rather than demonstration and market development.[74] In fiscal year 1980, $8 million worth of photovoltaic projects had been scheduled for funding under FPUP until Congress passed a supplemental appropriations bill in July, 1980, which rescinded $5 million of those dollars.[75] The DOE's funding of programs has been reduced accordingly. It should be noted, however, that HR 7590 was amended on the House floor to restore $5 million to the FPUP program.[76] This bill, containing most fiscal year 1981 solar appropriations, is now public law.[77]

Another significant development in the photovoltaic area is the extension in the Windfall Profit Tax Act of the federal 40 percent tax credit to a photovoltaic purchase for a residential dwelling which is the principal dwelling of the purchaser.[78] Even with the 40 percent tax credit, however, photovoltaics are not cost effective for most residential applications. This should continue to be true for several years. According to a Department of Energy study, it would take $5 billion to meet both the production and price goals of the Solar Photovoltaic Energy Research, Development and Demonstration Act of 1978. With $3 billion the price goal could be met by 1986, but the production goal would have to be delayed.[79] Therefore, even with the 40 percent credit photovoltaics may not be cost effective for residential use prior to 1985 when the credit expires.

In addition to the federal government's effort to foster photovoltaic use, private corporations are also active in trying to produce a

72. Telephone conversation between Elaine Smith, Program Manager FPUP, and Peter Hoffman (July, 1980).

73. *Id.*

74. *Id.*

75. Supplemental Appropriations and Rescission Act of 1980, Pub. L. No. 96-304, 94 Stat. 857 (1980). *See also* H.R. REP. No. 1086, 96th Cong., 2d Sess. 65 (1980); H.R. REP. No. 96-1149, 96th Cong., 2d Sess. 26 (1980).

76. 126 CONG. REC. H5,570 (daily ed. June 24, 1980).

77. Energy and Water Development Appropriation Act of 1981, Pub. L. No. 96-367, 94 Stat. 1331 (1980).

78. Crude Oil Windfall Profit Tax Act of 1980, Pub. L. No. 96-223, § 202(b), 94 Stat. 229 (1980).

79. U.S. DEP'T OF ENERGY, FEDERAL POLICIES TO PROMOTE THE WIDESPREAD UTILIZATION OF PHOTOVOLTAIC SYSTEMS—EXECUTIVE SUMMARY FINDINGS F-23 (1980).

cost effective photovoltaic cell. One focus in the private sector is on the development of automated manufacturing plants for photovoltaics. One such plant is being build by Westinghouse Electric Corporation in Pittsburgh, Pennsylvania. Though all capital costs are being borne by Westinghouse, PG&E and Southern California Edison have each committed to provide 30 percent of the operation and maintenance funds required to run the plant in exchange for 30 percent of the output of the plant for each of the utilities.[80] The Westinghouse plan calls for plant development in three stages. The first stage, which is in operation now, is largely a manual operation which produces 50 kilowatts of photovoltaics per year. The second stage, which should start in the summer of 1982, will be a semi-automatic line with a capacity of 500 kilowatts per year. In 1986, a fully automated commercial line capable of producing 25,000 kilowatts per year of photovoltaic cells is expected to go into production. The target cost per watt on this fully automated line is 70 cents per watt.[81]

Most of what has been discussed above concerns congressional policy and budget authorizations. These elements of the budgetary process, however, go for naught unless supported by subsequent appropriations. Congress has passed an appropriations bill for energy and water development appropriations for fiscal year 1981.[82] This law appropriates $2,268,754,000 for operating expenses of the Department of Energy necessary for energy supply, research, and development activities. Of these funds, $133 million is to be devoted to photovoltaic energy research and development and $20 million will support the federal photovoltaic utilization program.[83] Thirty-three million dollars were also appropriated for expenses of the Department of Energy in connection with the purchase, construction, and acquisition of plant and capital equipment and other expenses necessary for energy supply, research, and development activities. Of these funds, $7 million is for photovoltaic energy development.[84]

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80. Los Angeles Times, July 24, 1980, § I, at 2, col. 6.

81. Telephone conversation between Frank McCrackin, Southern California Edison, and Peter Hoffman (July, 1980).

82. *See* Energy and Water Development Appropriations Act of 1981, Pub. L. No. 96-367, 94 Stat. 1331 (1980).

83. *Id. See also* H.R. REP. No. 1336, 96th Cong., 2d Sess. 6 (1980); H.R. REP. No. 1093, 96th Cong., 2d Sess. 14 (1980); H.R. 7590, as amended, 126 CONG. REC. H5,569 (daily ed. June 24, 1980).

84. *Id.* at 39.

V.
BIOMASS

Biomass is a generic term used to describe all organic matter. Organic matter, whether it is grain, trees, sewage, paper products, agricultural residues, or municipal solid waste has, by definition, recently (on a geological timescale) derived its energy from the sun through the photosynthetic process.

Many techniques are available for extracting energy from biomass. The oldest and most widely used process is direct combustion, which now supplies approximately two percent of the energy consumed in the United States.[85] Nearly half the homes in Maine are heated with wood burning stoves.[86] Lumber mills from California to South Carolina use slash and other by-products of their operations to produce electricity and process steam to power their plants.[87]

Aside from direct combustion, biomass can be fermented to produce ethanol, digested to produce methane, gasified to produce medium grade BTU gas, methanol, or low BTU gas, pyrolysed to produce oil, gas, or charcoal, or liquified to produce oil or gas. Additionally, since biomass is *stored* solar energy, it is not subject to the periodic supply problems associated with direct solar energy.

A. Windfall Profit Tax Act

The WPTA extended to December 31, 1985, the 10 percent investment tax credit available for purchase of biomass property.[88] The credit was previously scheduled to expire December 31, 1982. For the purpose of these credits the Internal Revenue Code, as amended by the WPTA, defines biomass as any organic substance other than oil, coal, natural gas, or any product of oil, natural gas,

85. Los Angeles Times, July 30, 1980, § II, at 4, col. 1.

86. Hoffman, *Site Selection Considerations for Land-Based Biomass and Wind Energy Conversion Systems (WECS) from a Legal Viewpoint* 6 (1980) (SERI/TR-434-372) [hereinafter cited as *Site Selection*].

87. ULTRASYSTEMS, INC., WOOD ENERGY FOR SMALL SCALE POWER PRODUCTION IN NORTH CAROLINA 27 (1978) (prepared under a grant from Energy Division, North Carolina Department of Commerce, with funds granted by the DOE).

88. Crude Oil Windfall Profit Tax Act of 1980, Pub. L. No. 96-223, 94 Stat. 229 (1980). The energy investment tax credit is subtracted from the tax liability remaining after the regular investment tax credit has been exhausted. The investment tax credit for biomass equipment is contained in section 221(a), which amends 26 U.S.C. § 46(a)(2)(C).

or coal.[89]

B. Energy Security Act of 1980

Title II of the ESA is the Biomass Energy Act of 1980.[90] The Act authorizes $1.2 billion for a comprehensive biomass and alcohol fuels program[91] and $250 million for a new Office of Energy from Municipal Waste in the Department of Energy.[92] The Act provides that where gasohol[93] is available, all federally owned or leased motor vehicles capable of using gasohol must do so.[94] The Act requires the Department of Energy and the Department of Agriculture to produce by December, 1980, a federal plan for biomass energy development designed to achieve an alcohol production level of 60,000 barrels per day by the end of 1982. The strategy is to use grants, loan guarantees, subsidized loans, and price guarantees to foster the commercialization by private industry of alcohol fuels and waste-to-energy programs.[95] Gasohol is already exempt from the four cent per gallon federal motor fuel excise tax.[96]

Appropriations for 1981 include $20.8 million for alcohol fuels and $47,750,000 for other biomass programs.[97] The $20.8 million for alcohol fuels includes $5 million for the newly created Office of Alcohol Fuels. The Office of Alcohol Fuels has a production objective of 500 million gallons of ethanol for 1981.[98]

Though biomass fuels appear to be receiving the most attention, they are by no means the only energy product obtainable from biomass. Waste-to-energy projects are also favored because they represent a step toward solution of both energy and solid waste management problems. For example, the City of Hempstead,

89. *Id.* § 222(g), amending 26 U.S.C. § 48(l)(15).

90. Energy Security Act of 1980, Pub. L. No. 96-294, § 201, 94 Stat. 611 (1980).

91. *Id.* § 204(a)(1)-(2). Six hundred million dollars are allocated to general biomass energy development and $600 million to alcohol fuels.

92. *Id.* § 204(a)(3).

93. Gasohol is a blend of gasoline and alcohol with a minimum of ten percent alcohol.

94. *Id.* § 271(a)-(c).

95. *Id.* § 211(a).

96. National Energy Tax Act of 1978, Pub. L. No. 95-618, § 221, 92 Stat. 3174 (1978).

97. H.R. REP. No. 1366, *supra* note 57, at 8.

98. *Id.* at 18. The initial House Bill, which was passed by the House with this report, contained only $15.1 million for alcohol fuels and included the $5 million for the Office of Alcohol Fuels. The Conference Committee raised the alcohol fuels appropriations to $20.8 million. *Id.* at 27 n.107 & accompanying text.

Long Island, is now burning 2,000 tons of municipal solid waste per day and generating 40 megawatts of electricity. The ash, three percent of the original volume, is then taken to a landfill.[99]

Title IIB of the ESA establishes the Office of Energy from Municipal Waste. The Secretary of Energy is authorized to provide construction loans of up to 80 percent of the total estimated cost for municipal waste energy projects.[100] Two hundred fifty million dollars is made available to the Secretary for municipal waste-to-energy activities under subtitle B.[101] The ESA also requires the Secretary to prepare by January 1, 1982, a report containing a complete description of the financial, institutional, environmental, and social barriers to the development of technologies for the recovery of energy from municipal waste.[102] No financial assistance may be committed to, or made under, this subtitle after September 30, 1984.[103]

Title IIC of the ESA directs the Secretary of Agriculture to establish 10 model demonstration biomass energy facilities and authorizes $5 million for each of the fiscal years 1981-1984.[104] For the purposes of this subtitle, biomass is defined as any organic matter which is available on a renewable basis except aquatic plants and municipal wastes.[105] Subtitle C also amends various agricultural and forestry acts to expand the Secretary of Agriculture's authority to study and promote the use of biomass energy in rural, agricultural, and forestry settings.

Federal funding programs are just beginning to recognize the full potential of biomass as an energy source. If biomass technologies develop quickly and their use is encouraged, at least one source indicates they could produce up to 17 quadrillion BTUs annually by the turn of the century.[106]

VI.

OCEAN THERMAL ENERGY CONVERSION

Ocean Thermal Energy Conversion (OTEC) systems tap the solar energy stored in the ocean. OTEC takes advantage of vertical

99. *See Site Selection*, *supra* note 85, at 46.
100. *See* Energy Security Act of 1980, Pub. L. No. 96-294, §§ 231-240, 94 Stat. 611 (1980).
101. *Id.* § 204(a)(3).
102. *Id.* § 231.
103. *Id.* § 240.
104. *Id.* § 251.
105. *Id.* § 203(2)(A)-(B).
106. [1980] 364 EN. USERS REP. (BNA) 11.

temperature differentials in the ocean.[107] An OTEC system consists of a power plant, a floating platform to house the plant, a surface level seawater system, a deep water seawater system, and a method of transmitting or utilizing the energy produced. The OTEC systems currently being investigated operate by pumping warm surface water into a heat exchanger to vaporize a working fluid. The resulting vapor is fed through a turbo-generator to produce electricity. The vapor leaving the turbine flows into a condensor where it is cooled by cold water pumped up from the deep ocean through a long pipe extending down to a depth of as much as 1000 meters.[108]

It was not until August, 1979, that OTEC was used to generate more power than it consumed. Today, Mini-OTEC, a test facility located off the Island of Hawaii, represents the world's first closed-cycle, self-sustaining OTEC system.[109] Mini-OTEC is a joint venture of Lockheed Corporation, Dillingham Corporation, the County of Hawaii, and the State of Hawaii.

OTEC can contribute to the national energy supply in a number of ways. First, the energy can be converted to electricity and shipped by submerged cable to landbased utility grids. Second, OTEC can be used to produce ammonia. Third, OTEC energy can be used at sea for the processing and refining of ocean-mined minerals.[110] Undoubtedly, when OTEC becomes a mature energy source, other applications will emerge. OTEC is capable of operating throughout the year, 24 hours a day, due to the huge solar collection and storage properties of the ocean. In 1980, Congress enacted three new laws to remove many of the legal and financial barriers to the commercial development of OTEC.

A. Windfall Profit Tax Act

The WPTA, signed into law on April 2, 1980, provides a financial incentive for OTEC development by creating a 15 per-

107. Temperature differentials, to the extent required for OTEC, exist generally between 20° north latitude and 20° south latitude.

108. Portions of this section on OTEC are borrowed from, Krueger, *Technology Requires Changes in Law of the Sea*, Legal Times of Washington, July 7, 1980, at 18, col. 1.

109. Dedmon, *Ocean Power Plant Successfully Tested*, Los Angeles Times, Apr. 18, 1980, § I, at 4, col. 1.

110. For a more extensive discussion of these uses, *see* Krueger, *Technology Requires Changes in Law of the Sea*, note 107 *supra*.

cent energy investment credit[111] for OTEC devices operated in either of two locations—which will be determined by the Secretary of the Treasury after consultation with the Secretary of Energy.[112]

B. OTEC Demonstration Act

On July 18, 1980, President Carter signed the Ocean Thermal Energy Conversion Research, Development, and Demonstration Act (Demonstration Act).[113] The Demonstration Act's major purposes are to establish 100 megawatts of OTEC capacity by 1986,[114] 500 megawatts by 1989,[115] and an OTEC system that can provide energy to the Gulf Coast at a price that is competitive with conventional energy sources by the mid-1990s.[116] It also establishes a national goal of 10,000 megawatts of OTEC-produced energy by 1999.[117] To accomplish these goals the Demonstration Act directs the Secretary of Energy to prepare a Comprehensive Program Management Plan[118] to design, construct, and operate at least two OTEC systems that will provide 100 megawatts of capacity by 1986.[119] The Demonstration Act will also initiate OTEC research and disseminate information to support the pilot demonstration program, and will develop a technology application and market development plan to realize the national goal of 10,000 megawatts of OTEC-produced energy by 1999.[120] Finally, the Act sets up the Technical Panel of the Energy Research Advisory Board, which will submit annual reports assessing the status of programs mandated by the Act.[121] The Demonstration Act authorizes $20 million to carry out these goals in 1981[122] and $60 million for 1982.[123]

111. Crude Oil Windfall Profit Tax Act of 1980, Pub. L. No. 96-223, § 221(a), 94 Stat. 229 (1980).

112. *Id.* § 222(b)(5).

113. Ocean Thermal Energy Conversion Research Development and Demonstration Act of 1980, Pub. L. No. 96-310, 94 Stat. 941 (1980).

114. *Id.* § 2(b)(1).

115. *Id.* § 2(b)(2).

116. *Id.* § 2(b)(3).

117. *Id.* § 2(b)(4).

118. *Id.* § 3.

119. *Id.* § 5.

120. *Id.* § 6.

121. *Id.* § 8.

122. *Id.* § 10(a).

123. *Id.* § 10(b).

C. OTEC Licensing Act

On August 4, 1980, the President signed into law the Ocean Thermal Energy Conversion Act of 1980[124] (OTEC Licensing Act). The OTEC Licensing Act establishes a license and permit program to be administered by the National Oceanic and Atmospheric Administration.[125] It also authorizes the use of the Maritime Administration's Loan Guarantee and Capital Construction Fund Programs for OTEC development, making OTEC projects eligible for federal assistance and mortgage guarantees.[126]

Congress has appropriated for the Department of Energy $38,300,000 for OTEC operations for fiscal year 1981.[127] An additional $700,000 have been appropriated for OTEC plant and capital equipment.[128] The final appropriation is $3,000,000 more than the amount initially appropriated to OTEC by House version of the Bill.[129]

VII.
WIND

Wind energy conversion systems (WECS) and small wind energy conversion systems (SWECS) are being actively investigated on both the federal and state level. The federal government, after extensive site selection studies, has installed six WECS ranging from 0.1 to 2.0 megawatts of rated power. These WECS are located in Rhode Island, Hawaii, Ohio, New Mexico, Puerto Rico, and North Carolina.[130] A wind-hydroelectric project is being constructed outside Medicine Bow, Wyoming, in conjunction with the Colorado Rivers Storage Project. The wind-hydroelectric combination is designed to store water behind dams for use when the wind does not provide adequate power.[131]

The Department of Energy has sponsored a fifty-state study of the legal and institutional barriers likely to be encountered in the installation of SWECS. In conjunction with this study the DOE has initiated a project which will install two SWECS, from 1 to 25

124. Pub. L. No. 96-320, 94 Stat. 974 (1980).
125. *Id.* §§ 101-107.
126. *Id.* §§ 201-203.
127. H.R. REP. No. 1366, *supra* note 57, at 8.
128. *Id.* at 24.
129. H.R. REP. No. 1093, *supra* note 56, at 14 (the capital and equipment appropriations were not changed).
130. *Site Selection*, *supra* note 85, at 41.
131. *Environmental Assessment Completed on Wyoming Wind Project*, 1 SOLAR L. REP. 267 (1979).

kilowatts each, in each of the 50 states.[132]

Appropriations for wind systems for fiscal year 1981 provide $83,700,000 in operating expenses[133] and $2,100,000 in capital and equipment funds.[134] The House Report on the initial version of HR 7590 notes that: "[W]ind energy shows the most promise of providing an early, economical renewable source for generating electricity particularly when combined with hydroelectric projects which can provide necessary storage reserve."[135]

A major wind energy authorization bill, The Wind Energy Commercialization and Utilization Act of 1980, was reported from conference on August 1, 1980, and passed into law on September 8, 1980.[136] This law calls for an acceleration of research, development, and demonstration of WECS, and sets an 800 megawatt goal for installed WECS' capacity by fiscal year 1988.[137] The Act authorizes $100 million in funds for fiscal year 1981.[138]

VIII.

PUBLIC UTILITY REGULATORY POLICIES ACT

For wind, photovoltaics, distributed solar thermal electric systems, and recovering projects the Public Utility Regulatory Policies Act of 1978[139] (PURPA) is extremely important. This Act provides that qualifying cogenerators and small power producers

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132. ROCKWELL INTERNATIONAL, IDENTIFICATION OF STATE GOVERNMENTAL RESTRAINTS ON SMALL WIND SYSTEM UTILIZATION (1980). Several other interesting wind programs are being considered or have been completed. In December, 1980, Southern California Edison unveiled its new three megawatt WECS in the San Gorgonio Pass area of Southern California. *See* Bennett, *Edison Dedicates Wind Turbine*, Los Angeles Times, Dec. 17, 1980, § I, at 3, col. 4. Hawaiian Electric Company, Inc., has negotiated a purchase contract for up to 80 megawatts of wind energy from Windfarms, Ltd. The contracts (there are three) will last for 25 years once Windfarms establishes commercial operations. Windfarms must produce this energy by 1986 or HECO's minimum price guarantees in the contract will no longer apply. Letter from Richard Bell, Vice-President of Engineering, HECO, to Peter Hoffman (Nov. 12, 1980). *See also Windfarms to Generate for Utility System*, 2 SOLAR L. REP. 695 (1980).

133. H.R. REP. NO. 1366, *supra* note 57, at 8.

134. *Id.* at 24.

135. H.R. REP. NO. 1093, *supra* note 56, at 19.

136. Wind Energy Systems Act of 1980, Pub. L. No. 96-345, 94 Stat. 1139 (1980).

137. *Id.* § 2(b)(2). WECS are slated to achieve 100 megawatts of the total 800 megawatt target power.

138. *Id.* § 14. Out of the $100,000,000 authorized for fiscal year 1981, $10,000,000 is authorized for Wind Resource Assessment, which includes a site prospecting program and establishment of a wind data center in consultation with NOAA, NASA, and the EPA.

139. 16 U.S.C. §§ 2601-2645 (Supp. III, 1979). PURPA is part of the National Energy Act of 1978.

be given special treatment in their interaction with utilities and in their responsibilities under state and federal utility laws.[140] The final rules were issued in 1980 to define qualifying facilities under Section 210[141] and to specify the rules which require electric utilities to purchase electricity from, and sell electricity to, cogenerators and small power production facilities.[142] Section 210 also exempts qualifying facilities from state utility rate-and-financial-organization regulation and from Federal Power Act[143] and Public Utility Holding Company Act[144] regulations. Regulations under Title II of PURPA are issued and managed by the Federal Energy Regulatory Commission.[145]

PURPA is also important to solar electric technologies because it defines the relationship between small power producers (which includes many solar technologies) and the utilities. One of the key elements of the Section 210 regulations is the formula established to determine what price should be paid by the utility for energy purchased from the small power producer.[146] The solar community is intensely interested in PURPA regulations because the solar small power producer is rarely in a position to supply his exact energy needs. For almost all small power producers, the amount of energy produced on site will sometimes be less than needed and other times be more than needed. Often the difference between an economical system and an uneconomical system is the difference between the price the utility will pay for the small power producer's electricity and the price the small power producer must pay for the electricity from the utility. The regulations under Section 210 set the price that the utility must pay for the small power producer's energy as the cost the utility avoids because of its purchases from the small power producer.[147] These avoided costs can be either avoided energy costs, if the qualifying facility merely saves the utility the cost of fuel, or avoided capacity costs, if the small power producer saves the utility the cost of building new

140. 16 U.S.C. § 824a-3 (Supp. III, 1979).

141. 45 Fed. Reg. 17,959 (1980).

142. 45 Fed. Reg. 12,214 (1980).

143. 16 U.S.C. §§ 791-825 (Supp. III, 1979).

144. 15 U.S.C. § 79 (1976 & Supp. III, 1979).

145. *See* 16 U.S.C. §§ 791a, 796, 824, 824i, 824j, 824k, 824a-3 (Supp. III, 1979).

146. 16 U.S.C. § 824a-3(b) (Supp. III, 1979), which requires any rates for the purchase of energy from cogenerators or small power producers to be "just and reasonable to the electric consumers of the electric utility and in the public interest and . . . not discriminate against qualifying cogenerators or qualifying small power producers."

147. 45 Fed. Reg. 12,214 (1980).

power plants. The Section 210 regulations are to be implemented within one year by state utility commissions. It seems likely that it will take at least that long for it to be incorporated into utility rate structures. Until favorable rate structures are actually in place, businesses will not be able to assess the cost effectiveness of solar electric devices. It will therefore be several years before PURPA's effect on potential small power producers and cogenerators can be meaningfully measured.

IX.
CONCLUSION

It is now almost two years since President Carter set the national goal of meeting 20 percent of the nation's energy needs with solar energy by the turn of the century. A study by the Mitre Corporation concluded that it will cost over $1 trillion of the nation's investment capital over the next 20 years to meet the 20 percent goal.[148] The study noted that much of the effort that the federal government will be required to make to stimulate this level of investment will be in the nature of regulatory reform—particularly with respect to land use and utility regulation. Solar commercialization will also require lowering the financial barriers created by infrastructural and historical investment patterns which strongly favor conventional energy sources. Though the advances embodied in the National Energy Act of 1978, the Windfall Profit Tax of 1980, and Titles II and V of the Energy Security Act represent constructive steps towards a reasonably active level of solar utilization in our society, the treatment of solar appropriations in the 1981 fiscal year budgeting indicates that the commitment to solar may only be moderate. Aggressive appropriations are required in coming years if a solar future is to be on the near horizon.

Even aside from funding, there are several major initiatives required to help solar energy reach its potential market penetration. The federal tax code inadvertently supplies a particularly strong bias against all solar electric technologies. This includes wind, central receiver solar thermal, OTEC, distributed solar thermal, and photovoltaics. Each of these systems has a high initial capital cost which is offset by low operating cost throughout the lives of the systems. Despite the fact that life cycle costs of the solar sys-

148. THE MITRE CORP., SOLAR ENERGY SYSTEMS AND RESOURCES 22 (1980). The report goes on to say that this $1 trillion would represent about one half the estimated present fraction of capital investment in energy. The federal expenditure over the twenty-year period would have to be in the $80 billion to $100 billion range.

tems may compete favorably with the life cycle costs of conventional systems, solar systems are often not economically competitive because the high capital expenses of the solar systems must be depreciated over a period of years while the fuel costs of conventional systems can be deducted in the year in which the expense is made. This disadvantage can be offset by allowing solar systems to be depreciated at an accelerated rate.

One scheme which could permit such accelerated depreciation, and would fit well into current legislative tax cut schemes, is the 10-5-3 depreciation schedule. The 10-5-3 depreciation schedule is currently popular in Congress as a method for substantially cutting taxes for the business sector. In June, 1980, the Republican version of a tax cut bill which used this depreciation scheme as its centerpiece was defeated in the Senate. The Republican Bill, S2788, alowed Class I items, which included buildings and structural components, to be depreciated on a 10-year schedule; Class II items, which included anything not in Class I or Class III, to be depreciated on a five-year schedule; and Class III items, which included autos, taxis, and light-duty trucks, to be depreciated on a three-year schedule. This sort of scheme is likely to appear in future tax cut bills. Solar technologies could be relieved of the competitive disadvantage imposed by the current tax structure by being placed in the three-year depreciation class. The technologies that would be most affected are those which generate electricity or process steam, namely, solar thermal electric, wind, OTEC, and photovoltaic systems.

Improving the position of solar electric technologies also requires that tax credit deadlines be extended and the regulatory environment be improved. Solar electric systems are still in the research and development stage. They are not expected to approach technical maturity until the mid-1980s. The tax credit, designed to advance the date at which a given system becomes cost effective, will only begin to have an effect at about the time the credit expires. Therefore in order to meaningfully promote the goal of extensive solar energy utilization, the tax credit deadline should be extended.

The current regulatory environment for small power producers is not positive. The value of cogeneration and small power producers was recognized in several parts of the National Energy Act of 1978. PURPA represents a congressional attempt to reduce the regulatory disadvantage experienced by small power producers by creating a clear federal policy favoring a more benign legal and

institutional atmosphere for small power production. The regulations for the critical section, Section 210, were not finalized until February 1980. These regulations exempt small power producers from state utility regulation and provide a price formula for purchase of power from small power producers by utilities. Because of uncertainties in the application of this formula, full implementation of these regulations may take several years and during that time the cost effectiveness of solar electric technologies for industrial power producers will be difficult to measure. To allow questions under PURPA to be answered well in advance of the expiration of the tax credit is important to the success of that credit. For this reason also it would appear that the tax credit deadline should be extended.

For small and intermediate size businesses engaged in research and development efforts for solar technologies, interaction with the huge bureaucracy of the Department of Energy can be debilitating. To encourage private sources of funding for these enterprises, tax laws should be amended to clarify the tax consequences for limited partnerships investing in solar technology research and development and to assure the availability of capital gains treatment upon sale of that technology. This would make it easier for the small businessman to generate sufficient capital to carry on an efficient research and development program.

Thus, much can be done to offset the disadvantages solar equipment faces in the marketplace today. First, accelerated depreciation should be provided for solar equipment. Second, the tax credit deadlines should be extended at least until 1988 in order to obtain their intended benefit. Third, the federal tax code should be clarified to encourage investment in solar research and development projects by the private sector.

Solar energy has an undeniably bright future. 1980 was a good year for solar programs and prospective solar users, but the long term solar picture has been clouded by the Federal government's uncertain support. Whether it will achieve its full promise in the near future is an open question.